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COMET South Africa

Final Report and Documentation of Test Results

Electricians, Mechatronics, Motor Mechanics and Welders

including

- Analysis of test motivation, vocational identity and occupational commitment
- Pre-test analysis for fabricators and millwrights
- Analysis of pre-tests for teachers and trainers

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COMET South Africa – Final Report and Documentation of Test Results of Electricians, Mechatronics, Motor Mechanics, and Welders. Including an analysis of test motivation, vocational identity and occupational commitment, a pre-test analysis for fabricators and millwrights and an analysis of pre-tests for teachers and trainers

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COMET South Africa: Final Report and Documentation of Test Results of Electricians, Mechatronics, Motor Mechanics, and Welders including an analysis of test motivation, vocational identity and occupational commitment, pre-test analysis for fabricators and millwrights and an analysis of pre-tests for teachers and trainers

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Executive Summary

COMET stands for Large Scale Competence Diagnostics (LS-CD) in and is an instrument for assuring and developing quality technical and vocational education and training. The South African COMET project which was implemented between 2013 and 2016 was an integral part of the project "VET research and Development in South Africa" conducted by the University of Bremen, Germany, in close cooperation with the manufacturing, engineering and related services Sector Education Authority merSETA, Johannesburg, who also initiated and funded this project. This report sums up major results of the competence assessments that took place within the duration of the project. Sometimes the documentation also refers to the experiences made in a preceding test which took place in 2012. In this part of the report major results, conclusions and recommendations for further action or research are bundled. The following part of the report is divided into two sections, the first one of which is referring to the COMET competence model and a description of the test instruments used. Section 2 concentrates on a very detailed analysis and presentation of test results.

1. General issues on test groups and data

More than 1400 participants took part in COMET tests during the project "COMET South Africa" from 2013 - 2016. All in all, apprentices, TVET teachers and trainers, subject matter experts from six different vocations were involved: electricians, mechatronics, motor mechanics, welders, fabricators and millwrights. In an international comparison, COMET South Africa counts for the second largest project after Germany in terms of vocations tested and the third largest project after Germany and China when it comes to numbers of test participants.

The two main tests conducted in 2014 and 2015 differ from each other in so far as in 2014 the number of test takers and also the number of occupations involved was higher. In 2014, a total of 850 learners in the professions "electrician", "mechatronic", "welder", "millwright", and "fabricator" took part in the test. In2015, the number of test takers was 405, but this time only one vocational group was tested, summed up under the umbrella of "motor mechanics", but including diesel mechanics and participants from courses of NCV automotive.

Test validity was very good in both years. In 2014, 774 tests were valid for the analysis, which is an equivalent of 91%; in 2015, the corresponding figure was even higher, reaching 96.5% or 391 valid cases in real numbers. This positive result can be linked to a very good test discipline of learners on the one hand (cf. section 2, part VII) and to a well-functioning test management secured by the merSETA on the other. But test validity was not only given by a high percentage of tests being valid for the evaluation and subsequent calculation, but also in terms of a very high degree of common understanding reached by the teachers and experts who were responsible for rating the learners' tests. In order to secure a high degree of common understanding (inter-rater reliability) in how to evaluate a learner's solution of a test task, two training seminars per occupational group were organised, all with sufficiently high outcomes (high degrees in inter-rater reliability) in the main tests 2014 and 2015 (cf. section 1, part 2.1, Figures 8a and 8b)[1].

The number of test sites and teachers and trainers who participated in the COMET tests in South Africa grew continuously. All in all, 23 different test venues, among them companies and other private training providers as well as public and private colleges were involved during the cooperation agreement between the merSETA and the University of Bremen. Some of these venues, more

[1] This does not count for a pre-test in fabrication in 2014 (cf. section 2, part 6.3 remarks on test validity)

specifically the teaching and training staff of these training providers were already contributing to the project in its preparation phase (task development and pre-tests), while some others only jointed for the assessments.

In September 2014, 850 learners participated in the COMET main test (COMET test 2014 South Africa). A pre-test in April 2013 and intensive work on test- and learning task development according to the COMET methodology in the occupations "Electrician", Mechatronic" and "Welder" preceded this large-scale assessment in a total of 13 test sites. In addition in 2015, COMET was introduced to field of motor mechanics and involved 11 different test sites. After a successful pre-test with 160 test takers in May 2015, 404 test participants took part in a COMET main test, 20 out of which were teachers or trainers.

Looking at the size of test groups according to vocations trained electricians, motor mechanics, mechatronics and welders had the biggest share, fabricators as well as millwrights playing a minor role due to their participation in terms of a pre-test. In 2014, electricians formed by far the biggest test group with a total of 389 test takers, which was an equivalent of about 50% of all test persons at that test time. The share of mechatronics was 18% (or 141 test takers in numbers), the share of welders counting for 16% (or 121 test person in numbers). In all tests, most of the participants were male (68% in 2914 and 89% in 2015) and in age group between 21-24 years.

Learners in each test were at all stages of their training, which means that there was a quite equal dispersion between test takers in year one, year two and a third (or further) year of training. The results provided thus allowed for a comparative analysis according to the different stages of training and delivered some interesting insights into the development of competence during the course of training. The following paragraphs sum up the major results and conclusions:

2. Strengths and weaknesses with a view to the occupations trained

When looking at the results of the occupation specific test analysis, the overall picture of the COMET assessment run between 2014 and 2015 is a very diverse one. First of all, it has to be highlighted, that after the initial test experiences in 2011 the results of the actual tests were much more encouraging. In each of the current assessments a considerable number of learners also reached highest competence levels, which was not at all the case in 2011. Figure 1 below shows the average competence profiles and average total scores reached by learners in the occupations tested in the main tests in 2014 and 2015.

Competence profiles of Electricians	Competence profiles of mechatronics	Competence profiles of motor mechanics	Competence profiles of welders
			
Average total score = 12.90 *n* = 224; *V* = 0.25	*Average total score = 22.70 n = 101; V = 0.15*	*Average total score* =30.02 *n* = 364; *V* = 0.30	*Average total score = 24.91 n = 97; V = 0.17*

Figure 1: Average profiles of test takers in the different vocations tested in COMET South Africa 2014-2015 (test takers with a total average score ≥ 5 points).

Among the most successful learners were the South African motor mechanics and welders with a total of 17% and 12% percent reaching holistic shaping competence. Still 9% of the mechatronics

were at this level, but only 1% of the electricians. When looking at the proportion of risk learners, the results correspond: On average (all tests), 42% of all test participants did not reach the first competence level, but with regard to the different professions trained, this only referred to roughly 20% of all motor mechanics, 30% of welders, 40% of mechatronics but to almost 70% of all electricians tested (see figure below for the exact results).

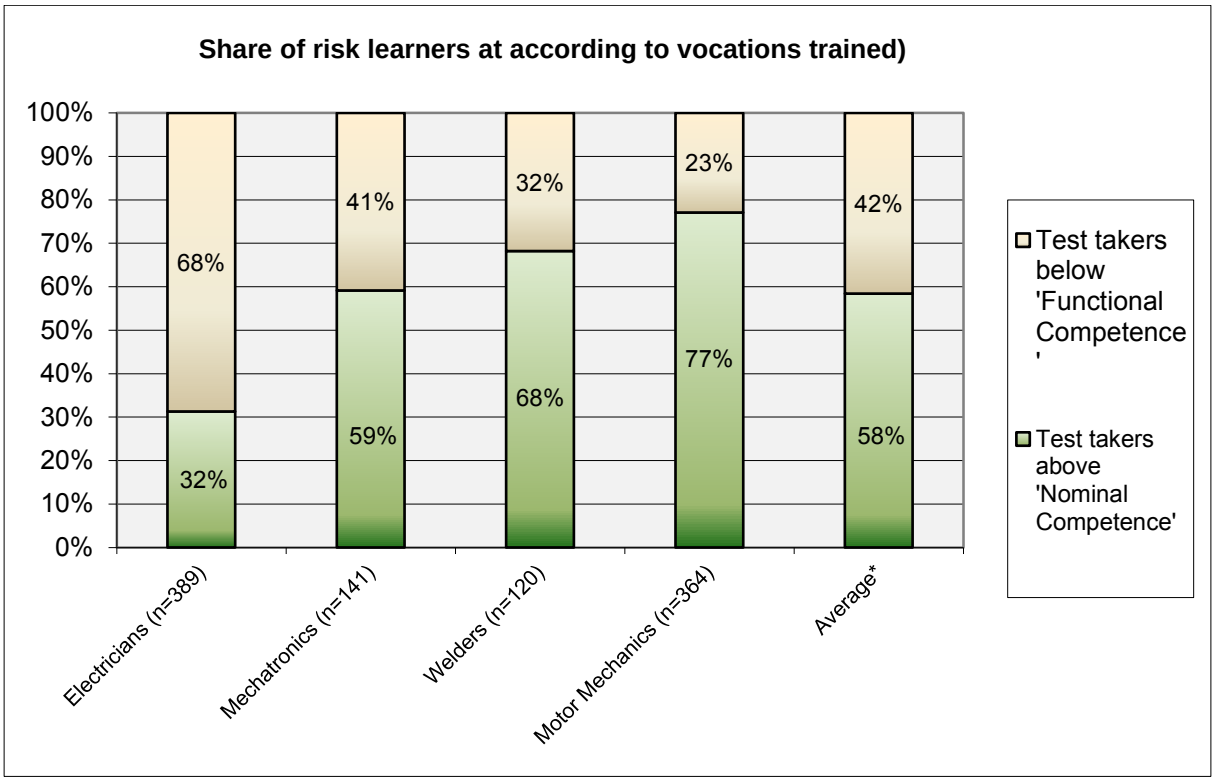


Figure 2: Test results according to vocations trained. Differentiation between test takers reaching competence levels (above Nominal Competence') and risk group learners (below 'Nominal Competence'). COMET main tests 2014 and 2015 South Africa.

However, such general occupation specific results are composed by learners at the various test venues and the more detailed occupation specific analysis according to test sites showed enormous differences in the performance of learners at the different training providers. Section 2, part II goes into detail and summarises the most important results and recommendations by test site, so that such findings will not be repeated at this stage. However, it should briefly be pointed out that among the most successful test sites were Barloworld Motor Retail Academy, the Automobile Association of South Africa and Sandown Motors (training motor mechanics), BMW South Africa and Eastcape Midlands College (training mechatronics), and Arcelor Mittal and West Coast College (training welders).

Best performing electricians were located at different places of learning, among others, EEC Daveyton, EEC-KWA-Thema, and Arcelor Mittal.

The occupation and test site specific analysis also showed that average (and single) competence profiles differed a lot regarding their shape and not only concerning the average total scores reached. In the electrical field and also very much in the domain of motor mechanics, profiles were often single sided, which means that test takers were not able to solve their task according to a complete action circle considering all competence criteria, that belong to a holistic solution. On the other hand, welders and mechatronics very often received very well balanced competence profiles, a fact, which has been verified and documented by the calculation of variation coefficients between 0.15 and 0.17 on average in these professions. To reach such values is a very positive result of the

South African test in mechatronics and welding, given the fact that some training providers did not have the opportunity to introduce learning tasks according to the holistic problem solving approach.

Among the weakest results: Electricians

Compared to the tests in 2015, the overall result in 2014 was extremely weak. With more than two thirds of all test takers a very high percentage of learners did not even reach the first competence level and was therefore considered as risk students. But as said, this relatively high degree of insufficiency was not equally relevant for all vocations. Instead, the analysis showed clearly, that this general result needed to be allocated to a very large group of electricians who participated in this assessment.

A very poor outcome in the electrical test was also a result which was found after a pilot test in 2011, so that one can possibly argue that the test exercises in 2011 and 2014 very much resembled and reflect an unchanged general situation: In both test years, the average total score was almost the same: 15.1 in 2011 and 12.9 in 2014. Also the general tendency towards a very function oriented task solution in the electrical field dominated in both years. Only if learners where trained in a company and possibly had some better chances to learn in real work processes, the results were slightly better. Consequently, a very important conclusion from the test in 2014 is that the preliminary findings of 2011 could be confirmed based on a sample that included new and different learning venues in addition to the first assessment.

But why did the South African COMET tests of learners in the electrical field reveal so many deficits? That electrical apprentices are less talented or motivated compared to others can certainly not count for an explanation. This would be a totally misleading conclusion, which can already be demonstrated by the test results obtained by a group of electrical learners who by mistake worked on a task designed for the mechatronic profession and – very surprisingly - performed much better compared to their classmates working on the correct task of their own occupation (cf 2.1.2.2 example of learners at P.E. College). It would as well be wrong to argue that the weak results in the electrical assessment can be drawn back to test site specific problems or the assumption that learning at one test site would be less advantageous or would lead to lower success compared to learning and being trained at another test site. Despite the fact that there are such differences in the performance of electrical learners according to the diverse learning venues, one has to consider that some test sites have participated with different cohorts of learners. For example Arcelor Mittal, P.E. College, VW South Africa, and West Coast College contributed with a number of mechatronics *and* electricians and in all cases, electricians had weaker results compared to those obtained by learners in the mechatronic field – regardless all existing test site specific differences.

As suggested in part 2.1.1 it may perhaps be argued that the weaknesses as documented in the electrical test, should partly be linked to the degree of task difficulty and complexity, which were probably higher in contrast to the assignments developed for the other occupations. But even if this might count for an explanation, it has to be stressed, that tasks for the electrical field were – as opposed to the competence test in 2011[2] – designed by a team of South African teachers, trainers and subject matter experts, who all agreed on these tasks as being relevant for the occupation trained and who – on the other hand – were also aware of the curriculum of their learners.

The fact that test takers in the electrical domain were –to a great majority – over-challenged with their tasks, might also be linked to a specific difficulty in this occupational field: Traditionally, electrical engineering is a science but the understanding of electrical engineering in vocational education and training has to be or was by tradition more use value oriented – a phenomenon that is

[2] In 2011, all tasks used in the South African test had been developed by Germany teachers and trainers and only translated for other international projects, like China, South Africa, and Norway.

also expressed by the very clear function oriented competence profile of an average learner's solution. This tentative conclusion however is an assumption which needs to be further examined, including a sound interrogation of subject matter and curriculum experts, TVET teachers and trainers.

For further COMET tests or the future work in teaching and training according to COMET, the recommendation would be to invest more time into the design of *learning* tasks for electricians that better correspond to the level of knowledge than the present test assignments, which may only be adequately solved by very advanced learners for the time being. Nevertheless, it has to be pointed out, that lowering the level of tasks for main tests should not be aimed at or if at all only to a minor degree, because lowering a task level will perhaps lead to lower degrees of frustration among learners and their teachers, but not to higher competence, which should remain the predominant aim![3] It can however be anticipated, that new and additional *learning* tasks (and their frequent use) would lead to a better performance of learners in a main test in the longer run, especially in terms of a holistic problem solving manner.

3. Heterogeneity or: the challenge of high diversity

A very common feature of the test results at many test sites is the huge difference between the levels of competence reached of learners - also at one and the same test site. The dramatic divergence has been documented by percentile bands (cf. section 2, part 1.2, Figure 8 and Figure 10) that show, that the best results of the weakest test site may even not reach a mean score at another test site. Apart from such very huge differences in the performance of learners *between classes,* the analysis also provided some evidence on the fact that there is a huge diversity of learners *within a single class* or at the various test sites themselves.

If one looks for example at the dispersion of test results obtained by some mechatronics and welders at different test sites, a typical result was a C-shaped bar diagram with some top performing learners at competence level 3 (Holistic Shaping Competence) and a big share of test takers below functional competence (Nominal Competence = Risk Level). Such results were often found regardless the nature of a test site, i.e. whether it was a public college or a private training provider. The following examples of mechatronics trained at EastCape Midlands College and BMW South Africa may illustrate this interesting feature – which has not been found to a similar extent in the reference projects of the COMET network.

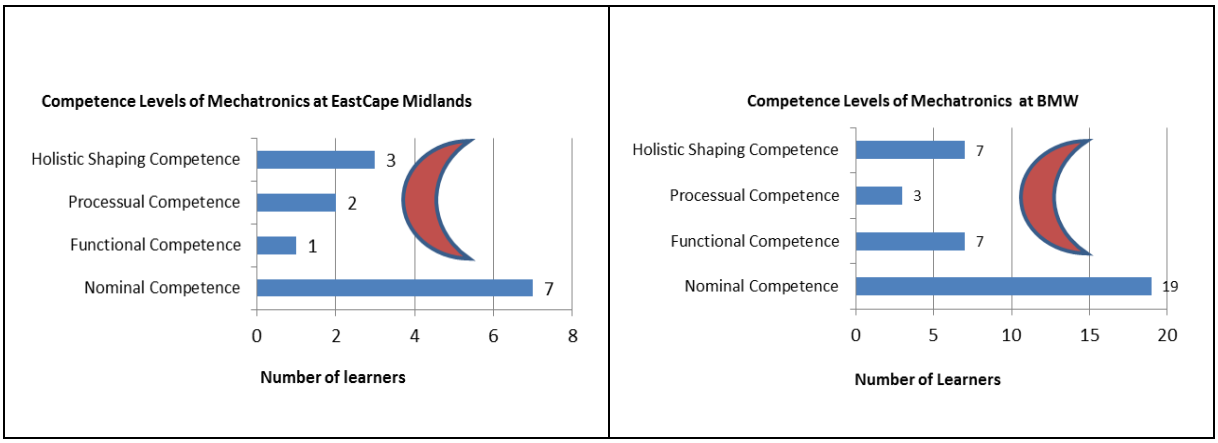


Figure 3: Examples of competence levels polarised towards a "C-shaped structure"

[3] Two of the electrical test tasks are used in reference projects - with much better results (cf. 6.1.2 performance of electricians by tasks in an international comparison); such reference results are important to understand why the level of tasks should not be considerably be lowered.

Such figures demonstrate very clearly, that very good and very weak often come together in one and the same class, maybe supervised and trained by one and the same teacher or trainer. But as a matter of fact, a high diversity of learners within a class or a group of learners needs to be considered as a substantial challenge for any training provider, above all the teaching and training staff. Teaching and training should always be done in a manner that all learners – the stronger and the weaker ones can benefit as much as they can and especially in a view that none are left behind.

Tackling the problem associated to high diversity would be an essential element of all future work on quality development in teaching and training in South Africa, especially because the willingness and motivation to learn is very high (cf. section 2, part VII). The current findings of the COMET assessments suggest seeking for test site specific solutions, because the degrees of heterogeneity, the percentage of risk learners and the context of learning vary a lot from venue to venue. Based on the current international COMET research and also based on the present research out comes of COMET South Africa, it can generally be assumed that heterogeneity within and between classes will be substantially reduced, when lifting the average competence level.

The following two diagrams shows two heterogeneity diagrams, the first one of which refers to test results in the various COMET activities in South Africa, the second one refers to a reference project in Switzerland. These heterogeneity diagrams provide an overview on the competence degrees reached in different test groups including a view on the learning time gaps between them.

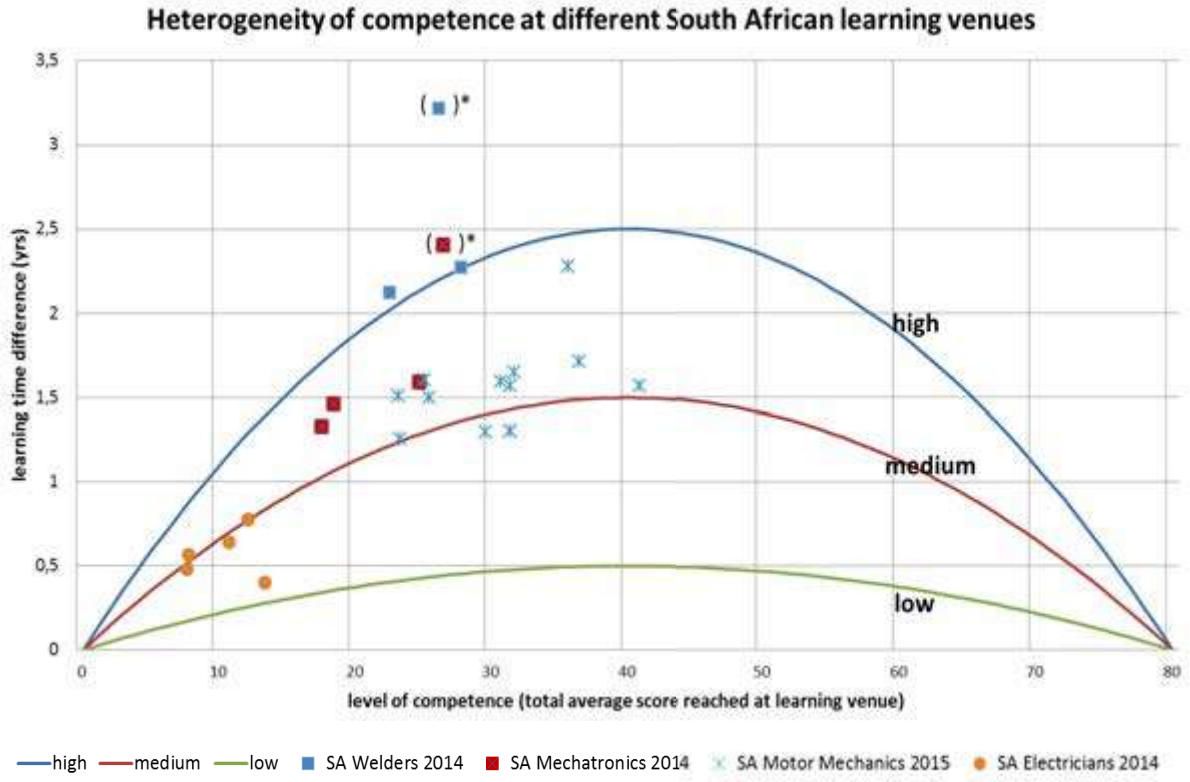


Figure 4: Heterogeneity diagram of selected South African COMET test sites 2014 and 2015
*) The extreme value in welding refers to a sample of only 10 test takers, the extreme value in mechatronics refers to a venue incl. two extraordinarily well performing learners that led to a higher average score (1)

In PISA tests differences of competences levels reached in different groups of learners are also translated into approximate learning times measured in school years. In PISA tests, a very rough measure that counts for the learning time difference from one year to another is about 40 points (DEUTSCHES PISA-KONSORTIUM 2005, p. 38). Likewise, in the COMET project one can assume a

difference of about 50 to 60 scores that distinguish an expert (or an advanced learner in a 3rd year of training) from a novice in a first year of apprenticeship. Within a course of training with duration of about three years one can consequently accept an approximate point value of about 15-20 as a learning gain between one and another year of training.

If, for example in a class of apprentices, some learners reach highest results (like 40 and over) while others only get less than 10 scores, the learning time difference between these learners can be regarded as up to 2 years! In the South African project such results have been found in many test groups, which has been documented by percentile bands according to test sites participating in the two major assessments in 2014 and 2015 (cf. section 2, part I, Figures 8 and 10).

The South African results (Figure 4) show that heterogeneity levels are between medium or high in a majority of classes. This picture demonstrates as well, that classes in motor mechanics reached the best average test results in terms of the total score (horizontal axis). Heterogeneity in these classes is lower compared to the classes of other professions trained. (Electricians were at such low competence level, that heterogeneity could not be high as well.) On the other hand, learners of the welding and mechatronic profession reveal greater learning time differences in the various classes represented in this graph. As better average scores tend to go with lower level of heterogeneity it would be one of the major tasks in a follow up project to lift the average competence in a class. This is assumed to be possible when consistently teaching according to the principle of open tasks which challenge stronger students and also provide good learning opportunities for the weaker ones.

In this regard, the Swiss heterogeneity diagram (Figure 5) demonstrates two issues: first, it is obvious that learners reached much higher competence levels on average and diversity was also lower – especially when competence levels rose.

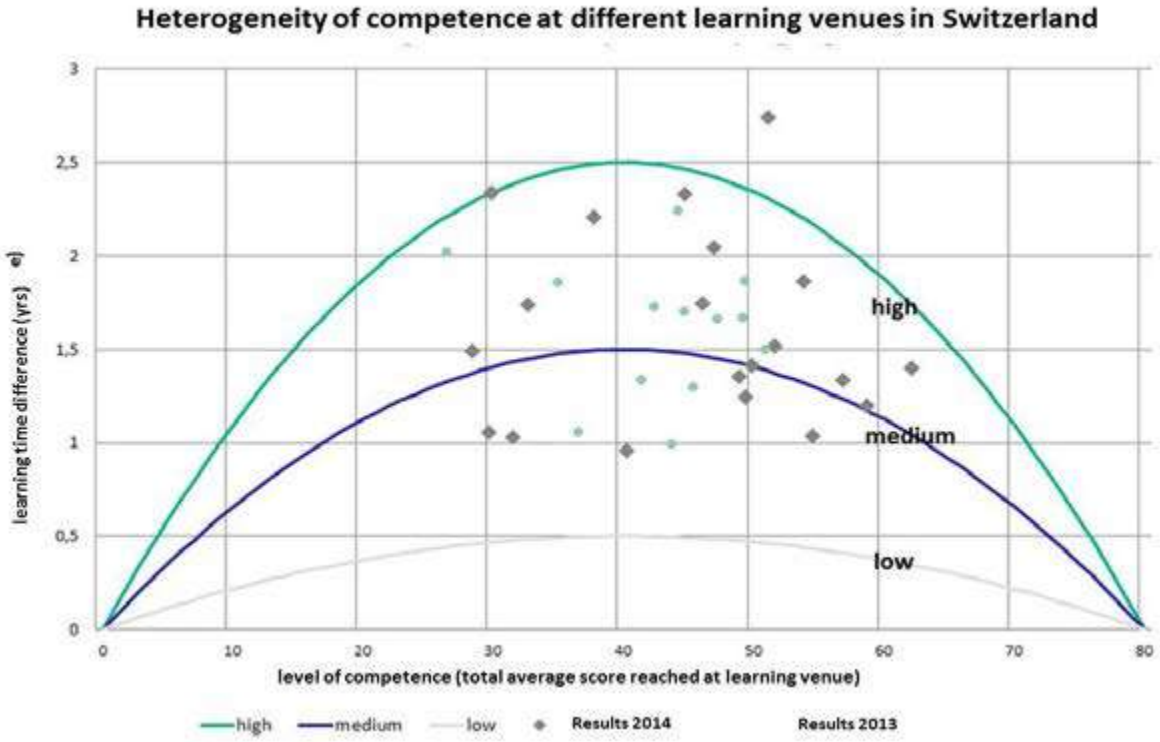


Figure 5: Heterogeneity diagram of selected COMET test sites in Switzerland 2013 and 2014

The second issue is that in this project the same test venues were assessed in two subsequent years. In between these two tests, COMET learning tasks were used in classes and in a second test, competence levels were considerably higher (no stagnation) and heterogeneity less significant. These reference findings are of high relevance for the South African context. A very strong

recommendation would lead to TVET teacher further education and a continuity of working and learning according to the COMET principles. Regular assessments monitored by a South African team of experts and a consequent evaluation of test results would support this process and provide the necessary continuity in the analysis about the achievements made.

Some encouraging samples from the motor mechanic test in 2015 already confirmed the argument that the polarised C-shaped profile of competence levels obtained at a test site linked to and based on high degrees of heterogeneity can be turned into the opposite – provided that the mid competence levels (level 1 and 2) can be strengthened. Where results were better on average, the overall picture did not lead to a polarisation of competence levels, but to the opposite of a C-shape, i.e. more learners in the mid competence levels, and less in the group with the lowest and highest results (see Figure 6 for two examples).

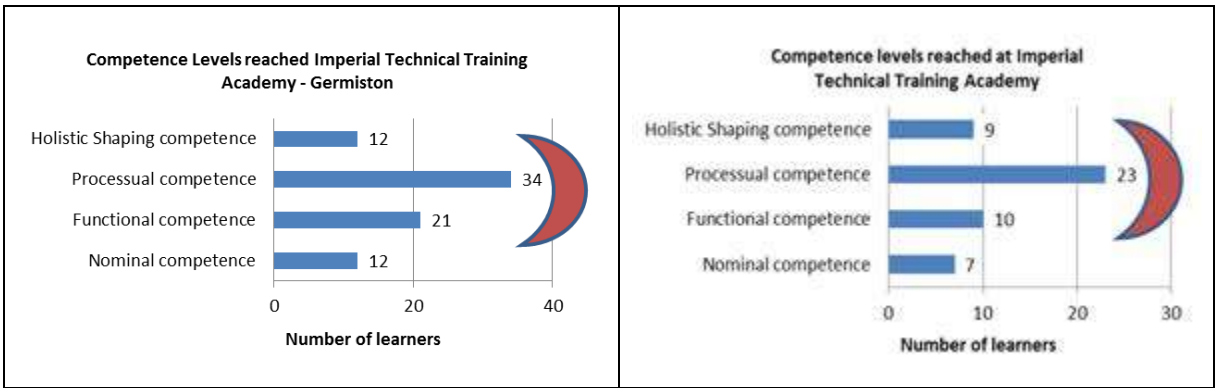


Figure 6: Example of competence level allocated to middle degrees

Last but not least it has to be added that addressing the problem of the high proportion of risk learners in vocational education and training generally also means to work on measures to further support female learners in the domains of the vocations tested. Even though gender issues did not play a superior role in the COMET project, the overall analysis of competence according to gender showed that the percentage of risk learners among female test takers was much higher (61.5%) compared to the one of their male colleagues (34.9%) and the proportion of best learners was more than double as high among male test takers (10.7%) as among women (4.6%).

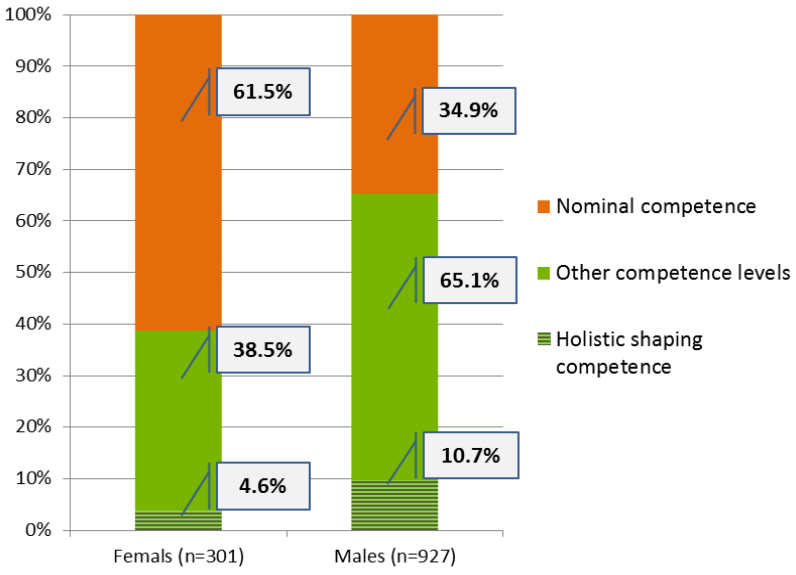


Figure 7: Percentages of male and female test takers reaching selected competence levels. COMET South Africa 2014 and 2015.

The result of relatively higher percentages of female test takers in the risk group level refers to all vocations tested in the 2014 pre-test and main test as well as to the test result in 2015. This is why it is strongly recommended that teachers and trainers pay special attention to the guidance of their female learners, i.e. to support and encourage them in order to make them as competent as (and as self-confident) as their colleagues, especially because they will need to be accepted as professionals in a rather male-dominated work environment later on. All gender specific results on competence profiles and with regard to the different vocations examined are summarised in section 2, part III.

4. Stagnation of competence development

One of the key findings of the COMET project is that competence development often stagnates during the course of training. Yet, this result cannot be considered as a 'typical' South African problem only, because similar difficulties have been observed in other COMET projects. Nevertheless, the extent of stagnation, which can also be viewed as a 'zero' or even 'negative' development as calculated for some South African test groups, was dramatic.

As the first main test result of COMET 2011 had already pointed towards a considerable degree of stagnation in competence development, the data analysis of the subsequent main tests in 2014 and 2015 was a key issue. Part V in section 2 sums up the actual results of the competence analysis according to the different years of training and looks at the different samples (total number of test takers) and occupation specific results.

Based on this analysis, the interim findings of 2011 can now be confirmed: stagnation (or even a slight decline) in competence development was relevant for *all* vocations and at all test sites, simply on a different competence level. Only in the electrical field it was observed that a longer training also headed to better overall results, and even if the competence levels acquired remained the same, results were on a better overall level (cf. Appendix I: differentiated analysis of competence level into sublevels high-medium-low and according to the different years of training).

Average Profile 1st year (test 2014)	Average Profile 2nd year (test 2014)	Average Profile 3rd year (test 2014)
		
Average score = 21.43 *n* = 164; *V* = 0.15	Average score = 20.61 *n* = 183; *V* = 0.18	Average score = 17.25 *n* = 84; *V* = 0.20

Figure 8: Stagnation/back-fall of vocational competence development from year 1-3. COMET South Africa 2014.

Still, such differences were very small and only relevant for a little group of learners, so that one can almost ignore this effect when looking at the very unhappy overall picture. The fact that the full potential of apprenticeship or study programs was by far not tapped can be illustrated best by taking the average profiles calculated according to the three first years of training as observed in the

COMET tests 2014 (see Figure 8).

It may be interesting to add that risk group learners were almost equally dispersed among all age groups, so that in general, there was no indication that age had a considerable influence on a learner's performance. The cumulated data collected in both COMET main tests in 2014 and 2015 did not show *any* correlation between age and good or bad performance. So, what might be a benefit for older test takers (experience), was – on average – of no advantage on a COMET test day. This result also supports the finding of stagnation in competence development in the South African context.

Finding out about the reasons for the degree of stagnation was not so much a subject of the current projects, therefore further research on this topic can count for a strong recommendation followed from the present case studies. The report of the predecessor project in 2012 had suggested that a highly modularised form of the existing training curricula could count for a major reason: Each time a new module is introduced, learners start again as beginners, and contextual understanding is not required. Also a 'training-to-the-test' philosophy may be relevant in this regard. Without further speculating on what circumstances exactly cause the current deficits leading to zero gains in competence development, one further suggestion would be to simultaneously invest into a modernisation of training concepts towards a more holistic problem solving didactical approach which addresses different knowledge levels of learners in an adequate (means differentiated and successive) manner.

When looking at the concept of work process knowledge and it different dimensions of 'knowing that', knowing how' and 'knowing why', the current knowledge level of test takers in the South African project is dominated either by the first – or the first two – dimensions. But in order to take over responsibility in a given occupation, a learner has to reach good levels in all three dimensions, because being professional means to be able to overlook a situation and to take suitable decisions. It will thus be of major importance to increase the *overall* level of knowledge of learners and to avoid 'anpassungsorientiertes Lernen', i.e. learning forms that do not allow for reflection. From a more global perspective one can argue that it will not be possible to build up a work force with a high (sense of) responsibility anchored in the direct value-added processes if knowledge levels are not substantially developed. A strong orientation towards competence-oriented teaching and training including a consistent assessment structure needs to be addressed in order to tackle the existing deficits. As the COMET competence profiles also serve as to reflect the prevailing levels of work process knowledge, the inherent feature of work ethics can as well be derived from the completeness of a learner's or a group of learner's profile. Overcoming the problem of stagnation will certainly be feasible when focussing on the conditions that foster holistic problem solving. Research issues in this domain could be linked to further PhD studies in vocational education and training in South Africa.

5. Teaching, training and learning with COMET: The importance of follow-up processes and feedback mechanisms

As it is one of the major elements of the COMET philosophy to not only measure competence but also to engage in teaching and training according to the approach, the composition of test venues was also interesting in terms of the analysis of experienced and non-experienced test venues. To sum up the findings in this regard, it needs to be stressed that among the test results of both main tests there were very promising examples for the positive effects that COMET exercises and the learners exposure to COMET learning tasks may have on competence development. Even if it was often not possible to step by step introduce COMET learning into classroom or practical training, there is some strong indication in the test results that those classes whose trainers or teachers were engaged in COMET for a while, have reached much better test results in a second assessment

A good example offers teaching and training at Arcelor Mittal, where a first COMET test took place in 2012 (electricians). Even though test results in the assessment of electricians were still weak in 2014, the way learners solved their test was not at all dominated by a function oriented problem solving approach, but much more towards a holistic style. Moreover, learners who participated in the second assessment reached higher average scores (cf. section 2, 2.1.2.1). None of the learners participated in both test, so the learning effect was not visible for a single test person. Here, the positive effect needs to be linked to the teachers' experiences with COMET as a didactic concept.

Another example refers to the experiences made by learners at Sandown Motors who took part in the pre-test and main test of motor mechanics in 2015 (cf. section 2, 2.3.2.9.). In the first exercise, the assessment of learners at led to a typical deficit in the two competence criteria referring to social and environmental responsibility: K6 and K7. These lacks were not that relevant any more in the second test – an effect which can only be drawn back to successful follow up discussions with lectures of teachers at Sandown after handing over and discussing the pre-test results with their learners. That such positive learning effects were possible is remarkable. Contrary to the experiences made at Arcelor Mittal, some of the learners at Sandown had the chance to take part in a test for a second time. Although it needs to be highlighted, that both test groups were relatively small, this analysis supports the hypothesis that competence levels and profiles can be successfully developed – if COMET didactics are introduced in a regular training and good feedback mechanisms are in place.

6. Investing into the quality of tasks

As in all other COMET projects the South African team needed to put much effort into the development of tasks which would be of sufficiently high quality as to equally address all competence criteria (including the respective sub-criteria) of holistic problem solving. All tasks which are used in a main test activity have to go through a pre-test with an adequate number of test takers per assignment so that tasks can also be reviewed or completely excluded from a main test.

The South African experience shows, that a very good preparation in terms of securing tasks validity was – for example – provided the case of the professions summed up under the umbrella of 'motor mechanics' where pre-test groups consisted of 20 - 30 learners per test task (cf. section 2, 6.3.1). Out of a total of initially eight tasks four assignments that were accepted as applicable for the main assessment. Also in the electrical, welding and mechatronic occupation, the preparations on test task development and the development of the corresponding solution spaced were very intense. In all professions test task development was a combined effort of two teams: a local South African one and a group of experienced German teachers cross-checking the tasks and solution spaces from their perspective. Initially, 10 tasks per occupation were developed. However, the subsequent pre-test activity in these occupations did not involve as many test takers as in motor mechanics.

Correspondingly, the analysis of the pre-test in welding and mechatronics was based on numbers between 5 and 10 learners, and only up to 4 test takers in the electrical pre-test. Whereas the quality of the pre-test in welding and in mechatronics can still be seen as adequate, this is not the case in the electrical pre-test (cf. 6.1.1; 6.1.2). Notably because the results in this pre-test were already very weak, but especially because the results by task were only based on a very small number of test takers, this was not a solid basis for the decision about which task to choose for the main test activity. Looking back, it was a mistake not to run a second pre-test based on a better sample.

The use value of a tasks and its relevance for the occupation trained is also crucial for the motivation of learners to accept working on them and taking time to find an adequate solution. When looking at the learners' estimations about the task's relevance for the occupation trained, the degree of contentedness was very high, except for 17% of the electricians, who did not find their

tasks very relevant or considered them as not relevant at all. This result corresponds to the general weaknesses in the electrical test and supports the need of further improvements for future test task design in this occupation. When comparing all test takers estimations one may say that mechatronics, motor mechanics, welders and the pre-tested fabricators form the groups with the most positive feedbacks on the relevance of the test assignment for their (future) occupation. This is a very good result for those engaged in the development of tasks.

Section 2, part VI documents the projects efforts on task development and sums up the results of the competence assessment by tasks in all 6 occupations tested between 2014 and 2015. A common finding is that pre-tests are no predictor for results in large scale assessments. Other interesting results refer to reference projects and the performance of learners working on the same tasks but trained in a different country environment.

As a consequence it has to be pointed out that COMET task development needs to be based on a very intensive and thorough preparation. Tasks cannot be used in a test without securing their suitability. Above all, it is necessary that all competence criteria are equally addressed in one task (degree of complexity has to be given). But it is also important that test results on specific tasks are linked to the information provided by the motivational questionnaire of learners in order to include their feedback into future test task design. For the present case of the welding test, it became visible, that best test takers were able to complete their task in a relatively short time (compared to their colleagues tested in the other occupations), an observation that might encourage test task developers to elaborate tasks with a higher degree of difficulty.

It is essential that all tasks have a similar degree of difficulty so that learners' competences as measured in a main test are comparable. A recommendation would therefore be to implement a system of quality assurance with regard to test and learning task development and to use the data obtained from large scale competence tests in order to run additional psychometric evaluations where this is necessary.

Buildings teams between teachers, trainers, subject and curriculum experts in order to design further learning tasks or to revise some of the existing ones can also be seen a major part of TVET teacher further education. It is one of the most important finding (or side-effects) of the present project that people invited to participate in COMET seminars (developing tasks or being trained in a rater training) benefited from the dialogue with their colleagues. Therefore it is recommended to further support structures where such mutual learning opportunities are given.

6. The need for further TVET teacher and trainer (further) education

That teachers and trainers are very likely to transfer their own problem solving horizon to their students or learners can be made visible when comparing teachers' and learners' competence profiles. Such exercises had already been made in reference projects in China and Germany. In order to better understand and link the results of the COMET test for learners in South Africa, the project team invited teachers and trainers to anonymously participate in a COMET test. Within the frame of the South African COMET project and during the test conducted between 2014 and 2015, a total of 34 teachers and/or trainers participated in the learner's assessment. These numbers are still very small so that general conclusions would not be possible at all. However they provide interesting information and may trigger some future initiatives and research in this area.

The first results obtained in 2014 (see figure below) were based on a test of 14 teachers and can be looked at as a very shocking experience as five teachers received only nominal competence (cf. section 2, part IX). In the subsequent exercise in 2015, five teachers and 15 trainers participated in the assessments of motor mechanics. Again, 2 trainers did not reach any competence level and another 3 were only at functional competence (level 1). For a teacher such weak result can be

considered as failure. It is thus a key level finding of the two tests that TVET teacher and trainer competence is sometimes alarmingly weak in South Africa.

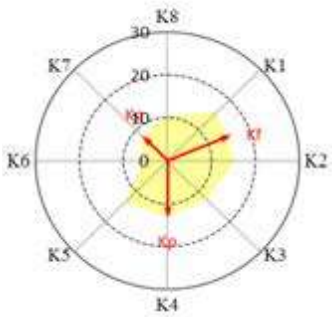
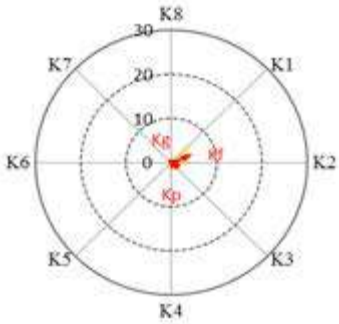
Competence profiles of teachers and trainers (result of top five)	**Competence profiles of teachers and trainers** (result of medium four)	**Competence profiles of teachers and trainers** (result of bottom five)
		

Figure 9:Competence profiles of teachers and trainers (n=14) participating at COMET South Africa 2014.

A differentiated analysis of teachers' competence on the one hand and trainers on the other, suggested that TVET *teachers* had the more holistic competence profiles and also reached the better average results in terms of the total scores if compared to the results achieved by *trainers* who had some more difficulties in addressing the criteria of social and environmental compatibility (cf Figure 146, p. 219).

In how far teachers and trainers were transferring their knowledge and problem solving horizon to a group of learners has been analysed by taking their competence profiles and comparing them with the respective class results. This analysis had not pointed to a unanimous picture. In fact three different patterns have been found [4]:

a) Teachers/trainers have a *very strong* influence on their learner's competence: The shapes of their competence profiles and the average scores reached in a test resemble a lot. Best test takers and averages obtained by a class only marginally differ (Figure 147 A). But best test takers may as well reach higher results as their teachers/trainers (Figure 147 D).

b) Teachers/trainers have a *relatively strong* influence on their learner's competence: The shapes of their competence profiles and the average scores reached in a test resemble a lot, but the overall results are much weaker. Best test takers and averages obtained by a class differ more. (Figure 147 B).

c) Teachers/trainers have *no strong* influence on their learner's competence, but do not manage equally address all COMET competence criteria: The shapes of the competence profiles and the average scores reached in a test differ between teachers and learners but not necessarily the shapes of the competence profile of best and average test takers within a class. (Figure 147 C).

[4] Where trainers failed, it was not possible to link the data to a group of learners. The results presented are based on trainers/teachers who have reached processual or holistic shaping competence.

From the current analysis these results can only be demonstrated but not further explained. Most of all because teaching/training is a profession itself, it would not suffice to test teachers or trainers with a same tasks as elaborated for learners. The quality of teaching does not only refer to the problem solving capacity a teacher or trainer has, when it comes to professional tasks in a given domain. Equally important are the didactical competences, which need to be tested in different manner (see Rauner 2013, and Zhao 2014).

Recommendations with regard to the preliminary findings of the South African COMET project are to engage in the provision of further teacher training and qualification. The recommendations as summarised in Section 2, part 9.2 focus on the introduction of a COMET Teacher and Trainer Certificate and to offer further training, also based on the didactical approach of the COMET methodology. Seminars on test and learning tasks development – as mentioned above – but also a special training on how to deal with the problem of high degrees of diversity count for promising measures to further qualification.

7. South Africa's learners: highly motivated and with a big willingness to learn more!

An extraordinarily high test motivation of South African learners is among the key findings of this project. The high level of interest refers to all domains, i.e. intrinsic (such as the time spent on solving a task and the degree of effort and concentration) as well as the extrinsic sources of motivation which are among others linked to the relevance of tasks for the occupation trained. This is a finding that distinguishes the South African experience from other COMET projects so far.

Principally in those professions where a big majority of learners did not reach adequate competence levels (electricians, millwrights, fitters and turners) a very big share of learners used the maximum amount of time given and put much effort into finding a solution.

Learners liked working with COMET tasks because these were estimated as very useful and linked to the profession trained. Even though the degree of difficulty has been considered as very high or high, more than 90% of all test takers (n=1,213) were appreciating COMET tasks becoming a regular part of their training (see Figure 10).

When asked about the reasons of their positive answers most of the test takers claimed a "desire to learn more" and the "relevance" of such tasks for a future career. Many learners also liked the "challenge" as such or found that it required "creativity and holistic thinking". With regard to the differences in the learners' explanations in both main test activities, it was also possible to conclude, that a very large number of test takers were aware of the fact that their competence level was not yet adequate for being able to solve their task.

All in all, the estimations of learners about this topic can be regarded as a true reflection and answer of the questions - as opposed to only providing a polite answer. This is a finding that can among others be derived from the interpretation and comparison of results between 2014 and 2015 (cf. section 2, part 7.1.4).

Because the South African test results showed high proportions of risk learners in all domains, the motivational analysis in this project has also explicitly been connected to competence test results in order to find out, whether the average outcomes of the motivational analysis corresponded to all learners in the same manner and it was very interesting to learn, that the general picture did not change at all when comparing the motivation of the best with the weakest performing learners/students (cf. section 2, part 7.2).

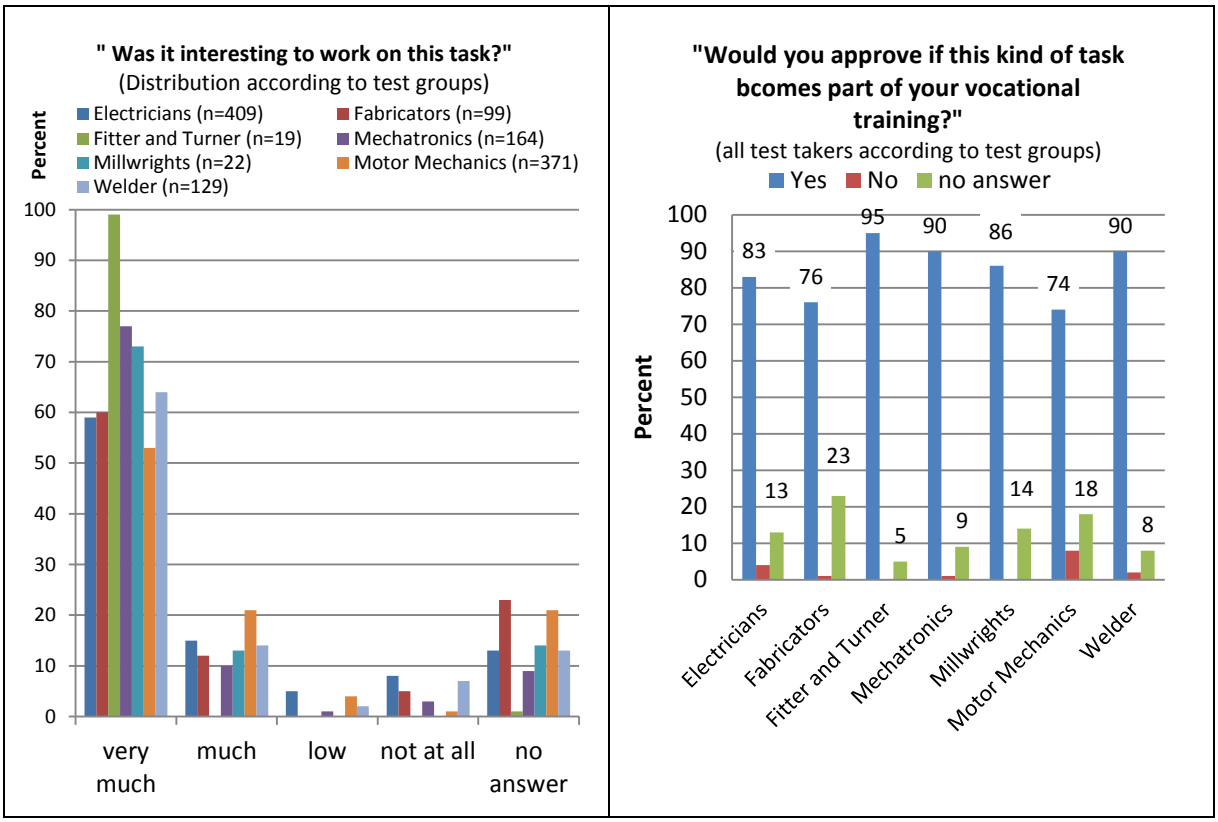


Figure 10: Analysis of test motivation: The learners' interest in working and continuing to work on COMET test tasks. Information according to occupations. COMET South Africa 2014-2015.

Again, this observation is relevant for all vocations tested and underlines a very high motivation to perform as best as possible, even though it might sometimes have been frustrating to be confronted with an unsolvable problem or a challenge that was obviously too high. This is very encouraging result, especially in comparison to other COMET projects, where weaker students/apprentices tempt to a cut and run behaviour when confronted with a problem they cannot solve.

A huge potential for further competence development is rooted here.

8. Organisational commitment as a source of vocational identity?

An important precondition for the development of occupational competence is a student's development from novice to expert. Only by developing vocational identity, one can take over the role of an expert, and to adequately put into use the knowledge and skills acquired during training.

Occupational commitment is defined as orientation towards the profession trained and is distinguished from organisational commitment as orientation towards the enterprise. Another source of motivation is general work ethics referring neither to the organisational environment nor to the contents of work, but to which an abstract sense of duty can be allocated (being on time, willingness to do what is expected to be done, etc.).

The documentation of results from the commitment data analysis as summarised in section 2, part VIII, reveals some very interesting insights into the factors determining vocational identity of South African learners. The interrogation has been an integral part of the competence test, which means that the learners who participated in the competence assessment had to answer a very detailed questionnaire on their personal attitudes towards their vocational education as well as the contextual issues of training at college or in companies (see Appendix III-2).

The response rate to the questionnaire was not as high as to meet the expectations of the organisers, because not all of the learners participated in the interrogation or the project's online

questionnaire, which was not available in some classes. Nevertheless, many learners handed in paper a pencil version that was inserted to the online data base later on. Due to the lack of information at some learning venues, the commitment analysis could only be adequately calculated for test takers at five out of eleven test sites in 2015 when only about a third of the distributed questionnaires were entering into the data base. In 2014, the feedback was a much higher allowing for a complete test site specific calculation, because more than two thirds of the questionnaires were completed and handed in. Together, the data provided in both years was of sufficiently high quality in order to draw some major conclusions.

A very striking issue is certainly the high overall degree of commitment of South African learners, a finding, which corresponds to the test motivation as described above. The results in all scales measuring occupational and organisational identity, commitment and work morale, were at an extremely high level. However, when comparing the different scales' results, one can observe, that the majority of learners were even more committed towards their training providers than to the profession in which they were actually trained (cf. Figure 123 – Figure 126). Organisational identity was extraordinarily high at some training providing companies, but also at colleges offering vocational education and training (see Figure below).

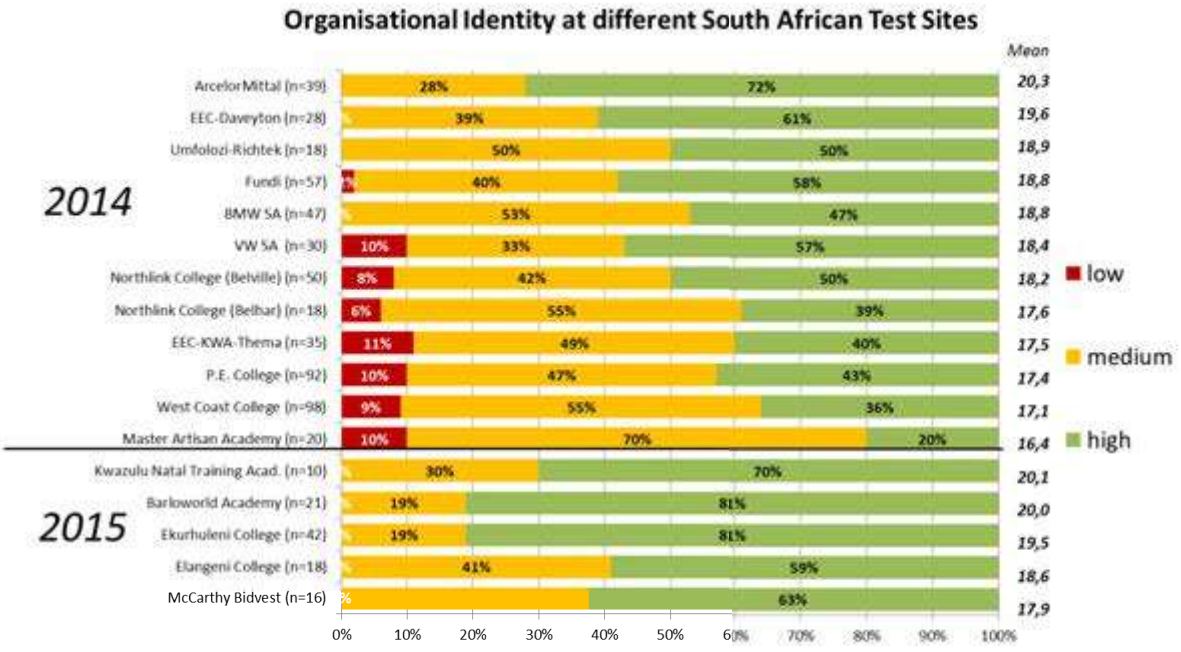


Figure 11: Analysis of VI Questionnaire: Organisational commitment according to test sites. COMET South Africa 2014 and 2015.

Vocational identity and commitment were also high, predominantly in some companies offering in-company training. Compared to the very good results in these domains, the learners' estimation on their general work morale (work ethics) was not as high (see Figure 127, p. 210).

When comparing colleges and private training providers, such as companies, there was a clear indication that those apprentices who were trained in a company had higher degrees of vocational identity (cf. Figure 135, p. 213). Regarding the analysis according to professions trained as documented in section 2, part 8.2, there were not so many differences. Among the learners with the highest degrees of identification with their profession and their organisation were motor mechanics. Also in terms of work morale, their result was much above the average.

It is of course of some interest to compare the learner's estimations by the profession trained, because such results provide some indication about the general attractiveness of occupations. But as

the South African COMET project has discovered high degrees of vocational identity in all professions, the question about TVET being in interesting and worthy career option does not seem to be of doubt. A view on reference project results in technical occupation tested in Germany opens the mind for the big differences between the estimations of apprentices trained in this domain, but in a different country environment. Figure 12 shows profiles of vocational identity and commitment in the in selected technical occupations in Germany and South Africa. On average, German figures are lower compared to the South African result. But looking at the sources of identity, the vocation played a bigger role for the German apprentices compared to the role of the company as a training provider. The idea that a vocation once learnt is something that would also lead to employment at the same or another company and that there has been and still is a freedom of choice may explain that a vocation itself counts for an essential source of identification for these learners. Moreover, also as opposed to the estimations of the South African group, general work morale of German apprentices was a bit higher compared to the other sources of motivation.

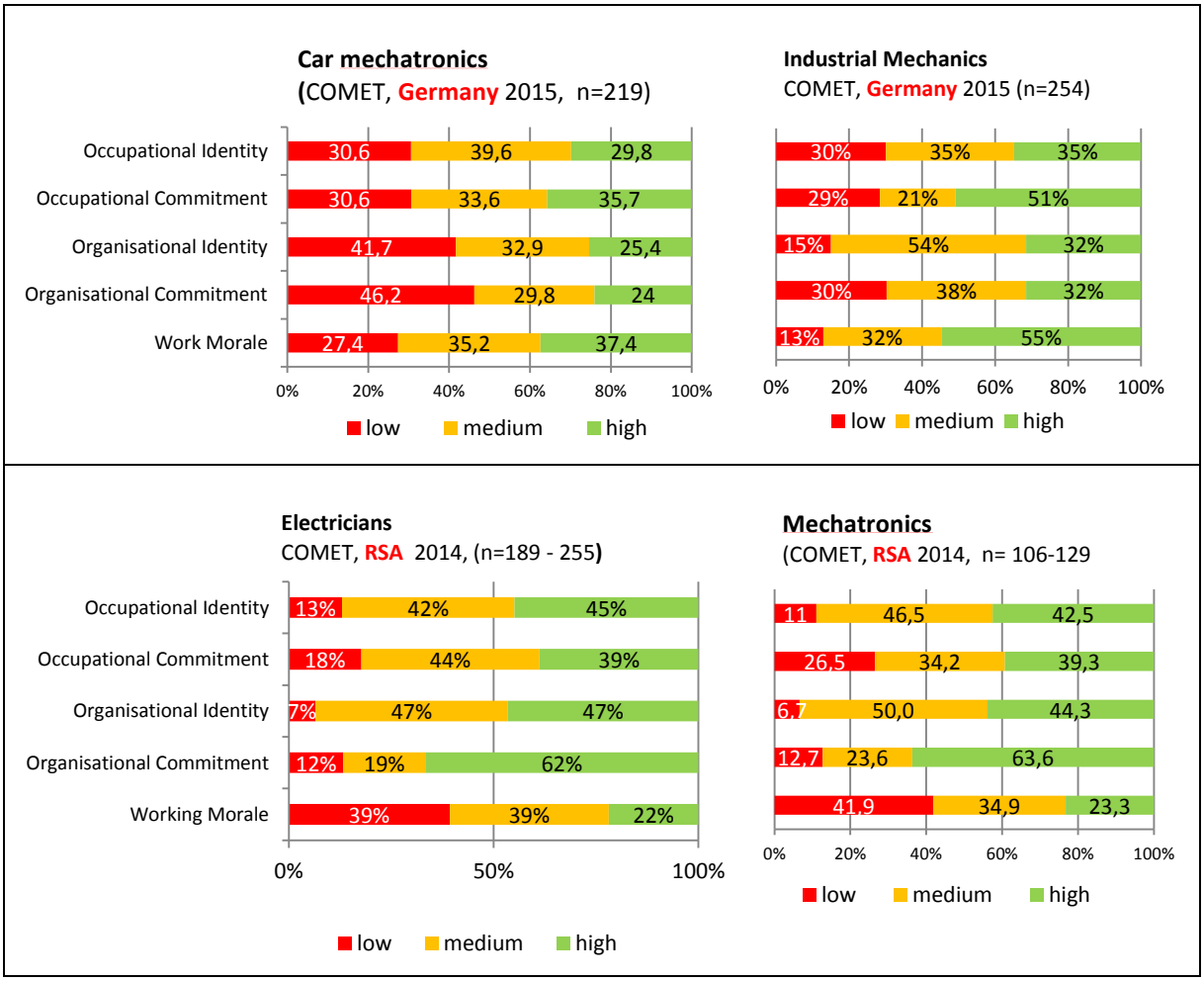


Figure 12: Profiles of vocational identiy and commitment in selected technical occupation trained in Germany (COMET 2015) and South Africa (COMET 2014).

Whether the current identification potential of the vocations analysed in the COMET tests in South Africa might be lower or higher compared to the similar occupations trained in another country environment is however not the most important question to ask. The fact that learners identify more with their training provider than with the their occupations is a result that may be regarded as a country specific finding, which has to be linked to the overall socio-economic situation of South Africa and makes much sense given the fact that youth unemployment has actually risen to a percentage of over 50% in 2016 while the overall rate of employment has not been reaching figures

that go much beyond 42% during the past five years[5].

A training contract with an employer has to be seen as a guarantor of economic security and can explain why South African learners have a stronger feeling of gratitude to the training company and act accordingly. In order to verify this assumption, learners were asked to comment on some statements. The one that said:

'It does not matter that much which vocation I learn, what counts is employment!'

was confirmed by one third of all test persons in both test years analysed in this report.

9. Factors of influence: Business process orientation, quality of training and the role of learning venue cooperation

Regardless where the training took place, a general observation was that the quality of teaching and training (based on the learners' estimations provided in the context questionnaire) played a central role for the development of occupational commitment (see Figure below and Figure 137, p. 214).

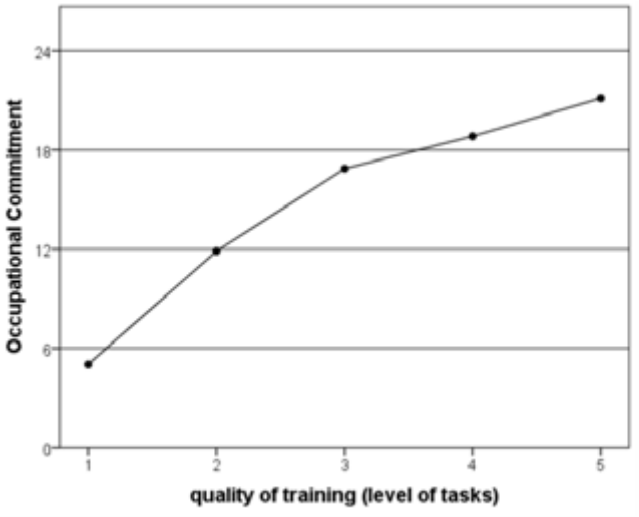


Figure 13:
Analysis of context and commitment questionnaire: Correlation between occupational commitment and quality of training (level of tasks).

In order to find out, what other factors determined higher or lower degrees of occupational identity and commitment and could positively influence competence development further contextual questions were taken into consideration. Among others, this analysis suggests a high correlation between occupational identity and the degree of business process orientation in a training curriculum. Such results were provided from the data analysis of the context questionnaire and in relation to the results of the commitment interrogation of learners at some of the vocational college participating at the test (Figures 138 and 139, p. 215).

Other correlations were evidenced between the cooperation of learning venues on the one hand and occupational commitment on the other (case of learners at VW South Africa, cf. 139, p. 215). How much practical training in real work processes, in other words a regular integration of learners in the business process is having a positive impact on their occupational commitment can already be derived by the relatively better performance of learners who were trained in companies (COMET South Africa 2011). In 2014, this argument could be strengthened taking into consideration the result of learners in the DSAP programs (DSAP = Dual System Apprenticeship Program) who follow a curriculum that includes workplace based training in companies. Even though the number of

[5] According to Trading Economics reporting from Statistics South Africa (www.de.tradingeconomics.com/south-afica/youth-unemployment-rate/forecast), South African Youth unemployment is currently at 53.7% and it is forecasted that this figure will not be substantially reduced in the next years. Employment rates were ranging from 41.0 and 46.2% during the time between 2000 -2016.

test takers in the newly established courses was still rather small, the comparison of their test results with the average of all test takers was encouraging.

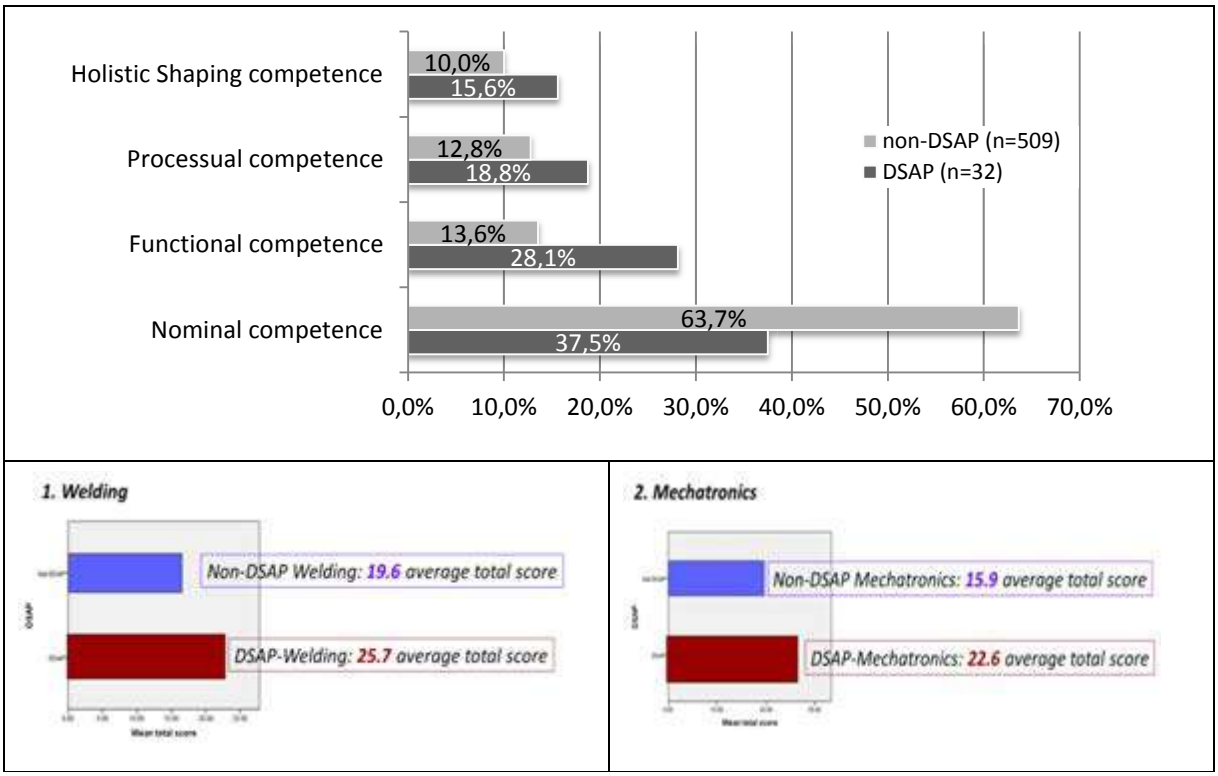


Figure 14: Comparison COMET results; DSAP / non-DSAP programms COMET 2014.

Last but not least, there is a strong indication on the image of an occupation itself having an essential influence on occupational identity (Figure 141). This finding is line with results from other (international) COMET projects and backs the general recommendation to support measures that address the image or reputation of specific vocations trained but also the image of TVET as such.

10. Further recommendations

The South African COMET project has revealed a variety of considerable difficulties linked to the current provision of vocational education and training in different contextual arrangements. The key challenges refer to overcoming the current stagnation of competence development during the years of training, a better integration of risk learners and dealing with the various aspects linked to diversity, but above all improving TVET teachers' and trainers' competences. On the other hand, the project has shown, that a huge potential lies in the COMET concept as a didactic model, which can contribute to tackling the prevailing problems.

Measures to quality development and quality assurance should therefore be the strategic issues to be addressed in future projects of further knowledge transfer. Here, the focus should be on a further introduction of the learning field concept into modern teaching and training.

The following measures can be recommended in addition to all references provided in the preceding summary and/or chapter specific conclusions provided in the main report in Section 2:

- **Continuity in the use of COMET, establishing a COMET office in South Africa**
  The South African COMET project has built on the close cooperation with private and public training providers established by the merSETA. A great number of VET teachers and trainers contributed to the work associated with the assessments on a voluntarily basis. This has been an enormous support and input, without which the project would never have been

possible. At the same time teachers and trainers have been trained in COMET. In order to benefit from this training and to further build on it, follow-up measures would need to focus on the provision of structures that enable the further use of COMET in South African TVET.

One possible measure could be to set up a COMET office located either at the merSETA or at a South African TVET research institute (linked to a university or independent) where the expertise is kept and quality assurance in all possible future project streams can be guaranteed. Moreover, international research cooperation and transfer project activities could be managed within the structures of a newly established office or institute. The successful implementation of research methods in the past years can then be secured and transferred into TVET practise for continuous quality development.

- **Investing in TVET teachers' and trainers' (further) education**
  The South African COMET office could offer regular refresher trainings for teachers and trainers who have already been qualified within the last three or four years but also introduce the concept to additional training personnel in cooperation with public and private training providers. The suggested introduction of the COMET TT certificate could support this (further) training of the trainers in accordance with the overall project aims to develop training quality. As for a first step, it is recommended to concentrate on the vocations already tested and analysed in the main test activities in 2014 and 2015 before introducing the model to further vocations. An essential element of the training would be to understand the nature of and being able to design learning tasks according to the learning field approach and to implement these tasks in classroom and workshop training. Other aspects of the training can be linked to a modularised concept, including the provision of training according to a variety of COMET manuals.

- **Supporting TVET teachers and trainers daily work:**
  Providing a COMET online platform for practitioners
  An online platform should be set up for the South African COMET project and its follow-up activities. This platform needs to be accessible for VET teachers and trainers as well as subject matter and curriculum experts engaged in the process of task design in order to enable a continuous exchange of learning tasks in the fields of electrical engineering, motor mechanics, mechatronics and welding for registered members.

  Among others, a COMET assessment tool should be provided via this platform that enables teachers and trainers to run smaller learning controls based on tasks which are not used for main test purposes. COMET feedback forms can then automatically provided for teachers training who wish to generate their own feedback forms for learners without any delay. The aim is to support the daily work of the teaching and training personnel providing an easy to use instrument only for teaching and learning purposes (as opposed to large scale COMET tests).

- **Qualification of PhD students in COMET and related fields**
  Further to the qualification of PhD students within the activities of the past years (three PhD students are being qualified in the current project), it is suggested that future transfer projects activities are linked to an integrated PhD program in order to contribute to building up the South African research competence in technical and vocational education and training. Future field of (research) activities include
  - A transfer of methods of competence diagnostic into trade test examinations
  - Occupational research and development: development of modern occupations

- Measures to upgrade informal apprenticeships
- Setting up apprenticeship partnerships / partnerships for lifelong learning
- Building of an architecture of vocational education and training / governance structures including the establishment of higher vocational education and training

- **Proper use of instruments / COMET tests and psychometric evaluations from time to time**
  Experiences from other COMET projects have shown that monitoring the proper use of instruments it an essential prerequisite for follow-up projects. The proper use of the research and assessment instrument requires some expertise that also needs to be build and located in South Africa. For example, task development needs to be monitored by trained COMET specialists in order to secure the quality (relevance, degree of difficulty, adequate and balanced consideration of competence criteria). In the longer run, such issues should be covered by a group of specialists trained that might be trained within a future PhD cooperation project. COMET tests and psychometric evaluations are recommended to be conducted regularly.

List of Figures (executive summary only)

Project Proposal:
Transfer Project VET Research and Development in South Africa

Prof. Dr. Dr. h.c. Felix Rauner, I:BB, University of Bremen, Germany
Dr: Raymond Patel, merSETA, South Africa

The project frame

The transfer project will serve as to describe the research cooperation between the merSETA and the University of Bremen within a three year cooperation. The successful implementation of research methods in the past years has to be secured and transferred into a TVET practise and continuous quality development. This refers to

1. Measuring and developing vocational competences (COMET) in the different tracks of vocational education in South Africa
2. The transfer of methods of competence diagnostic into trade test examinations
3. Self-evaluation of costs-benefits and quality of in-company training (CBQ method)
4. Teacher and trainer further education in the process of quality assurance and development

The three-year experience in research cooperation suggests to enlarge a transfer project in the following regard:

5. Occupational research and development (development of modern occupation)
6. the introduction of didactics oriented at the learning field approach as well as competence oriented didactics and work based learning within *dual* education and training
7. Realisation of an architecture of vocational education and training with consideration of partnerships for lifelong learning, Upgrading informal apprenticeships and establishment of Higher vocational education and training (see Handbook 2010/11 The national skill development; Rainbow as well as the INAP-Memorandum)

Aims of the transfer projects

The superior aim of the transfer project is the development of research methods for quality assurance and development in vocational education and training.

- Based on the project results of the current merSETA – IBB project (2013 – 2016) and the expertise of the personnel engaged in the current project and

- Based on PhD graduate program in six domains. The PhD research projects in these domains should be integrated into the different parts of the transfer project so that professionalisation will take place within the research process.

The transfer project and its integrated graduate program will form a contribution to the establishment of a group of experts that found the basis for setting up and running a South African Institute for Vocational Education and Training Research as well as at South African Universities and for the Professionalisation at Institutes responsible for vocational education planning (curriculum development, trade test examination and their administration management)

Organisation of transfer projects

Each of the five transfer projects will be steered by a local South African project committee and incl a scientific support by the University of Bremen, Germany. The PhD projects (PhD candidates) will be part of the scientific advisory team located at Bremen University. They form the bridge for innovation transfer from the University of Bremen to the South African context.

The research and development dialogue contains

1. Knowledge transfer conference (yearly) in South Africa, where project results are made public and local experts (VET practise, politics and researchers) can be informed;
2. regular PhD colloquiums (quarterly) in order to discuss project related and overarching research questions within the group of researchers in the six research domains;
3. Round table discussions within each of the sic projects (every six months).

The team providing scientific support will establish a method of continuous project evaluation in order to monitor

- how and in which quality the project aims are met and
- how the innovation potential of the transfer project can be exploited at a high degree.

List of Tools

M1 Curriculum Design I
M2 Measuring vocational competences
M3 Towards a competence oriented examinations practise
M4 The learning field approach
M5 With learning tasks towards holistic shaping competence
M6 Learning in in-company training / Learning in company
M7 Learning and teaching in partnerships
M8 Curriculum Design II
M9 Learners evaluation on training quality
M10 Shaping of learning venue cooperation

Transfer projects VET Research & Development in South Africa University of Bremen (IBB/ ITB)				
	Transfer projects in South Africa **(Project coordinator: merSETA)**	**PhDs**	**Tools**	**Scientific support & guidance [6]** **(University of Bremen)**
1.	Occupational research and development of occupations	Section 2.1 – 2.6	M 1	**Dr. Kleiner (Consultant)** Prof. Rauner Prof. Zhao (Consultant)
2.	Competence-diagnostic: apprentices & students, trade examinations	Section 3.1 – 3.5	M 2 M 3	**Prof. Rauner** U. Hauschildt Dr. Lars Heinemann Dr. Lehberger Prof. Martens Dr. Erdwien (Consultant) u. a.
3.	Learning in learning fields; multiple competence development; work based learning (WBL)	Section 3.4, 3.6 4.5	M 4 M.5 M 6	**Dr. Lehberger** Dr. Lars Heinemann Prof. Haasler Prof. Jenewein (Consultant.)
4.	TVET Teacher & Trainer Competence Development Professionalisation of TVET Teachers	Section 4.1-4.5	M2 M4 M5	**Prof. Rauner** Prof. Howe Dr. Lehberger Prof. Bauer Prof. Jenewein
5.	Architecture of TVET; Apprenticeship partnerships; Upgrading informal apprenticeships; Dual Bachelor- and Master Programs; Governance	Section 1.1 – 1.4 4.1 – 4.3 5.1 – 5.6	M 7 M 10	**Prof. Rauner** U. Hauschildt Dr. Ruth
6.	Cost - Benefit - Quality (CBQ) - Evaluation - Development	Section 6.1 – 6.5 4.4	M 8 M 9	**U. Hauschildt** D. Piening K. Wagnik (Consultant)

[6] The list of experts is to be considered as provisional, it needs to be further elaborated and confirmed.

The PhD Program: Topics

1. Upgrading informal apprenticeship

1.1. The potential of informal apprenticeship

The ILO has carried out a study on the informal training of apprentices in African countries. This study has highlighted the fact that the training of apprentices in African countries mostly takes place in the informal sector. The structures of these informal apprenticeships (henceforth abbreviated as IAPs) are, above all, embedded in the regional particularities of the informal sectors, which also affect all forms of apprentice training in these countries.
The European tradition of learning a trade under a master craftsperson (for example in the skilled trades in Germany, Switzerland, and Austria) is also the underlying concept for apprenticeships in the African countries, even if vocational training and the organisation of the skilled crafts labour sector is much less formally organized here than in Europe.
Line of Inquiry
In this proposed PhD thesis, the structure and the quantitative share of informal apprentice training in South Africa, following from the ILO study, will be examined. The following questions will constitute the foundation of inquiry:

- What are the typical characteristics of IAPs?
- To what extent, and in which occupational areas, are young people educated in IAPs?
- What level of training quality is achieved in the IAP?
- What is the role of (informal) masters (master craftspeople)?
- How are IAPs connected with local and regional labor markets?
- What are the typical vocational, educational, and professional paths apprentices take after being successfully trained in an IAP?
- What is the cost-benefit situation of the IAPs?
-

Methodological Approach
The study is based on the available official statistics of employment and educational administrations as well as those from own inquiries.

Expected Results
The study seeks to deliver results on both the quantitative and qualitative potential of IAPs and to conduct recommendations for the step-by-step integration of IAPs into the structures of (dual) vocational training and education.

1.2. Sector studies in specific occupations within auto service and maintenance, plumbing/heating/cooling, construction and construction-related trades

For the sector studies, we have chosen occupations which already have developed forms of apprentice training in those countries that have an established dual vocational training system.
The informal economic sectors as well as informal apprentice training are under considerable pressure from technological and economic changes taking place in South Africa. This pressure is increased through international competition for higher quality standards. Thus, IAPs are at a crossroad where this sector could either stay informal and be unsupported, with the possible consequence of increasing the number of untrained workers or upgraded to a modern dual vocational training system, towards the goal of skilled craftspeople under a “craft umbrella” that still

needs to be established.

Questions and Methodical Approaches

1. Which areas within the informal sector and IAPs have potential for modernization?
2. Sector studies should be conducted in selected occupations of the primary sector (agriculture and forestry), secondary sector (production of goods) and tertiary sector (services)
3. The following analyses will be carried out for each sector study: identifying future-oriented vocational spheres of activity as a basis for the modernization of vocations; assessing qualification requirements within those vocations; determining the objects, methods, and tools of the vocations as well as the qualification requirements that will form the basis for the development of training systems.
4. Reference examples for conducting sector studies will be taken from the respective occupational concepts in countries where an established (dual) vocational education and training system is available.

Expected Results

In the sector study or studies, results will ideally permit for the analysis of IAPs with regards to concepts of particular vocations, educational structures, as well as methods for education and training, and to establish new perspectives for further development.

1.3. Master Artisan and "Master Teaching"

The pivotal point of training apprentices is the tradition of learning under certified master craftspeople. Thus, this dissertation project will examine which forms of master crafts are present within IAPs in South Africa. Within the framework of a feasibility study, we seek to establish a professional qualification for Master Artisan, as well occupational guidelines as a foundation for "Master Teaching".

Questions and Sub-Projects

1. What forms of (informal) master craftspeople exist in the South African economic landscape?
2. What kinds of qualifications do those responsible for training in IAPs possess?
3. Feasibility study on the establishment of a "Chamber Structure" for IAPs.
4. Development of further education regulations for master craftspeople.

Methodological Approach

Case studies in the form of task analyses, with a focus on apprentice training, will be carried out in selected occupations.
Focus of the analysis and questions will be:

- The contents of situated learning within IAPs (learning within work processes)
- Does the training follow the novice-expert paradigm?
- What criteria do master craftspeople (trainers) use to organise apprentice participation in occupational tasks?
- What (informal) principles do master artisans (trainers) use to promote apprentice skill development?
- To what extent does the training represent a tradition of "on-the-job learning"?
- Does the master artisan make certain that the apprentice has reached the occupational goal of competent work practice, and if so, how?

- What kind of social competencies are conveyed during learning under a master artisan?
- How does the transition from an IAP into the job market work?

Methodological Approach

The analyses carried out in this project are based on a) the relevant data on IAPs and b) expert interviews with trainers and specialists in the relevant occupations as well as c) group discussions with trainees.

Expected Results

The findings of the investigation seek to shed light on the quality of training under a master artisan and to clarify what the chances are for the integration of the IAP system into a dual vocational system in South Africa. The feasibility study will examine the possibility of regulations for handicrafts as well as of further education for master artisans.

1.4. Evaluation and modernization of selected (informal) skilled craft trades and their integration into the vocational training system.

Informal apprenticeship training is differentiated from formalized (regulated) education and training. Any transitions to regulated apprentice training systems are thus fluid. A typology of informal apprentice training is thus developed, differentiated according to the level of regulation of the training content, length of time of apprenticeships, and the quality of certificates received.
On this basis the study will examine under which conditions it is possible to upgrade IAPs at a medium level of regulation to a regulated dual vocational educational system.

Research questions

1. What characteristics permit a typology of IAPs to be constructed?
2. Can the characteristics of a typology be brought together to create a quality index?
3. What level of quality in an IAP is necessary in order to develop it into an established dual vocational education?
4. Do the IAPs also have strengths that set them apart from established apprentice training in South Africa?

Expected Results

The results of this proposed doctoral project create a foundation for the targeted upgrading of informal apprentice training in South Africa. The quality index used to evaluate IAPs also creates criteria with which pupils and their parents can select an occupational training program.

2. Occupation research and development

2.1 The genesis of occupational structures for qualifications below the level of the Bachelor's degree

The vocational education and employment structures of various nations differ greatly from each other. One aspect of these differences is that in VET planning, there is seldom sufficient differentiation between educational and occupational systems. In South Africa, this issue is further compounded by the fact that college and school-based VET are oriented primarily towards subjects and less towards recognized occupations requiring formal training. Occupations requiring formalized

training are important because these constitute the foundation for the development of vocational identity and willingness to work hard within the vocation.

Questions

1. How does differentiation take place between recognized occupations requiring formal training and the concept of "good" occupations within the South African systems of VET?
2. How do the approaches or methods of vocational education for occupations requiring formal training in South Africa differ from those in countries with a developed dual vocational training system?
3. How do the different sectors in South Africa differ in their occupational distribution?
4. Which occupational fields, and thus which vocational training programs related to them, are seen as being of lower status?

Methodological Approach

The methodological approach is based on the analysis of data and its evaluation based on the relevant literature, as well as on interviews with experts. Expected results of the study will shed new light on the genesis of the systems of VET and employment in South Africa. Only when such a foundation has been laid, can the development of vocations and the vocational training system in South Africa be understood. This proposed dissertation should also create an incentive for historically based research on the occupational system in South Africa, which will permit deeper examination into the possible willingness to change various actors involved in the development of occupations (for example, business organizations, unions, government).

2.2 The determinants of developing occupations

International comparative research on occupations demonstrates that vocational work and thus the development of occupations cannot be derived from the changing skills requirements of the employment system. This can clearly be seen in the radically different types of national occupation and occupational training systems. While, for example, Germany has over 500 recognized occupations, Switzerland more than 220 and the United States has over 1,000 occupations. In the Japanese occupational system, in contrast, the occupational form of social professions is largely unknown. The results of research on industrial culture demonstrates that vocational structures are shaped by different industrial cultures.

Questions

1. What influence do international occupational classification systems have on the development of occupations in South Africa??
2. What is the connection between the NVQ framework and the development of occupations?
3. What are the ideas and goals of the unions and business organizations in South Africa with regards to developing occupations?
4. Are occupations defined, and if so, does this happen in the political sphere or through the government?
5. What is the relevance of international research on occupations towards the development of occupations in South Africa?
6. Are "concepts of occupations" being imported as a result of the internationalization of economic development?

Methodological Approach

The methodological approach is based on the evaluation of the relevant data and of the appropriate literature. Expert interviews will be carried out as an additional supplement to this information.

Expected Results

The analysis of the determinants for occupational development provides valuable clues as to how the methods and approaches of occupational development can be improved within the interplay between economy, politics, and vocational research. The comparison with vocational research and occupational development in countries with highly developed vocational education and training systems offers grounds for further conclusions.

2.3Methods of developing occupations as an issue for VET planning

This proposed doctoral study is particularly appropriate for a study which seeks to make international comparisons. Switzerland, Germany, and Australia could serve as good bases for comparison, since these countries have well-developed vocational education and training systems. It would also be advisable to include China, since it has gone through more transformation than any other country over the past three decades in terms of implementing far-reaching changes in the structure of vocational education and training. Related to this, is a comprehensive initiative for educational planning and political decision-making in the United Kingdom that seeks to reintroduce dual vocational training would be interesting, since this system was abandoned in the previous century as being contrary to economic development.

Questions

1. What methods are used to develop occupational qualifications in South Africa?
2. Within these processes, is there a difference made between dual vocational training, training TVET colleges, and training in specialized institutions?
3. What strengths and weaknesses does occupational development in South Africa demonstrate on its own, as well as when compared internationally?

Methodological Approach

The evaluation of methods for occupational development first requires a systematic comparison of internationally established practices used in the development of occupations. Next, the methods for evaluation will be developed, which will then be used in a third and final stage to identify the strengths and weaknesses of the South African system of occupational development.

Expected Results

The results of the evaluation of procedures developed in South African for occupational development, when seen in international comparison, give the rationale for conclusions about how vocational training and education planning with an emphasis on occupational development in South Africa should take place. The location of occupational development within the entire context of vocational education and training should be kept in mind, because occupations requiring regulated training can only realize their potential within the context of the relevant vocational educational system.

2.4 The influence of international economic collaboration on developing occupations

An excellent example for the internationalization of occupational development is the European Union Car Mechatronic Project (Rauner, Spöttl (2002)). This research and development project was initiated at the behest of the European automobile industry. The project was based on the hypothesis that international economic development also results in the internationalization of occupational development. For vocational education research in South Africa, there is therefore the opportunity to cooperate with global and regional industrial players in testing this hypothesis

Questions

1. Do international companies also export their forms of qualification for skilled workers when they transfer the organization of business and production structures to other countries? If so, does this mean that occupations that were developed elsewhere are transferred to South Africa?
2. Does the globalization of international businesses and thus the internationalization of occupational development accompany a simultaneous process of "localization"?
3. Within the realm of occupational development, can the theory of "global localization" be verified?

Methodological Approach

Selected industrial occupations (e.g., industrial mechanic, mechatronic, car mechatronic, chemist, industrial management assistant) will be examined in order to determine whether the internationalization of economic development is accompanied by internationalization of occupational development in South Africa.
The comparisons will apply to:

- Job Descriptions
- Training Regulations
- Testing Readiness for the Occupation

In other areas of the internationalization of economic development, such as agriculture and the food industry, climactic factors and other regional particularities play an important role. Thus, using the examples of these sectors (for example wine-growing), the study will examine how regional factors play a role in the internationalization of occupational development.

Expected Results

The results of the study will therefore give (exemplary) clues as to how the innovative potential for occupational development in different countries can be mutually used and how the interplay between internationalization and localization can be shaped within each sector.

2.5 Occupation identification potential and its impact on occupational commitment

Occupational training and education pursues two superior goals: the transference of occupational competence as well as the development of occupational identity. The development of occupational identity is the basis for occupational engagement. This represents a dimension of work ethics and of occupation-oriented motivation – a requirement for a company's competitiveness. Occupations requiring regulated training programs have very different potentials for identification. When the potential for identification is low, then it cannot be strengthened, even through high-quality training.

The measurement of vocational identity and vocational engagement fundamentally differs from the measurement of company identification as well as from organizational commitment. The measurement of the components of identity and engagement is a method of quality assurance within vocational training, which has been underestimated in established research on vocational and occupational training and education.

Questions

1. What level of identification potential do occupations that are already established in the vocational system in South Africa have?
2. How does identification potential in various occupations unfold within the confines of different forms and systems of vocational and occupational training?
3. How do occupational and organizational identification differ, and how does the resultant motivation for the job occur in various occupations?
4. Which contextual factors do the development of occupational and organizational identity dependent on?

Methodological instruments for the empirical study of occupational and organizational identity are the evaluation spectra used to measure these forms of motivation and commitment. In contrast to the measurement of vocational skill, here the spectra must be adjusted to the particularities of each national (industrial) culture. This includes psychometric evaluations of such spectra. If such scales for measurement are also used to measure identity within (specialized) educational institutions, then the measurement of organizational identity as well as organizational commitment will not be measured. Thus, it makes sense to create spectra for measuring 'organisational identity' and 'organisational commitment', always keeping the relevant international scales in mind.

Expected Results

The analysis of the potential for identification with occupations and the organizational commitment based on it offers the opportunity to examine the attractiveness of particular vocations, both from potential apprentices' perspective as well as that of companies. The outcome of this will be significant informative bases for the development and modernization of job profiles as well as of training regulations.

2.6 Substitution potential in vocational task areas under the conditions of progressive automation.

Progressive automation in the work world affects the evaluation of task areas for vocational education and training. A specialized field within vocational research is thus concerned with the substitution potential of particular tasks through progressive automation. This new field of study within vocational research seeks to develop stable occupations that are as resistant as possible to being replaced through automated technology. Thus, their emphasis is not on the occupation as a whole, but the particular task areas appropriate to each occupation.

Questions

1. What are characteristic task areas that can potentially be substituted for by automated technology in the near future?
2. Which occupations and occupational areas will be most affected by these changes, and which least affected?
3. Which skills can most easily be substituted or replaced through automated technology?

4. Which skills will be enhanced by automatization?

Methodological Approach

Vocational development and thus vocational education and training should reflect a level of quality that is oriented towards the future. It makes sense to break down the occupations being examined into task areas. In order to do so, a category system for the tasks must be developed. Then the potential of these tasks to be substituted will be evaluated by experts in each relevant domain.

Expected Results

The results of the study will help develop stable, and thus attractive, occupations and thus to strengthen the role of human competence within vocational development.

3. Competence diagnostic and competence development as well as assessment of professional capability in final exams (trade tests)

3.1 Psychometric evaluation of the COMET measurement model with regards to its application for further occupations and employment sectors

The COMET competence measurement model underwent a fundamental psychometric valuation for its use in corporate and technical vocational education and training. As a result of this evaluation, the COMET model was affirmed as being of use for educational theory and vocational education and training. Since the modified model, used for commercial occupations, differs only slightly from that developed for technical vocations, the results of the psychometric evaluation are most likely also applicable for these occupations. An expansion of the COMET test results to include further service sector occupations as well as educational occupations would, however, require further psychometric evaluation.

Questions

1. Can the pedagogically modified skill and measurement models be empirically proven?
2. Can the assignment of rating items for skill criteria be confirmed?
3. Can the model of cumulative skill levels be confirmed?
4. Can the stability of the scales be confirmed through reliability analyses?
5. Do the skill profiles of the test subjects represent characteristic skills which point back to the character of the examination tasks? (see Martens et al. 2011,114 ff).

Methodological Approach

In the psychometrical evaluation of the skills and measurement model, the Items Response Theory is used in such a way that a latent variable is identified that has exactly the property which represents a value for the different valuations on the part of each criteria(op. Cit. 111 f). The psychometric evaluation includes the testing of the distribution of the skill patterns on the examination tasks. In a further step, more effective and expanded forms of rating can be included through computer-supported integrated simulations.

Expected Results

The psychometric evaluation of the COMET model, as well as methods for skill diagnosis, is a necessary requirement for its academic acceptance as well as the relevance of its investigations of

skills.

3.2 How teachers and instructors transfer their specialized understanding to pupils and students

It was proven within the framework of several COMET projects that instructors (implicitly) transfer their specialized knowledge and thus their patterns of problem solving of vocational tasks to their pupils or students.
Similar results came from the RSA project, and these results permit conclusions to be drawn about an instructor's or teacher's skill profile based on the skill profile of their pupils or students. The question remains as to how this transfer process takes place during teaching.

Questions

1. On the basis of the COMET skill model, how can evaluation methods be developed which can analyze the educational behaviour of instructors with regards to the line of questioning being pursued?
2. How does the specialized knowledge of an instructor determine his or her educational behaviour with regards to:
   - the criteria for realistic solution of the task?
   - the level of work process knowledge
3. How does the specialized knowledge of the instructor determine how "solution space" or "freedom of determination of the process" is dealt with in the solution of vocational tasks during teaching?
4. What influence does the teacher's behaviour (in in-company-teaching) have on the transfer of patterns for solving problems?

Methodological Approach

With a small amount of case studies, the distribution of skills which an instructor is responsible for when teaching specialized classes will be determined. Teaching will be observed using the methods developed in the COMET-project in order to identify the didactical and communicative behaviour of the instructor.

Expected Results

When it is possible to answer the question as to how instructors and teachers are able to transfer their specialized knowledge (homogeneous or heterogeneous skill profiles) to their pupils, then these results will have considerable significance for teacher training and for practical teaching.

3.3 Extension and evaluation of the competence model with the addition of the component "implementation from plan to practice" (from conceptual to practical competence)

Diagnosing skills is generally limited – on a practical, economical basis if nothing else – to the ability to measure competence as a cognitive predisposition. For large-scale projects in vocational training, this limitation can be accepted, since the ability to plan and conceptualize is an important skill in modern occupations. In order to test readiness for the occupation for highly-skilled workers, it will be necessary to expand the model for measuring skills by including the aspect of "being able to put planned ideas into practice".

Research Questions

1. Can the expanded competence and evaluation model verify professional occupational competence in the context of practical examinations?
2. Can a sufficiently high interrater reliability be achieved with the expanded competence and evaluation model in the context of project-based practical examinations?
3. Can the practical part of examinations be evaluated on the basis of the documentation and explanation of the project result (work sample)?
4. Which forms of rater training are necessary in order to achieve a sufficiently high interrater reliability?
5. In which form is the professional discussion after the presentation of the project result being used for the rating?
6. How is the result of the examination determined?

Methodological Approach

The testing of the COMET-based practical part of the examinations consists of four steps.

Step 1: The exam participant works on the project task: description and explanation of the strategy and the solution variant;
Step 2: The result of the planning and the explanation of the task is evaluated by the examiners (double rating);
Step 3: The exam participant implements his solution on a practical level and documents the process (with explanation if he differed from the original strategy);
Step 4: The exam participant presents the result of his project and discusses it in a professional talk with the examiners.
Conclusively the examiners revise their rating (if necessary) and determine the result of the examination.

Expected Results

This expanded method of competence evaluation – including a practical part – allows for the identification of professional competence (as well as the ability to work) on a high level of validity and reliability.

3.4 The correlation between the development of professional competence and vocational identity

In the discussion of vocational education, the thesis of the close (inextricable) correlation between the development of professional competence and vocational identity is seen as fixed since its establishment by Herwig Blankertz (1983). For the praxis of vocational training this hypothesis has a high didactical importance. The hypothesis has yet to be empirically validated.

Research Questions

1. Can the hypothesis by Blankertz of the close correlation between the development of professional competence and vocational identity be verified on an empirical level?
2. What impact does the length and the course content of vocational training have?
3. In the context of empirical verification of the hypothesis, is it necessary to differentiate between different levels of development?
4. Do different occupations result in different values of correlation? If so, how can these

different values be explained?

Methodological Approach

Large scale projects usually provide the data of the development of vocational competence (for example: second and third year of training) as well as the data concerning the vocational identity. In correlating the data, the mean values of the classes (not the individual test results!) have to be correlated. For this dissertation project it is useful to expand the research question in order to take all criteria of the identity-commitment-model into account. This expanded research approach extends the production of knowledge of the study.

Expected Results

On a didactical level, verifying the hypothesis of Blankertz is very important for the praxis of education, since vocational education aims not only to develop competencies, but also vocational identity. The result of the study is highly important for the architecture of the vocational education system and has relevance for educational policy – if the hypothesis can be verified, the results confirm the plea for the establishment of a dual vocational education. The result would mean that especially a dual vocational training enhances the correlation between the development of professional competence and vocational identity by means of learning in the work process.

3.5 Influence of test motivation on the results of the competence measurement

First pilot studies (of the COMET project) concerning this topic established the hypothesis, that test motivation has an impact on the results of competence diagnostics. If the hypothesis is confirmed, this means a revision of the results of the first PISA project (2000), which stated that the test motivation does *not* have a verifiable influence on the test result.

Research Questions

1. How can the test motivation be determined?
2. Are the presented test methods appropriate?
3. Does the test model which differentiates between primary and secondary aspects of motivation suffice for the demands of this study?
4. How can cultural differences concerning test motivation be taken into account in the course of international comparisons?

Methodological Approach

Originating from the previously used and evaluated evaluation methods an expanded test method will be developed, which achieves a higher degree of selectivity of the items and dimensions of the motivation model. A supplementary context analysis provides data which facilitates the interpretation of the results of the study. Additionally, we suggest an evaluation of the correlation between vocational commitment and test motivation.

Expected Results

The development of a method for measuring test motivation and the implementation of this method provides additional data which can be used to interpret the test results.

3.6 The COMET competence and evaluation model as a didactical instrument

The COMET competence measurement model conciliates between the central ideas and purposes of vocational education and the development of test and learning tasks. Both forms of tasks have an identical structure. While the quality of test tasks for large scale projects has to be confirmed in a pre-test by means of quality criteria, learning tasks are developed by teachers and teams of teachers for their (individual) lessons. If the lessons stand the practical test, they are usually documented in the form of task collections which are accessible for interested parties. This form of lesson aims to convey vocational shaping competence and to improve self-governed learning.

Research Questions

1. Are teachers able to use the COMET competence model as a didactical concept to develop and implement learning tasks and the affiliated solution spaces after one rater training?
2. Which didactical quality do the COMET learning tasks have?
3. Like test tasks, learning tasks differentiate between tasks for beginners, advanced beginners, advanced learners and experts following the novice-expert-model. Can teachers establish a correlation between this differentiation and the professional fields of action?
4. Which didactical quality do the task/project based rating concepts have, that orient themselves on the structure of the rating scales?
5. Are learning tasks with a wide range of solutions suitable for use for different courses of education with different levels of qualification (such as the level of skilled workers and technicians)?
6. Is the rating method appropriate for self-assessment of the learning results by the learners?
7. How can learning tasks for the handling of heterogeneity be used for the design of learning processes?

Methodological Approach

The implementation of this dissertation project requires methodical competence of teachers in order to use this learning method. An effective method to acquire this methodological competence is rater training as well as practicing the development of test tasks and solutions under the instruction of experienced teachers.
The COMET method for evaluating the competence of teachers as well as the participation of teachers in student tests can be used to evaluate this method content-related and methodological training of teachers: handling of learning tasks. The three dimensional COMET competence and evaluation model can be used to develop a comprehensive evaluation concept.

Expected Results

Results concerning the assessment of the *didactical quality* of the COMET competence model and its potential for the qualification of teachers can be expected. The didactical quality shows itself in the increase of the level of competence of apprentices and students as well as in how teachers deal with heterogeneity in and between classes with different levels of qualification. The results of this study will additionally show whether the expectation that this learning method results in a higher degree of autonomy can be fulfilled.

4. Professionalisation of TVET teachers

4.1 Evaluation of the didactic action of teachers of vocational subjects (TVET Teachers)

In teaching-learning research it is agreed that teachers have a great influence on the development of knowledge and competence of their apprentices/students. This is confirmed by the results of the COMET competence diagnostics study. The heterogeneity of the competence level between classes in a variety of occupations is attributed to the didactic action of the teacher – however, the confirmation of this hypothesis is still pending. The demonstrated heterogeneity in the recent COMET study suggests further investigation through doctoral research. This investigation would determine what kind of subjective content and didactic factors (i.e., subject understanding and work integrated learning) are practiced by the Vocational Teacher. As a basis for the development of this topic, the TVET-Teacher-Competency model could be used.

Research questions.

1. In what way does the didactic action of the TVET teacher influence competence development of learners?
2. What importance is attached to the subjective understanding of the subject being taught - i.e., in problem solving patterns/capabilities?
3. How do TVET teachers express their technical understanding of subjects taught – i.e., as expressed through the TVET Teacher Competency Model, concept of holistic TVET teacher task solution?
4. To what extent do TVET teachers implement the model of complete action?
5. What criteria are used by TVET teachers to differentiate between learning tasks for beginners, intermediate, advanced and expert learners?
6. How do TVET teachers utilize the concept of 'learning tasks' in order to reduce the complexity of the teaching process?

Methodological approach:

The method of this research topic lends itself to (1) establishing the didactic competence levels as determined by the COMET-measuring method, (2) reflecting on the competency profiles of participating TVET teachers in feedback sessions. (3) repeating the process to check whether a sustained learning (i.e., TVET teacher development) has been established.

Expected results

It can be expected that TVET teachers improve their instructional activities (i.e., also levels of proficiency) and thereby achieve a higher degree of homogeneity of their pedagogical and didactic skills profiles.

4.2 Measuring the social-communicative competence of the TVET teacher

The hypothesis: "Achieving professional status for the TVET teacher through social and communicative behaviour plays an important role for their competence development", should be examined in this doctoral thesis. So far, only data provides the validity and reliability of the rating scales for social communication behaviour of the TVET teacher – i.e., through the TVET Teacher Competence Model. An alternative application of this form of assessment of teacher competence would be through demonstration lessons during teacher training and in the context of the teacher's examination for the award of a "TVET teaching certificate". The empirical evaluation of the rating

process for the evaluation of socio-communicative behaviour of TVET teachers is therefore the subject of the thesis project.

Research questions

1. Is the class observation rating process for evaluating the social-communicative competence of TVET teachers (i.e., practical teacher activity) a feasible approach?
2. Is a sufficiently high interpreter/observer reliability achieved?
3. Is the video/virtual presentation of TVET teacher cases suitable for Rater Training?
4. What reactions/comments trigger the feedback of the rating results in TVET Teacher Training?
5. Will the classroom observation and evaluation of TVET teacher behaviour result in the development of social and communication teaching competence?
6. What correlation exists between the level of teaching and the social-communicative action?

Methodological approach:

The previously developed rating procedures for assessing the socio-communicative teacher activity is available for this project.
(1) Interpreter Training on the basis of video/virtual documentation of teaching to secure Interpreter Reliability.
(2) Double rating carried out (i.e., two auditors) in teaching practices.
(3) Feedback sessions with teachers requires the development of an interview guide.

Expected results

With this instrument, a gap in the training and assessment of teacher competence can be closed. Moreover, it can be shown how this component of teacher competence affects the overall competence of TVET teachers. From a fundamental scientific interest it is also the relationship between TVET teacher competence profiles, didactical and social-communicative action of teachers that needs interpretation.

4.3 The development and testing of test tasks and participation in the rater training as a method of teacher training.

Up to now, the knowledge to adapt the technical understanding of the TVET Teacher to the characteristics of the COMET competence model show that teachers change their subject understanding in a relatively short time, through their active participation in COMET projects. This applies, for example, to the standard one-day Rater/Interpreter Training. After that, the TVET Teacher will be able to assess the task solutions of apprentices/ students at a high level of reliability. However, it is an open question whether these teachers - and to what extent - they can implement this altered specialist understanding of educational action in the classroom.

Research questions

1. What activities under COMET projects contribute to the change in the technical understanding of the TVET Teacher?
2. If the TVET Teachers develop their competence consciously, do they recognize their changed professional understanding?
3. What learning processes are triggered during the feedback of test results to the students/apprentices with the teachers?

4. Does the changed technical understanding have an impact on lesson preparation and classroom teaching?
5. Do TVET Teachers transfer their experiences from the Rater Training and Rater practice to the design of learning tasks?

Methodological approach:

Initially, it is a systematic recording of the activities of teachers in the COMET projects. This allows for the grouping of TVET Teachers differentiated by a different range of experiences. For the analysis of the formal and informal learning and learning outcomes, an extended technical understanding is required of analytical instruments. The COMET competence and measurement model is a basis for this study.

Expected results

The results of the project shed light on the way in which the activities from the participation of TVET teachers in COMET projects are systematically used for their training. Here the Rater training is of particular importance. Since this measurement method is suitable not only for the execution of tests, but also for the application of the COMET competence model in the design of teaching, it is relevant for a wider introduction of this method in the education and training of TVET teachers.

4.4 How do TVET teachers transfer their didactic specialist understanding (i.e., their problem solving pattern) to their students/apprentices?

In a large scale COMET project in China, and on a smaller scale in South Africa, it has been shown that TVET teachers - usually implicitly - transfer their professional understanding to their apprentices/students. Since this transfer process is largely implicit, VET research is challenged to analyse this transfer process. It is for this purpose that a PhD project would make a contribution.

Research questions

1. Do the class specific competence profiles of the COMET test participants (who reach the second and third level of expertise) represent the professional understanding of their teachers?
2. Check the hypothesis that this transfer of technical understanding and problem-solving capability of TVET teachers is an unconscious process.
3. What can also be said about the understanding of the TVET teacher as reflected in the lesson plan?
4. What didactic scheme/structure causes the transfer of technical understanding?
5. Does the dynamic genesis of the technical transfer understanding need to be reconstructed?

Methodological approach:

It is advisable to first perform a limited number of case studies in which the competence profiles of classes (test takers, who have reached the second and third level of expertise) is compared with the competence profiles of teachers. In feedback sessions with teachers it can be examined whether the teacher is aware of the transfer effect. This also applies to the interpretation of an increase in the level of competence and an improvement of the skills profile of the test participants during the project (for projects with two test points in time). For an analysis of the transfer effect, the methods of teaching observation are available (see the COMET measuring methods for teachers).

Expected results

The results of this study offer various possibilities: teachers are equipped with the concept of holistic task solution and incorporated therein, the theory of multiple competence.

4.5 The use of the solution space as a form of TVET Teacher training

In open test tasks, each case provides for a *"solution space"* given by the situational context. Professional competence finds itself through the exploitation offered by the solution space possibilities, i.e., for the solution of tasks. The more extensive and detailed a teacher can describe the solution space towards open test/learning tasks, the more developed is his understanding of the subject and its "multiple competence". An expansion of the solution space for a task to a "margin of discretion" assumes situational conditions (for example, given by the company business processes) that need to be transcended.

Research questions

1. What characteristic criteria are considered by teachers in the development of testing and learning tasks - including the related description of the solution spaces?
2. What is the area defined by the pattern of the teacher's subjective solution space that affects the design of learning tasks and learning processes?
3. Does the teacher differentiate between a context specific solution space (i.e. as it is given by the business environment) and a design freedom which detaches itself from the framework of a contextual solution space?
4. How does the teacher find a solution for the developed testing and learning tasks? And how will they derive "their" solution leeway?
5. What learning processes triggers the reflection of the test / learning tasks developed and the solution space with the teachers?
6. Do teachers recognize the ethical dimensions of the COMET competency model when handling the solution space?
7. Does the use of "solution space" succeed as a method of sustainable mediation of key ideas, such as: "the ability to help shape the world of work in social and economic responsibility"?

Methodological approach:

The central methodological approach is the development, evaluation and reflection of testing and learning tasks as well as the solutions and their leeway.

Expected results

The practical involvement of teachers in the development of test / learning tasks and the subsequent related solutions and leeway that participants develop are elaborated through the COMET competency model – particularly for technically orientated insights. The teachers' connection between their subject insight and the design and organization of vocational training processes is observed.

5. Apprenticship partnership

5.1 What are the more specialised companies' potentials regarding apprenticeship on the basis of broad and core occupations?

In countries with a sophisticated dual vocational training system, the proportion of companies that participate in the dual vocational training is between 20 and 30%. A more detailed analysis shows that a large proportion of non-participants have not grown to the extent that VET quality assurance requirements have been met. These primarily include the highly specialized companies that have a limited number of divisions. In order to cover the set of competencies for modern professions, companies from complementary business segments can be approached for a form of and training partnership.

Research questions

1. What is the percentage of companies from the manufacturing and engineering industrial sector that are too specialised to qualify for programme approval in a single professional trade related occupation - i.e., work processes do not cover the full curriculum of the trade.
2. Are there examples of training partnerships in South Africa? And if so, what training experiences do they have? What occupations have been involved?
3. Do the ITB (University of Bremen) developed methods for the formation of training partnerships offer an opportunity for expanding the practice of training partnerships in South Africa?
4. What are the insights and experiences from other countries in respect of the measurement of efficiency and quality of training of training partnerships?
5. How could the knowledge and experience in these countries on the formation of training partnerships in SA, be transferred?

Methodological approach:

In this PhD project a wide range of methods is applied: analysis of statistical data for occupational vocational training in South Africa, conducting interviews of instructors and industry experts and the analysis of relevant research reports on training partnerships in Germany, Switzerland and the USA.

Expected results

From the research results/findings, the potential of education partnerships involving specialized companies can be identified and fully developed in the context of educational partnerships for modern professions. One incentive is the expected result of the achievement of high profitability and quality of the training efforts.

5.2 Testing procedures to organize and regulate apprenticeship partnerships in the context of a model program

Findings from the German pilot project on organizational and content design of training partnerships can be examined as to whether the underlying organizational and didactic training concept can be transferred from the pilot project to the training partnerships in South Africa. This study would need to establish how this training model could be adapted to the educational situation in South Africa. On this basis, a pilot program involving companies with a limited number of training partnerships will be prepared, implemented and evaluated. This pilot project forms the core of the doctoral project.

Research questions and sub-projects

In cooperation with merSETA and other SETAS, a pilot program of "Training Partnerships" is prepared.

Using a method for identifying the complementarities of operational business, companies are selected for appropriate training partnership establishment.
The implementation of the training in the training partnerships will be supported by a manual created by the student for trainers.
Levels of quality achieved will be investigated.

Methodological approach:

Formation of training partnerships is based on previously tested and possibly still to be modified manuals. The didactic quality of education depends primarily on how it is possible to organize training cooperation between companies in a way that covers the full scope of a craft/profession. The exchange of trainees plays a special role. A challenge for the scientific monitoring is to develop methods for the formation of cooperative structures that form the basis for a high quality of training. The instruments of the COMET project are available for the analytical context of training partnerships.

Expected results

Expected findings from the pilot program, and examples of good training practice, would make it possible to implement this training model in South Africa as a variant of the apprenticeship. A particular challenge is to gain insights into the specific training skills within training partnerships from the pilot program, which can only be achieved with this specific form of cooperative education.

5.3 Are cross-company projects suited for the organisation of apprenticeship partnerships? And do they improve the quality of apprenticeship?

Education partnerships have a special didactic potential that extends beyond the concept of reciprocal complementarities of the apprenticeship. This is a method of inter-enterprise cooperative training schemes. Also to be investigated in this PhD project, is whether it is possible to establish these inter-company training schemes through the addition of training content agreed through the cooperation of the parties. To carry out such projects there is a handout (Manual) for German trainers. It is to be examined, under what conditions it is possible to realize this type of integrated practical training. Expansion of this concept to local TVET colleges will examine whether the teachers of these colleges can exercise a coordinating role in the design of training projects.

Research questions

1. What are the qualifying criteria that should be used to assess the potential for training partnerships between enterprises? - and how would these criteria be implemented for the benefit of cross-company training projects?
2. What role would the teachers of the colleges play?
3. Are the teachers able to raise the level of knowledge of students on the level of action reflecting knowledge?
4. What is the specific expertise of trainers and teachers (the enterprises involved and the Colleges) in cross-company projects?

Methodological approach:

It is recommended to set up local/regional projects under the pilot program, in which the companies involved can bring company projects that could be edited by the students in project groups. Another possibility is the creation of project-finding conferences (/chamber meetings), at regular intervals

(approximately three months) to source and develop training partnerships. Scientific monitoring (PhD candidate) develops an evaluation tool for the cross-company projects

Expected results

The project evaluation allows the identification of best practice examples. These examples can be incorporated into the training of teachers and trainers.

5.4 What are apprenticeship partnerships'effects regarding benefit and quality?

Vocational training in training alliances with Vocational Training Centres (this could be a private training provider or a large company's training academy who also trains for outside companies) often leads to a form of "dual" training. If the training participation of the company is not insufficient and the vocational training centres substitute the required practical workplace experience assignments with simulated practical training, the dual training model is compromised and cost of training increases disproportionably.
This form of "emergency measure" replaces learning in real work processes through practical training in outside establishments. In the broadest sense, these are also the training partnerships. In this doctoral project the cost-benefit ratio and the quality of education is examined in both the training partnerships of the pilot program and the training alliances with Vocational Training Centres.

Research questions

1. What are the net costs or net income of training in education partnerships of the pilot program compared to training in the projects of a training alliance?
2. What are the costs and revenues in the individual projects?
3. What quality benefits are derived in training partnerships and collaborative projects? - and what is the quality benefit of the individual projects?
4. What are the connections between the profitability and quality of training in the various forms of training partnerships?

Expected results

From the evaluation of results for the profitability and quality of training in education partnerships, those cases which have potential for innovation training partnerships can be identified. If the hypothesis is confirmed that training partnerships is a self-financed training model and if the context analysis shows how this form of dual vocational training can be sustainably established, then this training model forms the basis of dual vocational training for companies with a limited expansion potential/appetite.

5.5 Are apprentices able to take part in the cross-company organization of projects?

A dual vocational training in education partnerships has benefits for the trainees in that a range of different businesses with their specific contents and forms of professional work are exposed, each with their specific operating environment and "cultures". At the same time, the trainee retains the emotional attachment to the company with which he/she is completing their training contract. This form of training extends the professional technical horizon of trainees from a company-specific to an industry-specific. Training partnerships have the potential that the trainees participate in projects using electronic media in the organization of cross-company cooperation. This option results in the acquisition of a new dimension of professional competence. It examines whether and how trainees

of this opportunity are supported by their trainers and teachers.

Research questions

1. To what extent and in what form, do trainees participate in the company's multi-organization of cross-company projects?
2. How are they supported by trainers and teachers?
3. What communication/training media do trainees use?
4. What additional organizational and content skills can project trainees acquire in the participation of the organization and design of cross-company training?

Methodological approach:

The evaluation of the participation of students in the organization of multi-employer projects requires documentation of this dimension in the project design. Additional group discussions with the trainees and the trainers and teachers involved offer the possibility of deepening the analysis of this dimension of the didactic quality of training partnerships.

6. Quality of governance and support systems of the SA VET system

6.1 How do governance structures affect the stigmatisation of TVET?

In many countries, TVET faces the phenomenon of stigmatisation. In the hierarchy of qualifications vocational programs are assigned to the lower skill levels generally – this is very clearly evident in the European Qualifications Framework (EQF). Numerous factors influence the degree of stigmatization in the field of vocational training. It is important to distinguish between the forms and levels of vocational training, as they are defined by the National Qualifications Framework as well as between holders of vocational training, which are responsible for the quality and image of vocational training courses.

Research questions

1. What findings have been published through international VET research on the phenomenon of stigmatisation of vocational education and training?
2. What is the state of research on this subject in South Africa?
3. What factors determine the degree of stigmatisation of vocational education and training?
4. How does the management of the vocational education and training system affect the attractiveness of VET courses in South Africa? Do these factors contribute towards stigmatisation of VET - and if so, to what extent?
5. Which groups or categories of young people and parents, show an appreciation for vocational education and training – and why?

Methodological approach:

The research methodology for this PhD project is based on two processes: a) the evaluation of the relevant literature and b) different forms of interviewing the following groups:

- VET college students;
- Apprentices/trainees at different companies and
- Career guidance Counsellors at TVET Colleges and at the Department of Labour;

Expected results

This thesis can contribute to a differentiated image of TVET in South Africa. Moreover, there is the opportunity for comparative studies with other countries. From the situation analysis, evidence of changes in the architecture of the educational system and its control, counteract the stigma associated with TVET. The structure of an architecture of parallel pathways for qualifying scientific experts at universities on the one hand and technical and managerial on the other hand is outlined in programmatic texts in the field of VET planning in South Africa. It is advisable to use this programmatic consideration with respect to the expected results of this thesis as a basis for wider development of the education architecture.

6.2 Academic drift and Vocationalism in higher education in SA

International comparative educational research has for decades confirmed the progressive "academicisation" of education systems (i.e., academic drift) with associated evidence of "occupationalisation" in high school education and "vocationalism" in higher education. In this context, the research entails:

- the dynamic interaction between education and employment systems;
- the under employment of college graduates;
- the impact of this development on the innovation potential of economies, and;
- the weakening of high school education through the expansion of separate vocational qualification training courses.

Research questions

1. How are the proportions of highly skilled, middle-skilled (Intermediary sector), low and non-skilled distributed in the South African employment system?
2. Which quantitative and qualitative changes have had an impact on the development of qualification structures in the employment system?
3. How does the "academisation" of education affect the vocational education and training system in South Africa?
4. To what degree are graduates underemployed?
5. What weakens the "academisation" of the vocational education and training system in South Africa?

Expected results

The results allow an estimate of the development trends in more academic education as well as the associated "occupationalisation" academic education. The results can contribute towards further development and design of the architecture for parallel pathways of learning and towards anchoring educational practice. Such innovations have far-reaching educational outcomes benefits.

6.3 The vertical permeability of vocational and academic education system

In this doctoral thesis, the vertical permeability of the education system is examined with a focus on vocational education and training. The educational theory and the politically motivated educational forms of vertical permeability of the empirical situation are compared. This study is designed as an international comparative study. Trends are considered over a longer period. In the comparative study includes Australia, China and Switzerland

Research questions

1. What is the regulated vertical permeability in the education system of the countries of South Africa, China, Australia, Switzerland?
2. Which rules apply for the transition from vocational occupations to higher education?
3. How do the transitional arrangements affect educational streams?
4. What effect do the transitional arrangements have on the learning behaviour of pupils?
5. How does the transition practice affect the interaction between education and employment systems?
6. What impact will the transition practice have on the innovative potential of countries?

Methodological approach:

The methodological approach is determined by the evaluation of the relevant scientific literature and statistical data for the vertical transition in the education systems. Evaluations will include the correlations that exist between the employment systems and the innovative potential of countries.

Expected results

Study results should show by what rules the transient response and the transient currents in the education systems - especially in the transition from vocational to university education - depend. The comparative data can be conclusions about the design of the vertical transitions in the education system, which contribute to a good interaction between education and employment systems, a low youth unemployment and a high level of innovation of countries. The test results may contribute to supporting the concept of an architecture of parallel pathways.

6.4. Carreer guidance counselling and pre-vocational education as a preparation towards the selection of an apprenticeship

The course for an academic-scientific career or a professional qualification for specialist and management tasks are already provided in pre-school education and familial socialization. The national preschool program "Little Scientist's House" (Germany) in kindergarten already socialises pre-school children towards the mission statement of "researcher" - and not towards the identity of a "little master/expert". In the education systems of OECD countries, career-oriented education is pronounced very differently. In the professional orientation – the three ways are: (1) the way of an independent school subject, (2) career guidance as an "educational principle" and (3) a professional orientation as a teaching and learning subject across the established school subjects. The second approach is to undergo in the course of school education internships in companies. The diversity of the pedagogical-didactic approaches corresponds to the abundance of approaches related to vocational guidance, training advice and pre-vocational education studies. This PhD project examines how in South Africa, the career-oriented education and professional and vocational training consultancy affects the decision of the pupils and their parents to pursue vocational/occupational or academic-scientific careers.

Research questions:

1. What criteria determine the choice that students / young people make towards an academic or a vocational / profession-related pathway?
2. What forms of prevocational educational orientation are established in the school levels – i.e., primary, secondary and upper secondary?

3. If career guidance takes place in upper secondary education or at the end of lower secondary education, what importance is attached to the guidance at each point?
4. How do companies, business associations and the SETAS support on the job-oriented career guidance?
5. How important is the familial socialization and the local job market for career guidance?
6. How important is the Internet and other electronic media for career guidance?

Methodological approach:

The width of the research theme “school to work transitions” requires more specific questions. Since vocational orientation using the Internet and other forms of electronic media, as well as family employment traditions can hardly be influenced, it is natural to conduct a study at a range of learning institutions – e.g., pre-schools, primary schools, high schools. The quality of career guidance (from kindergarten to graduation of general secondary school), the relevant international research and international statistics should be included in the study (e.g., the OECD, UNESCO, World Bank, ILO). An essential element of this study is the identification and evaluation of best practice examples.

Expected results:

The results from this dissertation will elaborate how forms of career-oriented training and guidance will influence the attractiveness of vocational education for students - especially for a dual vocational training.

6.5 The relationship between education and employment systems

The annual publications of the OECD Education Statistics show that there has been, in recent decades, an accelerating increase in student enrolment rates. The OECD average of student beginners quota is now slightly above 60%. Some countries reach values of over 80%. A complementary trend is the decreasing importance of vocational education and the increasing establishment of vocationalism in higher education. This development provokes an investigation into the question of whether the occupational structure in the employment system of South Africa is converted into education qualifications: Is the gap between supply and demand for labor market related qualifications bigger? And what are the consequences for the transition from education to the employment system? One hypothesis is of an increase in demand from by highly qualified and another holds to the "de-skilling" hypothesis of Braverman. The significance of this thesis will be in the various empirical findings that result from this controversial scientific discussion.

Research questions

1. Has the introduction of flat hierarchies within internal business processes lead to companies/organisations having an increasing need for skilled workers to directly add value (i.e., at the level of skilled workers or professional) and a lower demand for executives?
2. How does the expansion of research and development departments in the companies of South Africa have an impact on the demand for university trained professionals?
3. If it is expected that powers and responsibilities are transferred to the direct value-adding processes of the business, how is this realised through education and training?
4. What consequences of the trend that reinforces international quality competition for the development of labor market structures?
5. How will the divergence of the structures of education and employment, associated with

academic drift, affect employment of graduates from both vocatonal and higher education?

Methodological approach

The national and international education and labor market statistics allow a review of the hypotheses of this dissertation project. The analyses should be complemented by case studies on the transformation of corporate organizational structures to verify the hypothesis that South African companies that are exposed to international quality competition, undo function-oriented organizational structures and overlap through business process oriented organizational structures - and whether this, where appropriate, has consequences for the employment structure and the qualifications of specialists in the company?

Expected results

The results make it possible to test the hypothesis of the increasing divergence of the education and employment system in South Africa and to establish recommendations for the control of the education and training system.

6.6 Recruiting professionals by the company for the level of skilled expert worker.

When recruiting a range of professionals to directly add value to company processes, companies choose different paths. If there is a tradition of high flexibility in the operational organization and human resources management, these companies manage to adapt their organizational structures and their operational requirements to the available skilled worker structure. Training of these skilled workers/professionals is of great importance in these companies. Other companies demand from the education system "tailor-made" education and training for professionals. A third group participates in the form of dual vocational training towards the qualification of specialists and ensures that the vocational/professional qualification takes place in a business-related context, so that after the completion of training, the learning curve is eliminated.

Research questions

1. What forms of professional recruitment are characteristic of the direct value-adding processes of the companies involved?
2. How important is the company's own training and education of professionals?
3. What types of professionals have developed the business? – i.e., graduates from colleges and/or universities?
4. How important is the underemployment of college graduates?
5. How is the "global player" adjusting towards the international trends of human resource management?

Expected results

It is expected that the findings of this thesis will provide valuable insights for colleges, universities, and in-company training academies, with additional suggestions for professional experts and underemployment of college graduates. Therefore, this dissertation also contributes to the question of whether the South African education and employment systems are divergent/ing.

6.7 The pluralism in the control of vocational training systems in international comparison

The plurality of control in training systems arises from the immediate integration of qualified professionals with the labour market skills needs of companies and industries. Participants/actors in this system include professional bodies, industry associations and labour as well as the representatives from a variety of policy areas and government departments on the management of vocational education and training. Plurality of control also exists because professional experts the in the fields of education, economic, labour and social policy are also influenced by policy makers in domain-specific government departments such as the health, transport, construction, agriculture etc. The participation of experts and representatives of organizations and institutions is needed, as education and training planning and control is dependent on the expertise within these institutions. In addition, many countries have national institutes of vocational training and labor market research, performing functions of policy advice and advice on education and training planning based on their research.
Governance research in the field of vocational education and training has developed methods for the evaluation of national control and support systems with which it is possible to assess the strengths and weaknesses of governance systems and conduct international comparisons

Research questions

1. Does the control system of vocational education and training in South Africa hinge on the concept of "integration of management-related factors"? – or, is the system a form of fragmented control, split by insulated control activities?
2. Does the control system favour economic, social or education orientated policy?
3. To what degree do stakeholders interact with the system?
4. Is there a balance between the management-related policies?
5. What distribution exists between the management of strategic and operational tasks performed at national, regional and local level?
6. Another dimension of control structures relates to the balance between an input and output control – how does this work?

Methodological approach

A necessary condition for the implementation of this doctoral project is an exploration of the previously conducted international comparative studies and the methods employed towards discursive group ratings. A crucial prerequisite for the implementation of this project is the participation in the relevant procedures for this expertise on discursive group rating. The scientific challenge for the dissertation is firstly, to determine the specific pluralism involved in South African players; and secondly, to adapt the rating items of the model and observe conditions for international comparative studies. Therefore, to carry out such a study, the involvement of an international team of experts is required.

Expected results

This PhD project has the potential to assess the quality of the system of the South African education in more detail and compare the evaluation results of international comparative studies. The expected high degree of validity and reliability of the test results represents a significant resource for VET policy and VET design.

7 Profitability and Quality of Apprenticeship

7.1 Investigation into the economic paradox of the quality benefit relation to VET

In the economic theory of education, a principle persists that investments in education sooner or later lead to an increase in quality of the VET system (return of investment): the higher the investments in education, the more positive the outcome regarding the educational system.
The evaluation of a high number of studies concerning the cost-benefit-relationship of vocational training in companies shows that a high quality of apprenticeship is not based on a respectively high investment in vocational training. In fact, the relationship is reversed: *The higher the quality of apprenticeship, the higher the net benefit of vocational training and the lower the costs of the apprenticeship.* This economical paradox of education needs to be shaped into an hypothesis based on empirical data in order to be investigated further. This dissertation aims to develop the theoretical framework upon which the hypothesis is built and to verify the hypothesis on the basis of the empirical data (CBQ/QEK-database). It is important that the economic paradox does not apply for a special case group: there are some cases of apprenticeship which display a net benefit while having a low quality of apprenticeship. In these cases the training relationship correlates with an employment relationship.

Research questions:

1. Which theoretical and economic correlations of education can be explained by the economic paradox of vocational education?
2. Which effects can the exceptional cases be affiliated with?
3. Can domain-specific (job-related) differences be verified?
4. What impact do the input factors of the quality model have on the profitability of apprenticeship?
5. How do the different factors of the quality model correlate with each other?

Methodological approach:

The discovery of the economic paradox of education in vocational training is based on the quality model for vocational training, which builds the foundation for the CBQ/QEK evaluation tool. Therefore, it is necessary to compare the quality model to other quality models (such as the one of the “Edding-Commission”) in terms of education theory. Since using other models of cost-benefit-assessment results in different values (than when using the CBQ/QEK tool), the different research methods need to be compared.

Expected results:

We expect to deepen the explanation and differentiation of the economic paradox of vocational education and training on a theoretical and economical level. This intermediate result of the scientific study can then be used to interpret the domain-specific evaluation of empirical data of the CBQ/QEK-database.

7.2 The psychometric evaluation of the rating procedure (inter-rater reliability) that forms the basis of the CBQ/QEK-tool

The CBQ/QEK-method for evaluating the profitability and quality of vocational training is founded on a very lean differentiation of quality criteria by means of very few rating items. Until now the degree of conformity of different assessments of the quality of apprenticeship has been evaluated for a limited amount of cases in terms of double- and triple-ratings by means of the quality criteria. In feedback meetings with the users of the CBQ/QEK-tool, the discursive validity of the CBQ/QEK-method has consistently been proven high. In spite of these consistently positive reviews of the CBQ/QEK-tool by the users, an extended psychometric evaluation of the quality model has yet to take place, which is the central topic of this dissertation.

Research questions:

1. Which methods are appropriate for the psychometric evaluation of the CBQ/QEK quality model?
2. Can the inter-rater reliability be increased by expanding the rating scales of the four quality (input) criteria?
3. Can the conformity of assessment between different raters be increased with a rater training (extended quality model)?
4. Can differences be determined between the rating results of instructors responsible for the respective vocational training and external raters having familiarized themselves with the apprenticeship cases?
5. Which correlation exists between the CBQ/QEK rating results of apprenticeship quality and the results of the final examinations?

Expected results:

The psychometric evaluation of the QEK rating model for the assessment of apprenticeship quality will increase the validity and reliability of the method.

7.3 AND 7.4 CBQ/QEK as an instrument of apprenticeship consulting (see dissertation of Lusanda Dodo)

7.5 CBQ/QEK as an instrument of international comparison studies in VET programs and VET systems

Since three to four year apprenticeships (as part of a dual vocational education) have similar structures on an international level, international studies on the profitability and quality of vocational training seem feasible. The higher the divergence between the regulations concerning vocational training in different countries with an advanced dual vocational education, the more difficult international comparison studies get.

Ascertaining apprenticeship costs is less difficult than estimating the benefit of apprenticeships, which is a result of the difficulties determining the profitability. In German speaking countries and regions the ratio between the trainee allowance (in vocational training) and the wages of professionals is 1:3. This ratio is not valid for countries in which apprentices don't get a trainee allowance but are paid as professionals in training – "training allowances" (wages) are much higher in these countries than in German speaking countries. There is a significant need for research on the

differentiated use of the QEK tool for the different forms of vocational training.

Research questions:

1. What is the quantitative relation in a dual vocational training system between the training allowance of apprentices and the respective wages for professionals? How does this impact the calculation of the profitability of vocational training?
2. Is vocational training being subsidized? Are the subsidies taken into account by the cost-benefit-model?
3. How are training periods split between learning in companies and in vocational schools? How is the distribution taken into account for ascertaining the profitability?
4. Do the raters (instructors) concur with the interpretation of the rating items for assessing the apprenticeship quality?
5. Is a rater training necessary in order to achieve a reasonable degree of inter-rater reliability?
6. Is there a necessity to extend the scales concerning the evaluation of apprenticeship quality?
7. Which methods can be used to evaluate the QEK quality model psychometrically?

Expected results:

International comparative CBQ/QEK-projects can improve the discussion on advantages and disadvantages of dual vocational training by providing evidence-based data. This would also be od benefit to the diffuse international discussion on work based learning (WBL).

7.6 Is CBQ a suitable consulting instrument for the establishment of apprenticeship partnerships?

The establishment of apprenticeship partnerships allows for a full training of modern widespread professions by the involved companies. This applies to the many companies which are only equipped with a limited amount of business/industrial processes. The question whether the establishment of apprenticeship partnerships results in an increase or a reduction of costs – i.e., whether the profitability of apprenticeships increases or decreases – has yet to be answered. For the quality of apprenticeship the hypothesis is that it can be increased by apprenticeship partnerships. The question whether the economic paradox of vocational training (7.1) also applies to apprenticeship partnerships is unresolved: Does the profitability of vocational training in an apprenticeship partnership increase with the elevation of the quality of vocational training?

Research questions:

1. Do the costs of vocational training (i.e., of each apprentice) increase due to the establishment and the organization of apprenticeship partnerships?
2. Or can the costs be reduced (or the benefit be increased) by means of this form of apprenticeship?
3. Which criteria are crucial to determine if and when the cost-benefit-relation (i.e., the profitability of vocational training) increases or decreases in apprenticeship partnerships?
4. Does the economic paradox of vocational education apply to apprenticeship partnerships?
5. Which impact does an apprenticeship partnership have on the ratio between the training period and apprentice?

Methodological approach:

Until now the CBQ/QEK-tool has been used as an instrument to evaluate case studies of individual companies. For the purposes of this dissertation the instrument needs to be adapted to the

organizational form of apprenticeship partnerships. Another challenge is the organization of the rating of quality within vocational training as a cross-company process. Simultaneously, this process offers the advantage that due to the involvement of a number of instructors or training advisors, a higher degree of inter-rater reliability can be achieved.

Expected results:

If the project succeeds in using the training potential of the involved companies and as a result achieves lean organizational structures, then we expect that the results will support the establishment of this form of apprenticeship

It can be expected that apprenticeship partnerships facilitate an increase in the quality of vocational training in comparison to vocational training carried out in individual companies, which would also mean a form of profit. The search for an economic quantification of this profit is therefore suggested.

SECTION 1: THE COMET PROJECT

A brief overview on the project's origin and development

COMET as acronym stands for Competence Measurement (COM..) in Vocational Education and Training and was initiated and developed in 2006 – first in the domain of Electro Technology (…ET) and later on adapted to other fields (crafts, administration, health care) by a team of researchers in vocational education headed by Professor Felix Rauner at Bremen University, Germany.

The first COMET project was inspired by a discussion with a group of vocational teachers who wanted to get better insights into the effects of vocational education on learners' development of competence (Rauner 2009, Katzenmeyer u. a. 2009). From their perspective measuring occupational competence was not seen as an alternative to the established forms of examination and testing during the course of education or at its end, but as an immediate support of the pedagogical work based on a better understanding of the strengths and weaknesses of teaching and training.

A second major reason to establish COMET as a theoretically sound and empirically verified competence model including a corresponding testing method was linked to a motivation that also refers to PISA or similar projects: large-scale competence diagnostics offer the chance of comparative assessments in different courses of training. It is indeed among the very significant aspects of the COMET methodology that it offers the opportunity to not only calculate and illustrate competence profiles of individual test takers, but to also enables comparisons of average results reached by different classes at a same test site or at different training institutions and relating to different forms in the organisation of vocational education and training.

COMET tests always include an analysis of contextual data and an analysis of the learner's development of vocational identity which makes it possible to interpret test results taking into consideration the learner's views on a particular course of training. In this regard, COMET generates a great variety of new knowledge on the quality of vocational education, which is to the benefit of a constructive VET dialogue between decision makers and all stakeholder groups in vocational education and training.

Especially as regards international comparative testing, vocational education and training is viewed as a heterogeneous and complex field with high demands on the assessment methodology. But despite all difficulties to compare highly divergent national VET systems the COMET concept offers considerable room for the coverage of countries and regions with different VET systems. After a first series of COMET pre-tests in Germany including a psychometric evaluation of all test instruments, the COMET network has rapidly grown and the methodology has been successfully applied in various national contexts and a variety of occupations. The following table provides an overview on the respective projects and their locations.

COMET South Africa has started as a first pilot project in 2011 involving only one occupation (electrician). It was continued and enlarged during the years 2013-2016. Within this period of time, COMET has been continued in the electrical profession but has subsequently been introduced into five further vocations in South Africa, namely electrician, fabricator, millwright, mechatronic, motor mechanic and welder.[7] The South African COMET project can therefore be considered as the third largest project after Germany and China. In the following, the COMET methodology shall be explained in more depth.

[7] Fabricators and millwrights were not tested on a large scale, which is why these occupations are not listed in table 1).

Occupations tested with COMET	Project Location
Carer (nursing assistant)	Germany
Car Mechatronic	Germany
	South Africa
Carpenter	China
	Germany
Electrician	Germany
	China
	South Africa
	Norway
Industrial Clerk	Germany
Industrial Mechanic	Germany
	South Africa
	Norway
Logistics Clerk	Germany
Motor Mechanic	South Africa
Nursing	Switzerland
	Germany
	Norway
	Poland
	Spain
	China
Welder	South Africa
VET Teachers and Trainers	China
	Germany
	South Africa

Table 1: COMET projects since 2006: Occupations tested and location

Part I: The COMET competence and measurement model and its dimensions[8]

Measuring occupational competence requires a standard-based competence model, which can be developed into a measurement model based on sound psychometric criteria (Martens and Rost 2009, pp. 95 et seq.). The main function of such competence model is to operationalise the criteria that have to be met in the context of solving vocational tasks in the world of work and with regard to the associated principles and objectives of vocational education and training and further to provide the guidelines for the development of test tasks.

The COMET methodology and assessment procedure is based on a competence and measurement model, which is linking the guiding principles and objectives of vocational education and training on the one hand with the construction of test and learning tasks on the other. In other words, this competence and measurement model serves as the foundation for the proper development of vocational tasks to be solved by learners/test takers (Figure 1).

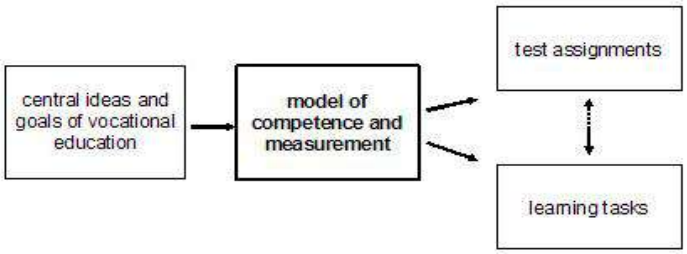


Figure 1: The COMET competence model connects the guiding principles and objectives of vocational education and the construction of test and learning tasks

The central ideas and goals of vocational education and training are represented in the COMET competence model in terms of three dimensions that are defined as *requirement dimension, content dimension, the dimension of action* (see Figure 2).

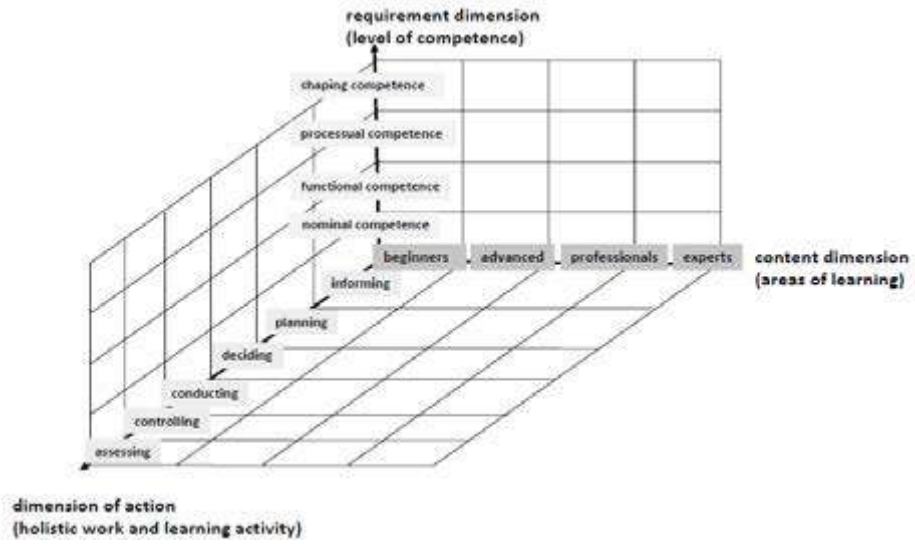


Figure 2: The three-dimensional COMET competence model

[8] This part of the report is to a large extent based on the following publications: Rauner, F./Heinemann, L./Hauschildt, U. (2013): Measuring Occupational Competences: Concept, Methods and Findings of the COMET Project. In: Deitmer, L.; Hauschildt, U.; Rauner, F.; Zelloth, H. (Eds): The Architecture of Innovative Apprenticeships. Springer. Dodrecht. pp.159-175 and Rauner, F. et al (2013): Competence Development and Assessment in TVET (COMET). Theoretical Framework and Empirical Results. Springer. Dodrecht. Chapter 2-3, pp. 19-53.

1.1 The content dimension

The content dimension of a competence model describes the contents of teaching and learning in a specific subject or area of learning as a basis for the development of test assignments. In projects of international comparative competence assessment it is crucial to identify, following the idea of a "world curriculum" (PISA), contents that are characteristic for a discipline or an area of learning. This makes it necessary to abstract from the specific national or local curricula. Accordingly a derivation of the test contents from existing vocational curricula or training plans is ruled out for good reasons.

One of the justifications for a comparative large-scale measurement in the field of vocational education lies in the perspective of using the test results for comparing the strengths and weaknesses of existing VET systems and programmes, provided that the specific curricula can be assigned to the same fields of professional activity. Therefore the COMET project adopted the concept of *professional validity* as a criterion for the definition of the contents of test assignments. The validity has to be demonstrated for the fields of professional activity in question.

If the content dimension is described in the form of a model for the systematisation of contents that can be applied to vocational education and training, the novice-expert paradigm makes it possible to arrange the occupation-specific training contents according to learning areas. Granted that the legitimacy of vocational education and training is based first and foremost on the fact that it supports the integration into a profession – the development from novice to expert – by giving learners the opportunity to develop their professional competence through the solution of professional tasks, the most promising approach to the structuring of the content dimension is a model based on development theory. The organisation of work tasks according to the levels of novices, advanced beginners, competent performers and proficient performers offers a basis across different occupational areas for the systematic identification and selection of contents for the construction of occupation-specific test assignments.

Whenever the competence development is to be assessed over the entire training period it is necessary to identify the characteristic work tasks and to arrange them as developmental tasks. The situation is easier when the competence level towards the end of the training programme has to be evaluated. In this case the point of reference is the professional aptitude as described in the relevant occupational profiles. In international comparative studies it does not make sense to refer to the more formalised descriptions in the form of standards or training regulations, for this would lead to an overrating of the formal aspects and impede the development of test assignments. The experience of the international COMET studies (for example with regard to test in the field of electro technology in Germany, China, and South African) shows that the selection of appropriate (characteristic) work tasks is possible without much difficulty. The implicit validity criterion applied by the educators involved consists, besides their common vocational discipline, in the professional work in the area of electrical engineering and electronics. The communication about the contents of competence development takes place at the level of professional fields of activity on the one hand and through the selection and development of test assignments on the other.

1.2 The action dimension

"Action" is a fundamental category of work psychology and pedagogy and refers to the concept of compete professional action (Hacker 1986, Volpert 2005). This means that activities have to be performed completely, including all preparatory steps and a final evaluation of the results according to criteria that are derived from the (sometimes contradictory) requirements of a particular work task to be solved.

Along with the pedagogical differentiation of the categories of vocational education and professional competence the paradigm of 'complete professional action' gained support and acceptance in theory and research in labour studies, which aimed at a humanisation of the world of work. The manifold efforts in labour studies to develop a scientific foundation of this concept obscure the fact that the category of complete professional action ultimately has a normative basis. The concept is rooted in the critical reflection of the Taylorist organisation of work and the interest to counteract the dequalification in fragmented work processes with a shaping concept (Gestaltung) based on labour studies.

Empirically the concept of complete professional action is supported by many HdA (*Humanisierung des Arbeitslebens*, humanisation of the world of work) and 'Arbeit und Technik' (work and technology) projects, which demonstrated that non-Taylorist types of work organisation were an advantage under the conditions of international competition (Ganguin 1992). The core of the concept of complete professional action is that learning requires knowledge of the whole of a professional task, i.e. form informing to planning, decision making, conduction to controlling and assessing (see Figure 2).

Ulich (1994, 168) emphasises five characteristics of "complete" or "holistic tasks":

- the independent definition of objectives that can be embedded into overarching goals,
- independent preparatory activities in the sense of exercising planning functions,
- selection of instruments including the relevant interaction for adequate goal attainment,
- executive functions with process feedback for a continuous opportunity to correct activities,
- review and feedback on outcomes with the opportunity to evaluate the matching of results of one's activities with the defined objectives

It is remarkable that Ulich emphasises the category of "holistic tasks", thereby referring to the shaping of work as a core research topic in labour studies. When adopting the concept of action dimension is in the COMET methodology, this was done in the tradition of labour studies where the design of work tasks is always also viewed as an aspect of personality development. This is one of the roots of the programmatic relevance that the idea of holistic tasks has gained in vocational pedagogy. Another one is the degree of medium-level operationalisation in the form of the differentiation of the complete work and learning action in successive steps of activity. This scheme provides some degree of orientation and security for the didactic activities of teachers and trainers. Moreover, this structural model of agency was disseminated also at the international level through the introduction of the concept of learning areas in curriculum development.

Addressing the action dimension in a competence model implies that the corresponding instruments (here: test tasks) cannot be related only to isolated aspects of a work assignment. Measuring occupational competence means to evaluate if a learner really understands his or her actions, the prerequisites needed and their effects (i.e. on a company's work processes and the final product. But this is only one (necessary) dimension of the COMET competence model. Without linking it to the requirement dimension, complete action can become meaningless (see section 1, part 2.3).

1.3 The requirement dimension

The requirement dimension represents the *levels* of professional competence that build on top of one another. These competence levels are defined on the basis of skills that are associated with the complete or holistic solution of professional work tasks. The objective and subjective requirements for the work on and the solution of professional tasks are related to the relevant professional skills.

When one reviews concepts of competence assessment in empirical educational research one encounters the concept of 'literacy'. The PISA project interpreted basic education in the natural sciences as 'literacy'. Following Bybee's (1997) design for the study of successive literacy levels it is possible also in VET research to draw a distinction of a total of four competence or literacy levels (see table 2). The further development of Bybee's concept of scientific literacy was achieved by the Science Expert Group (2001) on the basis of an analysis of the test items. The result was a division of the functional and the conceptual-procedural competence levels into two sub-categories each.

Competence levels	Bybee	COMET	PISA
Nominal	***I Nominal literacy*:** Some technical terms are known. The understanding of a situation is largely limited to naïve theories. Narrow and superficial knowledge.	***I Nominal competence*:** Superficial conceptual knowledge that does not guide activity, the meaning of the professional terms remains at the level of colloquial language.	***I Nominal competence***: Simple factual knowledge and the ability to draw conclusions without extending beyond everyday knowledge.
Functional	***II Functional literacy*:** Scientific vocabulary is used adequately in a narrow area of situations and activities. The terms are hardly reflected and the background remains unknown.	***II Functional competence*:** Basic technical knowledge leads to technical-instrumental skills. "Professionalism" is displayed as de-contextualised technical knowledge and corresponding skills ("know that").	***II Functional competence I*:** Common scientific knowledge constitutes the ability to evaluate simple situations on the basis of facts and simple rules.
			III Functional competence II *(scientific knowledge)*: Scientific concepts can be used for the prediction or explanation of events.
Conceptual-processual	***III Conceptual and processual literacy*:** Concepts, principles and their context are understood, as are basic modes of scientific thinking and working.	***III Processual competence*:** Professional tasks are interpreted in the context of company work processes and situations. Work process knowledge leads to professional action competence ("know how").	***IV Conceptual-processual competence I*:** Elaborate scientific concepts can be used for the prediction and explanation of events.
Multi-dimensional, holistic	***IV Multidimensional literacy*:** At this level an understanding of the essence of science, its history and its role for culture and society is attained.	***IV Holistic shaping competence*:** The complexity of professional work tasks is fully realised, and tasks are solved with a view to diverging demands and in the form of intelligent compromises ("know why").	***V Conceptual-processual competence II (models)*:** Analyse scientific studies with regard to the design and the hypotheses tested, develop and apply simple conceptual models.

Table 2: Competence levels in scientific literacy and industrial training (Rauner et al., 2013)

The requirement dimension in the COMET model follows eight specific criteria of holistic problem solving (see below) and thus allows for the concrete description (in terms of content) of competences at different levels. It can be illustrated how a solution of a task looks like when a test taker has solved it at a high level of competence and how it looks like when the competence level has been low.

What is of concern here are the *quantitative* and *qualitative* differences between the competence levels which become visible when summing up the information from an assessment of

the different competence criteria in with the help of individual competence profiles or competence profiles of test groups (see section 1, part 2.4 on representation of results).

COMET competence criteria: Eight criteria of holistic problem solving

The following figure shows the dimensions of work process knowledge ("know that", "know how" and "know why") and the COMET criteria for holistic problem solving, which are explained in the following box.

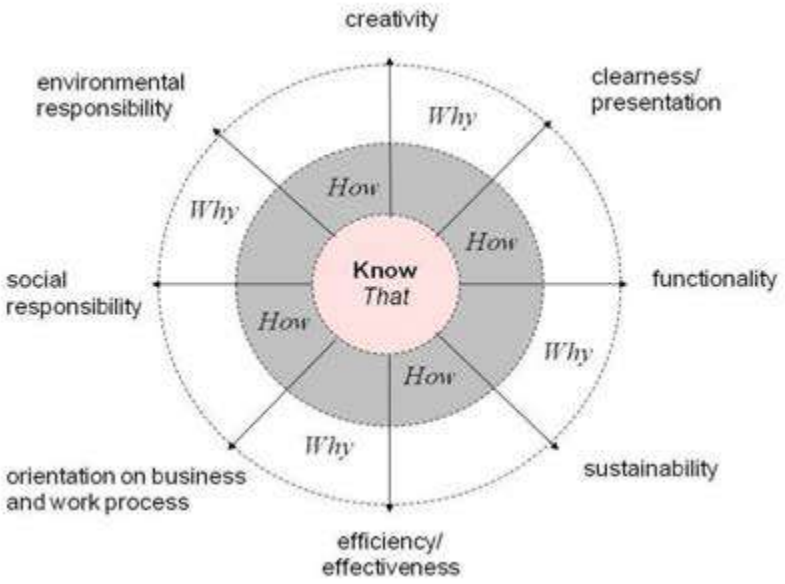


Figure 3: Work process knowledge and the eight criteria of holistic problem solving (COMET)

K1 Clearness/presentation:
The results of professional tasks are anticipated in the process of planning and preparation, and they are documented and presented in such a way that principals (customers, work superiors) can understand and review the proposed solutions. Accordingly the explanation and presentation of a solution is an instance of professional learning and professional work. A core element of communication in the work context is the ability to express one's thoughts in a clear and organised way by giving accounts, drawings and sketches. The adequacy of the presentation with regard to the facts is a sign of professionalism.

K2 Functionality/operability:
The functionality of a proposed solution is an evaluation criterion that immediately presents itself. Functionality refers to the instrumental technical competence or the context-independent, subject-specific knowledge and skills. Evidence of the functionality of a solution is fundamental and determines all further requirements that are posed for the solution of work tasks.

K3 Efficiency/effectiveness:
Professional work is in principle subject to the aspect of economy. The context-specific consideration of economic aspects in the solution of professional tasks is a characteristic of the competent activity of professionals. There is a constant necessity in professional work to evaluate how economically a task is carried out, and to consider quite diverse types of costs and influences. Costs that will be incurred in the long run (derivative costs) need to be taken into account as well. Decisions are made on a summative assessment of the ratio of expenses and benefits. In addition, economic responsibility also includes an awareness of the societal aspects as not all strategies that make sense at the organisational level may also be acceptable for the national economy.

K4 Sustainability/utility:
Professional activities, workflow, work processes and work assignments are ultimately oriented towards a customer, whose concern is the utility of the work result. In highly diversified production and service processes the aspect of utility often gets out of sight when subtasks are performed and vocational education is reduced to the aspect of action. The criterion of utility orientation therefore points at the utility of a solution in the entire context of work. A high utility of a solution depends not only on its immediate applicability for the customer, but also on the prevention of liability to failure and the consideration of aspects of easy maintenance and repair. Sustainability of application and the perspectives for enhancement must also be taken into account when the utility is assessed.

K5 Business and work process orientation:
This criterion refers to the preceding and the following operations in the organisational hierarchy (the hierarchical aspect of the business process) and in the process chain (the horizontal aspect). This aspect is particularly relevant in an environment characterised by programmed work systems in networks in and between companies. A business process oriented solution takes into account the linkages with the preceding and following processes and includes also the aspect of cooperation beyond the boundaries of one's own professional work.

K6 Social acceptability:
This criterion refers above all to the aspect of a humane organisation of work, health protection as well as the social aspects of professional work that go beyond the work context (e.g. the often divergent interests of principals, customers and society). This includes aspects of work safety and prevention of accidents as well as the potential impact of a specific solution on the social environment.

K7 Environmental compatibility:
By now this criterion has become relevant for almost all work processes. What is at stake here is not the aspect of environmentalism in general, but the professional and technical requirements for professional work processes and their results that can be considered relevant for the criteria of environmental compatibility. It has to be taken into consideration whether environmentally friendly materials are used and whether an eco-friendly work organisation is followed in the solution of the work task. Other issues that need to be considered are energy saving strategies and aspects of recycling.

K8 Creativity:
The creativity of a solution is an indicator that plays an important part in professional problem solving. This is due to the fact that the room for manoeuvre for the solution of professional tasks varies strongly in the different work situations. The criterion of a "creative solution" has to be interpreted and operationalised in an occupation-specific way. In the arts and crafts, creativity is a core aspect of professional competence. In other domains the aspect of "creative solution" is a relatively independent concept of professional work and learning. The distinction of creativity in a specific solution also shows the sensitivity for the problems to be solved. Competent professionals are expected to find creative and unusual solutions which at the same time make a meaningful contribution to the attainment of the goal.

Box 1: The eight COMET competence criteria (K1 – K8) in more detail

The framework for the interpretation of test results is constituted by these eight criteria and their attribution to the three COMET competence levels presented *Functional Competence*, *Processual Competence* and *Holistic Shaping Competence* (Figure 4). Nominal competence, as listed in table 2 has to be excluded from the field of professional competences. Trainees who only attain the very low level of nominal competence are regarded as risk learners who are likely to fail in the training programme. Their actual competence level is equivalent to the level of unskilled or semi-skilled work.

The COMET approach of criteria-oriented interpretation of the quantitative values includes a clear definition of rules for the transition from one competence level to the next that is based on the definition of threshold values as well as rules according to which a participant is assigned to a specific competence level. This feature distinguishes the COMET methodology from norm-oriented test procedures where the boundaries between the competence levels are drawn on the basis of the complexity and degree of difficulty of the test assignments.

A multi-level model implies the idea that the competence levels represent a ranking in the sense of an increasingly higher value of competences. In the case of the COMET model the first competence level is the lowest (Functional Competence) and the third one the highest possible level of competence (Holistic Shaping Competence). The competence levels that can be attained by a trainee are independent of the phases of the training process.

The following figure illustrates which competence criteria are principally linked to the three different competence levels, very roughly speaking, in order to reach holistic shaping competence, a test taker has to perform well enough in all eight criteria, functional competence can already be achieved if a test taker reaches good results in the two basis competence criteria: functionality/operability as well as clearness/presentation.

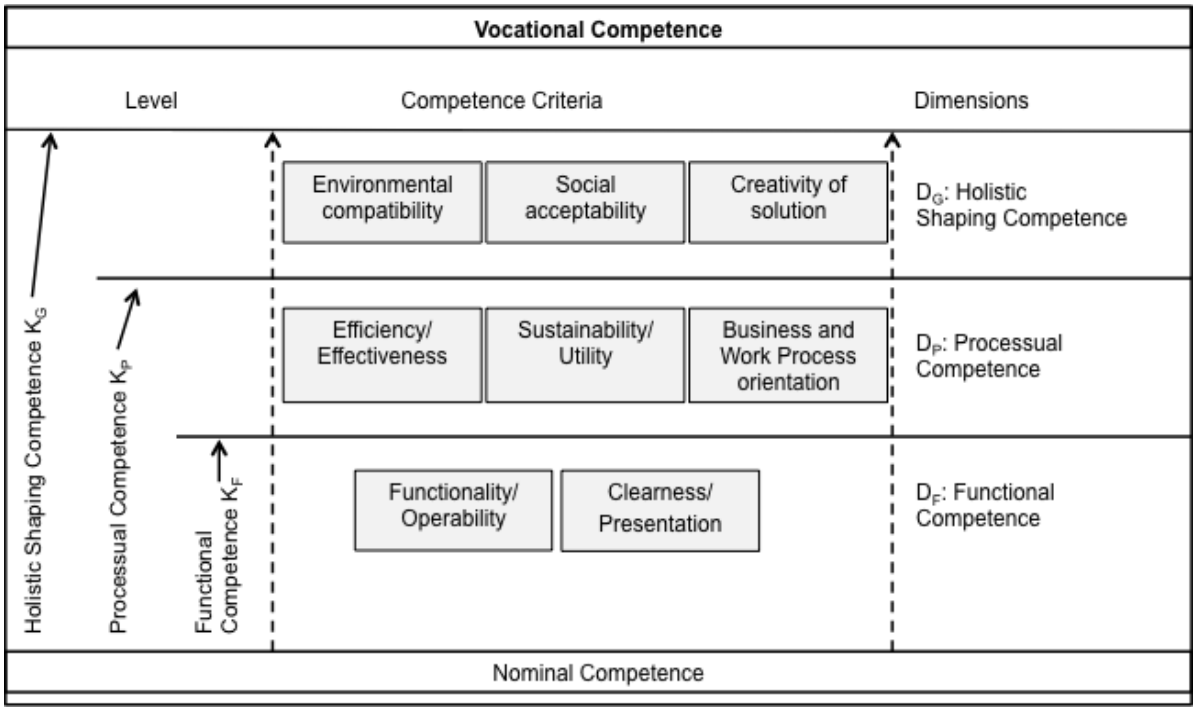


Figure 4: Levels of competence and the eight COMET criteria of holistic problem solving (Rauner 2016)

The theoretical definition of the competence levels on the basis of the eight COMET criteria for the holistic solution of tasks is based on the following considerations.

The *functionality* of a solution and its clear *presentation* must be given before the relevance of the other criteria comes into play. When the aspects of economy, utility and sustainability as well as business and work process orientation are considered in the solution of test assignments, then the candidates have a *professional concept of work* (as opposed to an academic and merely *functional* understanding of the tasks). The solutions that can be classified under this competence level demonstrate that the competences that are essential from an occupational as well as organisational point of view.

The third competence level is defined by skills that reach beyond business and work processes

and aim at aspects of *social* relevance. This means that there is a hierarchical order of competence components and solution aspects in the sense that an increase in competence is associated with a wider perspective of the trainees of the issues to be considered in problem solving. A purely technical or functional competence is followed by organisational and social problem solving competences at the higher levels.

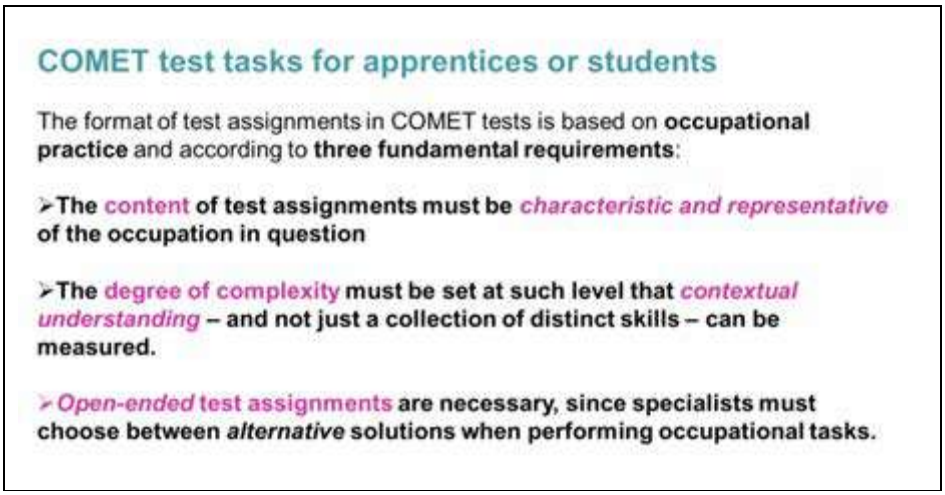
Part II Test instruments

Development and selection of test instruments follow the aims of the project and considerations immanent to it. The following test instruments are used in the COMET project:

- Open test tasks and solution spaces
- Rating sheets (paper pencil or online)
- Context and commitment questionnaires
- Motivational questionnaires (test motivation)

2.1 Open test tasks and their evaluation

Open and complex test tasks are COMET's main test instrument. This form of tasks has been developed and used in the COMET project in accordance with order transactions in professional work and represent the training objectives defined in the training regulations. COMET test tasks have a paper pencil format and are to be solved by test takers either at a theoretical place of learning (vocational school, college) or in a class room at a practical training provider within a maximum time of 120 minutes. They represent the core and occupation-specific competences and capacities of a skilled worker which makes it possible to measure professional competence in such a way that the specific qualifications of a skilled worker as described in the occupational profile are adequately represented. In a test, test takers are able to use test books and electronic devices, they also may use their notes.



Box 2: Requirements for COMET test tasks

In this regard it is of major importance that tasks are of such nature that all eight competence criteria of the COMET model are imbedded in them, i.e. that a test taker has the potential to equally address these eight different criteria when framing a solution. That's why elaborating and formulating such complex tasks has to be the result of team work: it needs the discussion with experts working (or teaching) in the same occupational domain. Some essential requirements for staff engaged in elaborating COMET test and learning tasks are summarised in the following box.

Experts involved in the COMET test development need to

1. have an in-depth understanding of the COMET competence model,
2. be familiar with the relevant professional practice in its scope and depth (this includes knowledge of the fields of application for the occupation in question),
3. be willing to distance themselves emotionally and intellectually from their own practice of vocational education and to reflect this practice critically,
4. be able to reflect on professional qualifications and competences across learning venues and from the perspective of professional action competence,
5. be able to estimate the future development of occupations in the sector.

Box 3: Requirements for experts envolved in COMET test and learning task development

In the all COMET projects these requirements were met thanks to the professional and didactical competence of the teachers in the coordination teams. In South Africa, first COMET tests took place in electro technology and were based on tasks elaborated by a German consortium. These tasks including their corresponding solution space (see below) were translated and found relevant for the South African context. After this experience, further tasks were elaborated by South African VET teachers and trainers in close cooperation with subject matter experts and specialists in the different occupational domains. In the (new) fields of welding and mechatronics but also in the further project in electrical engineering all tasks were elaborated by the different occupational teams in South Africa and cross-checked by a group of German vocational teachers who commented and edited the different tasks based on their own experiences. After ultimate editing under supervision of the merSETA, all test tasks went into pre-tests at different learning venues and finally, a selection of four tasks for main test purposed was made based on the pre-test results (see Section II, part 2).

Learning tasks

Not being test instruments in the narrow sense, the development and introduction of learning tasks is an essential element of all COMET projects. The tasks' main purpose is to help the test takers to familiarise with this sort of tasks but also to enrich the lectures/lessons because such complex and open tasks often better address the learners' creativity and individual problem solving capabilities than "ordinary" tasks that form a regular training curriculum.

If competence-oriented learning forms take place and the learners enable to solve occupational tasks *in a way related to real life* while paying attention to all relevant aspects of a solution, then, they acquire *cohesive knowledge* of their occupational field as well as competence to act in and shape their profession (*Handlungskompetenz* and *Gestaltungskompetenz*). Learning according to fragmented modules does not allow the development of occupational *Handlungskompetenz*. If one introduces forms of learning and teaching that are informed by the COMET competence model, i.e. learning tasks as well as other forms of learning projects, than - according to experience - the level of competence may rise significantly (Figure 6). A similar effect has been visible at one test site in South Africa, where trainers had introduced COMET learning tasks into their lessons: Test results achieved in a second test where at higher levels than in a first test (see Section 2, Figure 19).

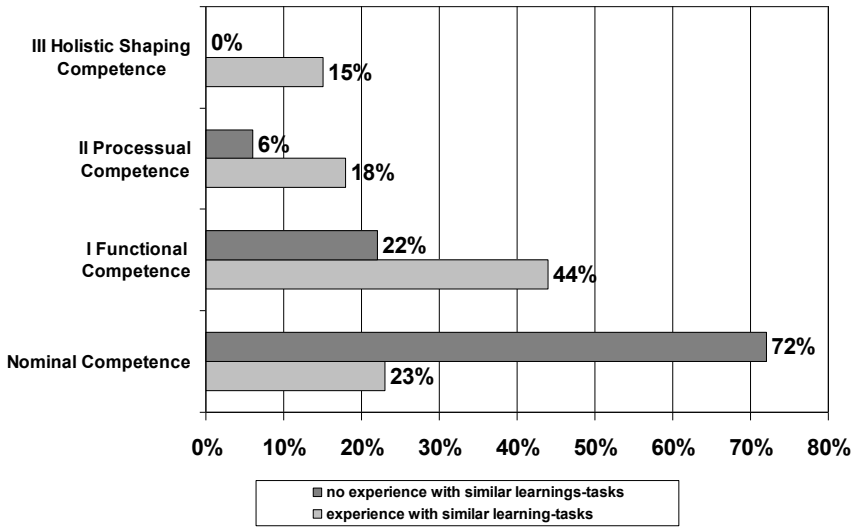


Figure 5: Competence levels of electrician (industry) Hessen, Germany, with and without prior test experience

Solution space

Elaborating a test (or learning) tasks goes hand in hand with the development of a task specific solution space that sums up what possibilities and varieties of solutions are inherent into a specific task. Every test task is thus checked in terms of the expectation horizon of the future examiners (who later rate the test takers' solutions). In a test task's solution space, it needs to be documented in how far the eight competence criteria could be addressed in a sample solution (or as parts thereof).

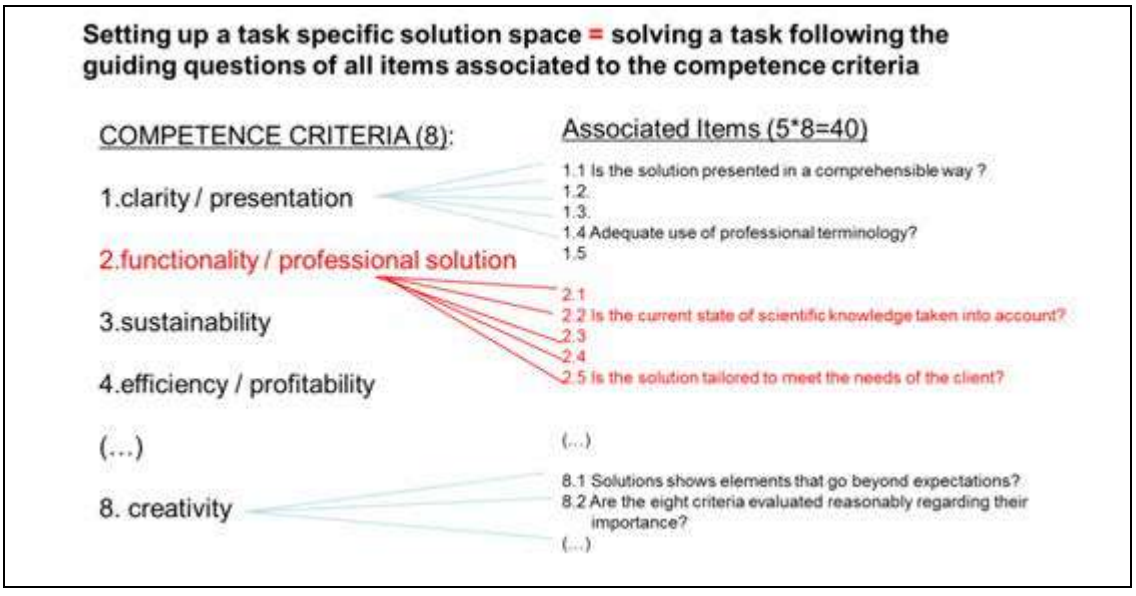


Figure 6: COMET Competence criteria and items of a task's solution space as a mean to derive a corresponding solution space.

In order to be able to rate a solution, a solution space is of essential help and guidance for those teachers or trainers who later on have to assess the solutions of test takers because this document describes what possible solutions and variants are associated with the open test assignments.

The rating sheet

All in all rating a test taker's solution is done according to a total of 40 items that are linked to the competence criteria (5 items per criteria, see Figure 8 below). The rating sheet is based on these 40 items, which are used for the evaluation of a participant's solution. Given that all items are formulated neither in an occupation-specific nor in an assignment-specific way a rater training aims above all to establish a link to the context of a specific test task. Since the instrument is applied in a specific domain, it needs to be clarified how each of the items can be interpreted in the context of the underlying occupational profile and the expectations associated with the test assignments. Each solution is evaluated according to these 40 items and referring to the four different estimations "fully met", "rather met" "rather not met" or "not met at all".

Rating Sheet Version August 2011

Task: skylight control signals drying area paint shop pebble treatment plant
Code:
Teacher:

	Requirement is...			
	fully met	rather met	rather not met	not met at all
(1) Clarity/Presentation				
Is the solution's presentation understandable for the client/orderer/customer/employer?				
Is the solution presented on a skilled worker's level?				
Is the solution visualised (e.g. graphically)?				
Is the presentation of the task's solution structured and clearly arranged?				
Is the presentation adequate (e. g. theoretically, practically, graphically, mathematically, causative)?				
(2) Functionality				
Is the solution operative?				
Is the solution state-of-the-art?				
Are practical implementation and construction considered?				
Are the relations to professional expertise adequately presented and justified?				
Are presentations and explanations right?				
(3) Use value/Sustainability				
Is the solution easy to maintain and repair?				
Are expandabilities and long-term usability considered and explained?				
Is countering susceptibility to faults considered in the solution?				
How much user-friendly is the solution for the direct user?				
How good is the solution's practical use-value (e.g. of some equipment) for the orderer/client?				
(4) Cost effectiveness/Efficiency				
Is the solution efficient and cost effective?				
Is the solution adequate in terms of time and persons needed?				
Does the solution consider the relation between time and effort and the company's benefit?				
Are follow-up costs considered?				

Figure 7: COMET rating sheet (extract). For full information see Appendix III-1, p. 245.

Tests are evaluated independently by two raters (teachers or trainers) and on an anonymous basis: each test taker's solution is coded and copied and does not contain any personal information (name or training institution of the learner). After the "rating" proceedure (or marking), individual competence profiles can be derived, while each profile is calculated as an average result of the two anonymous ratings (for a more detailed description of the test instruments including the nature of a solution space and the rating documents, see Rauner et al 2009).

The rater training[9]

The quality of a measurement tool for the evaluation of professional competence and competence development depends largely on the question to what extent the ratings of the individual solutions of the participants by the evaluators (raters) converge or diverge (inter-rater reliability). In order to

[9] For a very detailed describtion of the rater training procedure see Rauner, F. et al (2013): Competence Development and Assessment in TVET (COMET). Theoretical Framework and Empirical Results. Springer. Dodrecht. Chapter 9, pp. 149-164.

secure high inter-rater reliabilities, the COMET methodology builds on regular rater trainings seminar for those teachers and trainers who serve as "raters" in a specific occupation tested. Such seminars are a core element of all COMET projects and ideally take place around an examination day so that the all results can be calculated and made available relatively soon after the completion of a test. Moreover and from a rater's perspective, it is always good to start a rating proceeding when the lessons learnt during a training seminar are still "fresh".

The first aim of a rater traininig is to introduce teachers and trainers to the COMET methodology or to fresh up their knowledge in case the method had already been introduced before. Likewise, raters have to get familiar with all test tasks which have been used in a COMET test as well as the corresponding solution spaces of these tasks.

Programme COMET Rater Training	**Time amount**
1. Introduction (plenary session) - COMET competence model - COMET assessment model - items of the rating scale	3 to 5 hours depending on the prior knowledge of the participants
2. Preparation of a sample rating on the basis of selected solutions to all four test assignments with the following steps: - presentation of the first test assignment and the solution space - presentation of the solutions to be rated	30 to 60 minutes (plenary)
3. Setting up of work groups of 5-6 persons (random selection); Sample rating in the work groups with the following steps: - Each of the raters carries out an individual rating. - The outcomes of the ratings are compared within the groups. Differences are analysed. - A group rating is carried out. Difficulties in finding a consensus are documented in a short summary. - The results of the rating (individual and group ratings) are entered into the laptop for the plenary.	1.5 to 2 hours
4. Plenary session - presentation of the rating results of the different groups, and of the difficulties encountered - comparison of all rating results with the rating by experienced raters, analysis of extreme scores (on single items or by single raters) - presentation of the second test assignment and the two solutions to be rated	1 to 2 hours
5. Rating in groups (same procedure as for the first assignment)	1 to 1.5 hours
6. Presentation and analysis (rating outcomes in a plenary session)	1 to 2 hours
7. Rating of the third and fourth test assignment (according to the procedure described above)	Approximately 2 to 3 hours for each test assignment
8. Final individual rating of all solutions	Approximately 15 to 20 minutes for each solution

Table 3: Programme for the training of COMET raters

The principal idea of a rater training is to get a common understanding about how to assess test takers, i.e. to "speak with one voice" when judging a learner's test. Ideally, raters have to come to the very same estimation on the quality of a solution, but due to the nature of COMET tasks which allow for a broad range of solutions at all levels this is highly difficult and certainly not possible without being trained. In order to get as close as possible to the aim of maximum congruence in

individual teachers' and trainers' ratings, the training includes phases of individual work and thinking combined with phases of discussion with professional colleagues on the different expectation horizons so that uncertainties can be clarified within a group and raters can come closer to a more uniform judgement pattern. The three-phase procedure – single rating, reflection in small groups, plenary session – is continued until all test assignments of a specific test have been fully understood by the entire rating team. Table 3 shows the standardised procedure of a COMET rater training.

During a seminar all test ratings given by each individual participant are documented in a manner that inter-rater reliability can be calculated and supervised throughout the entire training procedure.

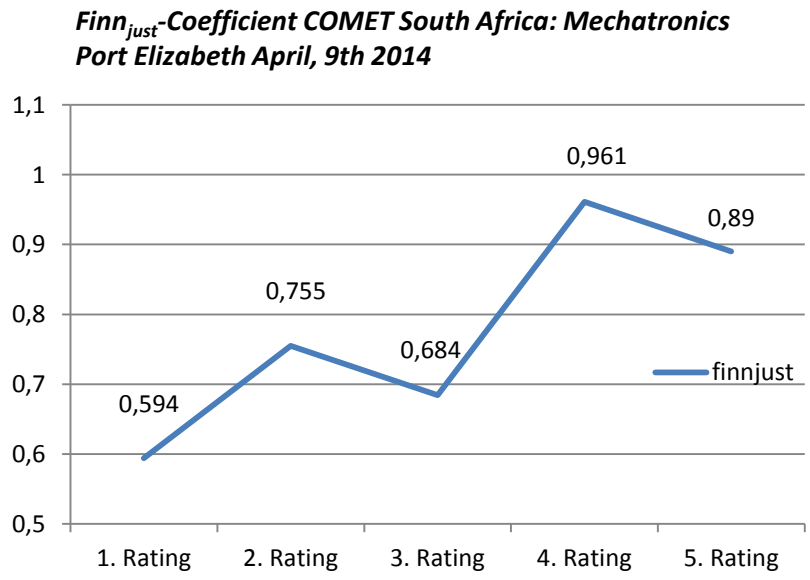


Figure 8a: Results of a South African rater training. Calculation of inter-rater reliability using the Finn Coefficient. (Trainer: U. Hauschildt, L. Heinemann, P.Jacobs)

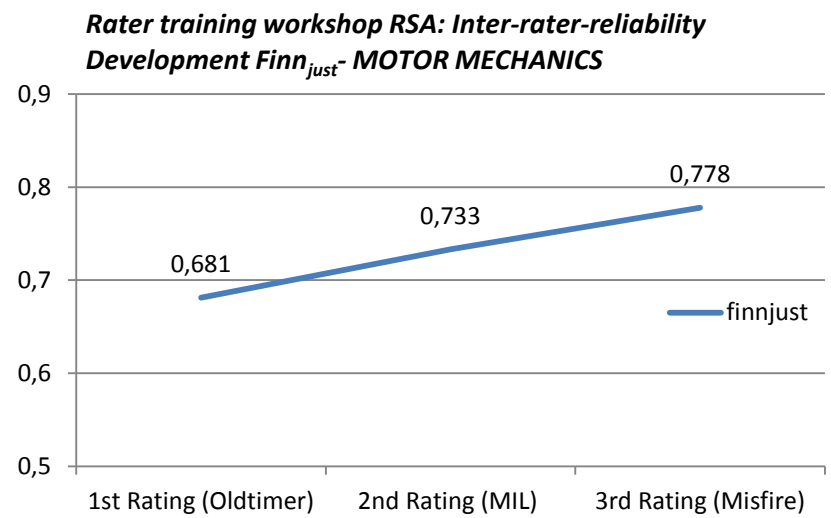


Figure 8b: Results of a South African rater training. Calculation of inter-rater reliability using the Finn Coefficient. (Trainer: H. Brown, P. Jacobs)

Figure 8: Results of South African rater tainings, COMET 2014 and 2015

Figure 8a shows as an example the development of inter-rater reliability in the first test in mechatronics in South Africa in 2014 based on the calculation of the Finn coefficient. In this case very

sufficient results were reached by the end of the training[10]. It may be added that the group of raters were not quite happy with the results of the third task they were rating, so that another student's solution (of the same task) was chosen as a fifth exercise. The very good result of this fifth rating proved that the participants had developed a very high degree of common understanding about how to rate a learner's solution of the task in question. Any inter-rater reliability above 0.7 is considered as sufficiently high to secure test quality.

Whereas in 2012 and in 2014, rater trainings have been conducted by German team colleagues, in 2015, all this has been realised without their direct involvement. It is a major aim of the COMET project that the research methodology and project design is organised as a knowledge transfer project in which – by its end - a partner country is enabled to run the project activities without further support of German partners or initial project coordinators. Rater trainings in motor mechanics have successfully secured inter-rater reliability and a high quality in the assessment of the tests in this occupation. Figure 8b illustrates the training results of teachers and trainers in motor mechanics.

2.2 The context and commitment questionnaires

Context questions

In addition to a test task, each learner has to fill in a questionnaire that captures the students' personal background as well as the context of learning at school and at the workplace. The aim of the context survey is to identify possible variables influencing the development of occupational competence. If one gains insights into these variables' modes of operation, practical and political argumentation can be linked to a more solid basis.

Therefore, the first objective of the context questionnaire is to collect *personal data* about the learners that might be relevant for professional competence development. These include predominantly the educational attainments before the beginning of the training programme and biographical data like socio-economic background, data about previous and prevocational education and the question of motivation for the present training. The following table sums up the questionnaire's subjects in more detail.

Personal background	Context of in-company training	VET college/school context
• Socio-economic background • School performance and previous learning career • Training motivation	• General characteristics of company • Work-process orientation of training • General training situation at company	• General characteristics of school • Pedagogical context • Work process orientation

Table 4: Contents of the COMET context questionnaire

[10] The Finn coefficient can have a value between 0 and 1.0. A value of 0.0 means that there is no connection between the judgments of the raters while a value of 1.0 means that there are equal means as well as equal variances between the raters. The closer the value is to the maximum of 1.0, the higher is the reliability of the ratings. In the case of the Finn coefficient, values between .5 and .7 can be regarded as satisfactory and values over .7 as good. Given the low rigour of the coefficient, the COMET project considers only such values as acceptable that represent a high inter-rater reliability, i.e. only Finn values of at least .7 are regarded as sufficient (Rauner et al 2009 p. 154).

A learner's estimation on the training provider(s) can be regarded as an important predictor with regard to competence development and the development of vocational identity. If training takes place in at alternating learning venues (alternating between a theoretical and a practical training provider) the training contexts at both learning environments have to be investigated. When it comes to the *context of in-company training*, these are questions regarding the general characteristics of the training provider as well as the specific training program. Issues that are surveyed by the instrument are listed in table 5.

General characteristics of the enterprise	Work process orientation of the training programme	Training situation in the enterprise
- number of employees - number of trainees - economic sector - status of the enterprise (branch, independent company)	- learning venues (training workshop, corporate work process) - organisation of training (full-time trainers, part-time trainers)	- work climate - social integration - measures to promote transparency - inclusion into the expert culture - complexity and variety of tasks - autonomous working - matching of demands and skills - relevance of tasks

Table 5: Context variables of in-company training

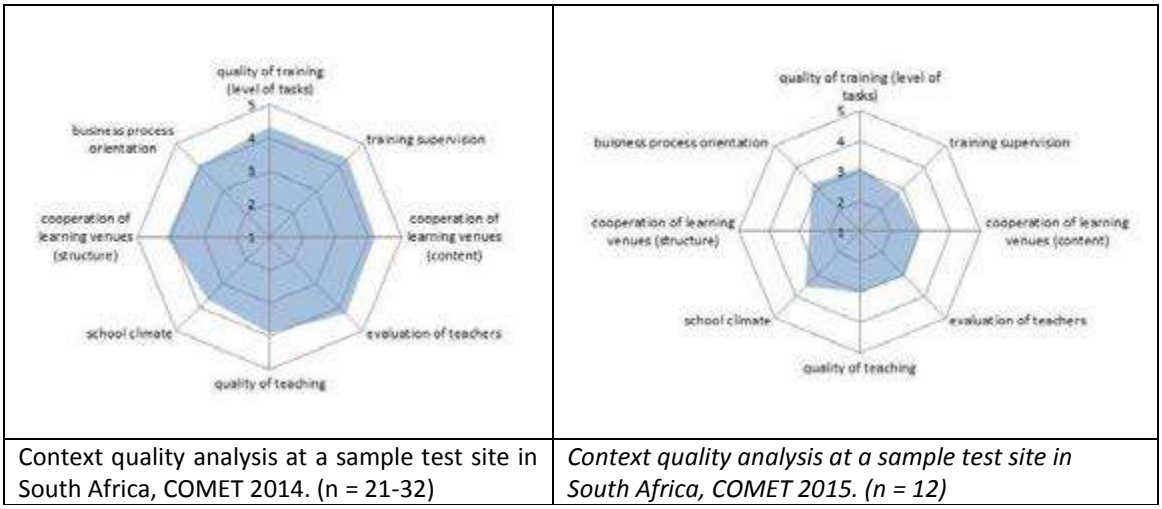
The analysis of relevant characteristics of a theoretical training provider (*VET college/school context*) takes place by surveying the views of trainees on the school environment, their estimation on the pedagogical context and on the degree of work process orientation at college[11]. Table 6 sums up the major issues of interrogation in this regard.

School environment	Pedagogical context data	Work process orientation
- size of the school and the vocational department - age structure and composition of teaching staff	- teacher/student ratio - cooperation among teaching staff - school culture (student orientation and deviant behaviour) - individual support - self-reliance of learners - teaching attitudes	- connection of teaching and professional practice - cooperation of learning venues - teacher's overview on professional work - acceptance of the school by the training enterprise

Table 6: Context variables of a theoretical training venue (vocational college or school)

[11] The scales that are used have been validated in several projects on the quality of schools conducted by the DIPF (Gerecht et al. 2007). However not the complete inventory is used in the COMET project, only such items that were adequate for the specific situation of vocational schools or colleges. Some items were added that referred to specifically vocational dimensions of teaching quality, e.g. cooperation of learning venues and practice orientation.

It has to be stressed that in international perspective, the relevance of the different items of the context questionnaire may vary considerably due to the different organisational forms or structures in the provision of vocational education and training. Therefore, the full questionnaire (see appendix III) is not always equally relevant in all COMET projects or – as regards the South African context – not equally relevant for the different test sites taking part at a COMET test (for example if a practical training provider is also responsible for the theoretical lessons or, if training predominantly takes place at a college that also offers practical training. In such cases, test takers were asked to skip those parts of the interrogation which did not apply to their specific training situation.



Context quality analysis at a sample test site in South Africa, COMET 2014. (n = 21-32)	*Context quality analysis at a sample test site in South Africa, COMET 2015. (n = 12)*

Figure 9: Representation of context quality analysis in two sample test sites in South Africa. COMET 2014 and 2015.

Questions regarding vocational identity and commitment

An important precondition for the development of occupational competence is a student's development from novice to expert. Only by developing vocational identity, one can take over the role of an expert, and to adequately put into use the knowledge and skills acquired during training. As a consequence, the COMET project attempts to measure this part of competence development as well which requires additional instruments apart from the test tasks.

Occupational and organisational commitment are seen as sources to develop motivation and thus occupational and organisational identity. Another source of motivation was widespread in Tayloristic work environments: a work ethics that does neither refer to the organisational environment nor to the contents of work, but relies on an abstract sense of duty.

For the COMET project, commitment is not in the first place relevant as a predictor of work performance, which is the predominant view in the research literature. This would be difficult because commitment is conceptualised as a disposition of employees in favour of their job and/or their company that has consolidated over time and that is strong enough for reliable tests only after some years. In addition, the construct of organisational commitment usually includes the tendency to continue employment with the enterprise. These two facts make it problematic to apply the commitment approach to trainees when commitment is to be interpreted as a reliable predictor of work performance. Instead, commitment is relevant in connection with the development of professional identity when the assessment of professional competence is at stake. The normative areas to which commitment refers are decisive. Occupational commitment is defined as orientation towards the profession trained and is distinguished from organisational commitment as orientation towards the enterprise and work ethic as the general motivation to work. Professional identity, on the other hand, denotes a combination of attitudes corresponding to the development from novice

to skilled worker in the course of the training process, e.g. quality awareness or self-initiative.

The COMET project investigates organisational and occupational commitment with the help of established scales that have been modified[12] so as to be applicable to the attitudes of trainees. For the measurement of occupational and organisational identity further scales were derived within the course of the various COMET projects, tested for their reliability and practical applicability (Rauner et al 2015) before they have been introduced to the COMET project in South Africa.

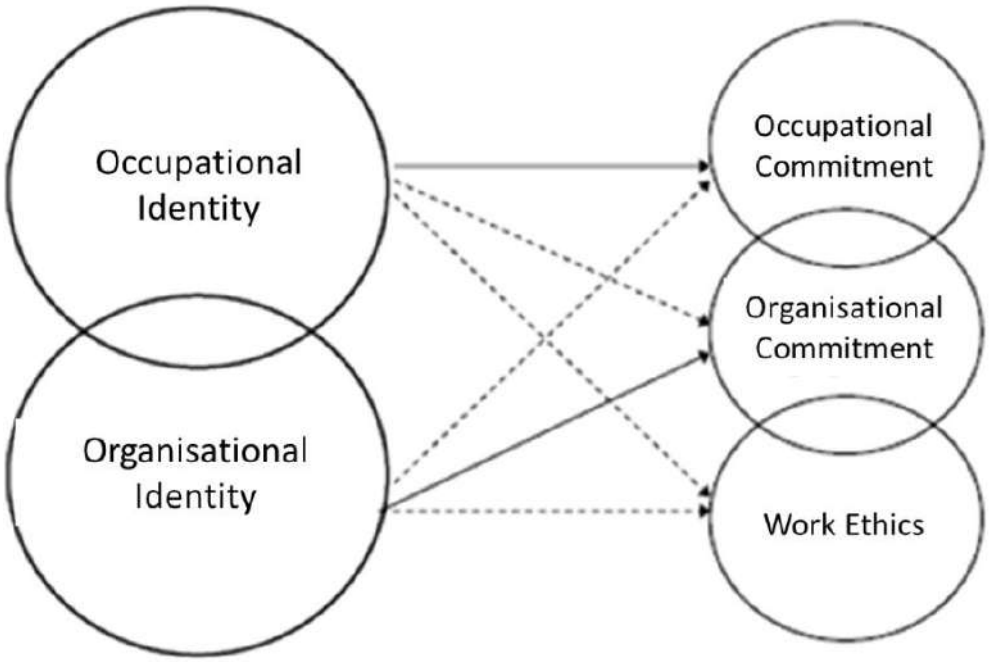


Figure 10: Extended model to illustrate the interrelation between commitment, identity and work morale

The methodology used in current South African COMET project differs in so far from the methodology introduced in the first South African competence measurement project in 2012, as the former project did not consider and calculate organisational identity. But especially because in the South African context, the organisation (the training company) often plays
a substantial role in a learner's development of professional identity, the distinction between organisational identity and occupational identity made a lot of sense.

The following table lists scales and the corresponding items together with the results in terms of their quality (using Cronbach's Alpha). All scales sum up to 24, the one measuring work morale consisting only of three items is doubled to also reach 24.

[12] For a detailed description of the development of the COMET scales to measure vocational and organisational identity and commitment, see Heinemann, L./Rauner, F. 2009 as well as Rauner, F. et al 2016.

Scale	Items	Cronbach's Alpha[13]
Occupational Identity	I like to tell others which profession I am learning now	α= .87
	I „fit" to my profession/I work well with my profession	
	I would like to continue working in my profession after training, it could as well be in another company	
	I am proud of my profession	
	I feel kind of home in my profession	
	I am not that interested in my profession (-)	
Occupational Commitment	I am interested in how my work contributes to the overall company's workflow	α= .82
	„Profession" means to submit quality	
	I am taken up in my profession / I am merged in my profession	
	I know what the tasks I carry out have to do with my profession.	
	I sometimes think about ways how to improve my work or its quality.	
	I want to have a say on my work content	
Organisational Commitment	For my company I always want to submit quality	α= .71
	With my work I would like to contribute to the company's success	
	In my company, I like to accept liability/responsibility	
	In order to get a job in this company, I would have taken up an apprenticeship in another profession than the one I am learning now	
	I am interested in the employee suggestion scheme of my company*	
	The work in my company is so interesting, that I often do not realise how fast time is passing by	
Organisational Identity	I feel kind of ‚home' in my company	α= .90
	I would like to continue working in m company – even when I have the opportunity to work for another employer	
	I like to tell others about my company	
	I „fit" to the company	
	I care about my company's future	
	I don't feel very attached to my company (-).	
Work Morale[14]	I am motivated no matter what my work tasks are	α= .69
	I am reliable no matter what tasks I get	
	I am always on time - no matter whether my work tasks require this or not	

Table 7: Scales of the COMET commitment questionnaire

* this item was not considered as being relevant for the South African project and was not applied.

The extended model has been evaluated based on the data of two substantial studies in Germany (A: n = 1121; B: n = 3030) using a confirmatory as well as an exploratory factor analysis (Kalvelage/Zhou 2017 forthcoming). The results of the analysis however do not clearly support the idea to differentiate between two sources of commitment (organisational vs occupational) because it

[13] Cronbach's Alpha of these scales was calculated on the basis of 3030 data sets involving more than 70 different occupations. For a detailed analysis of the extended model see Kalvelage, J. and Zhou, Y. 2014.

[14] The scale for work morale has been modified after the project COMET South Africa and actually also contains 6 items (see Rauner et al. 2016, forthcoming, for further information).

seems as if on average, apprentices do not manage to clearly distinguish between these two (see Figure 10).

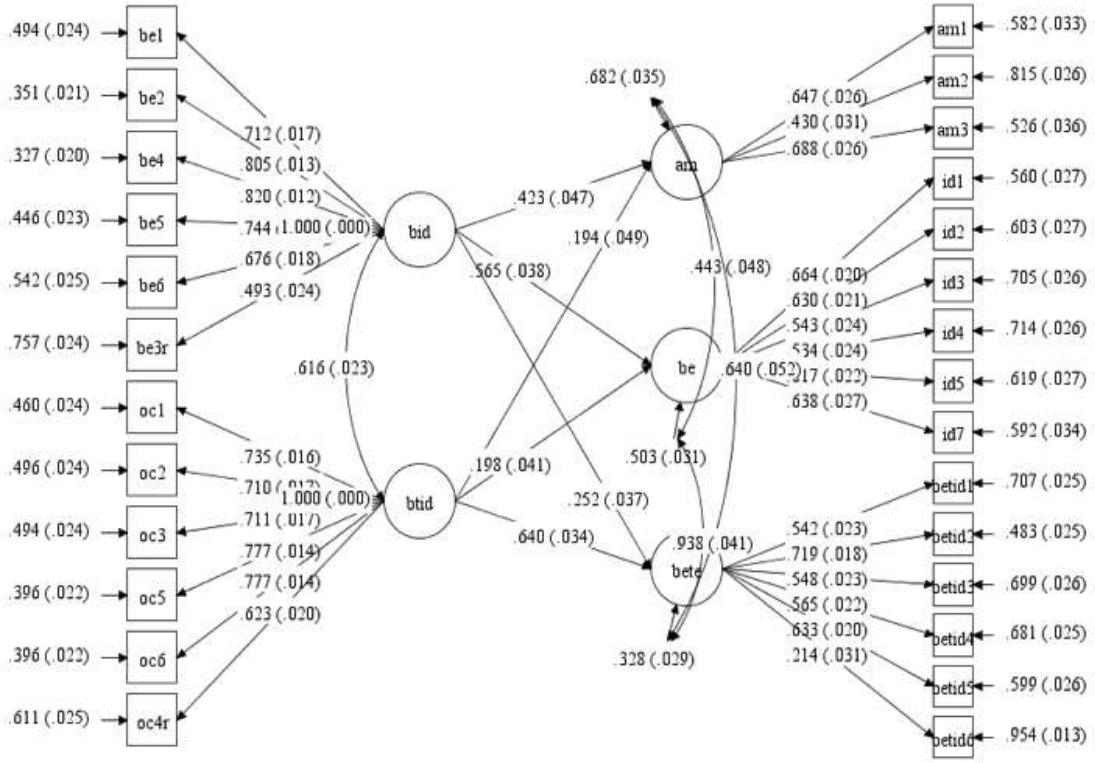


Figure 11: Confirmatory factor analysis on extended model to measure occupational (bid) and organisati-onal identity (btid), occupational (be) and organisational commitment (betid) and work morale (am). Studie by Kalvelage and Zhou, see Kalvelage, Heinemann, Rauner, Zhou, 2015)

These constraints still need to further investigated, especially because the data base of this analysis refers to very diverse groups of test persons (i.e. including a very high percentage of 1st year students who had only limited training experiences and who therefore might not have been in a position to clearly estimate on the different items of the questionnaire).

In the South African context, it was decided to stick to the analysis based on the extended identity and commitment model. In order to get some more information on the learner's understanding on the issues discussed in the questionnaire, the latest version of the interrogation tool included some additional questions on their general understanding.

2.3 Test motivation

Each COMET test investigates the test takers' test motivation. The formulation of the questions follows the PISA test practice. After a COMET test, the leaners are asked to give a short feedback on their personal test experience. The questions refer to the time spent on working on a task but also to the relevance of task and whether a learner found it useful, interesting, or relevant for the occupation trained. In South African version of the motivational questionnaire also included the question whether the learners would appreciate continuing working with tasks like the one they were solving in the test but as a part of their regular training and they were asked to comment on their estimations. To document the feedback of learners in a comprehensive analysis on test motivation provides some very useful information on how to interpret test results in the light of a learners' view. Especially in the South African case this has been an important source of information

(see SECTION 2, 1.2).

In addition, the teachers who supervise the classes during the tests fill in a questionnaire that collects information about the motivation in the class and the working atmosphere. Supervising teachers or trainers are also asked to answer a short questionnaire on their use of COMET learning tasks prior to the test as well as on their general attitude towards this sort of open tasks. Due to the very low response rate, the current project report does not summarise the information collected via this survey. Because the local project management has coordinated a series of COMET feedback seminars where test results have been discussed among the participating teachers and trainers supervising the different groups of learners, the questionnaires were of minor importance for the overall analysis.

2.4 Representation of results

Competence profile

One possibility to show the individual or average group test results is via a radar chart. Such a diagram is created for each participant as a personal feedback form (Figure 11). This presentation, which shows not only the three competence levels but also the eight competence criteria, emphasises the multidimensional character of the competence model. In the example below the test taker has performed very well in the criteria K1 (clearness/presentation) and also K2 (functionality). There is still some potential for improvements in all other criteria, but especially with regard to K4 (efficiency) and K7 (environmental compatibility).

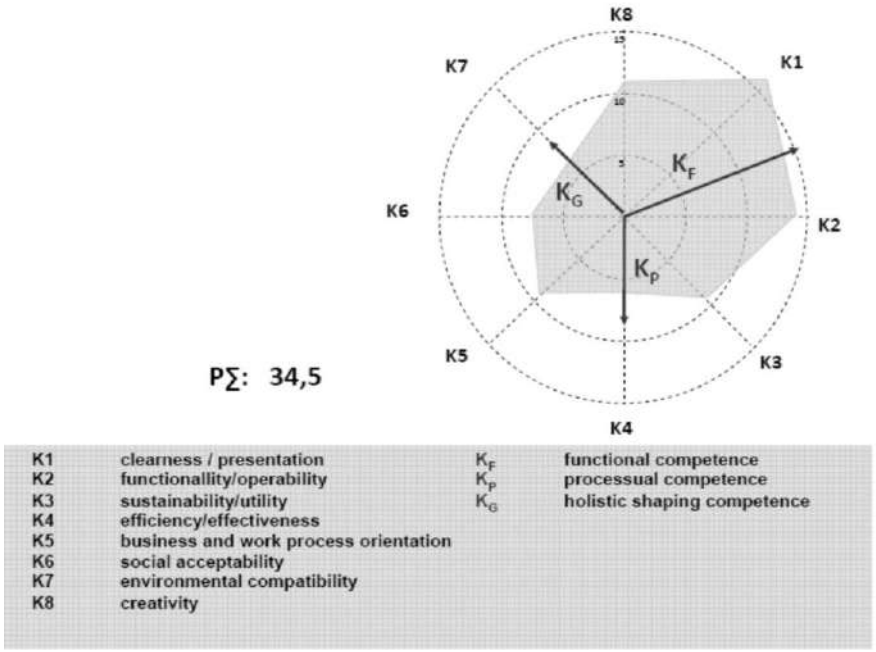


Figure 12: Example of a competence profile

Teachers also receive feedback forms regarding average performances of their classes. Such feedbacks serve as a direct support for the planning and structuring of future lectures.

Percentiles

It is also possible to compare the average scores of different groups by means of percentile bands. The differences and the dispersion of competence scores between test persons and test groups,

which are selected according to various criteria like occupation, test site etc., give information about the degree of heterogeneity to be expected in vocational education and training. An appropriate means for the visualisation of this heterogeneity are the percentile bands which have also been introduced in the PISA studies.

The visualisation by percentile bands makes it possible to give a clear presentation of three different characteristics of the various groups. First, the marking in the centre shows the mean of the group. By comparing the means of the different groups it becomes possible to identify differences with regard to the average performance.

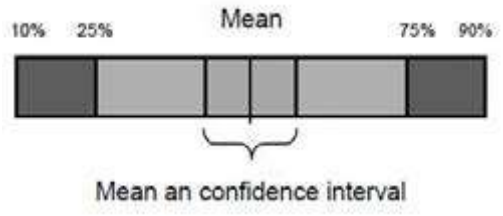


Figure 13: Example of a percentile band

Second, whether or not these differences are significant is expressed by the highlighted parts of the percentile bands, the confidence intervals. With a probability of 95% the 'true' mean, i.e. the average that can be inferred from the sample for the entire population, lies within this interval. This means that differences between two groups are significant and most likely not due to random when the mean of one of the bands lies outside the confidence interval of the other.

The third important aspect covered by the percentile bands is the dispersion of the results, i.e. the distance between better and worse test scores. The lighter parts of the bands represent the scores for 25–50% and 50–75% of a group. This range includes the scores of those 50% of the trainees who are grouped around the mean. The darker parts include the cases that constitute the lower (10–25%) and upper ends (75–90%) of the scale. The best and the worst 10% of the test scores are not included in order to avoid distortion by freak values.

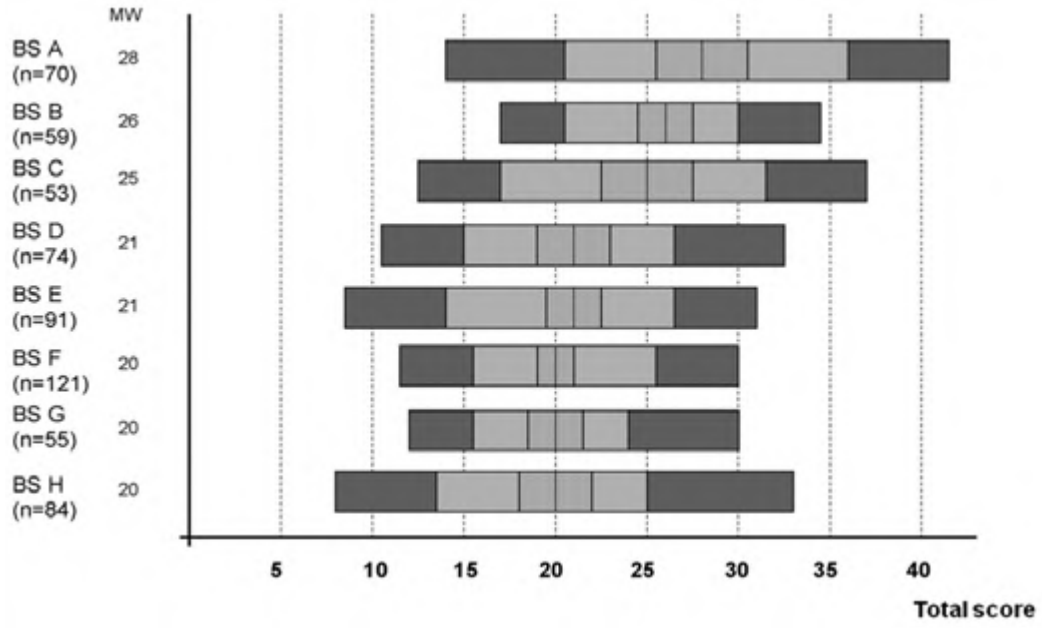


Figure 14: Example of a comparative presentation of competence distributions in different classes tested ("MW" means "arithmetic mean")

Bar diagrams for the distribution of competence levels reached

In order to provide overviews on the average results achieved by a class or test group (selected according to different criteria, like test sites, gender, year of training etc.) the COMET analysis shows the performance of test groups according to the different competence levels reached (0= Nominal competence, 1 = Functional Competence, 2 = Processual Competence and 3 = Holistic Shaping Competence. Because learners can always also reach these different competence level at lower medium or higher levels, differentiated analysis according to these sublevels are made where necessary. Figure 14 shows a sample of such bar diagram including the differentiated analysis. In this case, the performance of learners was rather weak at all level – also the more elevated ones.

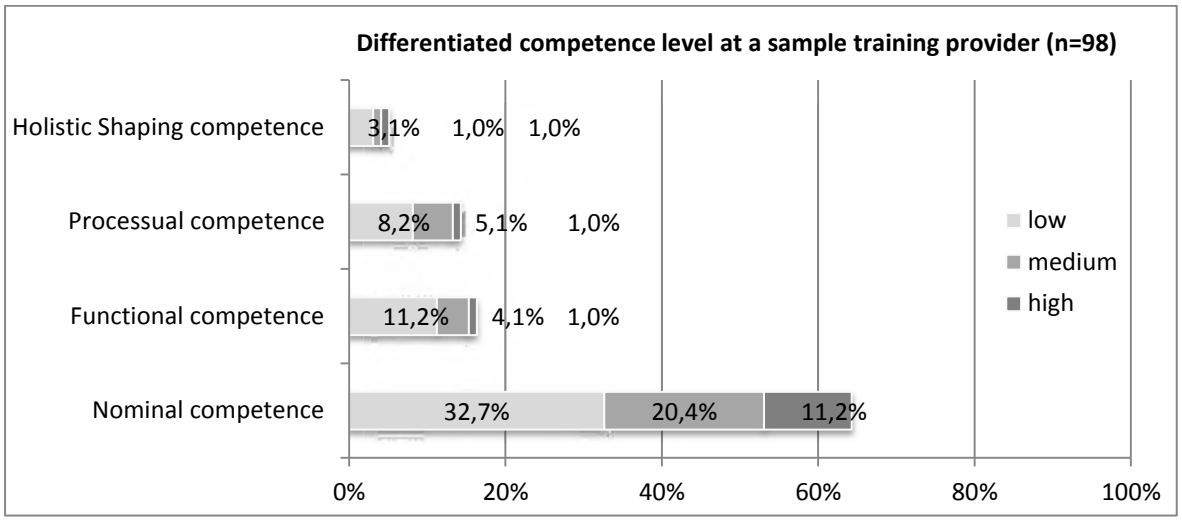


Figure 15: Example for the analysis of a test group according to competence level differentiated into sublevels (high medium and low)

Bar charts illustrating the results of the commitment questionnaire

The degree of a group of learners' vocational identity or commitment is illustrated with the help of bar charts in traffic light colours, where the percentage of test takers with a relatively low degree of commitment is coloured in red and the share of test takers with a very high commitment is in green colour. The group in-between reaching only medium results are in yellow colour.

These diagrams also help to provide a very clear picture on the attractiveness of different vocations when the results of all five scales of the commitment questionnaire are illustrated in such manner. Some vocations have a lower identification potential than others which does not necessarily refer to the context of training in a specific training company and vice versa.

The sample analysis in Figure 16 illustrates the representation of results. In this example, only one out of the five commitment scales have been analysed and documented according to the different test groups (apprentices in different occupations). Likewise the results of data analysis in all other four scales can be documented in this manner.

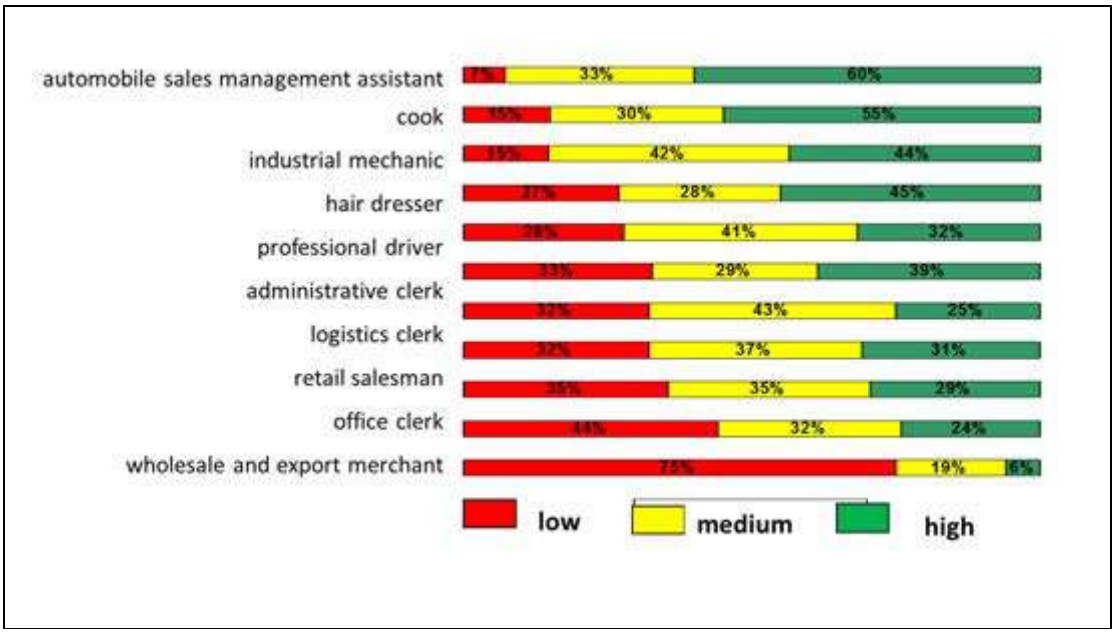


Figure 16: Example for the analysis of *ccupational commitmen*t in selected vocations in Germany differentiated into sublevels (high medium and low)

The aggregated data of the commitment survey do not only offer an occupation specific or test site specific analysis. Furthermore, it is possible to derive identity/commitment (IC) profiles that reflect results according to specific organisational forms of apprenticeship, different curricular arrangements or types of training that are for example predominantly located in companies as opposed to the training opportunities at colleges. As for an example, Figure 17 sums up the comparative result of the commitment analysis referring to training at different locations.

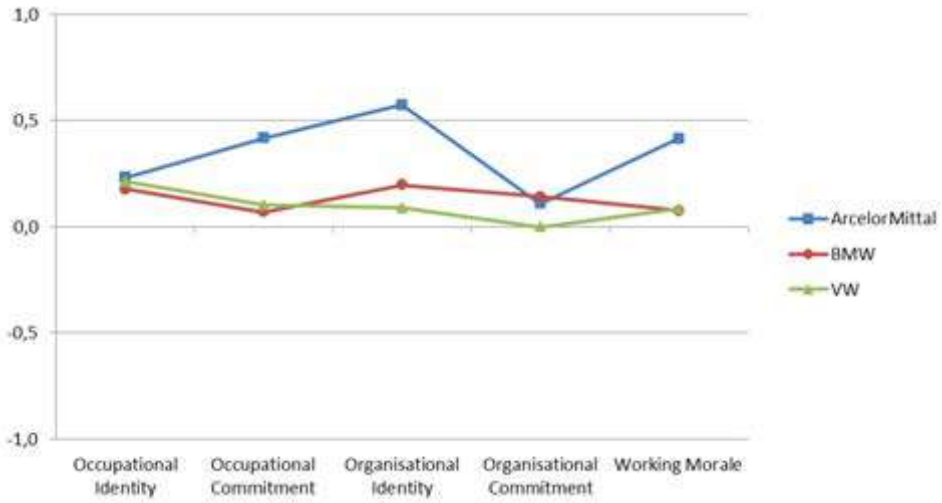


Figure 17: Example for IC profiles calculated in three different in-company training providers (COMET Test 2014 South Africa)

A third option to illustrate the results of the commitment questionnaire is a representation with the help of a four-field matrix that allows for a clearer distinction between occupational and organisational commitment or occupational and organisational commitment (Rauner et al 2015).

2.5 Strengths and limits of the measurement instruments

The topic of what can be measured by the COMET test instrument and what cannot be measured or only be measured with a greater effort was often discussed among the members of the different project consortiums. Addressing this question is of crucial importance to neither link unrealistic expectations nor underestimate the potentials of large scale competence diagnosis.

Measurement of professional competence means in the first place that the evaluation tools are based on standardised measurement methods and target forms of professional knowledge and skills that can be measured. But many aspects of professional skills, including important ones, escape the methods of quantitative measurement, though. Quite often 'tacit knowledge' (Polanyi 1966; Neuweg 1999; Fischer 2000) is the basis of important professional skills that can be demonstrated in an examination but not described in the form of explicit knowledge. When a toolmaker is asked how he manages to carve a steel surface more exactly than a machine would do, the reply is often: "That's experience" (Fischer/Jungblut/Römmermann 1995).

At this point large-scale competence diagnostics reaches some limits as it depends on standardised test procedures that are incompatible with the idea of assessing practical skills in real work situations. A realisation of a standardised observation procedure for the assessment of professional competence by proven experts would require an amount of human and temporal resources that rules out the feasibility of such a project from the outset. In order to better overlook the benefits and limits of competence diagnostics it makes sense to list and examine in some detail those items that can or cannot be measured by its methodology (or only with a greater effort)[15]:

Measurement	
is possible	**requires a greater effort**
Cognitive domain-specific dispositions	Situated professional qualifications
Competence levels related to professions as well as trans-professional, independent of VET forms and structures of test groups on the basis of individual test results	Implicit professional knowledge (tacit knowledge)
Competence profiles and shapes	Individually situated professional ability (professional aptitude)
Heterogeneity of competence levels and shapes	Learning gains related at curricula
In combination with context data, insights into a multitude of relations relevant for steering and developing VET, for example - Educational systems - Contents and forms of occupational learning - Co-operation of learning venues and curricula - Work organisation - School organisation - International comparisons	Craftsmanship
	Social competences (with reservations)
	Skills and capacities displayed in the interactive course of work (with reservations)
	Competences displayed in creative skills

Table 8: Possibilities and limits of measuring occupational competence

[15] For a more detailed summary and explanation of the different limitations of large scale competence assessments, see Rauner et at (2013), pp. 13-16.

The first row of table 10 describes the objects of competence diagnostics: cognitive domain specific dispositions. These dispositions are *cognitive* as competence diagnostics does not look at performance during the work process, but looks at the test persons' ability to comprehend occupational tasks in its complexity, to weigh up different aims and to develop a viable approach.

The strengths and peculiarities of large scale competence diagnostics are based in the standardisation of tasks on the basis of a competence model. This is not restricted on measuring individual occupational competence but holds for comparing different groups in different forms and systems of vocational education. Good and very good results express a good or very good VET practice.

The characteristics of COMET competence diagnostics can be summarised as follows:

- The COMET model of competence can be applied in the whole range of vocational education and training - cross-professional and cross-system. This opens up a new quality in VET research, quality assurance, qualification and curriculum research and in international comparative VET research.

- Test results are not only presented in terms of competence levels but as well by competence profiles. This way the results become important in terms of organising learning and didactics.

- COMET offers a method to measure occupational competence that allows statements on how specific VET systems are able to impart the central idea of vocational education: *professional holistic shaping competence*.

- Longitudinal studies (of about one year) offer an identification of qualitative and quantitative aspects of competence development.

- Apart from testing occupational competence, the COMET test instruments contain scales to measure vocational identity, occupational and organisational commitment as well as abstract work ethics (or working morale).
  This enables the measurement of the different occupations' attractiveness

- Collecting context data on the test persons' biography as well as on the learning environment at school and company allows far-reaching interpretations of the COMET results. This enables to derive recommendations for
  - Teachers and trainers,
  - VET research and VET planning as well as
  - VET policy.

- The COMET competence model is at the same time a didactic model to develop and evaluate instructions and education according to the concept of learning areas.

SECTION 2: TEST RESULTS

Part I: Test participants and average test results

1.2 The test cohorts

During the project "COMET South Africa" from 2013 - 2016, more than 1400 participants (learners as well as some teachers and trainers) took part in COMET tests organised under the managerial direction of the merSETA, Johannesburg, and in close cooperation with the University of Bremen. All in all, apprentices of six different vocations were involved: electricians, mechatronics, motor mechanics, welders, fabricators and millwrights.

In September 2014, 850 learners took part in the COMET main test 2014 (in some graphs also referred to as COMET test 2014-2 South Africa[16]). A pre-test in April 2013 and intensive work on test- and learning task development according to the COMET methodology in the occupations "Electrician", Mechatronic" and "Welder" preceded this large-scale assessment in a total of 13 test sites, eight out of which had not been introduced into the COMET methodology before.

In 2015, COMET was introduced into one further profession: motor mechanics (including diesel mechanics, and NCV automotive apprentices). After a successful pre-test with 160 test takers in May 2015, 404 test participants took part in this main test, 20 out of which were teachers or trainers.

Figure 1 provides an overview on the occupations in which the COMET main tests 2014 and 2015 took place. In addition to the occupations tested in the pre-test of April, also "Fabricators" and "Millwrights" were tested in September 2014. With regard to the latter two occupations, the test has to be considered as a pre-test.

In 2014, out of the total of 850 tests, 774[17] were valid for the analysis of vocational competence, while the complete data set of 850 test participants has been analysed in a further study on test motivation, vocational identity and occupational commitment (cf. Part VIII). Figure 2 lists the participants according to the occupations tested. Electricians, mechatronics and welders had the biggest share, fabricators, fitters and turners as well as millwrights playing a minor role due to their participation in terms of a pre-test. Electricians formed by far the biggest test group with a total of 389 test takers which is an equivalent of about 50% of all test persons.

In 2015, almost all tests were valid for the analysis. Only 7 were not considered in the competence assessment because of their status of "drop-out" (see below)

[16] COMET 2014-2 was the label of the main test in 2014 which followed a pre-test in 2014. This report always refers to main test results, unless results. Pre-test results are always indicated as such.

[17] In addition to the number of 774 test takers, 17 fitters and turners took part in the test. Their participation – which was based on tests elaborated for electricians, was considered as an exercise only. Test results are not part of the overall analysis.

Test Site 2014	Number of test takers	Test takers per occupation
ArcelorMittal	42	14 Electricians 18 Millwrights 10 Welders
BMW SA	37	01 Electrician 36 Mechatronics
EastCape Midlands College	13	13 Mechatronics
EEC- Daveyton	83	67 Electricians
EEC- KWA THEMA	68	68 Electricians
Master Artisan Academy SA	19	19 Electricians
Northlink College (Belhar)	32	32 Electricians
Northlink College (Bellville)	76	76 Fabricators
P.E.College	173	86 Electricians 01 Fabricators 82 Mechatronics 03 Millwrights
SIEFSA Training Centre	53	30 Electricians 23 Welders
Umfolozi-Richtek	40	40 Electricians
VW SA	19	09 Electricians 10 Mechatronics
West Coast College	109	22 Electricians 87 Welders

Test Sites 2015	Number of test takers	Test takers per occupation
Barloworld	24	24 Motor Mechanics
College of Cape Town	29	29 NCV Automotive
Erkurhuleni	45	45 NCV Automotive
Elangeni	41	41 NCV Automotive
Imperial Technical Training Academy	43	28 Motor Mechanics 15 Diesel Mechanics
Imperial Technical Training Academy - Germiston	73	73 Motor Mechanics
Kwazulu Natal Automotive Training Services	9	09 Motor Mechanics
McCarthy Training Centre Midrand	17	17 Motor Mechanics
Northlink College	57	57 NCV Automotive
Sandown Motors	13	13 Motor Mechanics
The Automobile Association of South Africa	19	18 Motor Mechanics 01 Diesel Mechanic

Figure 1: Test sites and numbers of test takers in different occupations. COMET Test 2014 and 2015 South Africa. (Some test takers did not provide information on the occupation trained and have not been listed in the 2014 overview)

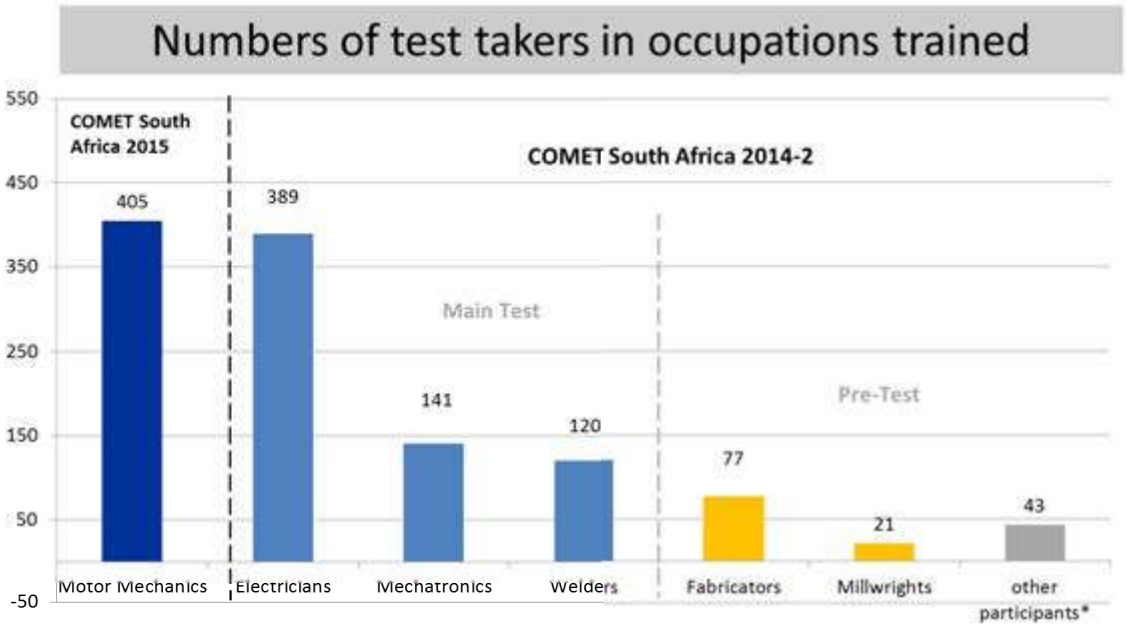


Figure 2: Total number of test takers by occupation. COMET Test 2014 South Africa.
*) The cathegory "other participants refers to 17 fitters and turners (see footnote 1) and test takers who did not provide an answer on the occupation trained .

A closer look on the participating test sites and the according number of test takers shows (Figure 3), that in 2014, a total of 382 participants were located at test sites, where COMET test had already been introduced against a group of 365 participants who took part at test sites without a previous introduction of COMET.

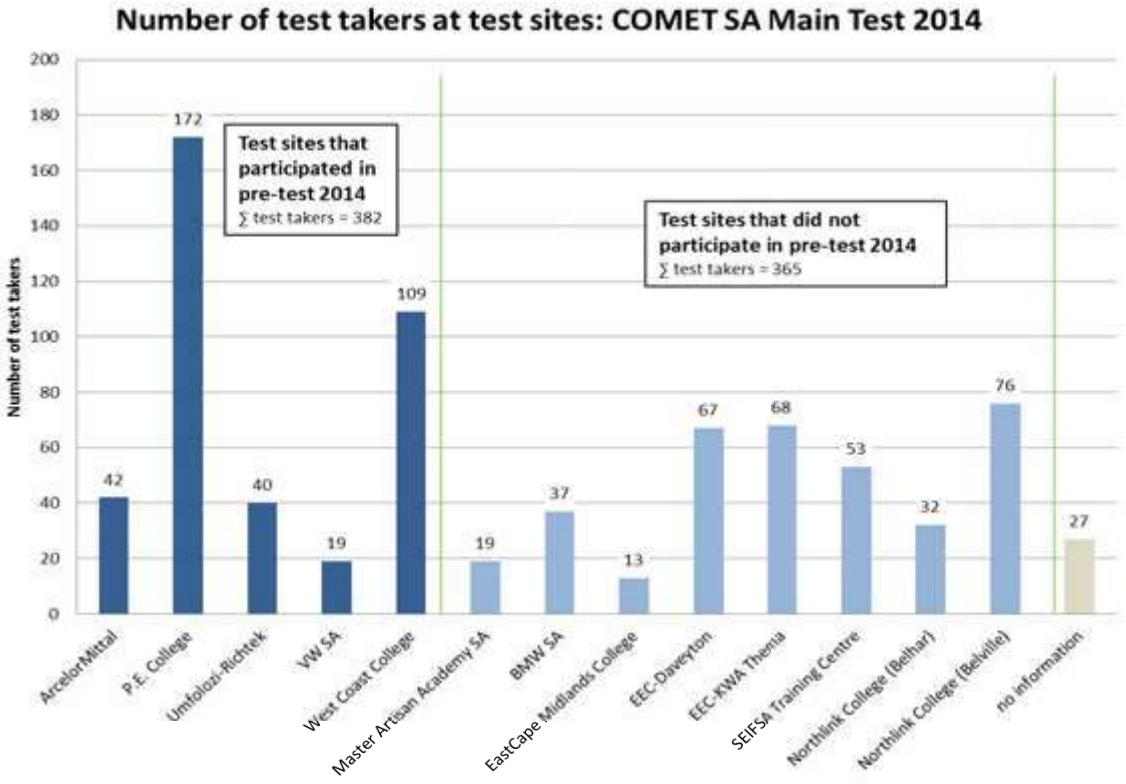


Figure 3: Number of test takers by test site and their involvement in previous tests. COMET Test 2014

This means that in 2014 almost equal numbers of learners were in each of these two groups[18].

In the analysis in Part II of this section, test takers will always be examined according to their average performance followed by an analysis at the respective test sites, starting with those that were involved in previous test(s) followed by those that were new, each time in an alphabetical order.

At the 2015 main test, all test sites were new, and except Northlink College who already participated with a group of leaners in different vocations, all training institutions took part for the first time and thus without a possibility to introduce COMET learning tasks into their classroom teaching prior to the test.

Test takers by age group, year of training and gender

The majority of test takers were between 21 and 24 years. 19% were younger (17-20 years), 22% were older (25-40 years). Approximately 1/4 of all test takers did not provide any information on this question.

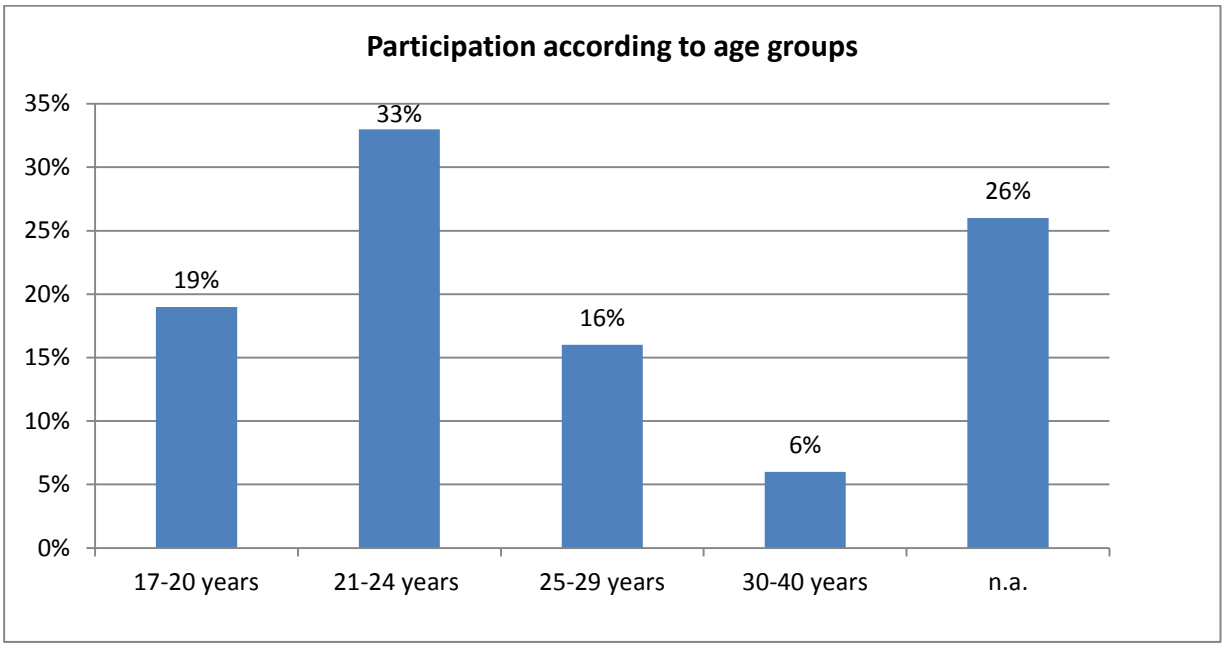


Figure 4: Numbers of test takers by age groups. COMET Test 2014 and 2015 South Africa (n=1214)

With regard to the year of training, the overall picture shows, that most of the test persons were in the 2nd year of training (34%). 29% were in the first year and 27% in a third or fourth year of training. 10% of the total cohort was not providing an answer to this question (see Figure 5).

[18] This does not refer to a similar extent to the number of test takers in the newly tested vocations in the pre-test in fabrication and in the millwright occupation. Here, most of the learners were at test sites which had not been introduced to COMET. Only for millwrights, who were almost tested at ArcelorMittal only, a previously involved test sites was in charge.

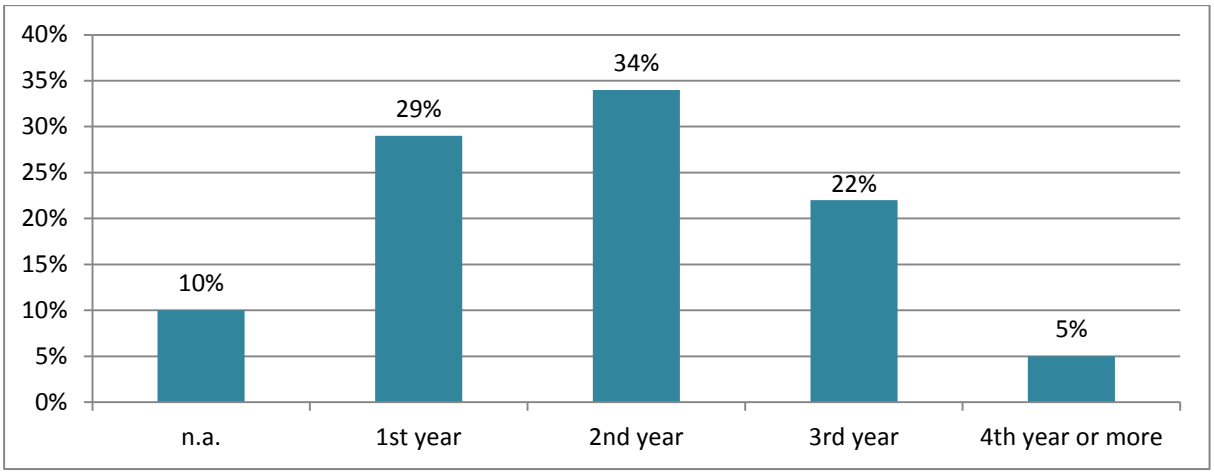


Figure 5: Numbers of test takers by year of training. COMET Test 2014 and 2015 South Africa. (n=1214)

The dispersion according to gender was 68% male against 32% female test takers in the test 2014 in the mixed test with 5 different vocations and 89% against 11% in the main test 2015 with mechatronics only. As the test took part in a domain that is traditionally dominate by males, the share of female test takers can be considered as relatively high in the cohort tested in 2014.

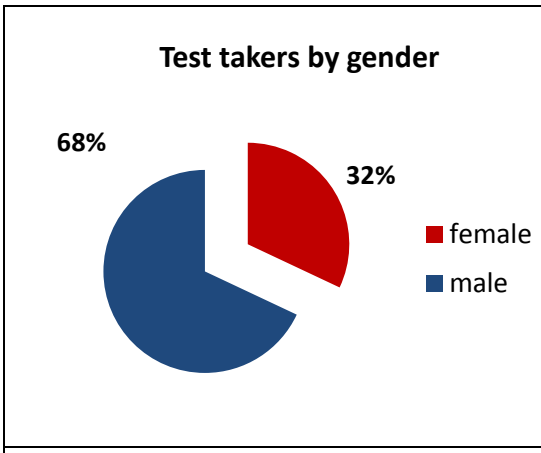


Figure 6a: Test takers by gender. COMET Test 2014 South Africa (n=844)

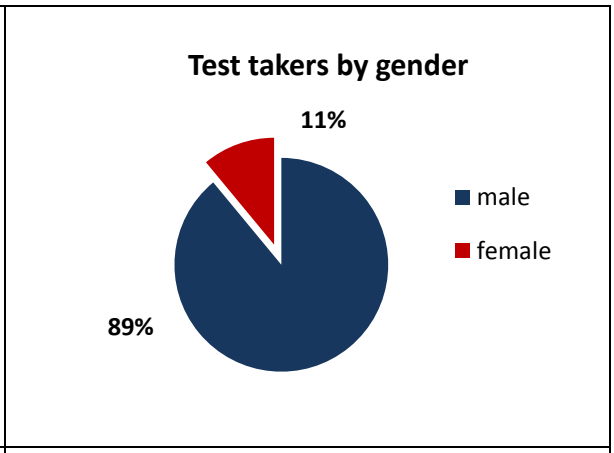


Figure 6b: Test takers by gender. COMET Test 2015 South Africa (n=364)

1.2 Overall average test results

On average, test takers reached a rather low total score of 14.60 or 19.84 in 2014. The lower value refers to an analysis based on a consideration of tests that are usually regarded as drop-outs. According to the definitions of COMET competence model, candidates with an average of five points or less are recognised as dropouts[19]. In general, these are candidates who did not really work on their task, left an empty piece of paper or declined to participate at the test after a few minutes of test time. Because *this was not the case (!)* for the big majority of the South African test takers (see section VII on test motivation) this subsequent test analysis will be based on both types of calculation techniques where necessary: one without the critical number of so-called “drop-outs” and another

[19] See Rauner, F. Heinemann, L., Li, J., Zhao, Z. (2012): Messen beruflicher Kompetenzen. Band III. Drei Jahre KOMET-Testerfahrung. Lit. Münster, p. 192

one where these test takers are included as the latter approach reflects the situation in a more realistic way. Figure 7 shows the overall average results with and without drop-outs. The group of drop-outs represents a total of 250 learners, which is about one third of the total cohort tested. As this is a very high number, this group will not only be included in the analysis, but as well looked at in a more detailed manner (cf. section VII).

As a general average picture of the test result neither reflects any information on the different vocational groups or test sites, nor any contextual data, this result can only be taken as very rough information which should nevertheless be the starting point for all further investigation. Both radar charts show a rather weak average result of vocational competence with a little focus on those competence criteria that represent the presentation or functionality of a professional solution (K1/K2). Nonetheless, all other competence criteria except K7 (environmental responsibility) and/or K8 (creativity) are addressed in an almost balanced manner. This issue is as well reflected by a relatively low variation coefficient of 0.18 or 0.17, which is a good indication even though at a weak overall level.

The bar diagram below the two radar charts shows the competence levels of the entire test cohort. The two highest competence levels, which are holistic shaping competence and processual competence are reached by 16.1% or 23.5 % of all test takers. In the further analysis, this report will as well look a bit more in detail at those learners who received good or very good results.

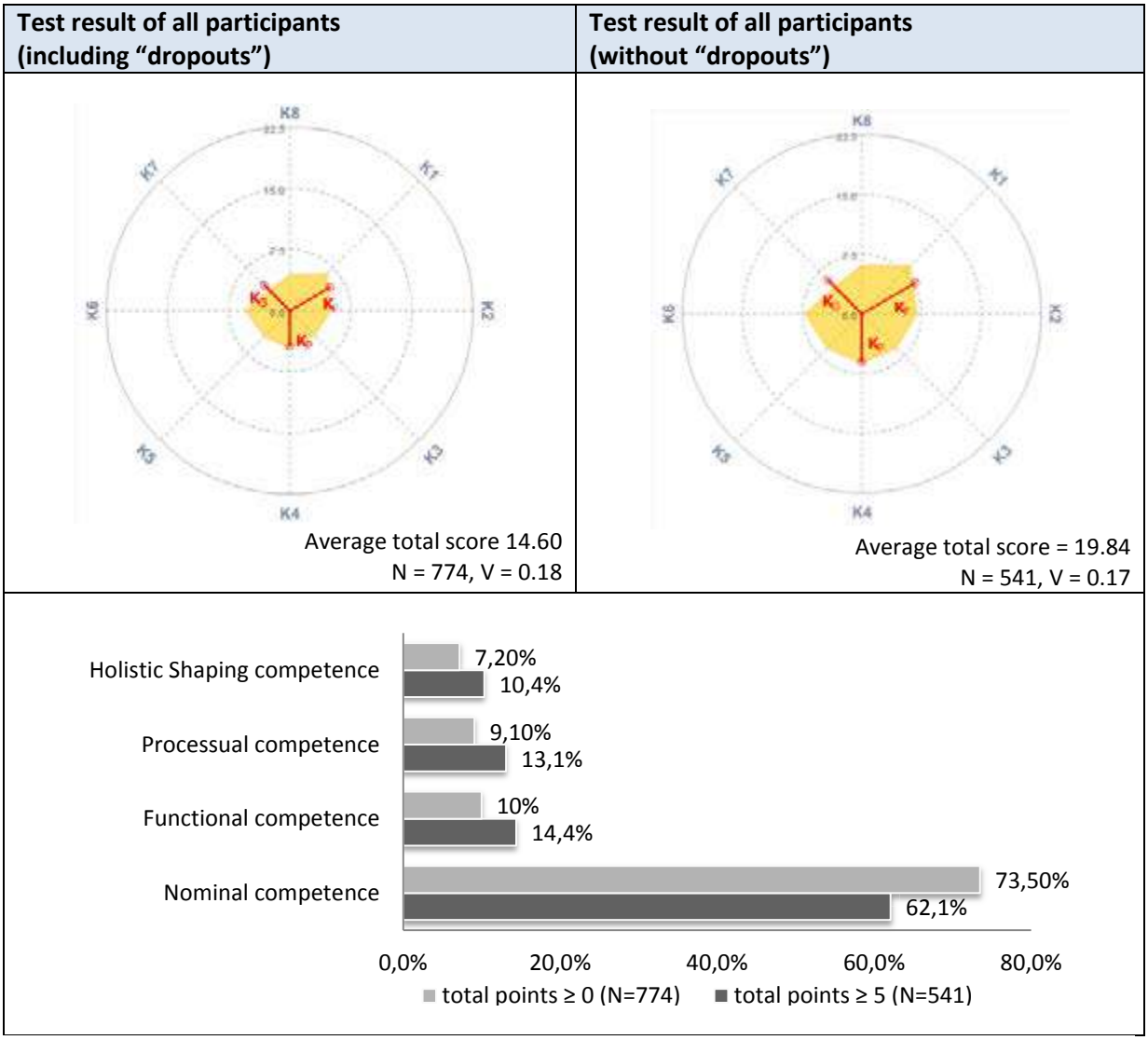


Figure 7: Main test result South Africa 2014. Average competence profile and distribution of competence levels of all test takers (including information on "drop-outs")

The following illustrations provide an overview of the test result in a more comprehensive manner, i.e. including the dispersion of test results at the different test sites (Figures 8 - 15)[20] including information on the respective shares of risk learners and those who reached the highest competence level.

Figure 8 (percentiles of test results) combines information about the mean results achieved at the different test sites and the dispersion of these results – i.e. the distance between lowest and highest results achieved within the different test groups (test sites). Here, it becomes visible, that there is a big variety in the performance of learners according to the learning venues on the one hand (mean values between 8.7 and 27.5!) but also a considerable heterogeneity of learners within different test groups.

VISUALISATION of test results by PERCENTILE BANDS

The band as a whole represents the scores of 80% of the participants. The best and the worst 10% of the test results are not represented.

The lighter parts of the bands represent the scores for 25–50% and 50–75% of a group. This range includes the scores of those 50% of the test persons who are grouped around the mean. The darker parts include the cases that constitute the lower (10–25%) and upper ends (75–90%) of the scale. These lighter parts of the percentile bands represent the range in which the middle-ranking 50 % of the test scores are located.

However, when interpreting Figure 8 which represents the test results of 2014, one has to consider that these graphs not reflect the fact, that test groups at the different test sites are sometimes composed of test takers in different vocations (for example ArcelorMittal, P.E. College and West Coast College, cf. Figure 1) and in some other cases only reflect test takers of only one vocation tested, for example Umfolozi-Richtek: Electricians only or BMW: all mechatronics except one electrician). The latter two examples also count for the two extremes shown in Figure 8 according to the mean scores reached and as it will be shown in Part III, electricians were reaching weakest results, while mechatronics performed much better on average. In so far the results represented in the percentile bands are based on and have to be linked to another essential test result that cannot be derived from the information seen in the percentile bands. In other words, performance by test site and as well the degree of heterogeneity of test groups is not only a test site specific problem as it relates to the strong differences in the performance of test takers in the different vocations.

Figure 9 summarises the 2014 test results by test site providing information on the COMET competence levels reached at the different venues. At only seven out of the participating learning venues, test takers achieved the highest competence level. The highest shares of learners at this competence level were reached by test takers at Eastcape Midlands College[21] (33.3%), and BMW SA (25.0%). Except of these three learning venues, all other test sites had a very high proportion of test takers at risk level (nominal competence). Among those test sites with the highest shares of risk

[20] Due to some problems regarding test validity (see section 2, part 2.5), Northlink College (Bellville) is not listed in this overview

[21] One has to consider that EastCape Midlands College participated with a very small number of learners as opposed to other test sites. So this figure of very good performing students at EastCape Midlands which is based on a total of 3 learners reaching holistic shaping competence stands next to a results of 7 learners at BMW and 24 learners at Northlink College (Belville) reaching the same result.

learners were Umfolozi-Richtek and Northlink-College (Belhar) (with a share of 100% each) followed by EEC-KWA Thema (90%) and EEC-Daveyton (87%).

Two colleges, namely West Coast College and P.E. College and those learning venues related to apprenticeships offered by companies got better results in this regard (a percentage of risk learners of between 55.6 and 65.8%), which is however still much too high to be considered as a "good" result.

The same type of analysis has been made in 2015, with only motor mechanics (and related professions, like diesel mechanics or NCV automotive) participating at the test. Figure 10 representing the percentile bands according to test sites shows less diversity than the corresponding analysis in 2014. Mean values reached were ranking from 24.2 to 41.9 but the variety in the performances of learners at the different test sites is still present, for example the mean value reached at Barloworld Academy is about the same as compared to the highest results obtained at Northlink College. Test site specific results according to the different levels of competence reached in 2015 are represented in Figure 11, which shows that the biggest share of learners reaching Holistic Shaping Competence were located at Barloworld Academy followed by Sandown Motors and The Automobile Association of South Africa. Among the weaker test sites according to this analysis were Elangeni College, Erkurhuleni West College, the College of Cape Town and Northlink College.

The performance of test sites with a view to the proportion of risk learners and the on hand and best learners reaching holistic shaping competence on the other is as well documented in Figure 12 and 13 for the test conducted in 2014. The share of risk learners was extremely high in 2014 ranking form 26% at ArcelorMittal to 88% at Umfolozi-Richtek. At only 7 out of 13 test sites who participated at this test learners were able to reach the high level of holistic shaping competence and their proportion with regard to the total number of test participants at the respective test venues was always low.

However, it has to be highlighted that such results have a lot to do with the vocations tested, in other words with the composition of test cohorts at the different test sites: On average, weakest results were achieved by electricians. More encouraging were the results in the tests in the domain of welding and mechatronics (2014) and in motor mechanics (2015). Figure 15 shows, that approximately 2/3 of learners in the electrical profession were below functional competence whereas this was only the case for 1/3 of motor mechanics. Therefore, and in a next step, the test results will be analysed according to test sites and the different vocation tested (Part II).

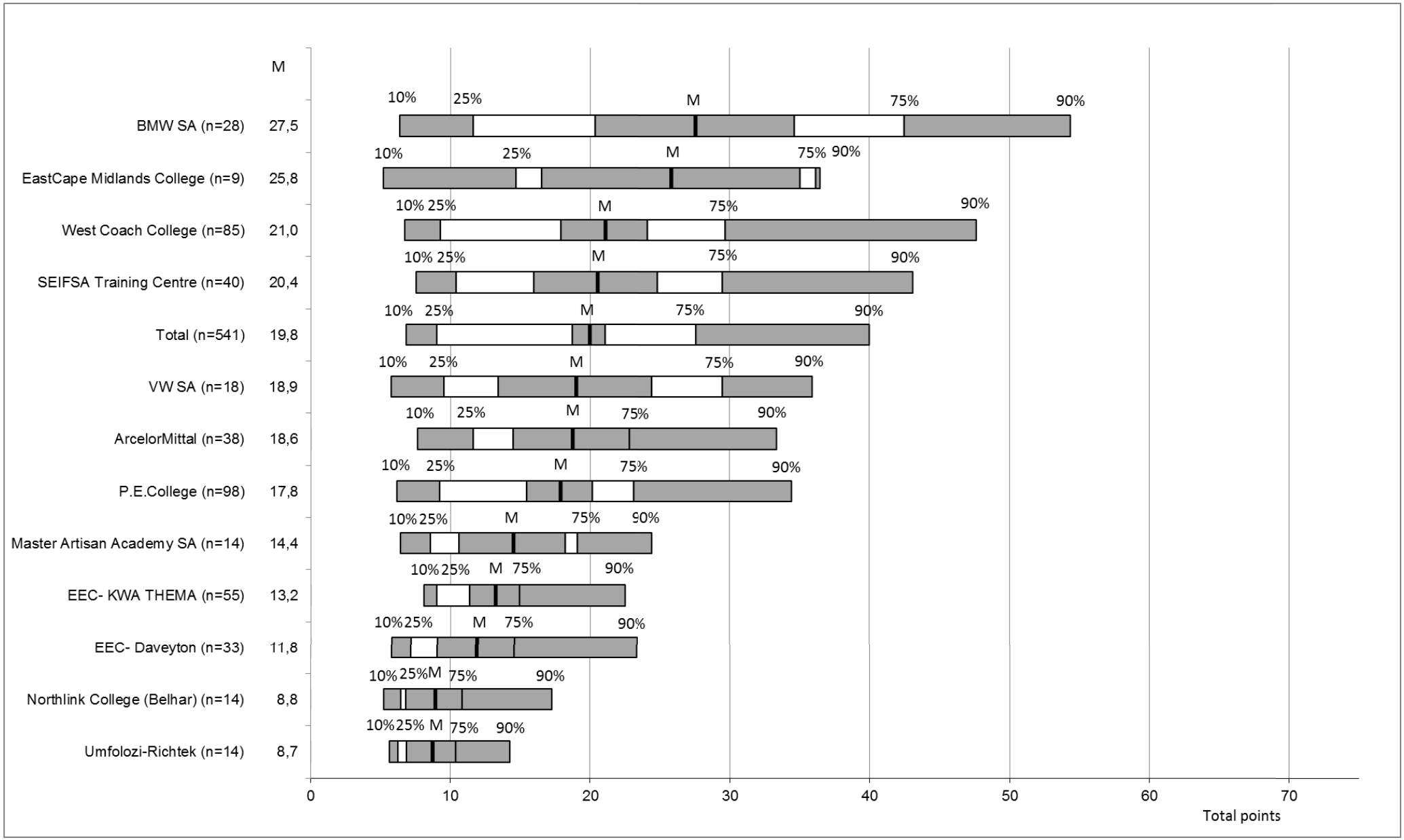


Figure 8: Percentiles of test results according to test sites. COMET Test 2014 South Africa.

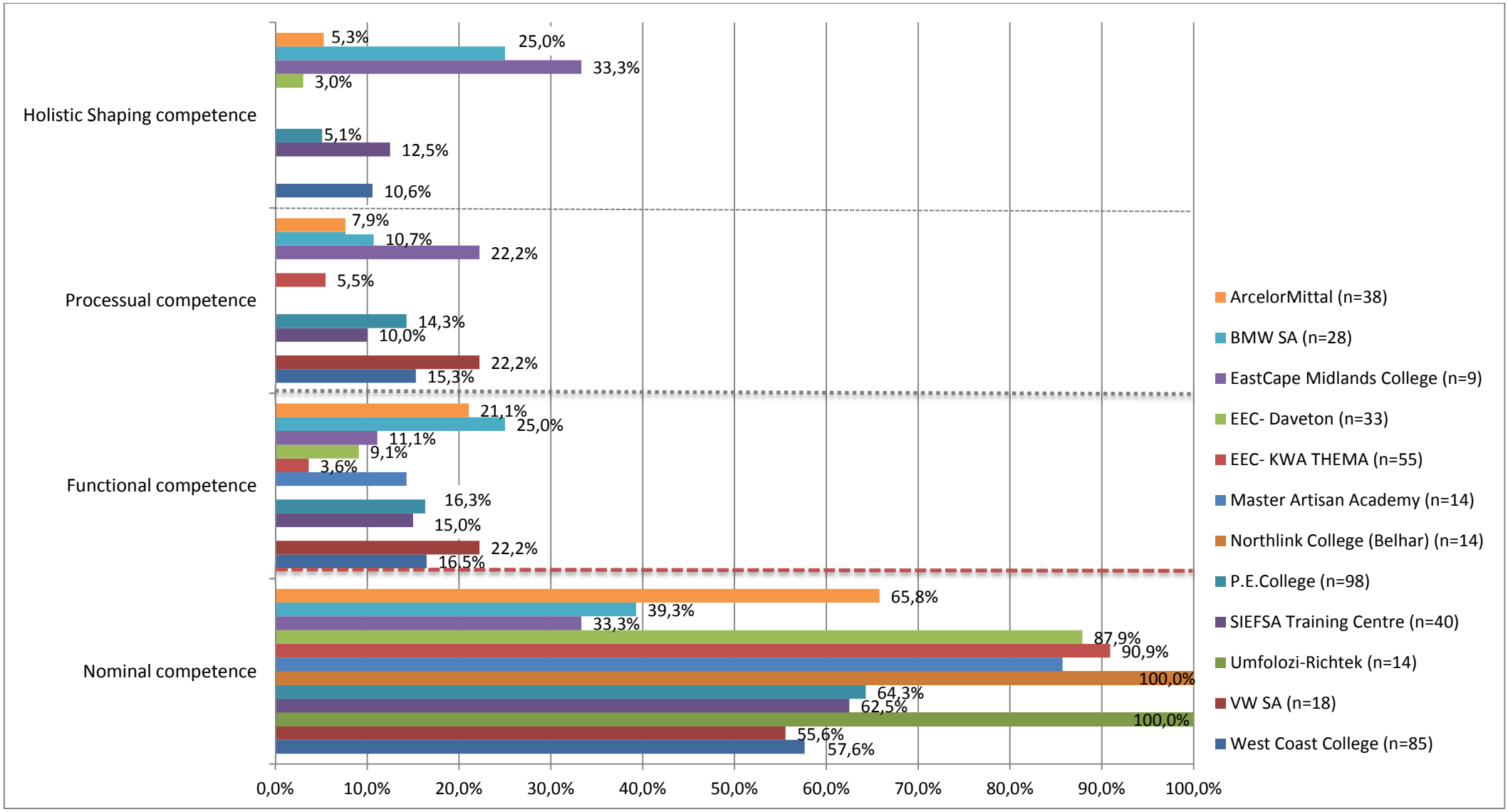


Figure 9: Competence levels reached according to test sites (test takers with a total average score of ≥ 5). COMET Test 2014 South Africa.

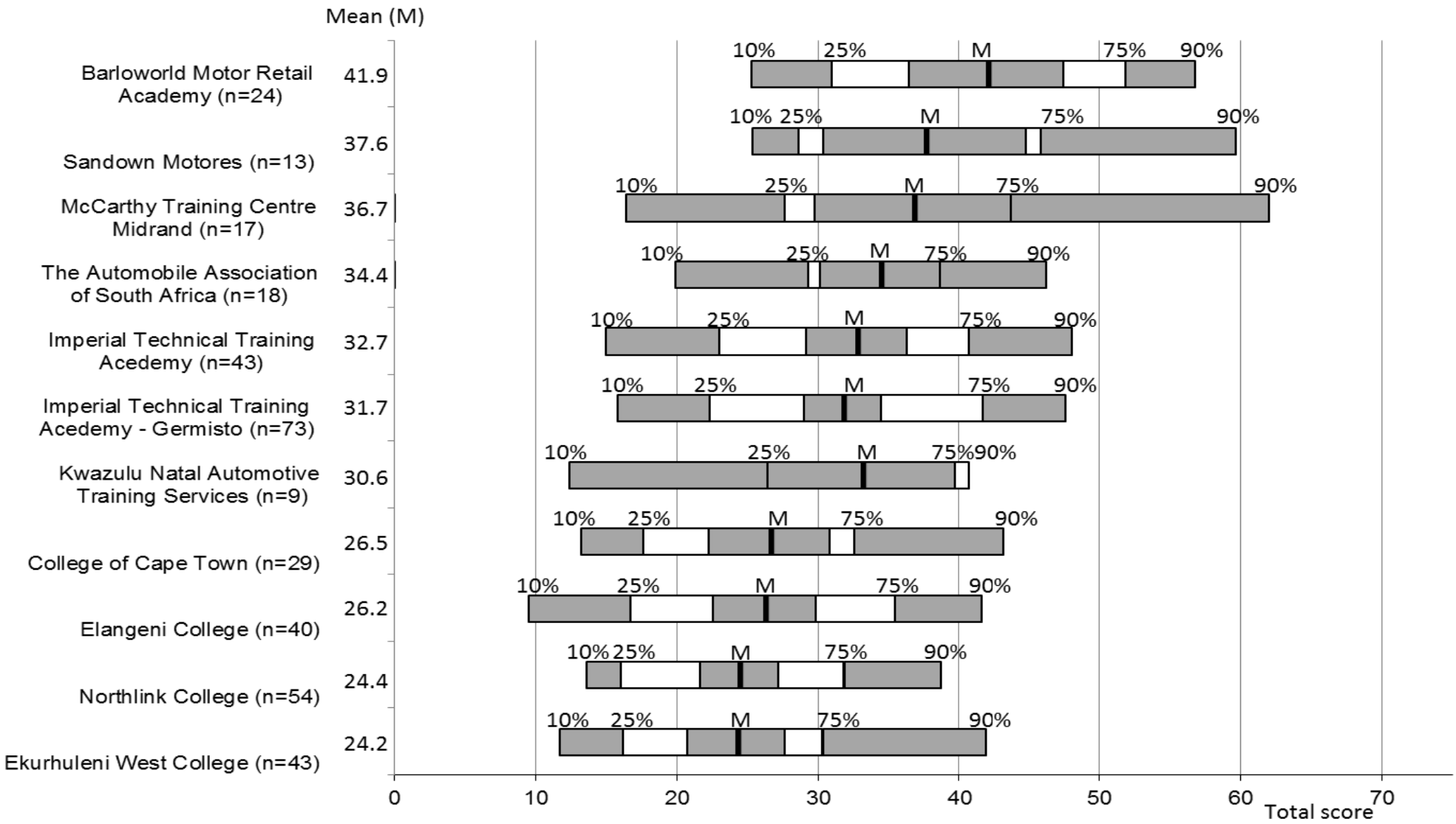


Figure 10: Percentiles of test results according to test sites. COMET Test 2015 South Africa.

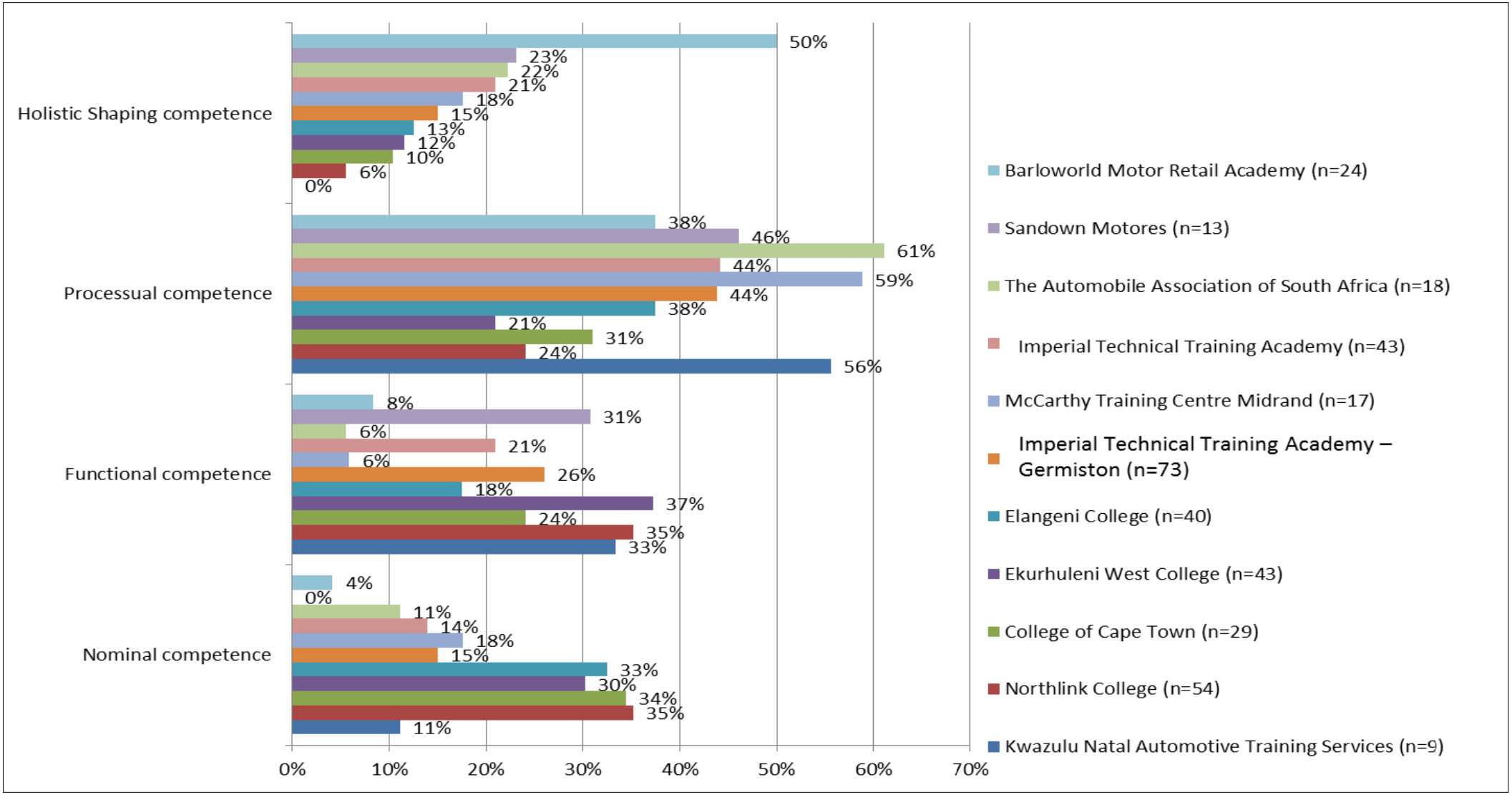


Figure 11: Competence levels reached according to test sites (test takers with a total average score of ≥ 5). COMET Test 2015 South Africa..

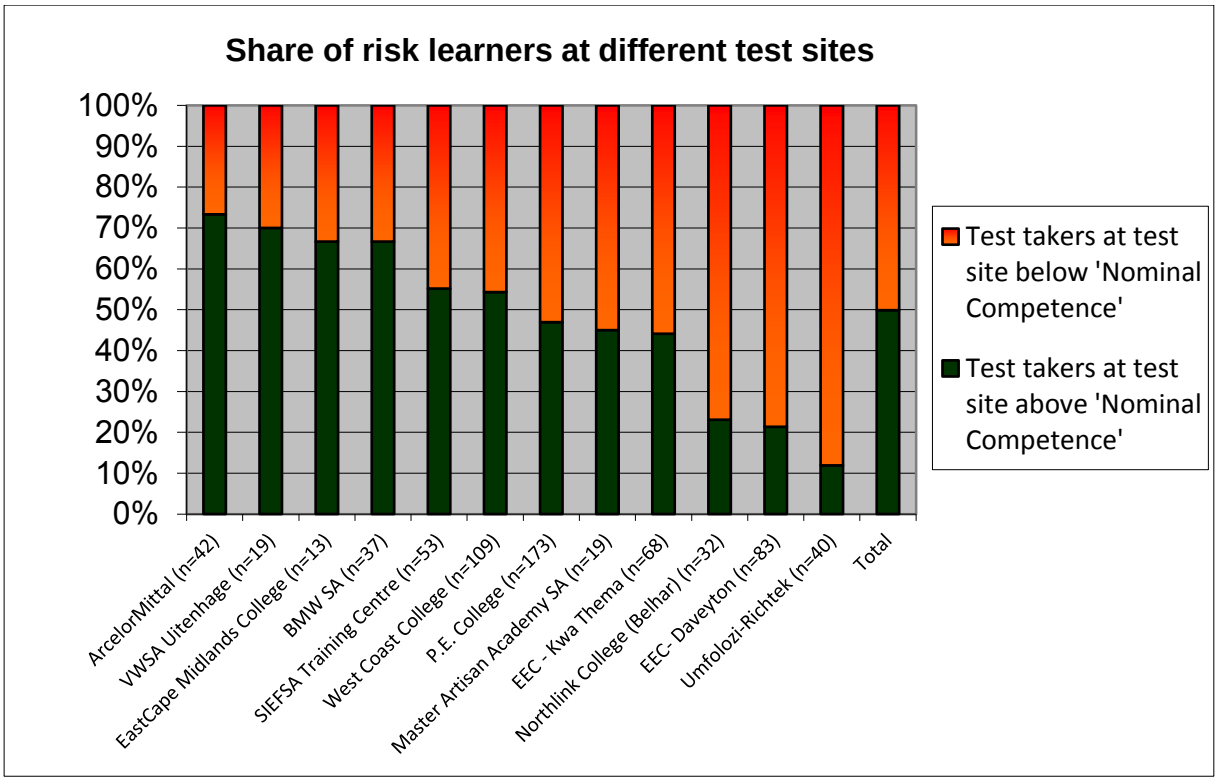


Figure 12: Test results according to test sites. Differentiation between test takers reaching competence levels (above 'Nominal Competence') and risk group learners (test takers below 'Nominal Competence'). COMET Test 2014 South Africa.

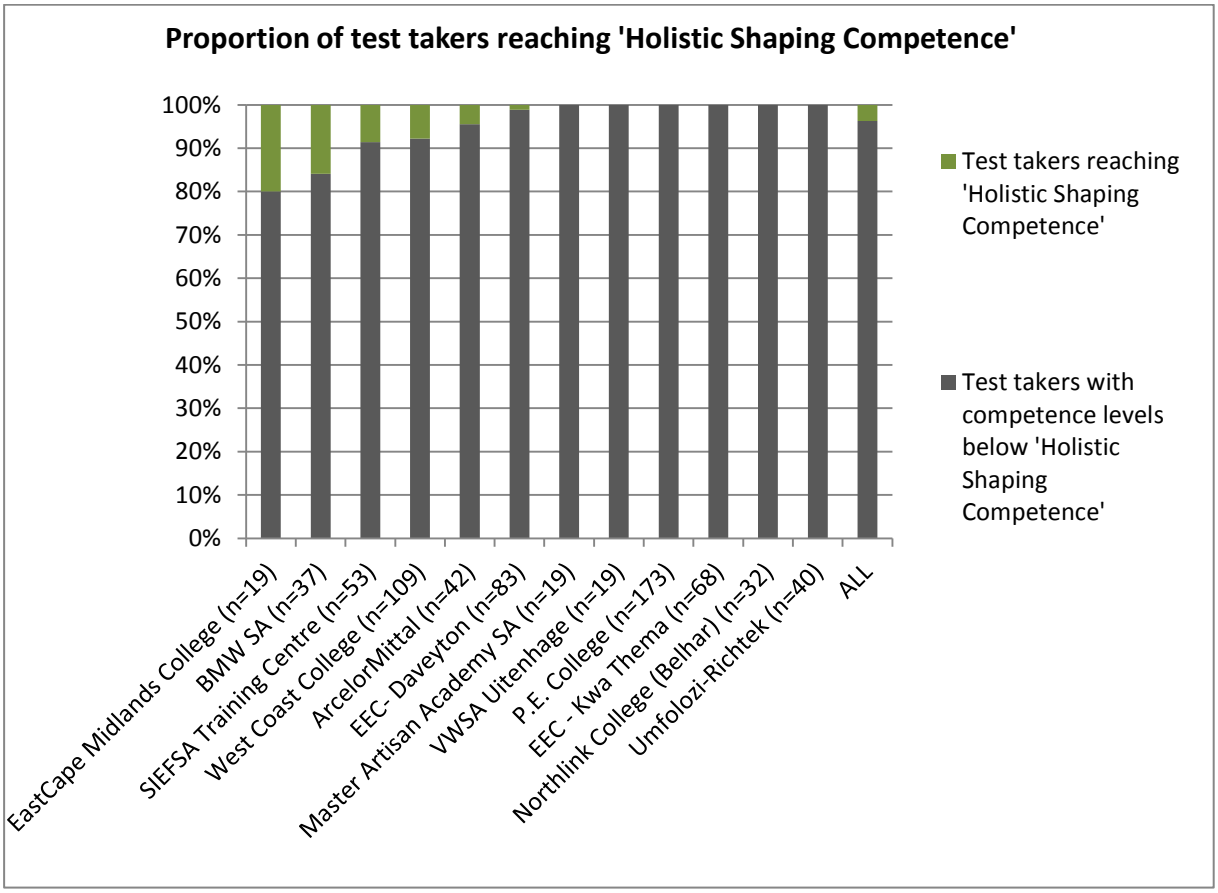


Figure 13: Test results according to test sites. Differentiation between test takers reaching the highest competence levels ('Holistic Shaping Competence') and all other learners (test takers below this level). COMET Test 2014 South Africa

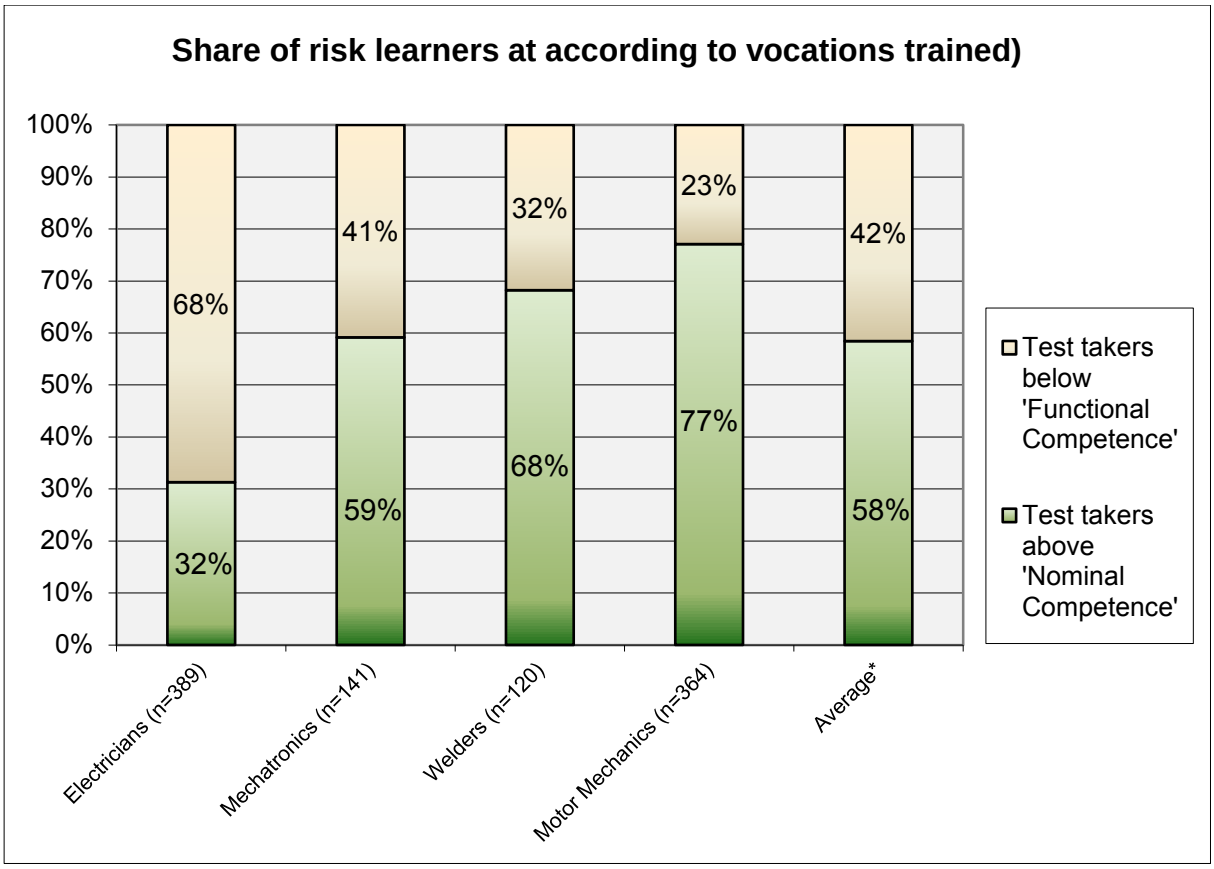


Figure 14: Test results according to vocations trained. Differentiation between test takers reaching competence levels (above Nominal Competence') and risk group learners (below 'Nominal Competence'). COMET main tests 2014 and 2015 South Africa.
*) The average value includes other test takers, i.e. fabricators (n=77), millwrights (n=21)

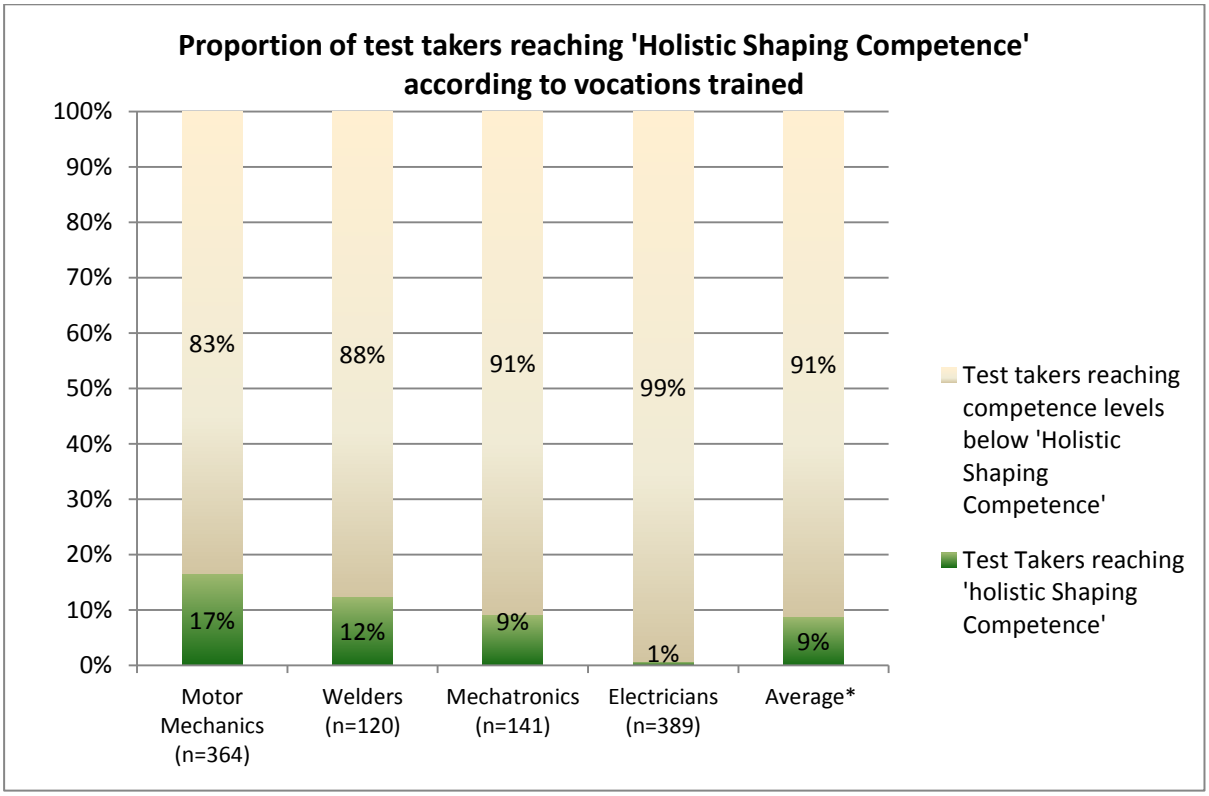


Figure 15: Test results according to vocations trained. Differentiation between test takers reaching the highest competence levels ('Holistic Shaping Competence') and all other learners (test takers below this level). COMET Test South Africa 2014 and 2015
*) The average value includes other test takers, i.e. fabricators (n=77), millwrights (n=21)

1.3 Learners' perspectives[22]

Despite the fact, that test results have been weak for the big majority, it can be counted as one of the essential test results that the learners themselves were highly motivated and appreciated the tasks they were working on. As it will be further demonstrated in Part VII, there is no indication that learners did not reach better results because they were not dedicating enough time or effort to elaborate a solution. Quite on the contrary, the time allocated for finding a solution was adequate and only a few learners gave up at early stage because they found unable to solve the problem. Moreover, a very high proportion of learners in all vocations tested in the COMET tests 2014 and 2015 found that the tasks were very relevant, interesting or useful for the vocation learnt. Among the most relevant results of the motivational questionnaire handed out to the participants after completion of the test is the fact that more than 90 % of all test takers wanted to continue working with COMET tasks, although there were some differences according to the vocational groups (Figure 16). From the estimations of the learners, it can be derived that also in cases, where the challenge of a COMET tasks might have been too high, learners were not discouraged but very eager to learn more.

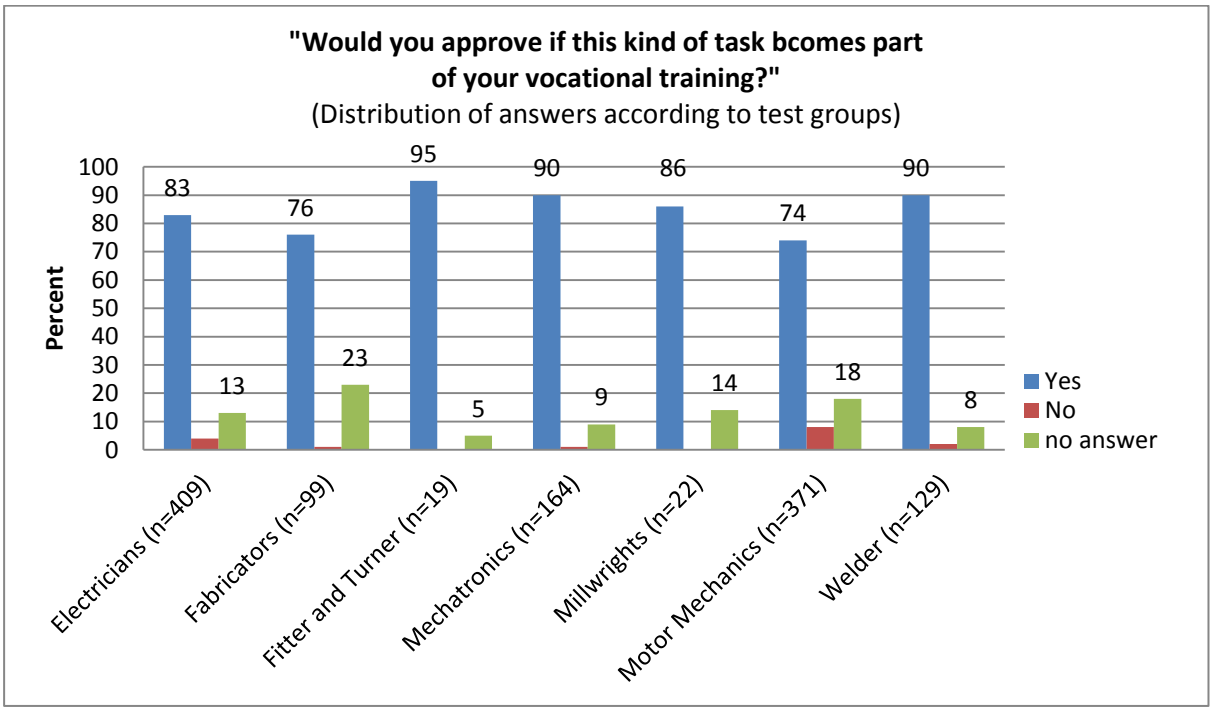


Figure 16: Analysis of test motivation: The learner's interest in continuing working on tasks designed like their COMET test task. Information according to occupations and incl. percent values. COMET South Africa 2014.

The analysis of learners' answers on why they would appreciate COMET tasks as a part of their regular training program in future are summarised in Figure 17. These results are based on a clustered interpretation of 1094 individual comments (the questionnaire allowed to provide one or more reasons and the possibility to write down comments in their own words). Reason number one is "a desire to learn more", followed by comments on the "relevance of the tasks for the future career and real work life". The idea that a task combines "practical and theoretical knowledge" or

[22] This section also includes estimations of all test takers (pre-test and main test) and also refers to learners whose competence data was not subject to the general analysis (i.e. fitters and turners) or where competence data was not available.

that it "suites very much to the profession trained" has as well been a motivation for learners in this context. COMET tasks were found "challenging" and many test takers also said that this was "what they love". Very interesting is as well the fact that many students or apprentices found that such tasks required "holistic thinking" and that working with such tasks more regularly might lead to a higher competence and commitment – without knowing that this was one of the central ideas of the project.

The learners' perspective: Should COMET tasks become a regular part of training?
… if the answer was yes: Reasons for the learner's interest

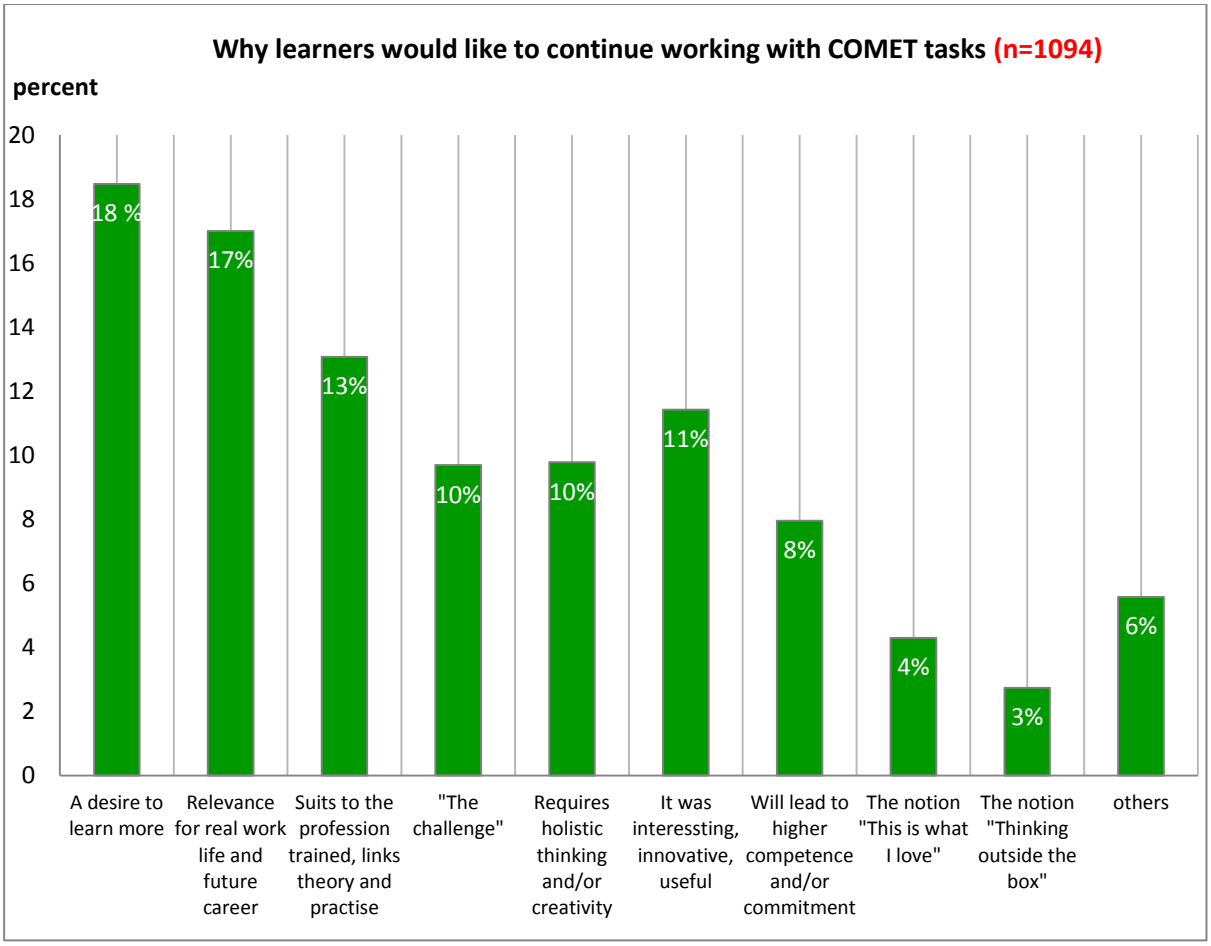


Figure 17: Analysis of test motivation: Why learners wish to continue learning according to COMET. Results are an interpretation of data provided in form of 1094 individual learners'comments. Information given in percent values. COMET South Africa 2014 and 2015
*) other resasons were mainly making parents/family happy, serving South Africa, and "change the world" or "doing anything in order to get a job"

Only a total of 66 test takers were providing negative answers when it came to the question of further use of COMET tasks as a regular training part. In this case the reasons were mostly linked to the degree of difficulty (too high) or to a general lack of interest in the task they were working on, (sometimes because it did not relate to what was trained in the previous lessons, sometimes as well because – by mistake – a learner had not received a task designed for the profession trained). Even though these cases are only representing a very small minority, the team needs to take these comments as serious as the more optimistic ones. A consequence might be to reduce the degree of difficulty in COMET learning tasks, notably in the electrical field.

Part II Differentiated analysis: Competence Profiles of Learners by Occupation and Test Sites

2.1 Electricians

2.1.1 Average competence profiles of apprentices trained as electricians

Competence profiles of Electricians (result of all electricians including „dropouts“)	**Competence profiles of Electricians** (result of electricians with a total score ≥ 5)	**Pre-test result 2014 Electricians** (result of all electricians including „dropouts“)
 Average total score = 8.24 n = 389, V = 0.29	 *Average total score* = 12.90 *n* = 224, *V* = 0.25	 Average total score = 14.04 n = 21

Figure 18: Average competence profiles of apprentices trained as electricians. COMET Test 2014 South Africa.

The overall result of electricians participating at the COMET main test 2014 is very weak. With a total score of 8.24 on average this result is even more critical that the one reached within the pre-test 2014 which was a total average score of 14.04 (n=21). The number of candidates that did not even reach 5 points was 165, which represents 42% of all test takers in the electrical vocation.

All in all and despite the fact, that the competence profiles of apprentices in the electrical vocation are very weak, it has to be stressed that the average profile is as well pretty much single sided towards functionality (K1/K2). This average result however will not be confirmed when analysing the learner's performance according to test sites (cf. 2.1.1)

Possible explanations for the overall weakness of the results of electricians:

1) The level of difficulty in the electrical test is very high (i.e. higher in comparison to the tasks in other occupations tested).
   This assumption is supported by the fact, that the performance of electricians, who were exposed to test tasks in the mechatronic domain, was better on average. For example, out of all electricians reaching holistic shaping competence or processual competence (this refers to a total of 13 cases) 5 learners were working on task originally elaborated for another profession (mechatronics task: 4 cases, welding task: 1 case) and reached higher levels of competence in a vocational field that was not their own. [23]

[23] Moreover, in COMET pre-test 2014, a smaller group of learners in the electrical profession who had also been tested on a mechatronic task had received better average results (this result referred to 6 learners out of 27 test persons in the electrical pre-test.) But as the test group of electricians participating in the pre-test was far too small to derive general results in this regard, this indication only becomes more relevant in the light of the main test results.

2) Only a limited number of test persons were able to practise according to the COMET methodology. No practise was possible for learners at the test sites that did not participate in the pre-test 2014 or the first COMET test in South Africa 2011 because the teachers and trainers of these test sites had not been involved in rater trainings or COMET seminars at all. This refers to a number of 197 learners which is an equivalent of 50.6 %.

   Even the remaining share of learners with a possible exposure to a COMET learning task (which was the case for test takers at ArcelorMittal, P.E. College and West Coast College), the time for exercises was limited, since the time span between pre-test and main test was less than 6 months.

3) Tasks for electricians have been developed for learners at an advanced level. Even though the tasks might be difficult (or more difficult in comparison with tasks in other occupations tested), one has to stress that a considerable share of learners working on these tasks were participating in short term programs (upfront institutional training, for example at SEIFSA).

   According to the COMET philosophy it is impossible to fully learn an occupation in a period of less than 3 years. For learners in short-term programs, the COMET test tasks were too challenging from this perspective.

Possible measures:

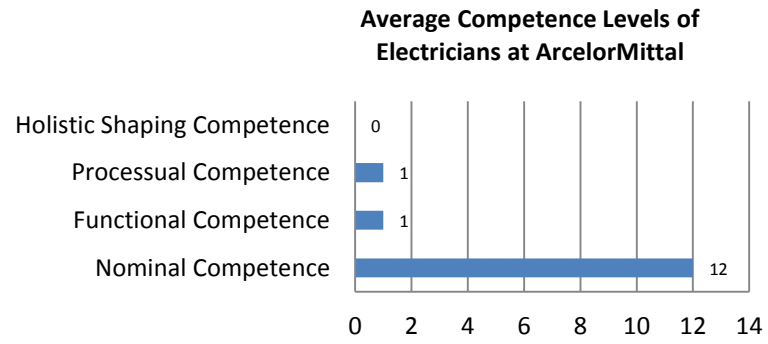
A Elaboration of COMET test and learning tasks on beginner's level in working groups incl. subject matter experts and TVET facilitators.
B Training the trainers
C Introduction of/further training with COMET learning tasks in teaching and training

2.1.2 Competence of electricians according to test sites

The following section starts with those test sites that have been involved in COMET tests before and follows an alphabetical order. Afterwards, the newly involved test sites are analysed, also in an alphabetical order.

2.1.2.1 Average (and best) competence profiles of electricians trained at ArcelorMittal

n=14
Average total score = 12.75



n=3
Average total score 19.83

Best 3 electrician trained at ArcelorMittal
Competence level: Functional (1) or Nominal Competence (2)

Reference ID: RSA_EL_2014_1248, 1247,1249
Year of training: 2 (1) and unknown (2),
Time spent on task: 1.5-2 h (2) and less than 1 hour (1)
Age: 38, 30 and 26 Gender: M (all) Test motivation: very high

Tasks:
12_EL_Drying Space (1)
5_EL_Traffic light system (1)
10_EL_Rock crusher (1)

Comments: "Task was rather easy" (1) or rather difficult (2),
"good experience for training", "enables to work on problems" I had to put my whole concentration and experience on it", "It's an eye opening phenomena"

Figure 19: Competence levels and profiles of electricians trained at ArcelorMittal. COMET Test 2014 South Africa.

Comment: Despite the fact that the overall result of the test of electricians was weak, the results from participants at ArcelorMittal are much better than average results. Moreover and even though the level of competence is still not very high, one can see, that electricians at ArcelorMittal have a relatively balanced competence profile on average, which means that all competence criteria are addressed in an almost equal manner. It is interesting to note, that the best test taker at ArcelorMittal has reached relatively high scores in those domains (K6, K7) that are usually not well elaborated by learners participating in the electrical test and that these criteria have been worked out even better that issues related to K1 or K2.

Possible Explanation: Electricians at ArcelorMittal had teachers and trainers who were more familiar with the COMET methodology and were able to change their teaching and training towards a more COMET oriented style. This hypothesis is strengthened by the fact that in a very first test in 2011, electricians who were tested at ArcelorMittal had a much more unbalanced competence profile on average:

COMET Test South Africa 2011 Overall result ArcelorMittal (electricians)	**COMET Test South Africa 2014** Overall result ArcelorMittal (electricians)
 Average total score = 9 n= 124	 Average total score = 12.75 n=14

Figure 20: Comparison of results: Electricians at ArcelorMittal. COMET South Africa 2011 and 2014

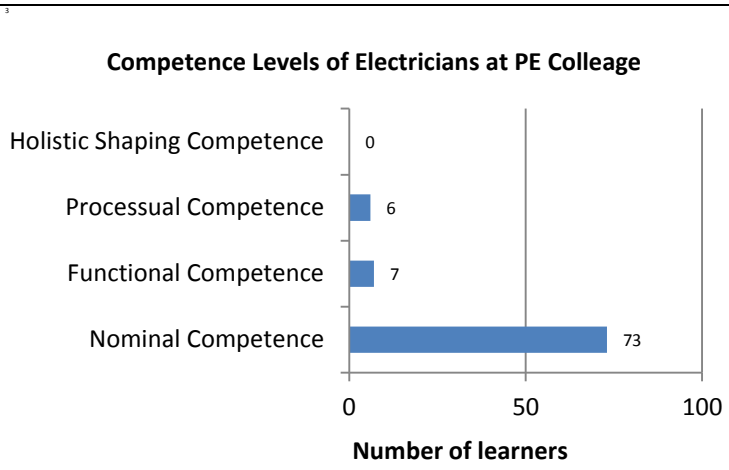
Additional remarks:

- All electricians trained at Arcelor were in their first or 2nd year of training, none in the 3rd or 4th year of training, this means, that a high proportion of test persons was still at a stage of a beginner of advanced beginner and in this light the result is relatively good. Moreover and thanks to a good test management at the test site
- all test takers at ArcelorMittal in the electrical profession have been working on tasks designed for electricians. (No tasks for mechatronics or welders were used for electricians – which – in other test sites might have led to an unrealistic reflection of the situation. Cf. section 2.1.1.2)
- Out of all learners at ArcelorMittal (n=12) who only reached “nominal competence”, there were 9 learners who were very close to functional competence but could not compensate the missing scores for the first competence level with adequate scores allocated in the areas of the subsequent competence levels. This becomes quite visible if one differentiates the levels of competence into high, medium and low (cf. Appendix I, I-2.1).

2.1.2.2 Average competence profiles of electricians trained at PE College

At P.E. College 86 electricians participated at the COMET main test. 73 learners did not reach any competence level higher than nominal competence. That means an equivalent of about 85% was at risk level. This is a situation which still reflects the result of the pre-test, where a similar share of test takers only had nominal competence but in the pre-test the number of test takers was too low to derive general conclusions. The following figures show average profiles and focus on those results provided by the best test takers at the test site and according to the two competence levels reached.

<table>
<tr>
<td> 

n=86
Average total score = 8.2</td>
<td> 
</td>
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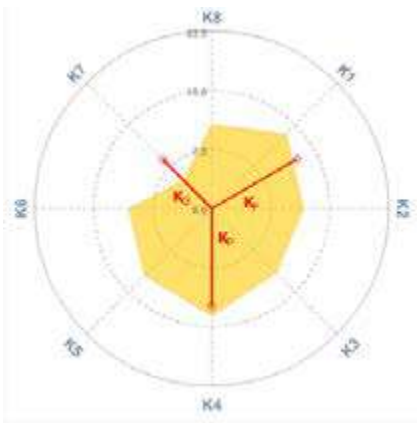
<td> 

n=7
Average total score = 21.3</td>
<td>Average competence profile of test takers at PE College reaching Functional Competence (Competence Level 1)

<u>Average time spent on tasks</u>: 1-1.5 hours (3) 1.5-2 hours (4)
<u>Average age:</u> 23.5 <u>Gender</u>: M (5), F (1) n.a. (1)
<u>Test motivation</u>: high - very high

<u>Tasks:</u>
10_EL_Rock crusher
12_EL_Drying Space
5_EL_Traffic light system
3_MT_Automating drill press (mechatronic !)
8_MT_Robot cell safety (mechatronic !)
3_MT_Automating drill press (mechatronic !)
4_MT_Beverage can packing (mechatronic !)</td>
</tr>
<tr>
<td> 

n=6
Average total score = 33.6</td>
<td>Average competence profile of test takers at PE College reaching Processual Competence (Competence Level 2)

<u>Average time spent on tasks:</u> 1-1.5 hours (3) 1.5-2 hours (3)
<u>Average age:</u> 25.6 <u>Gender</u> M (4), F (1) n.a. (1)
<u>Test motivation</u>: high - very high

<u>Tasks:</u>
12_EL_Drying Space
5_EL_Traffic light system
4_MT_Beverage can packing (mechatronic !)
8_MT_Robot cell safety (mechatronic !)
3_MT_Automating drill press (mechatronic !)
8_MT_Robot cell safety (mechatronic !)</td>
</tr>
</table>

Total score = 44.44

"Best" electrician trained at P.E. Colleage
Competence Level reached: Processual Competence

Reference ID:	RSA_MT_2014_2140
Task:	4_MT_Beverage can packing
Year of training: 1	Time spent on task: 1.5-2 hours
Age: 23	Gender: M, Language: IsiXhosa
Entry qualification:	NTC 3 + 4,
Training in	Favorited profession
Practical training:	At college
Test motivation:	high - very high
	(Task did not relate to profession)

Learners estimation on task:
Rather difficult but appreciated for further training.
Personnel comment: "I would like to learn more and improve my skills and knowledge I got from school. My knowledge gained from the Electrician engineering course was also advanced"

Comments of other test takers reaching Processual Competence:
- Tasks was challenging, it took some time to understand it
- It can open doors for me and I will be aware of what goes on in the workplace
- It gives me a clear understanding of what I can expect in the electrical field
- Very difficult and did not relate to what was trained (This comment was given by the only learner reaching Processual Competence who did NOT want to be trained on simelar tasks. All others indicated that they wanted to continue working on COMET tasks)
- I am interessted to work with machines and would like to learn more about machines and motors
- In the field, you may get problems that you are not clear with. Then you must investigate what needs to be done

Figure 21: Competence levels and profiles of electricians trained at P.E. College. COMET Test 2014 South Africa.

While the average profile reflecting the total number of test takers shows a rather single sided competence profile towards K1 at low levels, the analysis of test takers reaching functional (n=7) or processual competence (n=6) shows – to some extent - a different picture. Especially those learners who reached processual competence were able to address all competence criteria (except K7) in a more balanced way. While in previous tests the age of test persons or their year of training did not necessarily play a role for competence development (cf. COMET Test 2011), at P.E. College, the average age of those electricians reaching functional or processual competence was a higher than the average. Electrical learners at P.E. College were 23 while the ones reaching processual competence were between 25 and 26 years old. Nine learners were in the 2nd or 3rd year of training.

Meanwhile it is interesting to note, that a significant number of test takers reaching higher competence levels was working on tasks originally not designed form them. This refers as well to the best performing electrician[24] trained at P.E. College who received the highest total score. Therefore, the analysis of competence levels at P.E. College needs to include a differentiated look at the performance of best test takers according to test tasks, which is shown in Figure 22.

[24] The term „best" only refers to the total score reached and not to the shape of the competence profile that shows a deficit in K7 (environmental compatibility).

Profile of best Electricians at P.E. College working on tasks designed for Electricians	Profile of best Electricians at P.E. College working on tasks designed for Mechatronics
	
Total average score = 22.6 N = 5	Total average score = 29.79 N = 8

Figure 22: Comparison of results: Electricians working on tasks for electricians and on tasks designed for mechatronics. COMET Test 2014 South Africa.

These results demonstrate that on average, electricians were having more difficulties with their own test tasks. The higher results were reached with mechatronic tasks: With an average total score of 29 on a mechatronic task, the best learners in the electrical domain at P.E. College reached higher results than their colleagues working on electrical tasks (average total score of best test takers: 22.6).

Even though it was not intended to expose learners to the "wrong" tasks, this result is an important one for the future work on test and learning task development.

Further steps:

- See general recommendations regarding learning task development and their introduction into electrical classes in section 2.1

2.1.2.3 Average competence profiles of electrician trained at Umfolozi-Richtek College

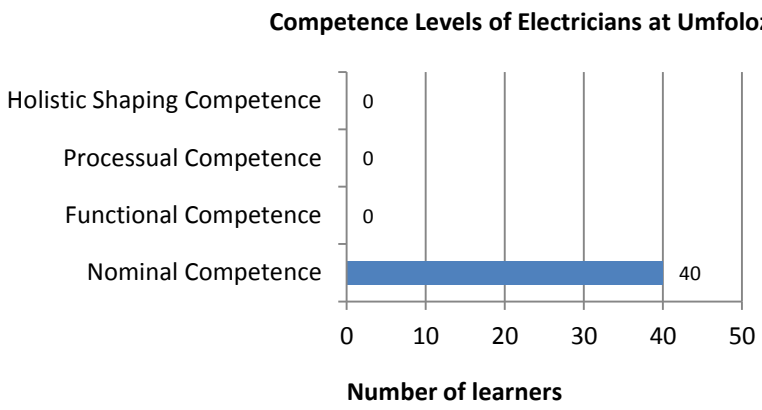
At Umfolozi College none of the learners was able to reach a competence level higher than nominal competence. Even though many learners finished their tasks relatively early (i.e. handed in their papers after less than one hour or after one hour (50% of the learners) which may be due to some degree of frustration, the test motivation of learners at this test site was high or very high. Many learners found that the tasks were difficult (also among the comments of best test takers at Umfolozi) but expressed as well their wish to continue working on such tasks. The fact that among the best test takers were equal shares of female and male test participants does not represent the average proportion of gender at Umfolozi, where two thirds of all test persons were female and one third male. In comparison with other test sites the percentage of females was much higher at Umfolozi.

The average age of learners tested was a bit over 24 years, which means, that those ones performing a bit better than the rest were a little younger. On the other hand, almost all of these students were learners in the 3rd year of training. Practically all 1st and 2nd year learners did not receive any scores higher than 5.

It has to be pointed out, that all learners were working on tasks designed for electricians. So, no effect like the one observed at P.E. College – where electricians were better performing on tasks for

mechatronics – could be found out.

n=40
Average total score = 5.8



n=8
Average total score = 10.5

Best electricians trained at Umfolozi
Competence Level reached: Nominal Competence

Year of training: 3 (7 learners) or 1 (1 learner),
Average time spent on task: 1.5 hours
Average age: 22 Gender: M (4 learners), F (4 Learners)
Test motivation: high

Tasks
10_EL_Rock crusher (1)
11_EL_Skylight control (2)
12_EL_Drying Space (3)
5_EL_Traffic light system (2)

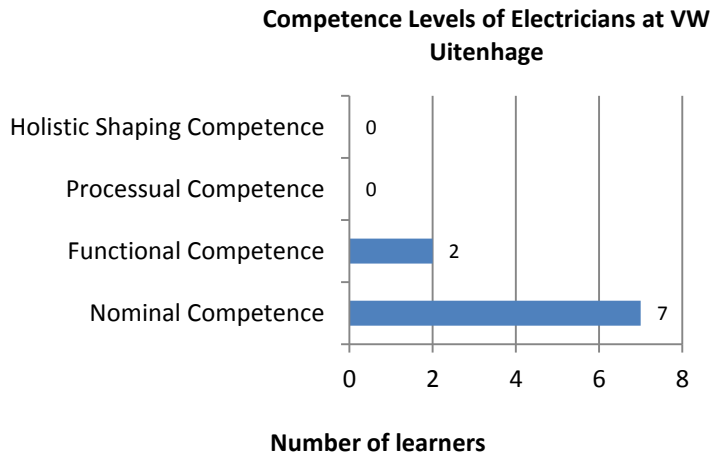
Learners estimation on task, were availabe:
Very or rather difficult but appreciated for further training.

Personnal comments of best test takers, were available:
"I found it very difficult"
"It opens your thinking to consider all aspects of our programme in one tasks"
"It is challenging and wants you to think outside the box"
"(I want to learn more) because it is electrician work and we have to know it"
"This task (rock crusher) really opens my mind. I like it"

Figure 23: Competence levels and profiles of electricians trained at Umfolozi. COMET Test 2014 South Africa.

2.1.2.4 Average (and best) competence profiles of electricians trained at VW

n=9
Average total score = 12.3



Total score = 25.5

Best electrician trained at VW Uitenhage according to total score
Competence Level reached: Functional Competence

Reference ID: RSA_EL_2014_1004 Task: 12_Drying Space (DE)

Year of training: 2, Time spent on task: 1.5-2 hours
Age: 20, Gender: M
Test motivation: very high

Learners estimation on task: Rather difficult but appreciated for further training. "It gives one insight into planning major projects"

Personnal comments of other takers, were available:
"IT GIVES ONE INSIGHT INTO PLANNING MAJOR PROJECTS"
"IT IS MORE FOCUSSED ON REALITY"
"GIVES YOU A REAL LIFE SCENARIO SO THAT WHEN YOU GET EMPLOYED YOU WILL KNOW THE SVCOPE OF THE WORK YOU WILL FACE"

Figure 24: Competence levels and profiles of electricians trained at VW Uitenhage. COMET Test 2014 South Africa.

Comment: Also at VW, test takers in the electrical profession only reached low scores, only two out of nine persons reaching functional competence. The best test taker (according to the total score reached) performed well in only 4-5 out of 8 competence criteria, so his profile was very unbalanced.

Possible explanation: Even though a total number of nine test takers cannot be considered as representative there is some indication towards the argument that electricians at VW at might not have had enough time to get familiar with the COMET methodology and were not trained to solve problems like the ones represented by the tasks.

If one considers the results of the previous main test in 2011 with a total of 51 learners from VW participating, the picture of the actual average competence profiles and also the total average score almost resembles to almost 100%. This means, that there was probably not introduction of learning opportunities according to the COMET methodology in the time between the two main tests, which might explain this problem of stagnation.

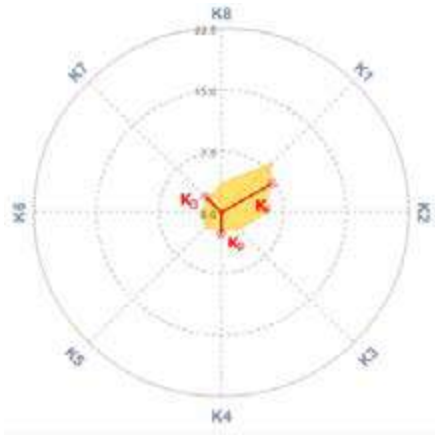
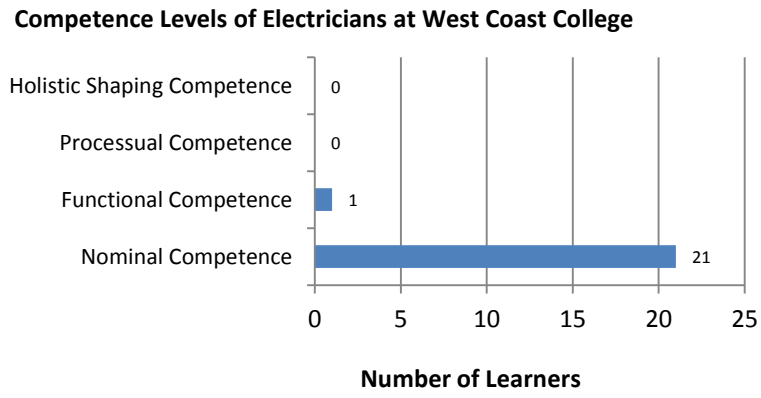
COMET Test South Africa 2011 Overall result VW (electricians)	COMET Test South Africa 2014 Overall result VW (electricians)
 n = 51 Average total score = 11.6	 n=9 Average total score = 12.3

Figure25: Comparison of results: Electricians at VW Uitenhage. COMET South Africa 2011 and 2014.

It has to be added, that test motivation of apprentices at VW was as well very high. Learners liked to be confronted with real life problems, only two of them said, that the tasks did not relate to what is trained or that questions were difficult to understand.

2.1.2.5 Average competence profiles of electricians trained at West Coast College

n=22
Average total score = 7.6



n=6
Average total score = 13.5

Best electricians trained at West Coast College
Competence Level reached: Nominal Competence (5)
or Functional Competence (1)

Year of training: 2 (all), Average time spent on task: 1.7 hours
Average Age: 26, Gender: M (4 learners), F (2 Learners)
Test motivation: high

Tasks
12_EL_Drying Space (1)
5_EL_Traffic light system (2)
10_EL_Rock crusher (2)
11_EL_Skylight control (1)

Learners estimation on task, were availabe: Rather easy (2) very difficult or difficult (3) but appreciated for further training (4).

Personnal comments of best 6 test takers, were available:
“It makes you think and focus to solve a problem”
“It's my trade and we have to fix matters if there is a fault”
“There wasn't much information that I got so I would like to improve in it”
“We don’t do tasks like this everyday and for me it would mean a lot because I struggled answering some of the questions. I 've never worked on a machine before; I only know it by looking at it”

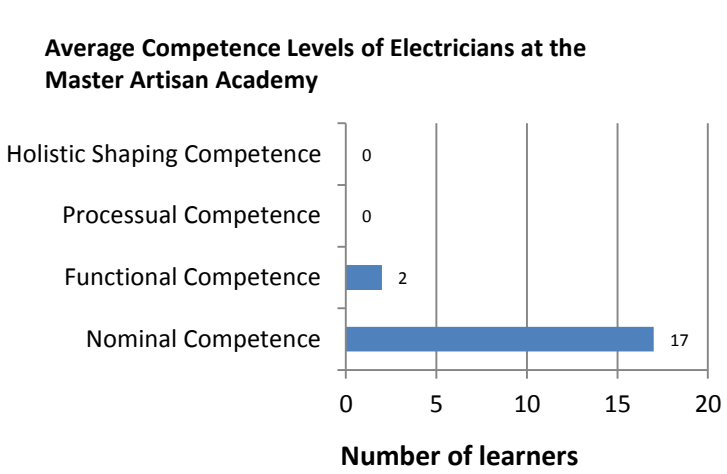
Figure 26: Competence levels and profiles of electricians trained at West Coast College. COMET Test 2014 South Africa.

Average competence profiles reached at West Coast College were quite low in the electrical domain (contrary to the participating welders at the same test site, see section 2.3.1.2). Among the best six test takers, five were still at a level of nominal competence.

Possible explanation: As it might have been the case in other test sites, learners were probably not trained on a basis of COMET learning tasks. Even though test motivation was as well high and learners generally appreciated the test tasks they have been working on, they also pointed, that they were struggling because of a lack of knowledge or information.

2.1.2.6 Average competence profiles of electricians trained at Master Artisan Academy

n=19
Average total score = 11.19



n=3
Average total score = 22.7

Best electricians trained at Master Artisan Academy
Competence Level reached: Nominal Competence (1)
or Functional Competence (2)

Reference IDs: RSA_EL_2014_1009, 1020, 1284
Year of training: 2 (all), Time spent: 1.5-2 hours (2) 0.5-1 hour (1)
Age: 22, 38, 31 Gender: M (all)
Test motivation: high /very high

Tasks
12_EL_Drying Space (2)
11_EL_Skylight control (1)

Learners estimation on task, were availabe: Rather difficult (2) or rather easy (1) and appreciated for further training

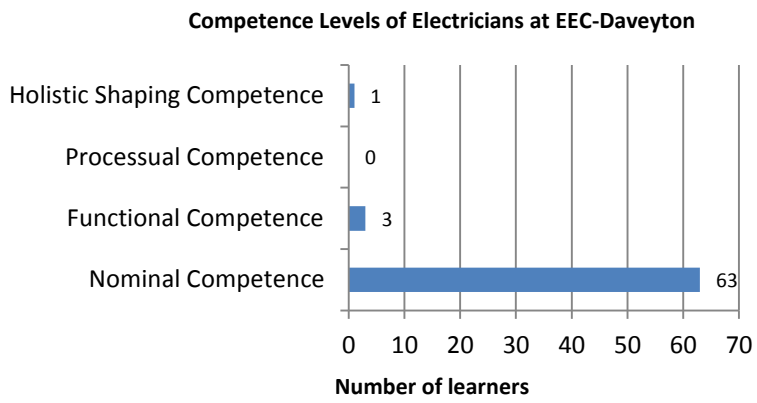
Personnal comments of best 3 test takers:
“Took effort but I definitely approve of it”
“(It) can help me in future to design and create”
“(It was) interesting. Like to solve problems”

Figure 27: Competence levels and profiles of electricians trained at Master Artisan Academy. COMET Test 2014 South Africa.

Average competence profiles at Master Artisan Academy were as well low with an average total score of 11.19 and the majority of test takers not reaching any competence level. Only two out of 19 test takers were at functional competence. Nevertheless it strikes, that those who performed well were as well able to reach quite homogenous profiles, touching also the more challenging competence criteria like K6, 7 and 8. All learners were in the 2nd year of training and test motivation was very high.

2.1.2.7 Average competence profiles of electricians trained at EEC-Daveyton and EEC KWA-Thema

<table>
<tr>
<td> 

n=67
Average total score = 6.4</td>
<td> 
</td>
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n=6
Average total score = 23.5</td>
<td>Best electricians trained at EEC-Daveyton
Competence Level reached: Nominal Competence (2) Functional Competence (3), Holistic Shaping Competence (1)

Year of training: 1 (1 learner), 3 (5 learners)
Average time spent on task: 1.5 hours
Average age: 23.5 Gender: M (1 learners), F (5 learners)
Test motivation: very high

Tasks:
10_EL_Rock crusher (2)
11_EL_Skylight control (3)
12_EL_Drying Space (1)

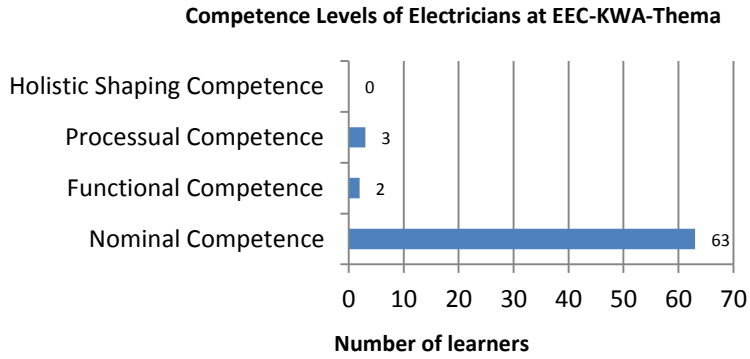
Learners estimation on task, were availabe: Rather easy (5) rather difficult or difficult (1) and appreciated for further training (all).</td>
</tr>
<tr>
<td> 

Total score = 45</td>
<td>Best electrician trained at EEC-Daveyton
Competence Level reached: Holistic Shaping Competence

Reference ID: RSA_EL_2014_1214
Task: 12_EL_Drying Space
Year of training: 3 Time spent on task: 1.5-2 hours
Age: 27 Gender: F, Language: Siswati
Entry qualification: no information, but exceptionally high grades in maths and foreign languages at school
Training in Favorited profession
Practical training: At college
Test motivation: very high

Learners estimation on task: Rather easy
Personnal comment:
“It is easy to do practical and I enjoy to do training and the task of painting is an easy task””</td>
</tr>
</table>

n=68
Average total score = 11



n=13
Average total score = 22

Best 13 electricians trained at EEC-KWA-Thema
Competence Level reached: Nominal Competence (8) Functional Competence (2), Processual Competence (3)

Year of training: 1 (1 learner), 2 (2learners), or 4 (5 learners) or unknown
Average time spent on task: 1.8 hours
Average Age: 22, Gender: M (8 learners) F (5 learners)

Test motivation: high or very high

Tasks:
5_EL_Traffic light system (6)
11_EL_Skylight control (3)
12_EL_Drying Space (2)
No information (2)

n=6
Average total score = 28

Best 6 electricians trained at EEC-KWA-Thema
Competence Level reached: Nominal Competence (8) Functional Competence (2), Processual Competence (3)

Year of training: 1 (1 learner), 2 (2learners), or 4 (5 learners) or unknown
Average time spent on task: 1.5 hours
Average age: 22, Gender: M (4 learners), F (2 learners)
Test motivation: very high

Tasks:
5_EL_Traffic light system (3)
12_EL_Drying Space (2)
11_EL_Skylight control (1)

Learners estimation on task, were availabe: Rather easy (3) rather difficult or difficult (3) and appreciated for further training (6).

Personnal comments of best 6 test takers:

"Engineers a problem solvers – knowing the numbers and terminology is not enough. It is important for us to be taught to think quickly but proactively given the content and environment we live in."
"It helps challenge the mind to think rather hard and provide not just an answer but a solution that would help solve a problem that will be beneficial not only to you but your country and citizens. It involves you to become part of the people of a team that solves problems"
"It needs a lot of common sense"
"It provides students with the information about the world outsite"
"I have no background of electricity so what I am going to train on I know nothing about" (commented by a leaner in the 4th year of training)

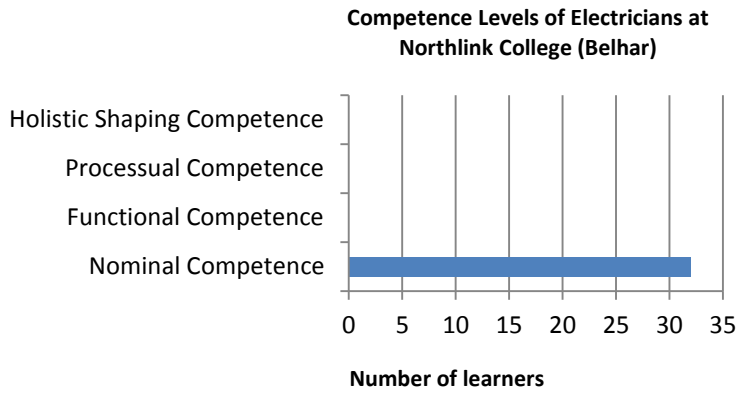
Figure 28: Competence levels and profiles of electricians trained at EEC-Daveyton and EEC KWA-Thema. COMET Test 2014 South Africa.

Good results were reached with all different tasks exposed to the learners, so, in this respect, success did not relate to one or two specific tasks. Further, it seems that success also not depended on gender or age. On the other hand, the year of training was to some extent relevant. Most of the learners with better results were in their 3rd or 4th year of training. Test motivation was very high and a majority of learners also appreciated to be trained further on similar tasks.

As teachers and learners at EEC had not been participating at COMET exercise before, it would be interesting to study the background of the best test takers a bit more in depth. Some indicators are given in the overviews presented in Figure 29 below (best test taker). But it would be also interesting to find out, whether best performing learners had the same teachers or just had a specific personal background.

2.1.2.8 Average competence profiles of electricians trained at Northlink College (Belhar)

n= 32
Average total score = 4.8



n= 3
Average total score = 14

Best electricians trained at Northlink College (Belhar)
Competence Level reached: Nominal Competence (all)

Year of training: 2 (all),
Average time spent on task: 1.5 - 2 hours
Average Age: 27, Gender: M (3)
Tasks
10_EL_Rock crusher (1), 11_EL_Skylight control (1) n.a. (1)

Test motivation: no data available
Learners estimation on task, were availabe: Rather easy (2),
no answer (1)
Personnal comments:
"Good, because it allows for free thinking"
"It help country towards better productivity"

Figure 29: Competence levels and profiles of electricians trained at Northlink College (Belhar). COMET Test 2014 South Africa.

Learners at Northlink College were not reaching any level higher than Nominal Competence. The three best performing students were considerably older than their colleagues and solved their task in a manner addressing all competence criteria in a balanced way. This is – despite the fact that the average performance was at such low level – a very encouraging sign.

Teachers and students had not been involved with the COMET methodology before, so the result can as well only be regarded as a one day reflection of a situation that bears the potential for substantial progress. This is also very much also due to the fact that most of the learners were highly motivated and appreciated the concept of COMET tasks.

2.2 Mechatronics

2.2.1 Average competence profiles of apprentices trained as mechatronics

Competence profiles of mechatronics (result of all mechatronics including „dropouts“)	Competence profiles of mechatronics (result of mechatronics with a total score ≥ 5)	Pre-test result 2014 (result of mechatronics including „dropouts“)
 *Average total score* =16.79 *n* = 141, *V* = 0.17	 *Average total score = 22.70 n = 101, V = 0.15*	 Average total score = 24.24 n = 47

Figure 30: Average competence profiles of apprentices trained as mechatronics.
Main test COMET South Africa 2014.

The overall result of mechatronics participating at the COMET main test 2014 reflects to some extent the results of the pre-test which was – compared to the electrical test – at higher level. With a total score of 22.7 (excluding drop-outs) or 16.79 (including them), test takers almost reached twice as many total scores on average compared to electricians. The number of candidates that did not even reach 5 points was still very high (40 learners) representing 28% of all test takers in the mechatronic vocation.

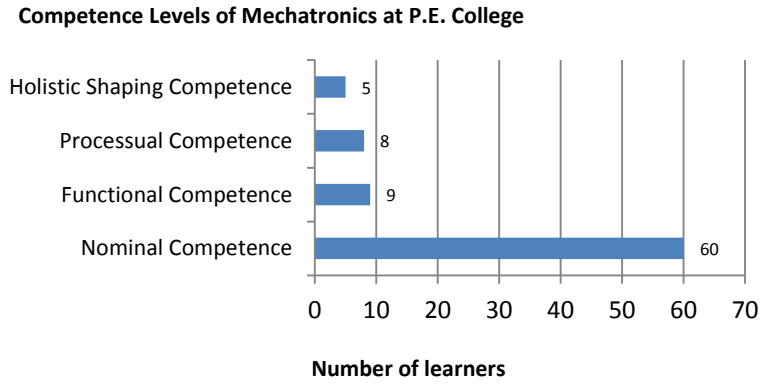
All in all it strikes, that on average, the profiles obtained in the mechatronic vocation are less single sided. Only with regard to K7 (social responsibility) there are still higher deficits compared to all other competence criteria.

2.2.2 Competence of mechatronics according to test sites

Two colleges and two company based test sites participated at the test. The following analysis also begins with those two test sites that have been involved in COMET tests before (P.E. College and VW) before addressing the newly involved test sites (BMW and EastCape Midlands College). It has to be said, that the number of test takers at VW (10) and also at EastCape Midlands College (13) was too low to derive general conclusions, or to compare their average results to the results obtained at P.E. College or BMW.

2.2.2.1 Average (and best) competence profiles of mechatronics trained at P.E. College

n= 82
Average total score = 13.6



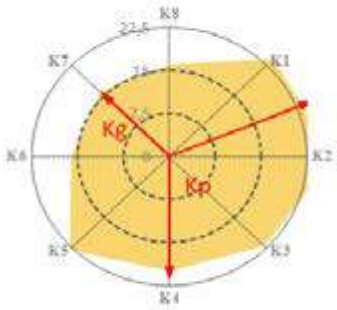
n= 14
Average total score = 37.7

Best mechatronics trained at P.E. College
Competence Level reached: Functional Competence (1), Processual Competence (8) or Holistic Shaping Competence (5)

Year of training: 1 (9 learners),2 (3 learners) and 3 (one learner)
Average time spent on task: 1.6 hours
Average Age: 26, Gender: M (13 learners), F (1 Learner)
Test motivation: very high

Tasks
10_MT_Workshop ventilation (8)
4_MT_Beverage can packing (3)
8_MT_Robot cell safety (1)
3_MT_Automating drill press (1)

Learners estimation on task, were availabe: Rather easy (5) or rather difficult (6) but appreciated for further training (all). (3 learners without an answer)



Total score 63.17 (!)

Best mechatronic trained at P.E. College
Competence Level reached: Holistic Shaping Competence (5)

Year of training: 3
Average time spent on task: 1.5- 2 hours
Age: 23, Gender: M
Test motivation: high (but with low concentration)

Tasks 10_MT_Workshop ventilation (8)

Learners estimation on task: Rather difficult.
Tasks like this appreciated for further training, because:
"It is challenging the individual mentally and also allows the student to understand the manner in which a client would request a job to be done so it not only satisfies the learning outcome but also prepares the student for industry and beyond"

Other personnal comments of best test takers, were available:
"It would be more clearer in what must be done if we we taught to think this kind of stuff."
"It will help me to get skills and also the knowledge to learn more"
"It helps you when you want to install ventilation systems at home"
"It allows us to expand our minds and thoughts more and it would be fun to do the practical part."
"I could learn more about scenarios and other things that were in my task. Maybe, one day I will be an engineer"
"It gives you an idea of the workplace and makes you want to lean more"
"I am interessted in my apprenticeship so that I can have more experience about work and want to make my family proud of me"

Figure 31: Competence levels and profiles of mechatronics at P.E. College. COMET Test 2014 South Africa.

82 mechatronics from P.E. College participated in the main test 2014. At first sight, the result seems to be rather week, compared to the average results obtained by mechatronics (The total average score of all mechatronics participating at the test was 16.79, while 13.6 at P.E. College). Moreover this results is weaker than the one obtained in the pre-test 2014 (see figure below) where 56% of all learners reached the two advanced competence levels (Level 2 and 3).

COMET PRE-Test South Africa 2014 Overall result P.E. College (mechatronics)	**COMET Test South Africa 2014** Overall result P.E. College (mechatronics)
 n= 33 Average total score = 36.5	 n=82 Average total score = 13.6

Figure 32: Comparison of results: Mechatronics at P.E. College. COMET South Africa 2014: Pre-test and main test.

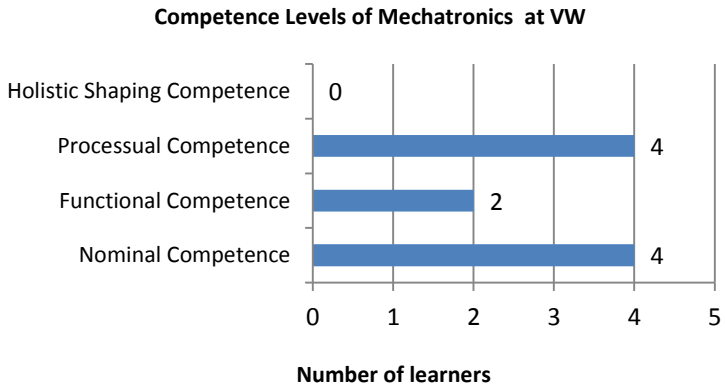
More than two thirds of the test participants in the main test did only reach functional competence, which was a considerably higher share than in the pre-test (73% against 40%). Therefore, it would be necessary to find out about the possible reasons. One explanation might be that the big majority of test takers (63%) were only in their first year of training. But since nine out of the 14 best test takers were learners in their first year of training (!), this cannot be accepted as a major impact.

A deeper analysis including an interrogation of the responsible teachers and trainers would therefore be recommended. In any case the result suggests that there has not been time enough to introduce COMET learning tasks into the regular training processes. The time between pre-test and main test was relatively short and mechatronics had not been tested in the previous test in 2011. While in the pre-test, the overall average shape of the competence profile was very balanced, this result was not fully repeated in the main test but still relevant for those obtaining the better average results.

In general, test motivation of mechatronics tested at P.E. College was as well high or very high and poor results did not relate to a lack of test motivation.

2.2.2.2 Average (and best) competence profiles of mechatronics trained at VW

n= 10
Average total score = 23.2



n= 6
Average total score = 32.4

Best mechatronics trained at VW
Competence Level reached: Processual Competence (2) or Holistic Shaping Competence (4)

Year of training: 2 (3 learners), 3 (3 learners)
Average time spent on task: 1.5 - 2 hours
Average Age: 30, Gender: M (5 learners), F (1 learner)
Test motivation: high - very high

Tasks
10_MT_Workshop ventilation (2)
8_MT_Robot cell safety (2)
4_MT_Beverage can packing (1)

Learners estimation on task, were availabe: Rather easy (1) or rather difficult (5) but appreciated for further training (5 out of 6)

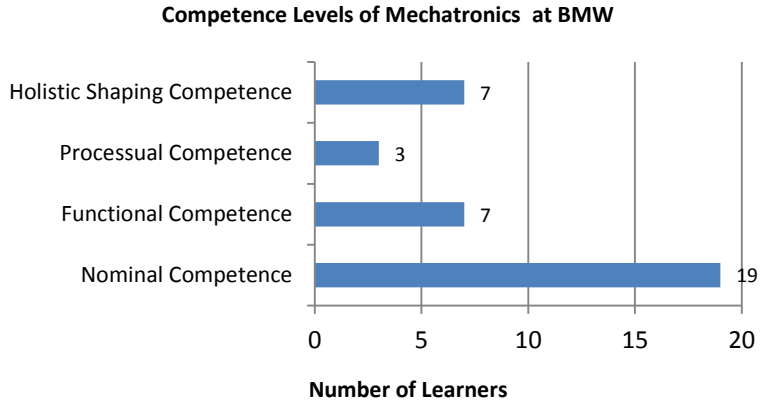
Other personnal comments of best test takers, were available:
"Very good was the amont of time given in order to plan."
"It improves the skills that you have learnt and to apply practical experiences that you might encounter that can be foundation for field of training (but is was difficult for me because) the information on price components was not available"
"It involves a lot of thinking and creativity"
"It is almost like being tested on what you are exposed to in the company while you are doing in-plant training"
"It is challenging in a way that it makles you think giving your creative juices some food and it helps you think outsite the box""
"(I don't want more tasks of this type because they did)"not relate to what was trained"

Figure 33: Competence levels and profiles of mechatronics trained at VW Uitenhage. COMET South Africa 2014.

As already stated, the number of test takers at VW was too low to derive general results. Still, it can be said that the average total score reached by the 10 participants (23.2) was higher than the overall result of all test takers in the same profession (16.8) but with some deficits in K7 and K3. Moreover, three out of the six test takers obtaining the better results were much older than their colleagues (28, 29 and 37 years!). In general, test motivation at VW was as well high or very high. Only one person complained about the task not being relevant, one other about the degree of difficulty.

2.2.2.3 Average (and best) competence profiles of mechatronics trained at BMW

n= 36
Average total score = 21.4

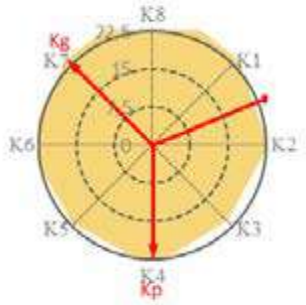


n= 10
Average total score = 48.6

Best mechatronics trained at BMW
Competence Level reached: Processual Competence (3) or Holistic Shaping Competence (7)

Year of training: 1 (2 learners) 2 (4 learners), 3 (4 learners)
Average time spent on task: 1.5 - 2 hours
Average Age: 24.8, Gender: M (8 learners), F (2 learner)
Test motivation: very high

Tasks
10_MT_Workshop ventilation (5)
8_MT_Robot cell safety (3)
3_MT_Automating drill press (1)
No information (1)
Learners estimation on task, were availabe: Very easy (1) Rather easy (3) or rather difficult (6) and appreciated for further training (all)



Total score = 72.83 (!)

Best mechatronic trained at BMW
Competence Level reached: Holistic Shaping Competence

Year of training: 2
Time spent on task: 1.5 - 2 hours
Age: 30 (!), Gender: M
Test motivation: very high

Tasks
10_MT_Workshop ventilation

Learners estimation on task: Rather easy.
Tasks like this appreciated for further training, because:
"YOU GET TO KNOW MORE ABOUT THE PROCESS AND PLANNING OF THE TASK"

Other personnal comments of best test takers, were available:
"It's all about learning and will help me to understand my responsibilities as an employee and to know whatz my working environment will be like"
"It would be good teaching experiences because it would cover a wide range of skills that need to be learnt"
"It relates directly to what mechatroni artisans must know as well as project management skills"
"It will equip me with knowledge skills and how to plan. Teamwork and communication will also be learnt in never forms"
"It brings out the creativity in a person and alows a person to express his/her potential"
"Most of the devices are not BMW devices", "My training needs planning research!"
"It broadens my mind and challenges a person mentally and it makes you think outside the box"
"This tasks has taught me to think about how important it is to cool down the workshop"

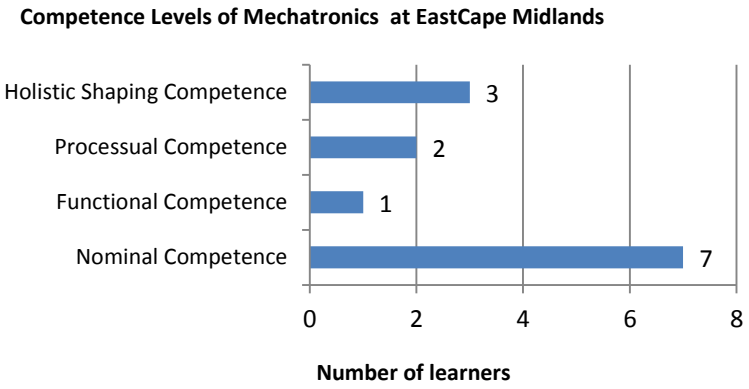
Figure 34: Competence levels and profiles of mechatronics trained at BMW. COMET Test 2014 South Africa.

BMW participated for the first time in a COMET test and had not been involved in the project before. To be more precise, teachers and trainers had not been participating in a seminar on the COMET methodology or were involved in test and learning task development. In this regard, the result can be considered as a pre-test at this test site.

Without any possible introduction of learning tasks to the apprentices, the average results were higher than average. Moreover, average profiles reached were much more balanced, i.e. addressing all competence criteria to a well weighted manner. Despite the fact that 50% of the test takers did not reach a level higher than nominal competence, this is a very encouraging result. The best performing mechatronic at BMW reached 72.83 total score, which was by far the highest score reached in mechatronics. Moreover, it should be interesting to note, that out of the 10 best mechatronics participating at the COMET main test, seven were located at BMW.

2.2.2.4 Average (and best) competence profiles of mechatronics trained at EastCape Midlands

n= 13
Average total score = 18.9



n= 4
Average total score = 36.2

Best mechatronics trained at EastCape Midlands College
Competence Level reached: Processual Competence (1) or Holistic Shaping Competence (3)

Year of training: 2 (all)
Average time spent on task: 1.5 hours
Average Age: 26.3 Gender: M (all)
Test motivation: high -very high

Tasks
10_MT_Workshop ventilation (1)
4_MT_Beverage can packing (2)
No information (1)

Learners estimation on task, were availabe: Rather easy (1) or rather difficult (2) and appreciated for further training (all)

Other personnal comments of best test takers, were available:
"It would better us in our qualification and abilitiy to do our duties as best as we can"
"I would really like to know how to assess problems like this and it would be a great asset to the company I would work for"
"A healthy work environment is the best for you to work in. Productive workers lead to happy workers and good quality products"

Figure 35: Competence levels and profiles of mechatronics trained at EastCape Midlands College. COMET Test 2014 South Africa.

East Cape Midlands College participated in a first main test in 2011 in the electrical domain. So test results from that experience cannot be compared to the actual test. Moreover and as stated

before, the number of test takers at East Cape Midlands College was too low to derive more general results relevant for a sound comparison between the different test sites participating in the mechatronic domain. As it was the case with test takers at other test sites, around half of the learners were only at a level of nominal competence. All learners tested were in their second year of training so that good or bad results did not depend on this issue. As it was the case at P.E. College, those learners in mechatronics reaching higher average results were also offering more balanced solutions. Test motivation was as well high in general.

2.3 Motor mechanics[25]

2.3.1 Average competence profiles of apprentices trained as motor mechanics

Competence profiles of motor mechanics (result of motor mechanics with a total score ≥ 5)	**Pre-test result 2015 (result of motor mechanics with a total score ≥ 5)**
	
Average total score =30.02 *n* = 364, *V* = 0.30	Average total score = 29.52 n = 158, V = 0.31

Figure 36: Average competence profiles of apprentices trained as mechatronics.
Main test COMET South Africa 2014.

On average, the test in motor mechanics let to a relatively good result, especially in terms of the total average score, which was around 30 point. However, due to some difficulties in the areas of K6 and K7, the variation coefficient is still not at a satisfactory level.

In both tests (pre-test and the main test) of motor mechanics, the number of drop-out was remarkably small. Only 2 persons had reached less than 5 total scores in the pre-test and only 7 test takers in the main test were at a similar level. Therefore, it is not necessary to look at the differentiated results between the two groups of learners (incl. or excluding the number of drop-outs). In the COMET test of motor mechanics, drop-outs can definitively be considered as drop-outs in its original sense.

The fact that the overall result of motor mechanics participating at the main test 2015 almost entirely reflects the pre-test result can be interpreted as a consequence of the very little time span in-between the dates of the two tests.

[25] The analysis of motor mechanics includes the test of diesel mechanics and of the learners in NCV automotive

2.3.2 Competence of motor mechanics according to test sites

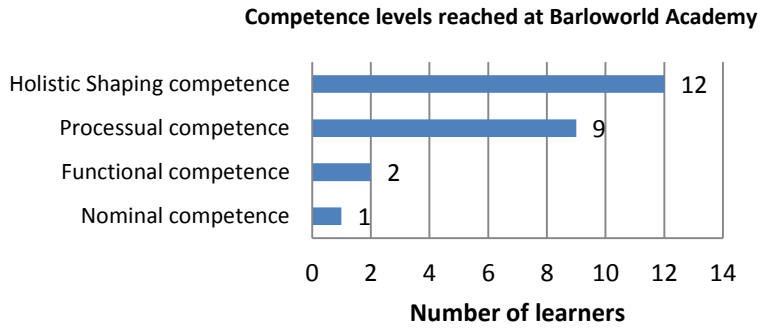
All in all 10 different test sites were participating at the COMET main test of motor mechanics. Six out of these test sides took part in the exercise of the pre-test. These were:

1. THE AUTOMOBILE ASSOCIATION OF SOUTH AFRICA
2. BARLOWORLD MOTOR RETAIL ACADEMY
3. COLLEGE OF CAPE TOWN
4. IMPERIAL TECHNICAL TRAINING ACADEMY
5. KWAZULU NATAL AUTOMOTIVE TRAINING
6. SANDOWN MOTORS/MERCEDES BENZ SERVICES

The following analysis follows a pure alphabetical order of all 10 test sides:

2.3.2.1 Average (and best) competence profiles of motor mechanics trained at Barloworld Academy

Average total score = 41.93
V = 0.23, n = 24



Average total score = 68.33

Best motor mechanic trained at Barloworld Academy
Competence Level reached: Holistic Shaping Competence

Year of training: 3)
Time spent on task: 2 hours
Gender: M
Test motivation: very high

Tasks
02_CMM_Oldtimer

Learners estimation on task: rather difficult (6) but appreciated “It was very interessting” and also for further training

Figure 37: Competence levels and profiles of motor mechanics trained at Barloworld Academy. COMET South Africa 2015.

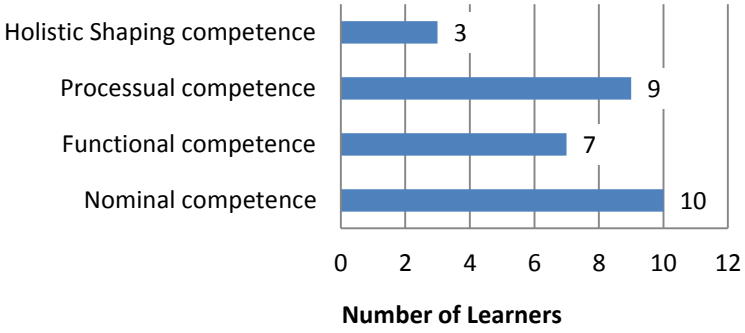
24 motor mechanics from Barloworld Motor Retail Academy participated in the main test 2015. Compared to the overall result obtained in this test, the performance of learners at Barloworld Academy was pretty much above average; in fact learners at this test site received the best average total score. Also in terms of the general shape of the profile, this has been quite balanced, only in K7 there have been some deficits (which was relevant for the test in general). That it was possible to obtain very good results in this area has been shown by Barloworld’s best test taker (see Figure 37) who wrote one of the best solutions in this regard. Half of all learners tested at Barloworld Academy were at the highest competence level. The test group consisted of equal shares of learners in the

different years of training (1-3) and highest competence levels were reached independently from the learner's year of training.

In general, test motivation of motor mechanics at Barloworld Academy was very high, all, except one apprentice appreciated COMET tasks for future training, mostly because they viewed their tasks as very relevant for their future work. Regarding the degree of difficulty of tasks, almost 50 % found it rather difficult; the other half said it was rather easy. This seems to be a realistic estimation because it corresponds to the overall (good) result.

2.3.2.2 Average (and best) competence profiles of learners in NCV Automotive trained at College of Cape Town

Average total score = 26.53
V = 0.30, n = 29



Average total score = 47.6
n= 3, V = 0.17

Best learners in NCV Automotive at College of Cape Town
Competence Level reached: Holistic Shaping Competence (all)

Year of training: 2 (1) and 3 (2 learners)
Average time spent on task: 1.5 - 2 hours
Average Age: 18.5 Gender: M (all)
Test motivation: high

Tasks
01_CMM_Engine warning light (2)
02_CMM_Oldtimer (1)

Learners estimation on task, were availabe: Rather easy (2) or rather difficult (1) but appreciated for further training (all)

Other personnal comments of best test takers, were available:
"IT BROUGHT UPON A LOT OF KNOWLEDGE AND ALSO REVISION ON THE THINGS WE WERE THOUGHT IN CLASS"
"IT WILL BE A NICE JOB TO DO AND IT WILL HELP A LOT WORKING ON A OLD CAR"
"CAN LEARN A LOT WITH THIS TASKS"

Figure 38: Competence levels and profiles of learners in the NCV automotive trained at College of Cape Town. COMET South Africa 2015.

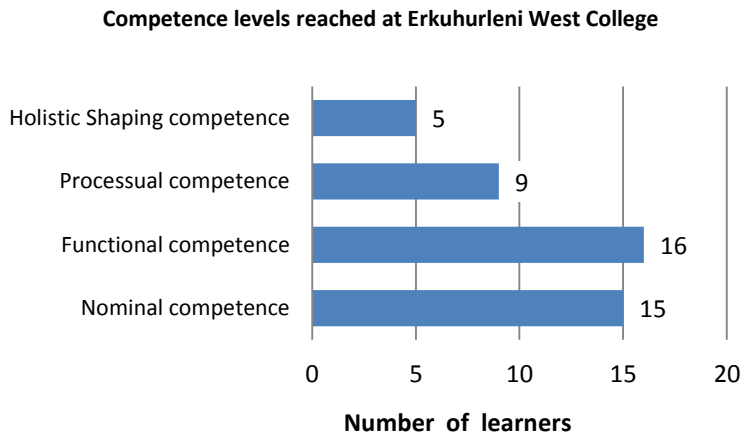
The average competence profile reached at the College of Cape Town is almost the same as the one of the entire test group 2015. Despite this fact it is interesting to note, that about 1/3 of the test takers at this test site did not reach levels above nominal competence. On the other hand the result of the three best test takers shows that it was possible to obtain highest scores and also in a relatively balanced manner (variation coeffient at only 0.17!). One has to conclude, that the group of learners tested at the College of Cape Tows was or is very diverse. Moreover the aspect of stagnation in competence development over the years of training highly relevant at this test site, because the majority of learners who only reached nominal competence were already in the third year of

training.

As in many other training institutions the general feedback on a possible introduction of COMET as learning tasks was pretty much appreciated and the general test motivation was good or very good.

2.3.2.3 Average (and best) competence profiles of learners in NCV Automotive trained at Ekurhuleni West College

Average total score = 24.21
V = 0.34, n = 43*



Average total score = 46.2
n= 5, V = 0.13

Best learners in NCV Automotive trained at Ekurhuleni
Competence Level reached: Holistic Shaping Competence (all)

Year of training: 1 (3 learners) 3 (2 learners)
Average time spent on task: 1.5 - 2 hours
Average Age: no information Gender: M (4) F (1 Learner)
Test motivation: very high

Tasks
02_CMM_Oldtimer (3)
03_CMM_Misfire (1)
05_CMM_Vibration complaint (1)

Learners estimation on task, were availabe: Rather easy (3) or rather difficult (2) and appreciated for further training (all)

Other personnal comments of best test takers, were available:
"BECAUSE I WANT TO STUDY MORE FURTHER OF THE MOTOR MECHANIC"
"BECAUSE I WANT TO LEARN MORE THAN I DID AND IMPROVE MY SKILL"
"IT WOULD HELP ME TO MASTER VEHICLE SYSTEMS AND THEIR POSSIBLE PROBLEMS EVEN MORE"
"BECAUSE AS A MOTOR MECHANICS YOUR MIND SHOULD BE ALWAYS FREE FOR ANY TASK AND YOUR MIND SHOULD NOT BE LAZZY TO THINK"
"BECAUSE I LOVE WORKING ON VEHICLES AND AGAIN I LIKE SOLVING SOME PROBLEM, CAUSE I LEARN NEW THINGS ON VEHICLES"

Figure 39: Competence levels and profiles of motor mechanics trained at Ekuhurleni West College. COMET Test 2015 South Africa.
*there were 45 test taker in total at this test site, 2 of which do not enter into this graph, because they have received less than 5 points and can be regarded as real drop-outs.

Learners participating in the NCV Program Automotive have performed a bit weaker than the average reached by the total test cohort. Moreover, the average shape of the competence profile does not only reflect the general weakness of all test takers in the competence criteria K6 and K7 but as well in K4 (Effectiveness / Efficiency). About two thirds of the test takers at Ekurhuleni West College reached the lower competence levels of nominal competence (34 %) or functional

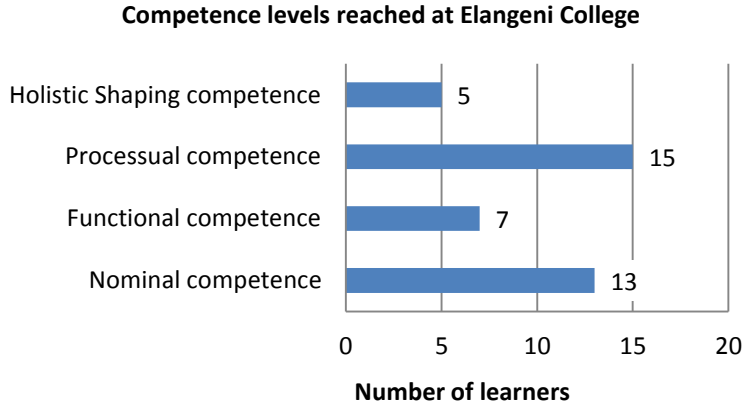
competence (36%). Like at the College of Cape Town the analysis of the group of best test takers shows that very high results were possible here. As the above figure shows, the best five learners reached holistic shaping competence with a total average score about 46.2. Their competence profile is also very balanced (V = 0.13).

Half of the learners at Ekurhuleni College were female; one of them also reached the highest competence result. In general, female test takers in motor mechanics had on average results which were about five points below the average results of their male colleagues at Erkuhurleni.

Ekurhuleni College was one of the test sites where COMET was introduced for the first time on the occasion of the test in motor mechanics. Test motivation was very high at Ekurhuleni too: the entire group of test takers wanted to continue with "learning according to COMET".

2.3.2.4 Average (and best) competence profiles of learners in NCV Automotive trained at Elangeni

Average total score = 24.21
V = 0.34, n = 40



Average total score = 44.5
V = 0.14, n = 6

Best learners in NCV automotive trained at Elangeni

Competence Level reached: Holistic Shaping Competence (6)

Year of training: 2 (4 learners), 3 (1 learner), one unknown
Average time spent on task: 1.5 – 2 hours
Average Age: 21.5 Gender: M (4), F (2)
Test motivation: very high

Tasks

01_CMM_Enigine warning light (1)
03_CMM_Misfire (3)
05_CMM_Vibration complaint (1)
1 unknown

Learners estimation on task, were availabe: Rather easy (3) or rather difficult (2) and appreciated for further training (all)

Other personnal comments of best test takers, were available:

"IT GIVES US YOUNG FUTURE GENERATION VALUES AND IDEA WHAT WE ARE STYDING, IT ENCOURAGES AND GIVE A CRUCIAL ASPECT IN LIFE. IT HAVE ENTHUSIASTIC AND CRUCIAL MOMENT THAT A HUMAN NEED TO KNOW, IF YOU ARE IN ENGINEERING FIELD. I HAD A THRILLED TIME, I HOPE THIS OF QUESTION HAVE A WAY OF PUSHING US TO DESTINATION"
"DOING THIS TASK WOULD BE GREAT FOR LEARNERS BECAUSE IT GIVES A MORE BETTER UNDERSTANDING OF THE TASK YOU WERE GIVEN, AND REALLY IMPROVE THE KNOWLEDGE YOU HAVE ABOUT A PARTICULAR PROBLEM AND HOW ABOUT TO GO WHEN NEED ASSISTANCE"
"BECAUSE IT WILL HELP LOT OF STUDENTS WHO WANT TO BECOME EXPERIENCED MECHANICS, IN MOST INDUSTRIES TO GET BETTER JOBS IN THE FUTURE"

Figure 40: Competence levels and profiles of motor mechanics trained at Elangeni College. COMET Test 2015, South Africa.

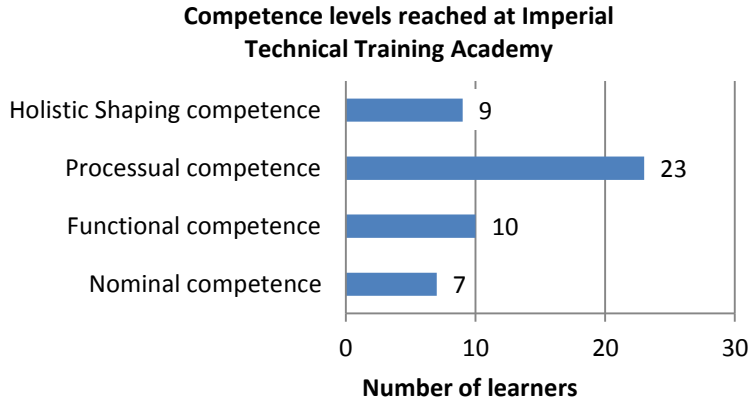
Elangeni College participated for the first time in the COMET test 2015 and almost half of the students reached good or very good competence levels. On the other hand a share of 34 % (or 15 learners in numbers) have only performed at a level of nominal competence. If one looks at the average profile of the test takers at Elangeni College, it strikes that the this picture resembles a lot the overall picture of the entire test cohort while a closer look at the best performing students offers a different picture. Here all competence criteria were addressed in a very balanced manner, whereas on average, solutions were not fully or adequately solved in terms of the criteria K6 and K7.

The number of female test takers reaching holistic shaping competence reflects the percentage of female test takers at Elangeni College.

Test motivation was as well high in general. All learners appreciated COMET tasks for their further training at the college.

2.3.2.5 Average (and best) competence profiles of motor and diesel mechanics trained at Imperial Technical Training Academy and Imperial Technical Training Academy – Germiston

Average total score = 32.72
V = 0.32, n = 43



Average total score = 50 (!),
V = 0.13, n= 5

Best motor and diesel mechanics trained at Imperial Technical Training Academy

Competence Level reached: Holistic Shaping Competence (all)

Year of training: 1 (1 learner), 2 (3 learners), and 3 (1 learner)
Average time spent on task: 1-1.5 hours
Average Age: 24 Gender: M (all)
Test motivation: high

Tasks

01_CMM_Enigine warning light (1)
02_CMM_Oldtimer (3)
03_CMM_Misfire (1)
05_CMM_Vibration complaint (1)

Learners estimation on task, were availabe: Rather easy (2) or rather difficult (3) and appreciated for further training (all, except one learner)

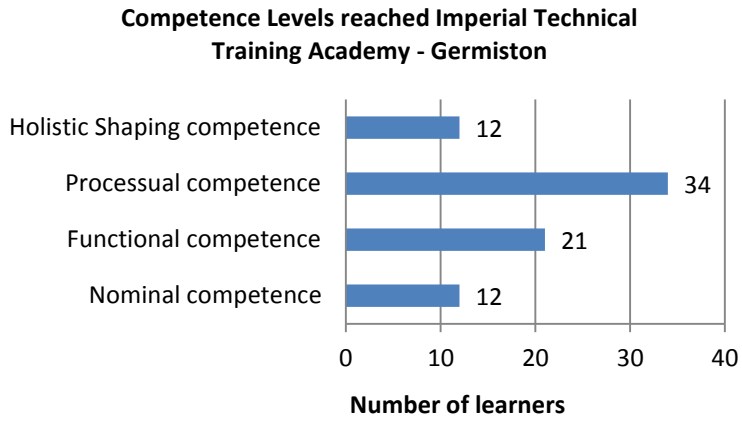
Other personnal comments of best test takers, were available:

"THESE SCENARIOS HELP THE LEARNER TO THINK FASTER AND IT HELPS HIS/HER DIAGNOSIS SKILLS SO THAT WE WOULD LEARN MORE THAN JUST WORKING SKILLS"

"AS A LEARNER WE NEED TO BE ABLE TO GET TO THE POINT OF THINKINH LIKE A MANAGER, LOOKING AT THE ENTIRE TASK AND BREAK IT DOWN AND LOOK AT THINGS FROM THE CUSTOMERS POINT OF VIEW. ALL ASPECTS ARE EQUALLY IMPORTANT","IT WILL GIVE ME A CLEAR INDICATION ON WHAT TO DO IN FUTURE IF I AM FACED WITH THAT KIND OF A PROBLEM" Where a learner was not happy with such kind of tasks for further learning: "THIS TYPE OF TASK IS GOOD TO SHOW SOMEONES TYPE OF THOUGHT BUT IT WOULD NOT BE FAIR ON EVERYONE AS NT EVERYONE THINKS THE SAME"

Figure 41: Competence levels and profiles of mechatronics trained at Imperial Technical Training Academy. COMET Test 2015 South Africa.

Average total score = 31.74
V = 0.31, n = 79



Average total score = 51.5,
V= 0.2, n= 5

Best motor mechanics trained at Imperial Technical Training Academy - Germiston

Competence Level reached: Holistic Shaping Competence (all)

Year of training: 1 (3 learners), 3 (2 learners)
Average time spent on task: 1.5 hours
Average Age: no information Gender: M (all)
Test motivation: moderate - high

Tasks

01_CMM_Enigine warning light (1)

03_CMM_Misfire (1)

05_CMM_Vibration complaint (3)

Learners estimation on task, were availabe: Very easy (1), Rather easy (2) or rather difficult (2) and appreciated for further training (yes (3), no (2)

Other personnal comments of best test takers, were available:

"GOOD TO ASSESS THE CURRENT LEVEL OF EMPLOYEES IN THE WORK PLACE, IDENTIFY GAPS IN KNOWLEDGE/NECESSARY TRAINING"

"SINCE THE SCENARIOS/SITUATIONS ARE WORK RELATED. IT WOULD HELP INTO KNOWING EXACTLY WHAT TO DO AND I THINK ITS A CONFIDENCE BOOSTER AS WELL"

"ITS INTERESTING AND YOU LEARN A LOT FROM IT"

Comments of learners who did not appreciate this kind of tasks for further leaning:

"IT HAS NO SPECIFIC REASON OR BENEFI OTHER THAN SURVEY REASONS, IF THE TASK WAS PREPARED FOR GIVEN TRAINING AND THEN MARKED WITH A POSSIBLE REWARD OR TYPE OF RECOGNITION, IT WOULD BE OKAY. BUT FOR NOW IT HAS NO BENEFIT TO THOSE WRITING IT"

"I DON'T SEE WHY IT SHOULD BE PART OF THE TRAINING COURSE I KNOW THE PROCEDURE FROM THE WORKSHOP AND IS WHAT THE TECHNICIANS DO IN THE WORKSHOP"

Figure 42: Competence levels and profiles of motor mechanics trained at Imperial Technical Training Academy Germiston, COMET Test 2015 South Africa.

Imperial Technical Training Academy and Imperial Technical Training Academy – Germiston were analysed separately. Both test groups consisted of an adequate number of test takers, 43 and 79 learners respectively. It is very interesting to see how almost identical the results of the competence test have been in the main test 2015. Even though at one of two test sites there may have been a little knowledge advantage compared to the other this was not transferred into better test results. First of all, none of the learners tested in the main test was tested in the earlier pre-test. And second, there was only very short time in between the two tests, so that the teachers who had already gained some experience in the first test might not have been able to benefit from it as much as possible

Imperial Technical Training Academy and Imperial Technical Training Academy – Germiston have resulted with an average score of about 32 and a profile that has a very strong deficit in K7 and

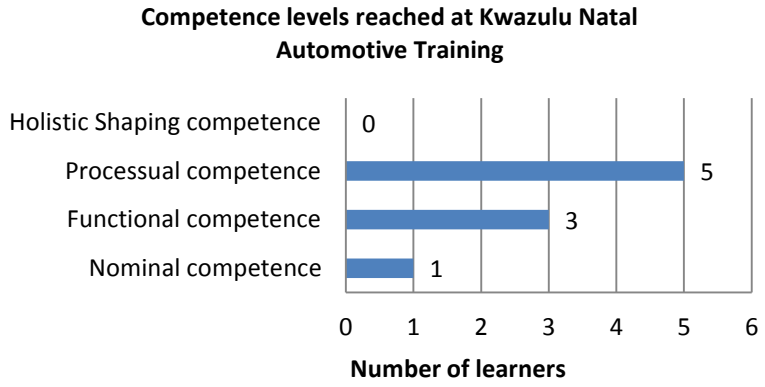
another one – but less significant – in K6. These weaknesses are not that strong when analysing the profiles of the groups of best test takers. But even though the results of the best are indisputable successful, one may argue that the general weaknesses of all learners in the two most difficult competence criteria are still visible when looking at the best.

The distribution of results according to competence levels are also almost the same in both test groups. The strongest share that consists of about half of the test takers at each test site were located at the advanced competence level of processual competence. About 40 % of the learners at each of the two test sites were in the two lower performing groups, achieving only nominal or functional competence, the remaining 15 (or 20% respectively) received the very good results of holistic shaping competence. The overall picture reflects a very strong diversity of test takers at these two test sites, and among the major problems to be addressed in future are the big difference between the lowest and best performers, i.e. to make the weaker students profit from their better performing class mates, because very obviously, training at both test sites has the potential to create very well performing students.

Test motivation was good at both test sites; however there were also some more critical voices among the learners, compared to other test sites – an issue that was as well relevant in the analysis of the best (see comments in the above figure).

2.3.2.6 Average competence profiles of motor mechanics trained at Kwazulu Natal Automotive Training Services

Average total score = 30.63
V = 0.44, n = 9



Some personnal comments of test takers, were available:
"IT WILL VERY MUCH INCREASE KNOWLEDGE, PASSION AND DEDICATION, I SAY THIS BECAUSE IAM NOW MORE MOTIVATED AND ENCOURAGED THAN EVER BEFORE MOTOR MECHANIC IS WHAT I, MOTOR INDUSTRY IS MY PASSION"
"IT WILL IMPROVE MY TRAINING WINDOW IN MY TRADE"
"I WAS A BIT SHOCKED AND SCARED, BUT WHEN THE INVIGILATORS EXPLAINED I BECAME RELAXED I APPRECIATE TO BE GIVEN THIS OPPORTUNITY"

Figure 43: Competence levels and profiles of mechatronics trained at Kwazulu Natal Automotive Training Services. COMET Test 2015 South Africa.

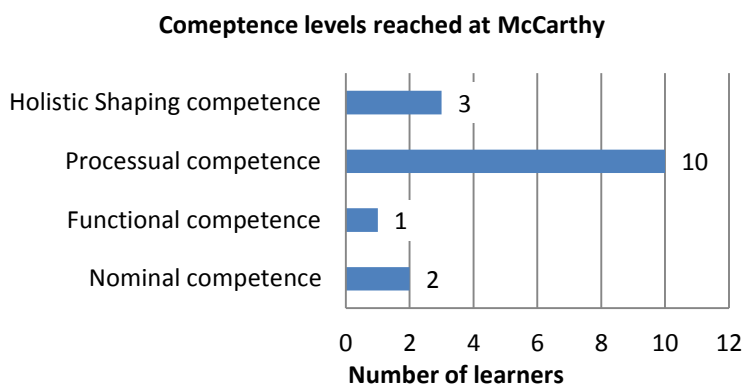
Kwazulu Natal Automotive Training Services has only participated with a very small number of test takers, which were only nine learners. The group even consisted of leaners in all different years of training form 1 to 4 so that he group is too small to separately analyse the best. None of the test takers was reaching holistic shaping competence, but what's more important: only one apprentice was at nominal competence. The big majority performed pretty well at an advanced level of competence, which was a good result, despite the fact, that also in this group almost none of the learners were able to address aspects of social and environmental compatibility in their solutions. This would probably be the domain the teachers and trainers at Kwa Zulu Natal Automotive Training,

will need to emphasise a bit more in future lessons.

It might be added, that one of the test persons took also part in the pre-test activity. This learner was able to lift his personal competence profile from nominal to functional competence with a substantial increase in the total scores reached (from 15.33 in pre-test to 28.33 points in the main test). But because this is just one single case.

2.3.2.7 Average (and best) competence profiles of motor mechanics trained at McCarthy Training Centre Midrand

Average total score = 36.74
V = 0.31, n = 17



Average total score = 62.08
V= 0.3, n = 2

Best motor mechanics trained at McCarthy Training Centre Midrand
Competence Level reached: Holistic Shaping Competence (2)

Year of training: 2 and 3
Average time spent on task: 1.5 – 2 hours
Average age: unknown, Gender: M (both)
Test motivation: high -very high

Task: 03_CMM_Misfire (2)

Learners estimation on task, were availabe: Rather easy (both)

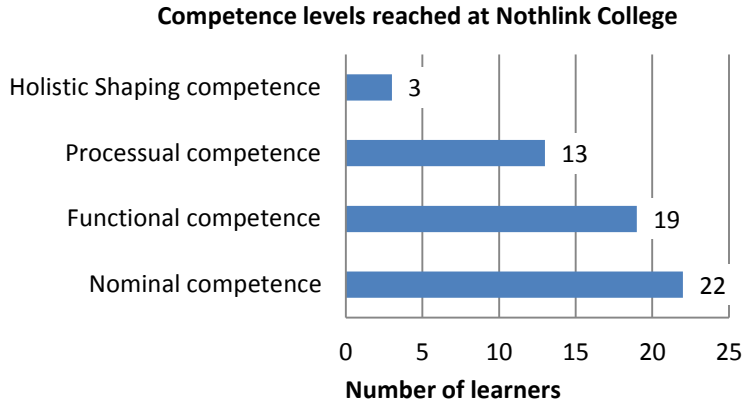
Other personnal comments of best test takers, were available:
"IT CHECKS YOUR KNOWLEDGE AND IMPROVES HOW YOU THINK ABOUT DIAGNOSIC AND REPAIRS"
Task was easy, because: "I AM EMPLOYED AT MERCEDES AND WE HAVE THAT PROBLEM OFTEN AND DO CYLINDER HEADS AND GASKET OFTEN"
"IT HELPS YOU THINK OUTSIDE THE BOX"
Task was easy, because "IT IS A SOMETHING I HAVE DELT WITH IN THE PAST"

Figure 44: Competence levels and profiles of mechatronics trained at McCarthy Training Centre Midrand. COMET Test 2015 South Africa.

With a total average score of 36.74 the group of apprentices at McCarthy Training Centre was among the best test groups in the 2015 test of motor mechanics. In the class of 17 learners only 32 did not perform at the advanced competence levels. The others provided good or very good solutions – only with a strong deficit in K7. Apart from this deficit that was relevant for all test takers and regardless the tasks they were given the overall competence profile was balanced and at a high level in all criteria. As for an advice to the teachers or trainers involved in the training of this class, one would therefore recommend to further stress environmental aspects of problem solving in their lessons - especially as it seems as if this was not an issue in the past, because also the best test takers did not refer to this criterion in their solutions.

2.3.2.8 Average (and best) competence profiles of learners in NCV Automotive trained at Northlink College

Average total score =24.39
V = 0.37, n = 54



Average total score =38.3
n = 7 V = 0.35

Best learners in NCV Automotive trained at Northlink College
Competence Level reached: Processual Competence (5) or Holistic Shaping Competence (2)

Year of training: 1 (3 learners), 2 (1 learner) 3 (3 learners)
Average time spent on task: 1 hour
Average Age: 23 Gender: M (6), F (1)
Test motivation: no information

Tasks
01_CMM_Enigine warning light (1)
02_CMM_Oldtimer (1)
03_CMM_Misfire (3)
05_CMM_Vibration complaint (2)
Learners estimation no information

Other personnal comments of best test takers, were available:
"IT MIGHT BE AN OPEN DOOR TO FURTHER OPPORTUNITIES AND TO KNOW THAT I HAVE PERFORMED THIS TASK AND TO HAVE THIS ON MY CV IS VERY BENEFICIAL TO MY SUCCESS IN THE FURTHER YEARS TO COME"
BECAUSE IT WILL EASY FOR US TO GET MORE EXPERIENCE AND UNDERSTAND IT"

Figure 45: Competence levels and profiles of mechatronics trained at Northlink College. COMET Test 2015 South Africa.

Northlink College participated with one of the largest class of test takers and for the first time in the profession of motor mechanics. So, even though Northlink College had some experience with COMET tests in the past, these where linked to other vocations and experience in the domain of motor mechanics was not given.

As a result of this first test only 16 out of 54 learners were reaching advanced competence levels, while 19 performed at the first level of functional competence and 22, or an equivalent of 40% did not succeed at a higher level than nominal competence. Nevertheless, when looking at the best test takers, it becomes clear, that the those learners, which were performing at the level of holistic shaping competence can compete with the best performing learners at other test sites because both in terms of the total average score as well as in terms of the shape of the competence profile, these learners do not differ that much from their colleagues at other training providers. It thus seems as if the performance of Northlink College students is more linked to the problems of heterogeneity (or diversity of learners) if compared to other test sites.

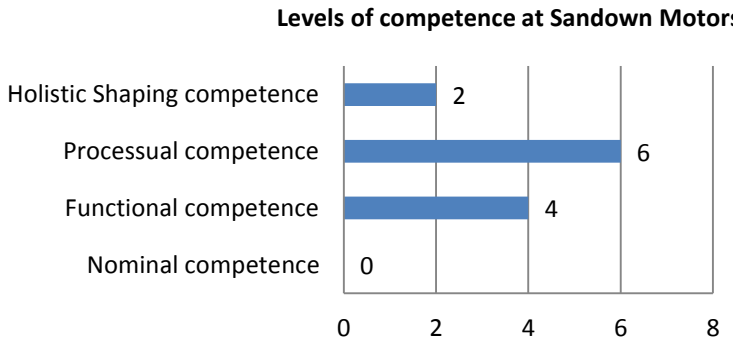
This assumption is supported by the fact that it was obviously possible to receive good or very good results regardless in which year of training the learners were and also in a relatively short time (good test takers did not need more than an hour time to finish their task).

Unfortunately there was not so much information on test motivation in general, because a considerable number of learners did not fill in the questionnaire, but from the information which was available, it became clear that many learners really felt over-challenged when confronted with their task which also leads to the recommendation to teachers and trainers at this test site to address heterogeneity issues as much as possible in the near future.

As in most of the other test sites, it would also be necessary to strengthen the aspects of social and environmental compatibility of solutions elaborated in the motor mechanics classes at Northlink College.

2.3.2.9 Average (and best) competence profiles of motor mechanics trained at Sandown Motors

Average total score =37.59
V = 0.22, n = 13



Average total score = 52.5
V = 0.2, n = 2

Best motor mechanics trained at Sandown Motors
Competence Level reached: Holistic Shaping Competence (both)

Year of training: 2
Average time spent on task: 1.5 hours
Average Age: 21.5 Gender: M (all)
Test motivation: high -very high

Tasks Tasks
03_CMM_Misfire (1)
05_CMM_Vibration complaint (1)

Learners estimation on task, were availabe: Very easy (1) Rather easy (1) or rather difficult (2) and appreciated for further training (all)

Other personnal comments of best test takers, were available:
IT PROMOTES IN DEPTH THINKING AND PROBLEM SOLVING
IT HELPS ME TO THINK ABOUT MY SKILLS I HAVE LEARNED AND USE IT TO THE BEST OF MY ABILITIES"

Figure 46: Competence levels and profiles of mechatronics trained at Sandown Motors. COMET Test 2015 South Africa.

Sandown Motors was one of the test sites, which were also participating at the pre-test in motor mechanics. Only 12 learners participated in the main test. None of them could be considered as "drop-out"; all of them reached competence levels of functional competence or above, which is a very good result. On average, a total score of 37.5 was obtained in this test group, which is about 7 points above the average result reached in this main test in motor mechanics.

At Sandown Motors, learners did not show the same degree of weakness in the more critical domains of social and environmental compatibility, even though also at this test site, this aspect is still relevant to some extent.

The analysis of the best test takers does not lead to a completely different shape of the competence profile at this test site. Well on the contrary, the shape looks pretty much the same, only at a higher overall level (with a total of 52.5 points reached compared to 37.5). This means that learners in this group had a similar understanding about the nature of the test task and addressed them in a very comparable manner. Heterogeneity might not play a significant role at Sandown Motors.

The very interesting result of the test at Sandown is that there is a notable change in the overall result of the average learner's competence profile if this is compared to the pre-test result. 12 learners took part at the pre-test, only some months before the main test. None of them reached Holistic Shaping Competence, none of them reached adequate results in K7 or K6. One learner was at Nominal Competence. Even though the test group is very small, one may conclude, that the test experience from the first pre-test had a very positive effect on the learners' performance in the subsequent main test, especially with regard to the two rather difficult criteria K6 and K7 (see below).

Pre-test 2015: Learners' performance			Main test 2015: Learners' performance	
in K6*	In K7*		In K6*	in K7*
4.6	2.4		8.2	7.2

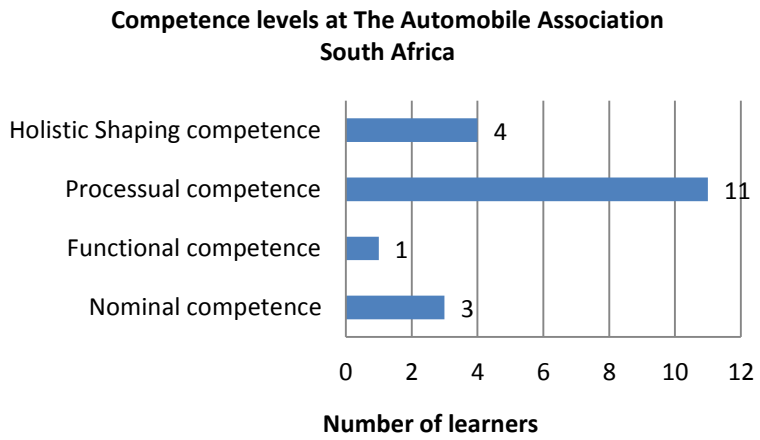
* mean value of a total of 12 test takers participating at the respective test. 8 test takers who participated at the pre-test were also in the group of test takers, who participated in the main test. Except on candidate, all of them were exposed to different test tasks than in the pre-test 2015.

This effect can only be linked to successful follow up discussions and lectures of teachers at Sandown after handing over and discussing the pre-test results with the learners. That such positive effect was possible is remarkable. Although it needs to be stressed, that this test group was relatively small, this encouraging results supports the hypothesis that with the introduction of COMET learning tasks, competence levels of learners can be uplifted.

Test motivation at Sandown Motors was high or very high. Most of the learners found their task rather difficult but appreciated them or further lessons.

2.3.2.10 Average (and best) competence profiles of motor and diesel mechanics trained at The Automobile Association of South Africa

Average total score = 30.73
V = 0.32, n = 18



Average total score = 44.1
n= 4, V = 0.08

Best motor mechanics trained at The Automobile Association of South Africa

Competence Level reached: Processual Competence (1) or Holistic Shaping Competence (3)

Year of training: 2 (2) and 1 (2)
Average time spent on task: 0.5 – 1 hour
Average Age: 26 ; Gender: M (all)
Test motivation: high -very high

Tasks

02_CMM_Oldtimer (1)

05_CMM_Vibration complaint (1)

Learners estimation on task, were availabe: Rather easy (3) or rather difficult (1) and appreciated for further training (all)

Other personnal comments of best test takers, were available:

"IT MAKES YOU THINK VERY HARD AND LOOK DEEPER THOSE MATTERS"
"IT TEACHES YOU RIGHTING SKILLS, AND BREAKING DOWN THE SITUATION WHICH HELPS YOU DIAGNOSE FURTHER. IT HELPS YOU PLAN YOUR TASK."
"THE TEST MADE ME GAIN MORE THEORETICAL KNOWLEDGE ABOUT MY WORK AT THE WORKSHOP AND IT MADE MY MIND TO BECOME MORE COMPLEX ABOUT MY JOB AND THINK OF POSSIBLE THINGS THAT MIGHT CUSE CERTAIN PROBLEMS AND QUICK SOLUTIONS".
"BECAUSE OF THE CHALLENGE IT GIVES OUT AND HOW IT HELPS AND INDIVIDUAL TO THINK AND RELATE TO WHAT THE TRADE IS ALL ABOUT"
"BECAUSE THAT IS WHAT I LOVE, AND IT GIVE ME SATISFACTION"

Figure 47: Competence levels and profiles of mechatronics trained at The Automobile Association of South Africa. COMET Test 2015 South Africa.

Also the Automobile Association of South Africa participated in both, the motor mechanics pre-test and the main test. The average score reached at this test site was 30.7 with a group of 18 participating at the exercise. While the average score does not differ at all from the overall average result reached in this test, the performance in the two critical criteria K6 and K7 is a bit better than on average. Even though none of the learners tested in the main test had some pre-test experience, the results obtained by learners at the Automobile Association of South Africa in the main test are better than the one reached by their colleagues who participated in the previous test, both in terms of the total average score but especially with regard to a more holistic thinking expressed in their solutions. It may well be that the learning effect from the first test experience was passed on the apprentices by their teachers.

Looking at the four best learners in this group it becomes clear, that it was also possible to address all competence criteria at a very superior level. Together with a very remarkable variation coefficient of 0.08, this is among the best results of the entire test.

Test motivation at the Automobile Association of South Africa was high or very high in general; almost all students appreciated the exercise and found it highly relevant for their occupation. Only one student was not happy with his task because in his view it did not relate to his future job description. Despite this fact, his performance was at a high level of processual competence.

2.4 Welders

2.4.1 Average competence profiles of apprentices trained as welders

Competence profiles of welders (result of all welders including „dropouts“)	Competence profiles of welders (result of welders with a total score ≥ 5)	Pre-test result 2014 (result of welders including „dropouts“)
 *Average total score* = 20.53 n = 120, V = 0.17	 *Average total score = 24.91* *n = 97, V = 0.17*	 Average total score = 28.57 n = 44

Figure 48: Average competence profiles of apprentices trained as welders. COMET Test 2014 South Africa.

The overall result of welders participating at the COMET main test 2014 reflects to a very high degree the results obtained in the pre-test. Compared to the main test results obtained in other vocations, the average results were at higher level. With a total score of 24.9 (excluding drop-outs) or 20.53 (including them), test takers reached the best results. The number of candidates that did not even reach five points was not as high as in other domains. In numbers, 23 test takers or 19% of learners in welding were in a group of so-called “drop-outs”.

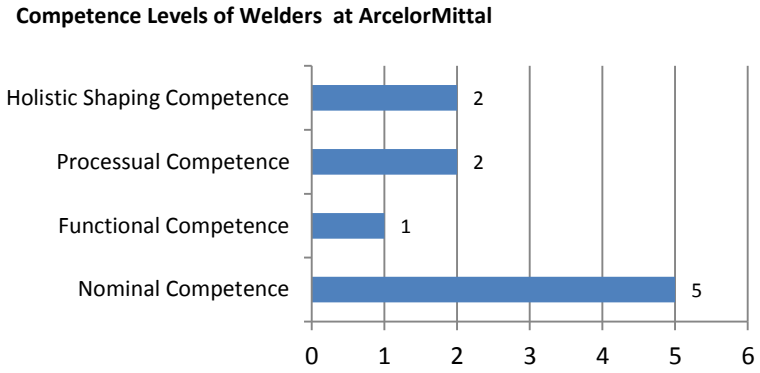
A considerable share of learners reached relatively balanced competence profiles, an issue, that is already not reflected by the average results shown in the figure above but also when looking at the better test takers averages at the different test sites.

2.4.2 Competence of welders according to test sites

All test sites involving the welding profession had been participating in a COMET test before. SIFSA as a part of the training offered by ArcelorMittal is the only possible exemption to the role.

2.4.2.1 Average (and best) competence profiles of welders trained at ArcelorMittal

Average total score = 27.15
n = 10, *V* = 0.24



n= 3
Average total score =51.7

Best Welders trained at ArcelorMittal

Competence Level reached: Functional Competence (1) or Holistic Shaping Competence (2)

Year of training: 1 (all), Average time spent on task: 1 hour
Age: 24, 30 and n.a.; Gender: M (all)
Test motivation: very high

Tasks

7_ WL_Pipeline repair (1)

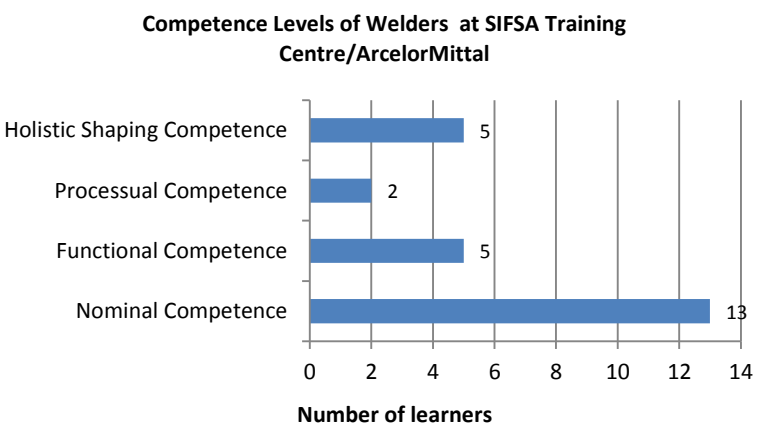
3_WL_Lifting lug (1)

4_WL_Tropical storm (1)

Learners estimation on task, were availabe: Rather easy (2) or rather difficult (1) and appreciated for further training (all).

"It is based on my trade!
"It is practical and required one to use the knowledge instilled in him. In (performing) the task effectively, it improves confidence in a person. The solution was straightforward"
"This is what I love."

Average total score = 28.82
n = 23



Total score 48.6
n = 5

Best welder trained at SIEFA Training Centre/ArcelorMittal
Competence Level reached: Holistic Shaping Competence (5)

Year of training: 1
Average time spent on task: 1.2 hours
Age: 23, Gender: M (3), F (2)
Test motivation: high - very high

Tasks
3_WL_Lifting lug (2)
7_ WL _ Pipeline repair (2)
4_WL_Tropical storm (1)

Learners estimation on task: Rather difficult () very difficult (3).
Tasks like this appreciated for further training, because:
"I can learn what will be required of me to come up with a solution to help the company"
"(I appreciate) the experience, thoughts and knowledge that training is more than welding but also about the environment and society
"(It) revitalised my mind in a way I thought world never be possible"
"It was challenging and I liked it"
"It helps you think beyond a situation"

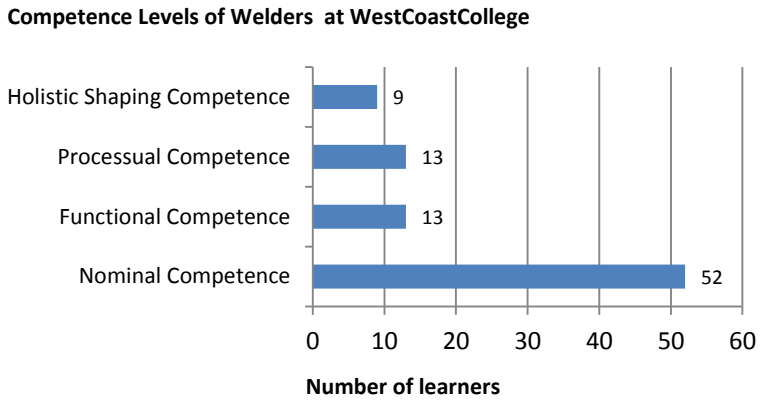
Figure 49: Competence levels and profiles of welders trained at ArcelorMittal and SIEFSA Training Centre. COMET Test 2014 South Africa.

Learners in the welding profession at ArcelorMittal and at SIEFA Training Centre at ArcelorMittal, have reached similar overall results (with 27 or 28 points on average) and almost half of the cohort at nominal competence. When looking at the best, learners trained at SIEFSA, were receiving slightly better (almost perfectly balanced competence profiles) than their colleagues at ArcelorMittal working on exactly the same tasks.

Learners were highly motivated and happy to work on their tasks. There are some very enthusiastic comments among the comments of test takers that indicate that they really appreciated the challenge.

2.4.2.2 Average (and best) competence profiles of welders trained at West Coast College

Average total score = 19.1
n = 87



n= 14
Average total score = 48.0

Best welders trained at West Coast College

Competence Level reached: Holistic Shaping Competence (9), Processual Competence (5)

Year of training: 1 (all), Average time spent on task: 1.5 hours
Age: 26 Gender: M (11) F (3)
Test motivation: very high

Tasks
- 3_WL_Lifting lug (7)
- 4_WL_Tropical storm (3)
- 7_ WL _ Pipeline repair (2)
- No information (1)
- 12_EL_Drying Space (1)

Learners estimation on task, were availabe: Rather easy (2) or rather difficult (7) very difficult (1) (no answer (4) but appreciated for further training (10).

Total Score = 60.67

Best welder at West Coast College

Learner ID: RSA_WL_2014_3029
Age: 20, Gender F, year of training: 1
Time spent on task: 1 hour or less
Motivation: very high

Task: 12_EL_Drying Space

Her comment:
"A welder must think out of the box and (has to know) how to adjust (to) a situation"
Tasks like this appreciated for further training.

Further comments on test tasks by other best test takers at West Coast College

"Its our trade I will not be surprised if a task like this is given to me"
"Its interesting and a part of welding"
"We will be prepared to deal with the situation in reality"
"It can help with the importances of paper and theory of my profession"
"It helps you to be creative and puts you in situation you may be in the future and this would really build up your knwoledge"
"It tests my creativity"
"It suits to the profession trainined"
"It would help me to think with an open mind ( ) not just as a welder"
"It can help me to achieve my goal and (has) given a lot of knowledge about how to repair pipelines"

Figure 50: Competence levels and profiles of welders trained at West Coast College. COMET Test 2014 South Africa.

With a total average score of 19.1 welders tested at West Coast College were performing a little weaker than their colleagues at ArcelorMittal and SIEFSA. The share of learners reaching competence levels higher than nominal competence was around one third – compared to about 50% at Arcelor Mittal and SIEFA. Nevertheless six out of the best welders participating at the COMET main test 2014 were trained at West Coast College, four of which were female. All in all, the result obtained at West Coast College are very encouraging, also if one considers the comments of the learners.

2.5 Fabricators (pre-test)

Apprentices in the fabrication domain have participated for the first time in a COMET test and did not take part in a larger group. As there is a huge similarity in the vocational tasks of a fabricator and a welder, the local project steering team has decided to introduce the three most relevant tasks developed for welders in the fabricator's test.

2.5.1 Average competence profiles of apprentices trained as fabricator

Competence profiles of fabricators (result of all fabricators including „dropouts")	Competence profiles of fabricators (result of fabricators with a total score ≥ 5)
	
Average total score = 32.81 n = 77, V = 0.08	*Average total score = 32.03* *n = 75, V = 0.08*

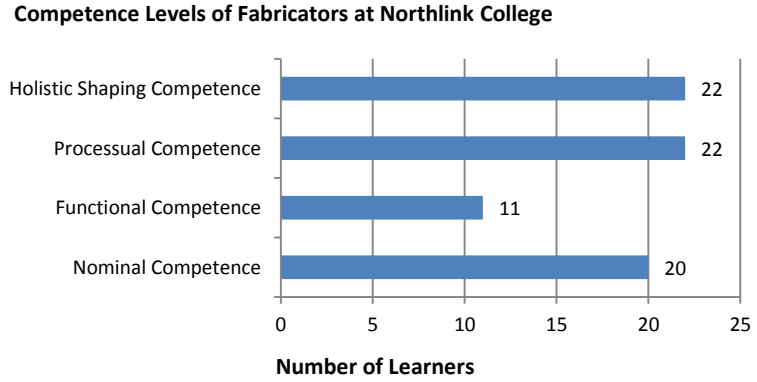
Figure 51: Average competence profiles of apprentices trained as fabricators. Pre-test, COMET South Africa 2014.

Test results should be regarded as pre-test results. As the average competence profiles of fabricators with and without drop-outs show there are almost no test takers at a critical level below 5 total scores. Moreover, the average shape of the learners' competence profile is fully balanced, which can be an indication for an adequate choice of test tasks.

2.5.2 Competence of fabricators according to test sites

2.5.2.1 Average (and best) competence profiles of fabricators trained at Northlink College

Average total score = 32.34
n = 75, *V* = 0.24



n= 13
Average total score = 56.9

Best fabricators trained at Northlink College
Competence Level reached: Holistic Shaping Competence (all)

Year of training: 1 (3 learners), 2 (6 learners), 3 (1 learner)
4 (2learners) , and 3 (no answer)
Average time spent on task: 1.3 hours
Age: 21.5; Gender: M (11), F (2)
Test motivation: moderate

Tasks

No answer (10)

3_WL_Lifting lug (2)

4_WL_Tropical storm (1)

Learners estimation on task, were availabe: Rather easy (2) or rather difficult (2) no answer (9) and not always appreciated for further training

"(it) helps to deal with crises", "(it) helps in dealing with disasters"

NOT wanted for further training:
"(I am) not a welder. Boring", "in line with boilermaking and welding and not with fabrication", "tasks was too difficult"

Figure 52: Competence levels and profiles of fabricators trained at Northlink College. Pre-Test, COMET South Africa 2014.

At first sight, it might be astonishing, that some of the best test takers in the fabrication profession were not as motivated as their colleagues and that their estimation on the tasks was also more reluctant. That only two among the best test takers in the Fabrication profession were female at Northlink College does not mean that female test takers were weaker in general. Because total the share of female fabrication participants at Northlink College was only nine %, the two best performing females adequately represented their group.

It has to be mentioned, that apprentices trained on fabrication were only trained at Northlink College. One apprentice at P.E. College stated that he was trained as "fabricator", but actually worked on a test task for electricians. This case might be based on wrong information of the candidate is not relevant for any comparative analysis.

2.6 Millwrights (pre-test)

2.6.1 Average competence profiles of apprentices trained as millwrights

Competence profiles of millwrights (result of all millwrights incl. „dropouts“)	Competence profiles of millwrights (result of millwrights with a total score ≥ 5)
 *Average total score = 14.21* *n = 21, V = 0.43*	 *Average total score = 15.55* *n = 19, V = 0.43*

Figure 53: Average competence profiles of apprentices trained as millwrights. Pre-Test COMET South Africa 2014.

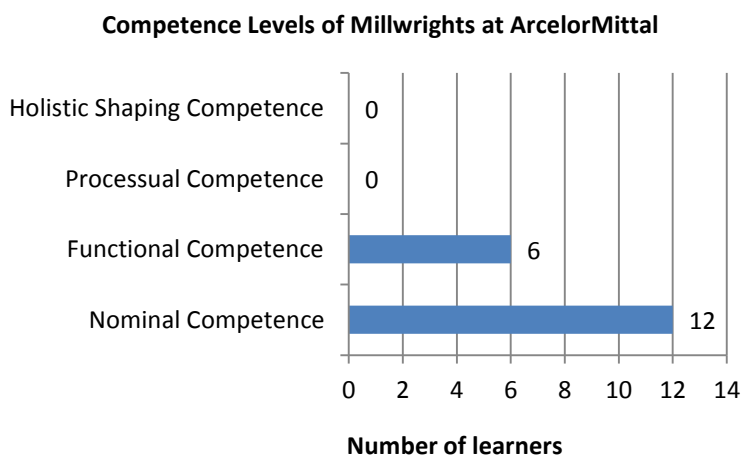
2.6.2 Competence of millwrights according to test sites

21 millwrights participated in the main test, 18 of which were from ArcelorMittal. As it was the case for the profession of Fitting and Turning, apprentices in the vocation of a Millwright had not been addressed in the pre-test 2014 and participated as a group for a first time. The tasks that had been chosen for a test were closely linked to the test instruments used in the electrical test. Only one of the tasks used in the electrical test was not relevant in the case of millwrights. While the students had not been prepared for the test as a group, teachers and trainers of the two test sites had been involved in the COMET tests before. Whether they have prepared their learners for the test remains to be asked.

2.6.2.1 Average (and best) competence profiles of millwrights trained at ArcelorMittal

Average total score = 15.07

n = 18



Average total score = 24

n= 4

Best millwrights trained at ArcelorMittal

Competence Level reached: Functional Competence (all)

Year of training: 1 (1 learner), 2 (3 learners)
Average time spent on task: 1.75 hours
Average Age: 23; Gender: M (all)
Test motivation: very high

Tasks

12_EL_Drying Space (DE) (1)
13_EL_Signals (DE) (1)
14_EL_Pebble Treatment Plant (DE) (1)
No answer (1)

Learners estimation on task, were availabe:
very easy (1), rather easy (1) rather difficult (1) or very difficult (1), appreciated for further training (all)

Learners comments:
"I enjoy designing the operation of machines and also doing fault finding"
This kind of test is very condusive to one's capabilities to think and they help a person to see how far they can think and how creative they can be"
"It is a good exercise for training"

Total score: 30.33

Best millwright trained at ArcelorMittal

Competence Level reached: Functional Competence

Year of training: 2
Average time spent on task: 1.5 -2 hours
Age: 22, Gender: M
Test motivation: very high

Task: no information
Learners estimation on task: very easy and appreciated for further training

Comment of learner:
"It deals with real problems. Very interesting"

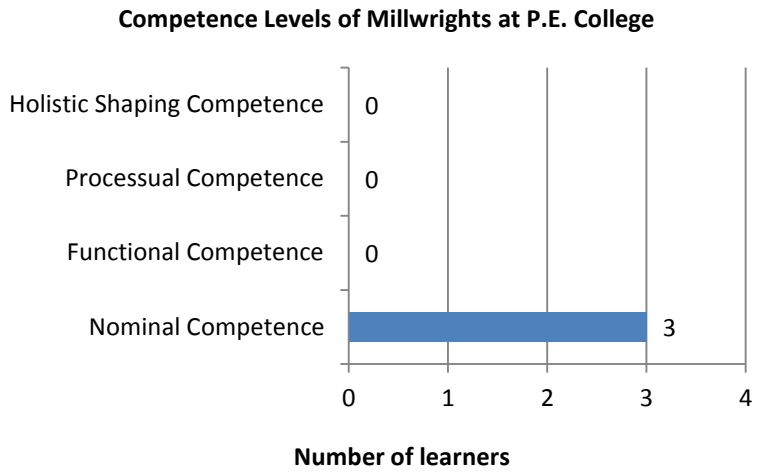
Figure 54: Competence levels and profiles of millwrights trained at ArcelorMittal. Pre-Test COMET South Africa 2014.

Even though competence profiles of millwrights were also rather weak in general, it strikes that the learners at ArcelorMittal did not receive their scores predominantly in categories that address the functionally aspect of a task. Learners also addressed aspects related to social and environmental responsibility, which is a good sign – even though the full potential of a task was not jet tapped. Due to the low number of participant from P.E. College, it is still not possible to compare competence levels and competence profiles of millwrights trained at the two participating test sites.

2.6.2.2 Competence profiles of millwrights trained at P.E. College

Average total score = 9

n = 3



Total score: 22.8

Best millwright trained at P.E. College

Competence Level reached: Nominal Competence (due to a lack of scores in K1 and K2)

Year of training: 1
Time spent on task: 1 hour
Age: no information, Gender: M

Test motivation: very high

Task: 5_EL_Traffic light system
Learners estimation on task: rather difficult and appreciated for further training

Comment of learner:
"It was challenging and involves other trades"

Figure 55: Competence levels and profiles of millwrights trained at P.E. College. Pre-Test COMET South Africa 2014.

Because of the very low number of test participants at P.E. College, no general conclusions can be derived from the result according to the test site.

Recommendation: As it was the case for the domain of fitters and turners, the next step of the project team should be to invest some time on further test and learning tasks development that can be used in the participating COMET test sites in order to prepare the learners for the next test.

Part III Competence Profiles by Gender

As mentioned in Part I, the share of female test takers was approximately 1/3 of the total number of test takers. Figure 56 provides information about the total number of female and male test participants.

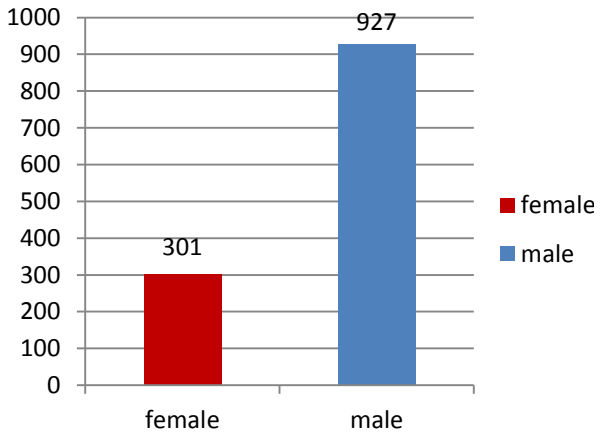


Figure 56: Total number of male and female test takers where this information was availabe (n=1228). COMET Tests 2014 and 2015

Given the fact that the test took place in vocations that are by tradition rather dominated by males, the share of female apprentices or students in this test was relatively high.

Therefore it was an interesting question, how well female learners performed in comparison to their male colleagues. Figure 57 provides a comprehensive overview on some selected competence levels reached by female and male test persons without considering the different vocations.

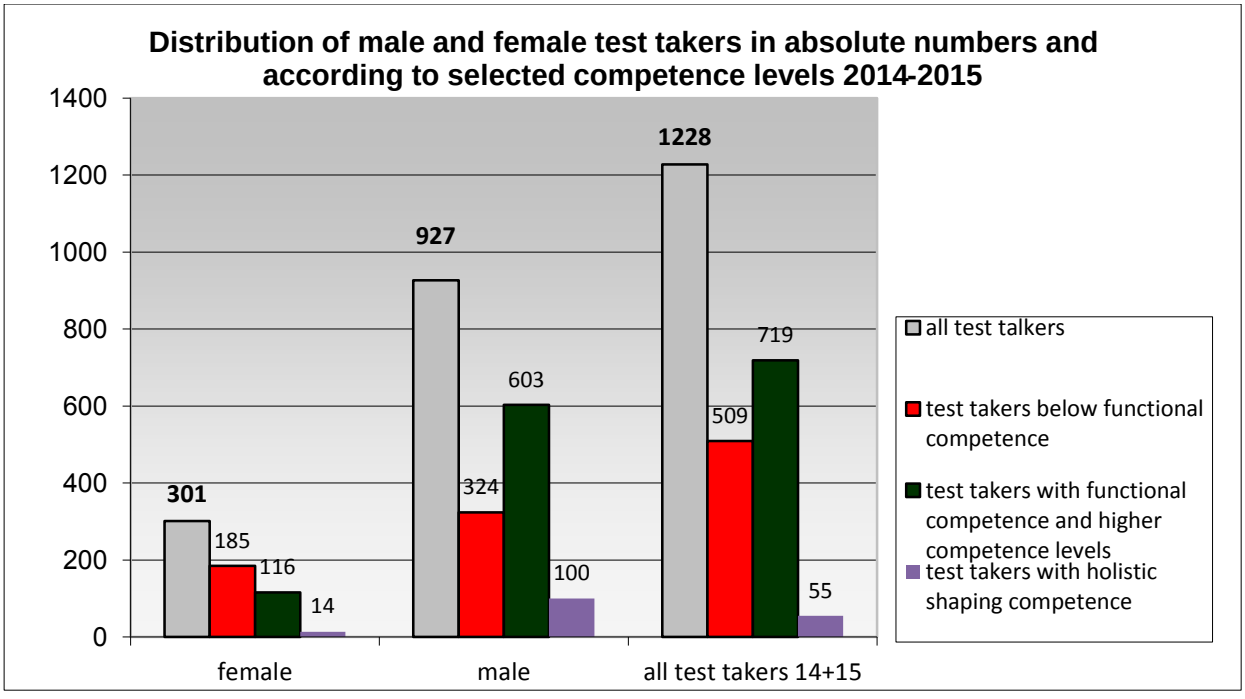


Figure 57: Distribution of male and female test takers in absolute numbers and according to selected competence levels. COMET South Africa 2014 and 2015.

The illustration documents that a bigger share of female test takers did not reach competence levels. 185 of them, which is an equivalent of 61.5 % of the total of female test takers, were still at the risk level of nominal competence while the reference value for the male test takers is about 35% (or 324 test persons in numbers).

The highest competence level was only reached by a total of 14 females or 4.6% the equivalent figure for male test takers being 10.7% or 100 persons in real numbers. Figure 58 illustrates the gap between test results of female and male participants.

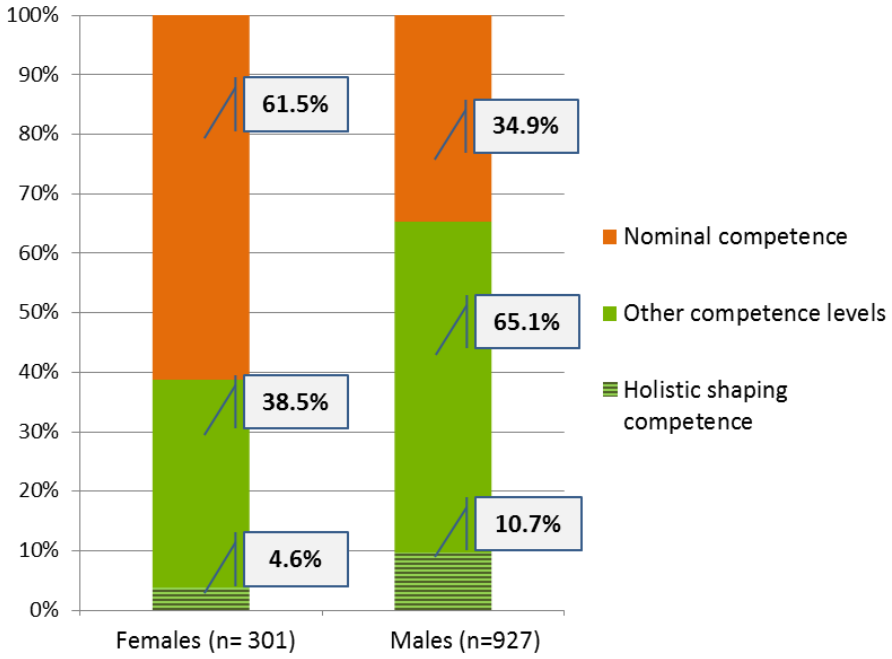


Figure 58: Percentages of male and female test takers reaching selected competence levels. COMET South Africa 2014 and 2015.

In a next step the analysis will be deepened towards the different vocations tested, starting with the vocations of the main test (electricians, mechatronics, motor mechanics and welders), followed by the vocations subject to the 2014 pre-test. All graphs and illustrations listed in the paragraphs 3.1-3.6 follow the same structure, despite the fact, that in some vocations the number of test takers are too low for general conclusions, namely in two of the pre-tested vocations (millwrights and fitters and turners).

For the remaining vocations the overall result of males performing better can only be confirmed for the electrical and in the mechatronic profession. In these two cases, competence levels of male test takers were higher. But whereas the shape of the competence profiles of electricians was more or less the same whether they were female or male, the shape the two profiles in mechatronics looked a bit different. Here, males were not only the better performing learners in terms of total scores and competence levels reached, but also their profiles were much more balanced. Except for criteria K7: social responsibility, all criteria were equally addressed. Female test takers in mechatronics had deficits in K5: orientation on business and work process, K7: social responsibility and K8: Creativity).

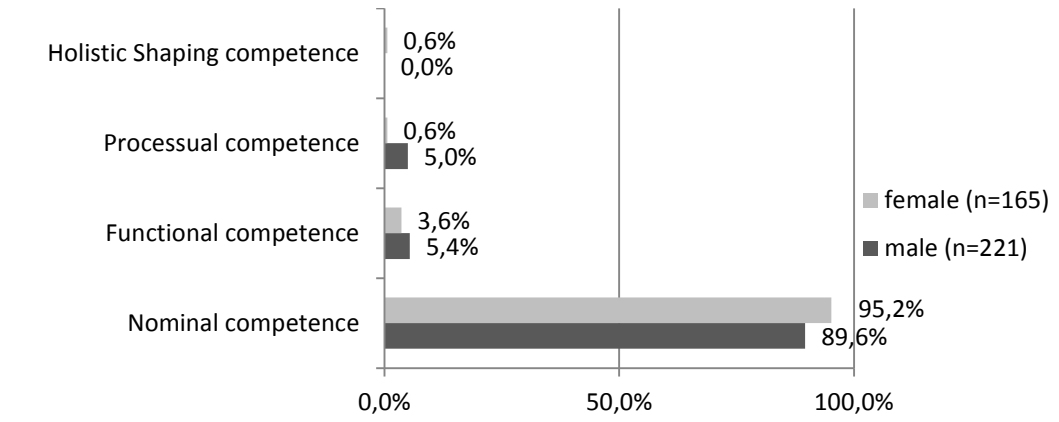
Contrary to electricians, mechatronics and motor mechanics, test takers in welding and fabrication were not showing any gender specific differences. The proportion of risk learners was however higher within these test groups as well. The reason why female test takers received almost equal results on average needs to be associated to the fact that females were also the ones who received more often the highest competence level.

Recommendations: In all vocations teachers and trainers could pay special attention to the guidance of their female learners, i.e. to support and encourage them in order to make them as competent as (and as self-confident) as their colleagues, especially because they will need to be accepted as professionals in a rather male-dominated work environment.

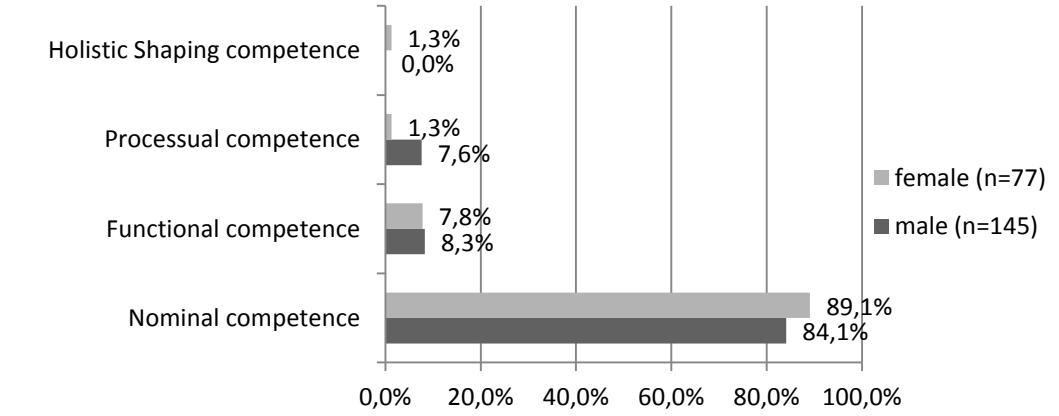
The following illustrations refer to the performance of female and male participants according to the vocations tested will not be commented any further.

3.1 Electricians

Competence levels of Electricians (result of all electricians partipating at the test and by gender and total score ≥ 0)



Competence levels of electricians by gender without ‚dropouts' (total score ≥ 5)

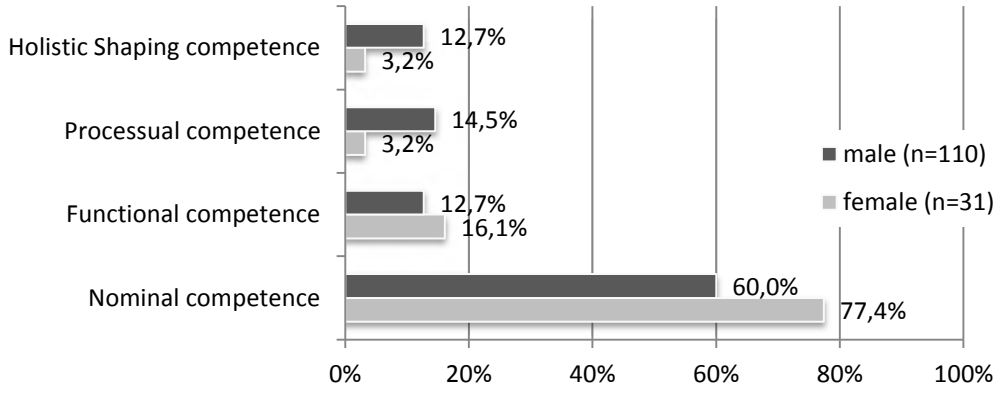


Electricians: Average profile female test takers	**Electricians: Average profile male test takers**
	
Average total score = 11.69 *n* = 77, *V* = 0.26	*Average total score* = 13.50 *n* = 145, *V* = 0.25

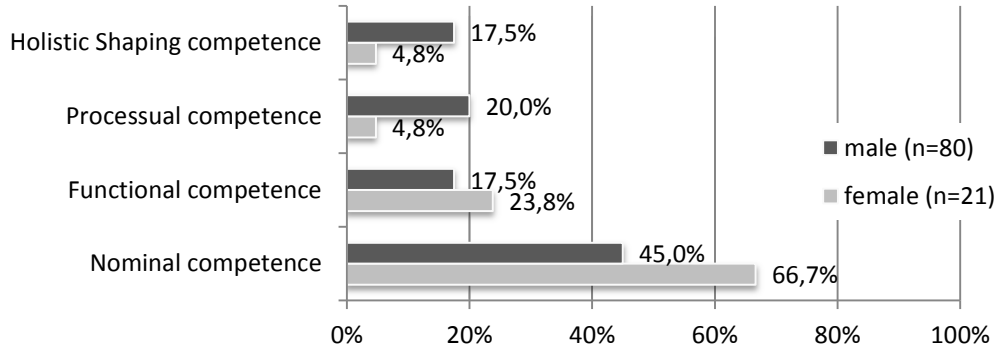
Figure 59: Competence profiles and distribution of competence levels reached in the electrical profession by gender. COMET South Africa 2014.

3.2 Mechatronics

Competence levels of Mechatronics (result of all mechatronics partipating at the test and by gender and total score ≥ 0)



Competence levels of mechatronics without ‚dropouts'
(total score ≥ 5)

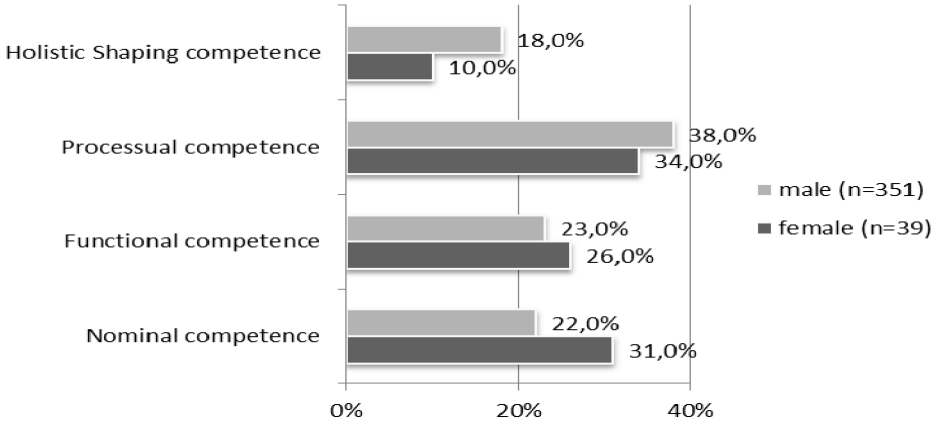


Mechatronics: Average profile female test takers	**Mechatronics: Average profile male test takers**
	
Average total score = 17.54 *n* = 21, *V* = 0.18	*Average total score*= 24.05 *n* = 80, *V* = 0.15

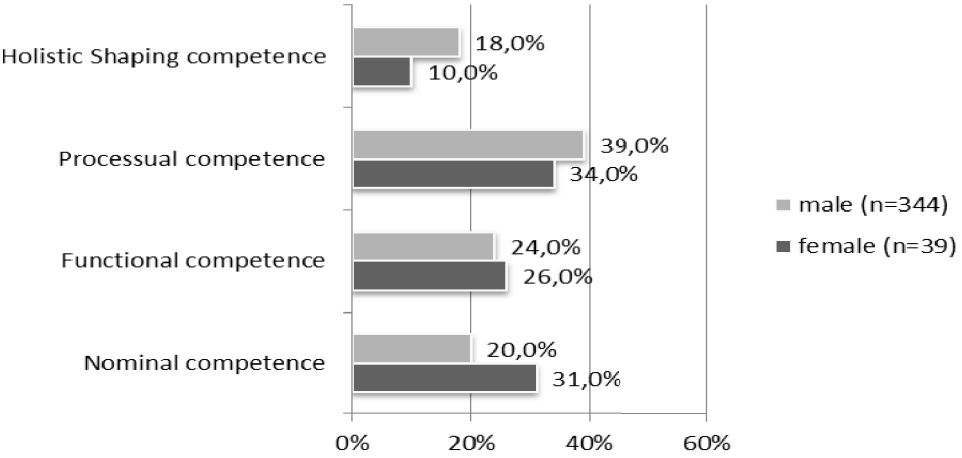
Figure 60: Competence profiles and distribution of competence levels reached in the mechatronic profession by gender. COMET South Africa 2014.

3.3 MOTOR MECHANICS (incl. diesel mechanics and learners in NCV Automotive)

Competence levels of motor mechanics (result of all motor mechanics partipating at the test and by gender and total score ≥ 0)



Competence levels of motor mechanics without ‚dropouts'
(total score ≥ 5)



Motor mechanics:
Average profile female test takers

Average total score = 26.39
n = 39, V = 0.34

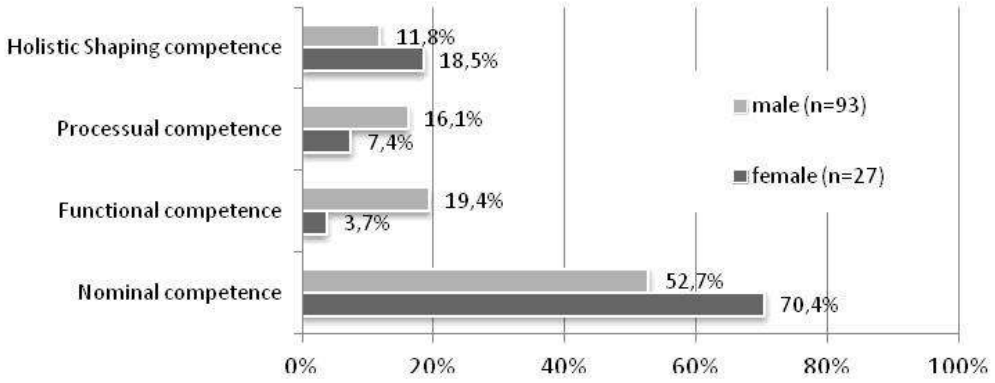
Motor mechanics:
Average profile male test takers

Average total score= 31.02
n = 344, V= 0.29

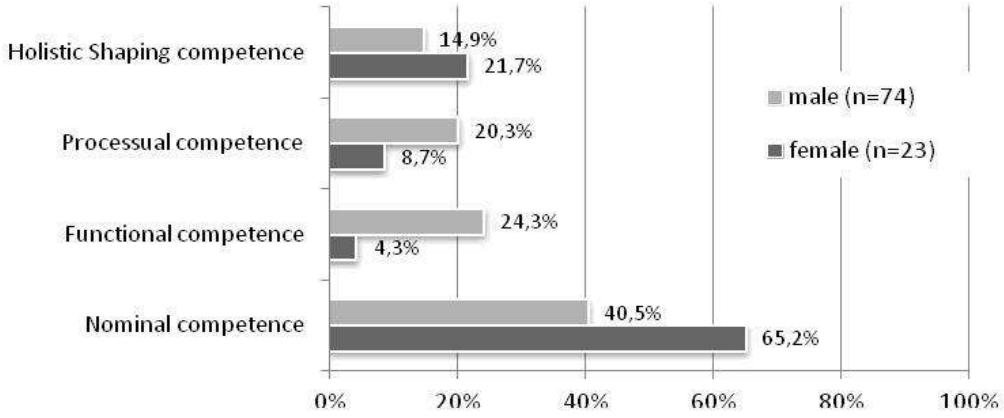
Figure 61: Competence profiles and distribution of competence levels reached in the motor mechanic profession by gender. COMET South Africa 2014.

3.4 Welders

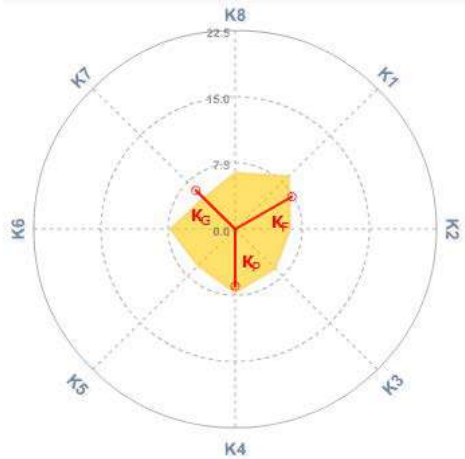
Competence levels of welders by gender result of all welders partipating at the test and by gender and total score ≥ 0)



Competence levels of welders without ‚dropouts' (total score ≥ 5)



Welders: Average profile female test takers



Average total score = 19.99
n = 27 V = 0.16

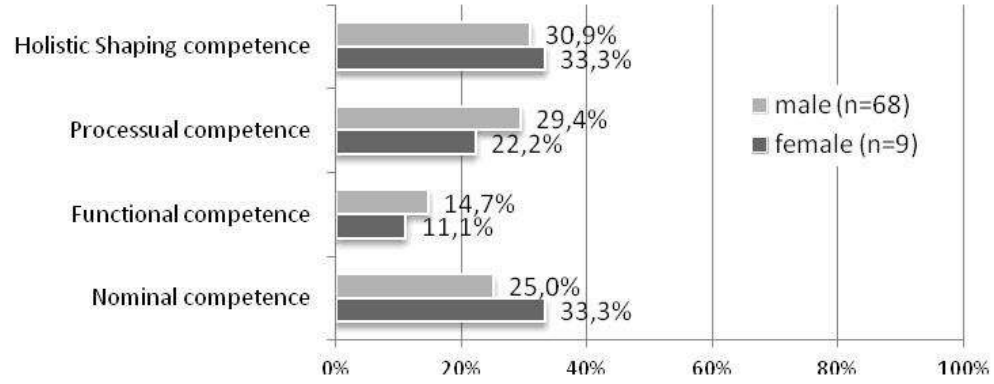
Welders: Average profile male test takers

Average total score = 20.69
n = 93, *V* = 0.17

Figure 62: Competence profiles and distribution of competence levels reached in the welding profession by gender. COMET South Africa 2014.

3.5 Fabricators (pre-test)

Competence levels of fabricators by gender result of all fabricators partipating at the test and by gender and total score ≥ 0)*



Fabricator: Average profile female test takers

Average total score = 32.37
n = 9, *V* = 0.07

Fabricator: Average profile male test takers

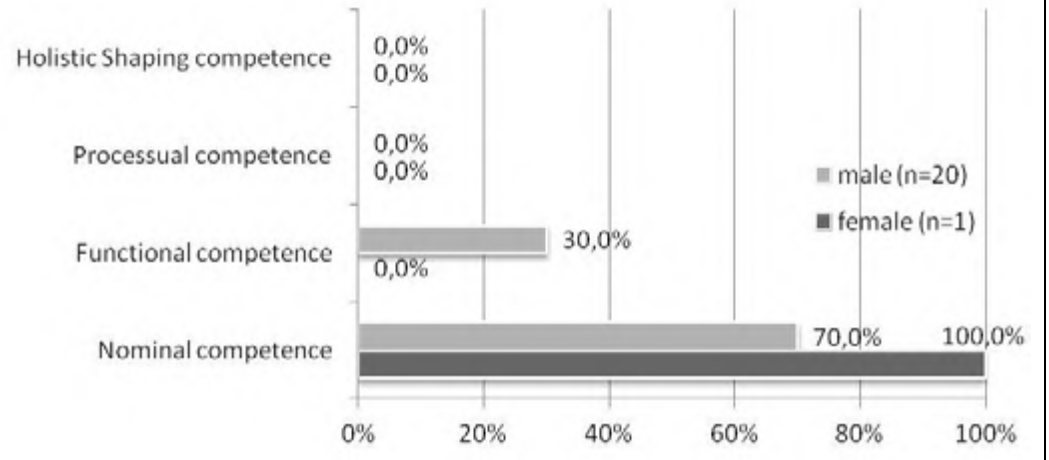
Average total score = 31.99
n = 68, *V* = 0.08

Figure 63: Competence profiles and distribution of competence levels reached in the fabrication profession by gender. COMET South Africa 2014.

*) In this profession, there were only two "drop-outs", both male, that's why not extra illustration on fabricators with a total score**≥ 5** is necessary.

3.6 Millwrights (pre-test)

Competence levels of millwrights by gender result of all millwrights partipating at the test and by gender and total score ≥ 0)***



Millwrights: Profile of one female test taker	**Millwrights: Average profile male test takers**
	
Average total score = 13.50 *n* = 1, *V* = 0.63	*Average total score* = 14.25 *n* = 20, *V* = 0.43

Figure 64: Competence profiles and distribution of competence levels reached in the millwright profession by gender. COMET South Africa 2014.

***) In the millwright profession, the total number of test takers was very low – too low and also too weak to draw two different pictures (with and without "drop-outs"). Moreover, there was only one female test taker participating at the test, so this result has only been generated for documentation purposes. It does not serve for any analysis.

Part IV Performance of DSAP participants

in 2014, 36 apprentices who were taking part in a Dual System Apprenticeship Programme (DSAP) participated in the COMET test. They were trained as electricians, mechatronics or welders, mainly at Wet Coast College and at P.E. College.

In the following, the performance of DSAP learners will be compared to the all other learners in order to find out, whether there were any specific differences that might be explained by the different nature of the learning programs/curricula. Most of the DSAP learners were in their 2nd year of training (30), while the remaining six were only in their first year. DSAP learners were as well younger than their colleagues; most of them were between 20 and 22 year old, whereas the remaining test persons were mainly in an age group above that age (see Figure 4) but as well predominantly in their 2nd year of training.

	DSAP	***non-DSAP***
Number of learners	36	814
Average age	22 (N=27)	23.2 (n=397)
Average total score of learners (excluding "drop-outs")	25.76 (N=32)	19.47 (N=509)
Percentage of learners reaching Holistic shaping competence	15.6 % (n=32)	10% (n=509)

Table 1: DSAP and non-DSAP learners

When comparing the differences in the performance of leaners, both, the levels of competences reached in the different groups and also the relating competence profiles including their variation confidents need to be compared. Even though the numbers of apprentices in DSAP is very little – compared to those involved in other programs the team decided to run this exercise. But when interpreting the results, one has to have this fact in mind.

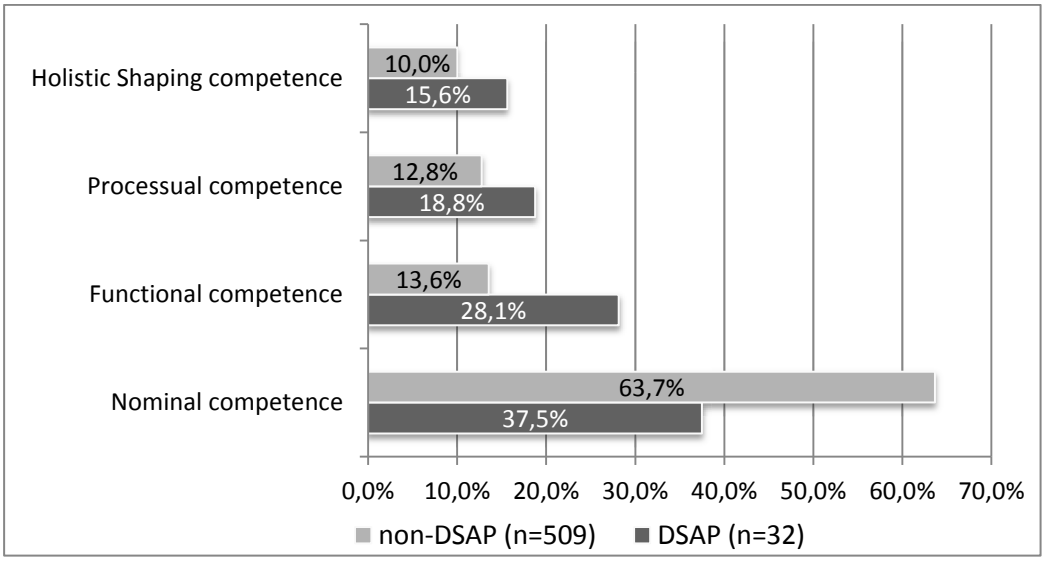


Figure 65: Distribution of competence levels: Comparison of DSAP and non-DSAP learners (excluding "drop-outs)

Figure 65 shows that competence levels reached in DSAP programs were higher while the share of learners in risk groups was lower: Around 37% of DASP learners were at nominal competence instead of almost 64% in the reference group. The different performance of the two groups is also relevant if one analyses the results according to the different vocations. For example in welding and also in mechatronics, DSAP learners were receiving slightly better results as the learners in the reference

groups. Again, it has to be pointed out, that the number of learners tested in DSAP programs is much lower than in the reference group so that this result can only be interpreted as a possible indication for some advantages of the DSAP teaching and learning concepts.

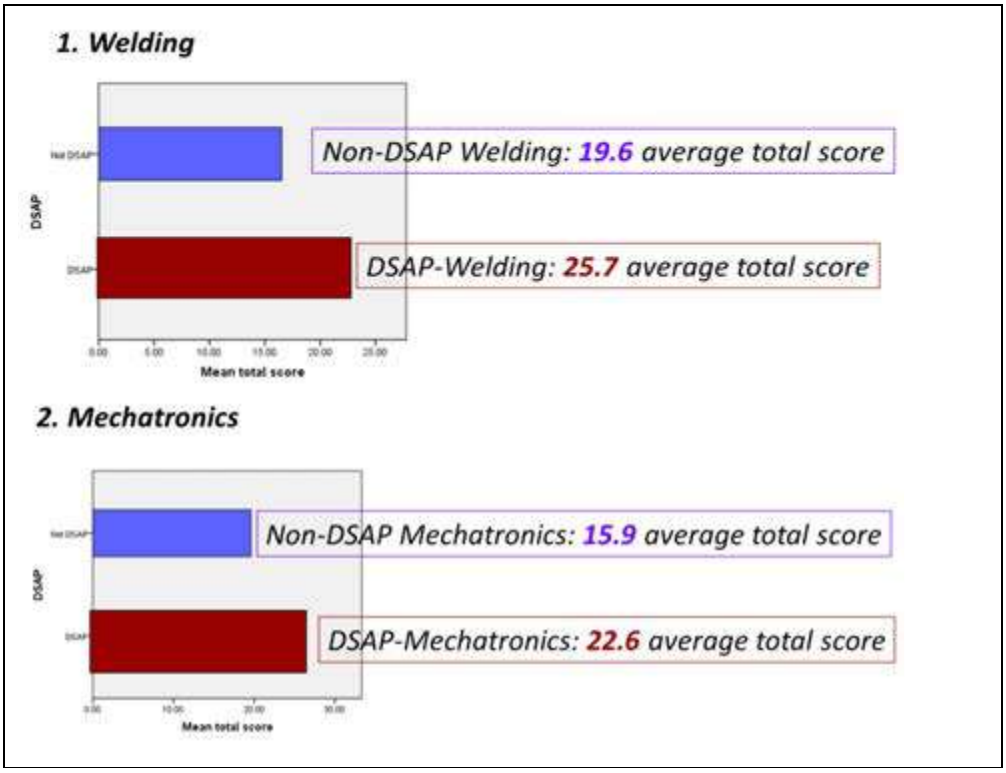


Figure 66: Comparison of Total scores DSAP / non-DSAP in two professions

As for the competence profiles, DSAP learners were reaching higher values in the variation coeffient (0.20) against 0.16 obtained on average by non-DSAP learners. This was basically due to the fact that leaners enrolled in DSAP programs were having more difficulties to consider aspects allocated to K7 (social responsibility), while all other competence criteria were addressed in a relatively balanced manner (see below, Figure 67).

Average result DSAP	Average result non-DSAP
	
Average total score = 25.76 *n* = 32, *V* = 0.20	Average total score = 19.47 *n* = 509, *V* = 0.16

Figure 67: Comparison of results: DSAP versus non-DSAP participants. COMET South Africa 2014

Part V Competence Profiles by Year of Training and Age Groups

5.1 Results by year of training

As the first main test result of COMET 2011 had shown a dramatic degree of stagnation in competence development, the data analysis of the subsequent main test in 2014 and 2015 was a key question. The following figure illustrates the results off of all three tests. First of all, it has to be said, that the data in 2011 and 2015 was based on only one vocational group (electricians in 2011 and motor mechanics in 2015), whereas the 2014 result relates to six vocation with a majority of electrical learners – which formed (together with some smaller groups of pre-test vocations (millwrights and fitters and turners) the weakest group of test takers in terms of their overall and average performance. Therefore, and when comparing the results of the different years, this has to be taken into consideration.

But above all, the three pictures are documenting that whatever the test cohort was like, and whatever the vocations tested in the past years, the result was pretty much the same – even though on different overall levels. There were only minor changes regarding the total scores reached by the learners within the different years of training. In the first test the total average score was only varying between 14.5 and 16, in 2014 between 12 and 17.1 points as the highest. In 2015, when the average overall levels were higher, they were stuck at about 30 points on average, reaching values between 28.7 (lowest) and 31.2 (highest).

When comparing the test results from 2011, 2014 and 2015, one can see that the only difference can be associated to the 3rd and 4rd year of training. In 2011 and 2015, stagnation or even back falls in competence development related to all years of training, i.e. also to the final year of training. In 2014 by contrast, the number of average scores were lower 3rd year of training whereas the 4rth year learners reached highest average scores compared to the “beginners” and “advanced learners” (in terms of years being trained). So in this regard, the analysis suggests that there was not only stagnation and/or some sort of fall-back but lastly also some positive competence development between year 3 and year 4 for test takers participating in 2014. However, the effect is still very small and needs to be looked at in more depth.

A differentiation of competence development according to years of training and including the different levels of competence reached are provided in Figure 69. Here as well, it strikes how learners in the third year fell back behind those who were in the first two years of their studies or apprenticeships. The composition of this group which - in 2014 - consisted of 137 learners (incl. drop-outs) does not suggest that the reason for this kind of cut-back in competence development can be explained with a high percentage of learners who were trained in the rather problematic vocations. If this was true, the group of 3rd year learners would have to include more electricians, fitters and turners or millwrights compared to the group of 4th year learners, who performed much better on average. But this was not the case (see Figure 70).

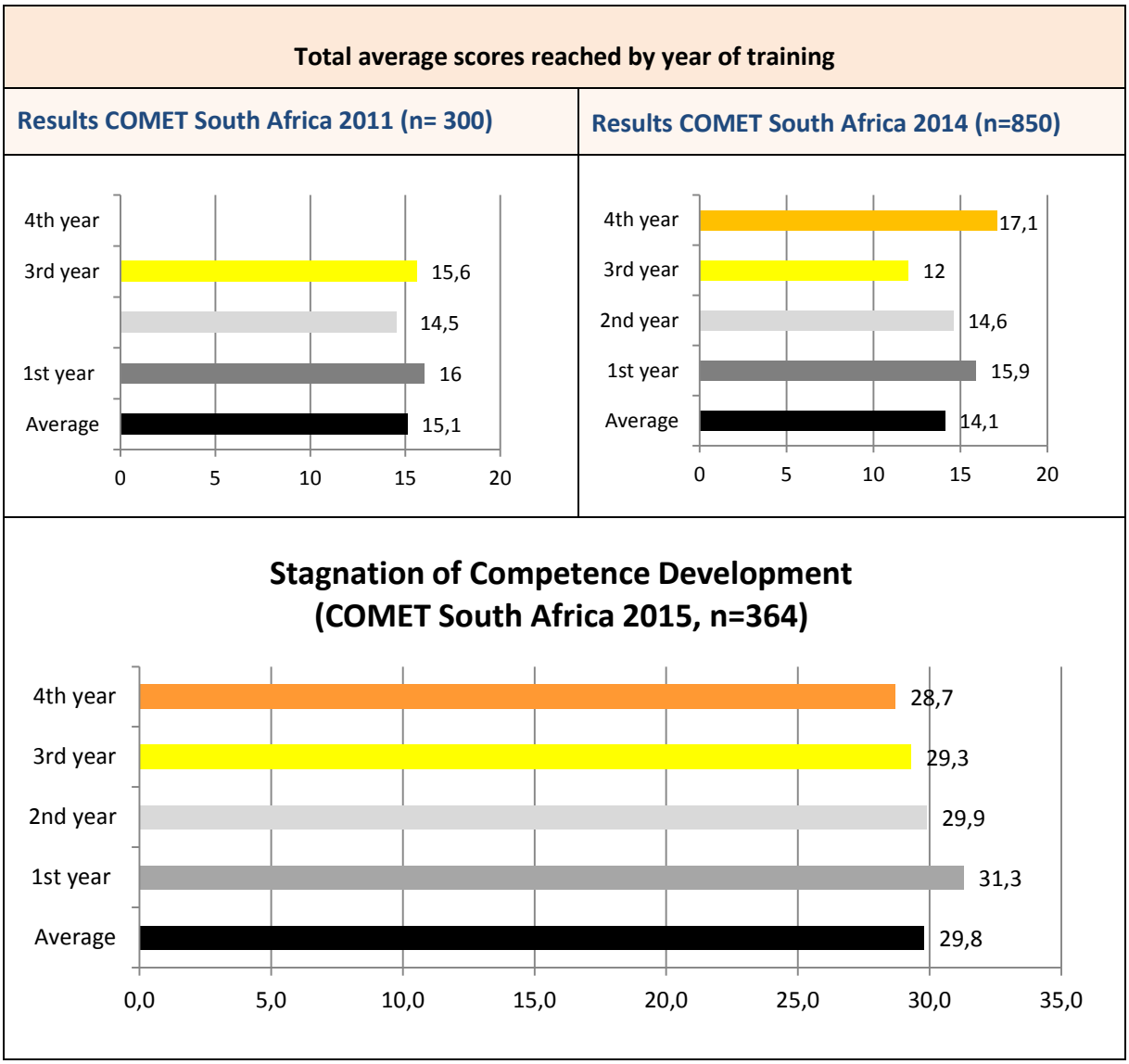


Figure 68: Total average scores reached by year of training. Finding of COMET tests in South Africa in 2011, 2014 and 2015)

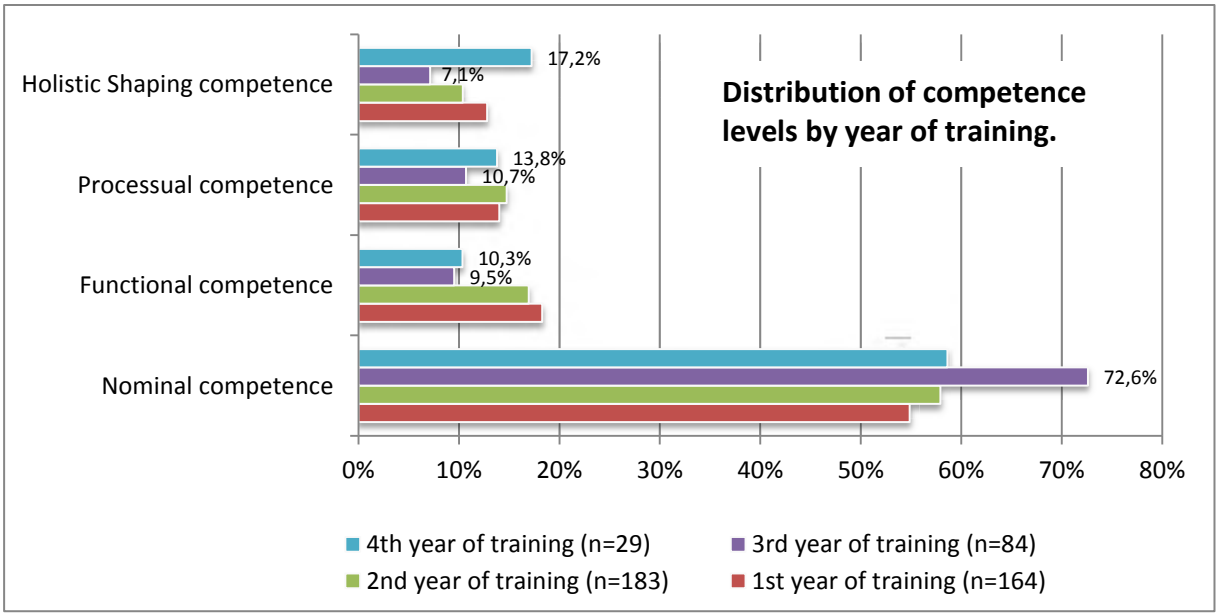


Figure 69: Competence levels according to year of training. COMET South Africa 2014.
*) Results based on a calculation excluding drop-outs (total average score ≥ 5).

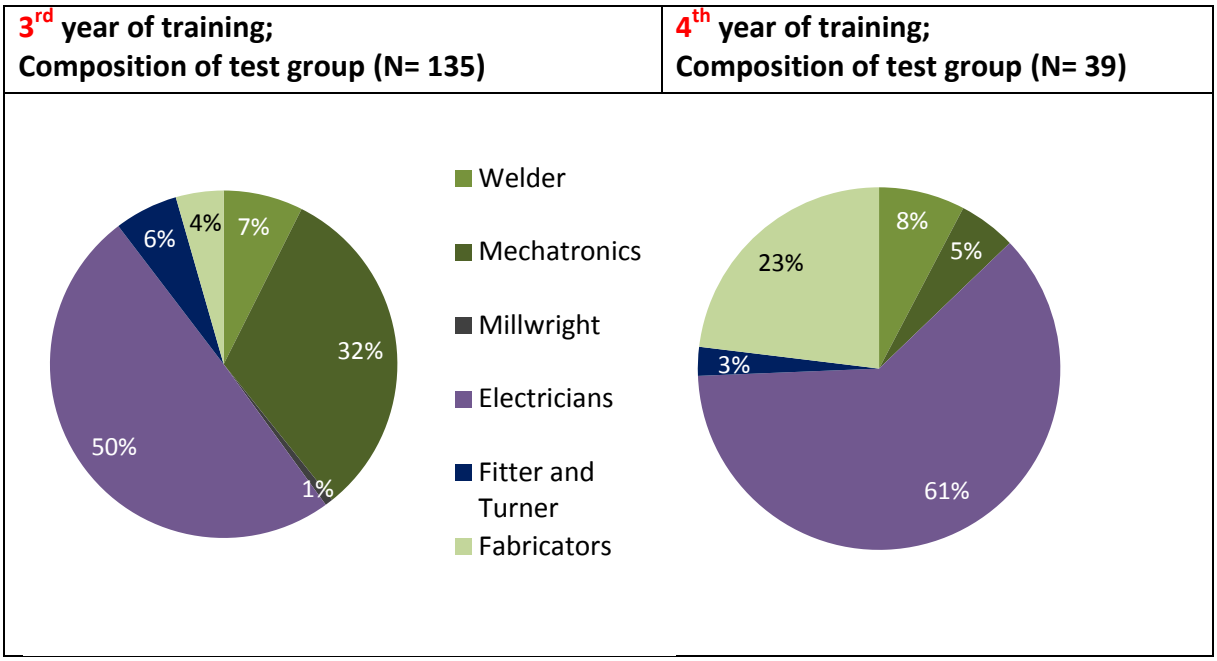


Figure 70: Composition of test groups (vocations trained) in 3rd and 4th year of training (including drop-outs. Total average score = ≥ 0) COMET South Africa 2014

That – in general – the problem of stagnation in competence development persists in all tests shall however not be documented by taking the total average score as the only point of reference. Stagnation is as well visible in the picture of the competence ***profiles*** according to the different training years. As Figure 72

shows, competence profiles also do not develop over the years. The only positive development took place in year 4 (test 2014), where also a bigger share of test takers solved their tasks more comprehensively or balanced, a fact which is supported by the lower variation coeffient of 0.13 reached on average in this group.

Average Profile 1st year (test 2014)	Average Profile 2nd year (test 2014)	Average Profile 3rd year (test 2014)	Average Profile 4th year (test 2014)
			
Average score = 21.43 *n* = 164, *V* = 0.15	Average score = 20.61 *n* = 183, *V* = 0.18	Average score = 17.25 *n* = 84, *V* = 0.20	Average score = 22.97 *n* = 29, *V* = 0.13

Figure 71: Competence profiles according to year of training (1-4) (All test takers with a total score ≥ 5). COMET South Africa 2014.

Moreover, an analysis of competence levels achieved according to a differentiation into high medium and low, which is attached in the appendix (I.3) suggests, that apprentices in the 4th year of training are achieving higher results within a given competence level than their colleagues in the 3rd or 1st and 2nd year of training. In this regard, it can be said, that stagnation of competence development was not purely relevant for the second main test in 2014, even though the full potential of

apprenticeship or study programs was by far not fully explored.

Like in the previous tests, the group of learners who took part in the motor mechanic main test in 2015 also could not show that qualitative chances in problem solving patterns were possible over the years of training. This is documented by the shape of competence profiles including their variation coeffient in addition to the total average scores. Although on different competence levels (compared to average results of learners tested in the previous COMET tests), one has to observe that during the course of training, the profiles of learners do not develop over time. In the classes of motor mechanics, there have been considerable problems in the learner's performance in the domains of social and environmental issues related to their work tasks. That's why the shape of their average profiles did not change over time. Moreover there has not been a general increase in the levels of competence reached; instead, there was a slight decline.

Average Profile 1st year (test 2015)	Average Profile 2nd year (test 2015)	Average Profile 3rd year (test 2015)	Average Profile 4th year (test 2015)
			
Average score = 31.29 n = 98, V = 0.27	Average score = 29.91 n = 105, V = 0.31	Average score = 29.36 n = 133, V = 0.31	Average score = 28.70 n = 21, V = 0.34

Figure 72: Competence profiles according to year of training (1-4) (All test takers with a total score ≥ 5). COMET South Africa 2015.

5.1.1 Stagnation of competence development

In order to further analyse the problematic of stagnation in competence development, it is necessary to examine this issue according to the different vocations tested so that it is possible to see whether it is equally relevant for all test groups. The following tables illustrate the calculations of average competence profiles reached in the various vocational groups and according to the different years of training for those test persons were data on this context was available. The analysis is only made for electricians, mechatronics and welders who participated in the main test 2014, because in the remaining two vocations of the pre-test the test group was rather small and moreover, the results were not good enough to allow for any useful distinctions. All calculations refer to the complete group of test takers, i.e. drop-outs are included in order to reflect the complete picture (the results of motor mechanics are documented in Figure 72.

As it can be seen from this analysis, stagnation (or even a slight decline) in competence development is relevant in *all* vocations, only on a different competence level. The fact that learners in their fourth year of training had better average results compared to learners in a 3rd year of training is mostly based on the point that this group result referred to a large extent on the better results obtained by fabricators[26] and electricians in the fourth year of training. Especially, because the test

[26] 10 Fabricators were in their 4th year of training. They have reached, 33.5% on average, which is a very high result that needs to be analysed further. A share of 25 Electricians also belongs to the group of 4th year learners. These were reaching only 11.3 Total average score on average (which just represents a minimum score in functional competence)

results of fabrications are based on a pre-test with some inconsistencies (cf. 6.5.3), it would be problematic to derive general results. It can therefore by far not be argued that stagnation of competence development was less significant in the fourth year of training, while in the previous years there was also no progression.

An analysis was not made in cases where the number of test participants in a test group was only three or four because average results with such low numbers should not be compared to average results in larger groups.

Recommendations:

- Introduction and consistent work with learning tasks designed according to the COMET approach
- further teacher training on test and learning tasks development
- regular meetings of the different vocational working groups of the project team.

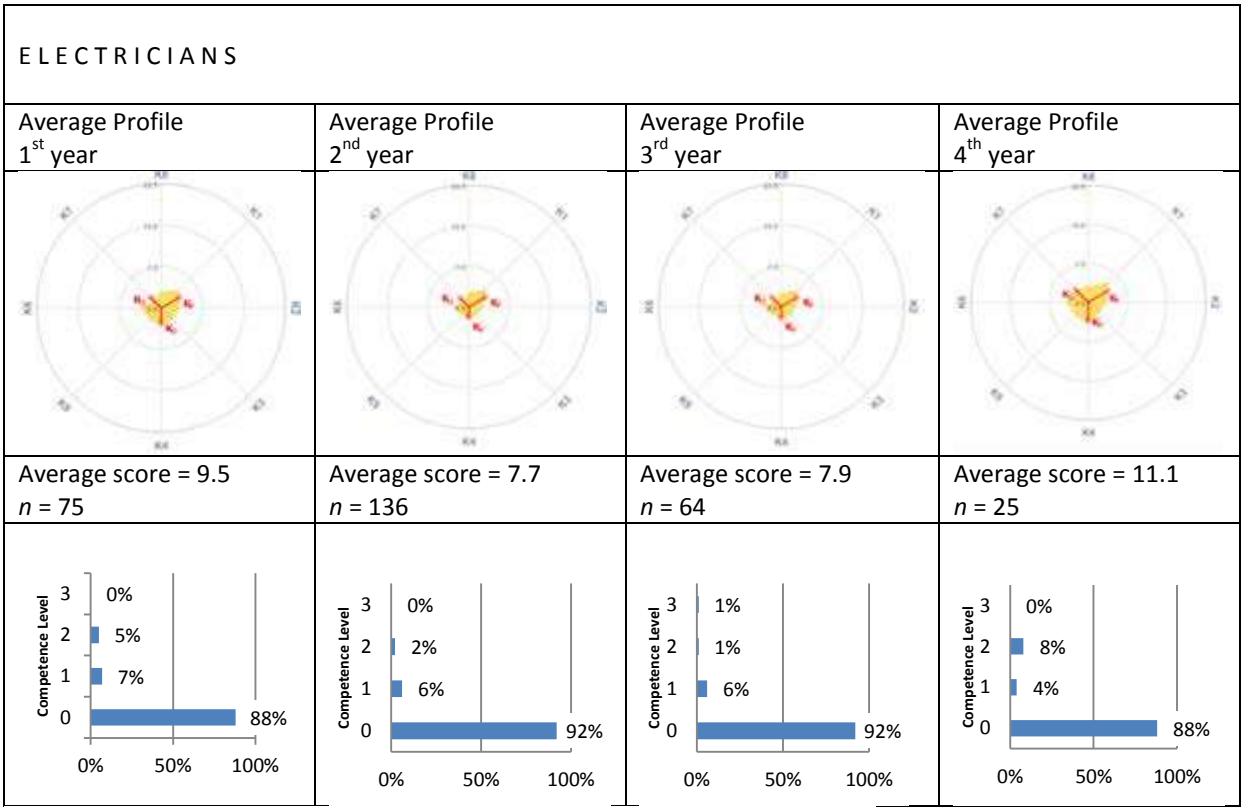


Figure 73: Competence development of electricians according to year of training

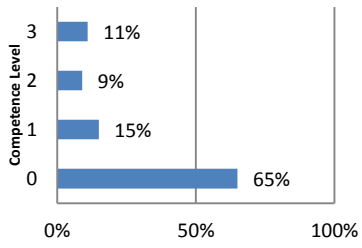
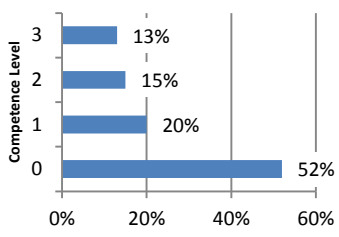
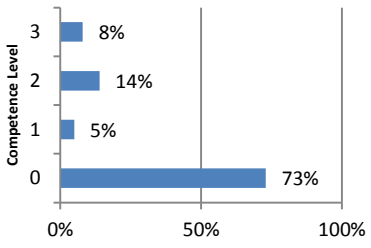
MECHATRONICS		
Average Profile 1st year	Average Profile 2nd year	Average Profile 3rd year
		
Average score = 15.9 *n* = 55	Average score = 18.1 *n* = 46	Average score = 17.5 *n* = 37
		

Figure 74: Competence development of mechatronics according to year of training
*) Due to the low number of only two mechatronics in the 4th year of training corresponding graphs are not documented.

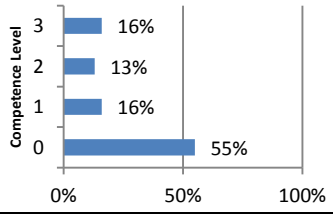
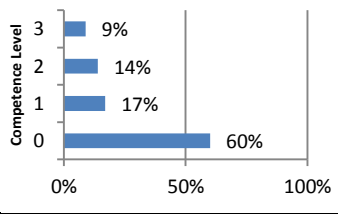
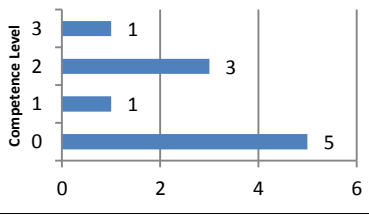
WELDERS		
Average Profile 1st year	Average Profile 2nd year	Average Profile 3rd year*
		
Average score = 21.3 *n* = 68	Average score = 19.7 *n* = 35	Average score = 21.3 *n* = 10 (!)
		

Figure 75: Competence development of welders according to year of training
*) Due to the low number of three welders in the 4th year, these results are not documented.

5.1.2 Results by age groups

A good indicator for the analysis by age groups is the share of risk group learners in a respective age group. Such analysis has been made and can be illustrated by the following graph. This graph shows that risk group learners are almost equally dispersed among all age groups so that in general, there is no indication that age has a considerable influence on the performance of learners.

The cumulated data collected in both COMET main tests in 2014 and 2015 does not show any correlation between age and good or bad performance. In an interim result based on the 2014 data, some better results (using the share of test takers above risk level as a reference value) were received by the first age group of rather young learners and also by those learners in relatively old age groups. But this trend could not be confirmed after the analysis of the total sample of 892 test persons who provided information on their age in all tests 2014 - 2015. The fact that many learners of the age group 24-29 did not perform well in 2014 compared to other test takers might have to be seen in the light of the fact that in the corresponding test, a big share of weak performing learners in this age group took part in the electrical test.

In any case, what might be a benefit for older test takers (experience), was – on average – no advantage on a COMET test day. This result also supports the finding of stagnation in competence development over the different years of training.

As for the age group analysis, no further calculations or analysis seems to be important at this stage.

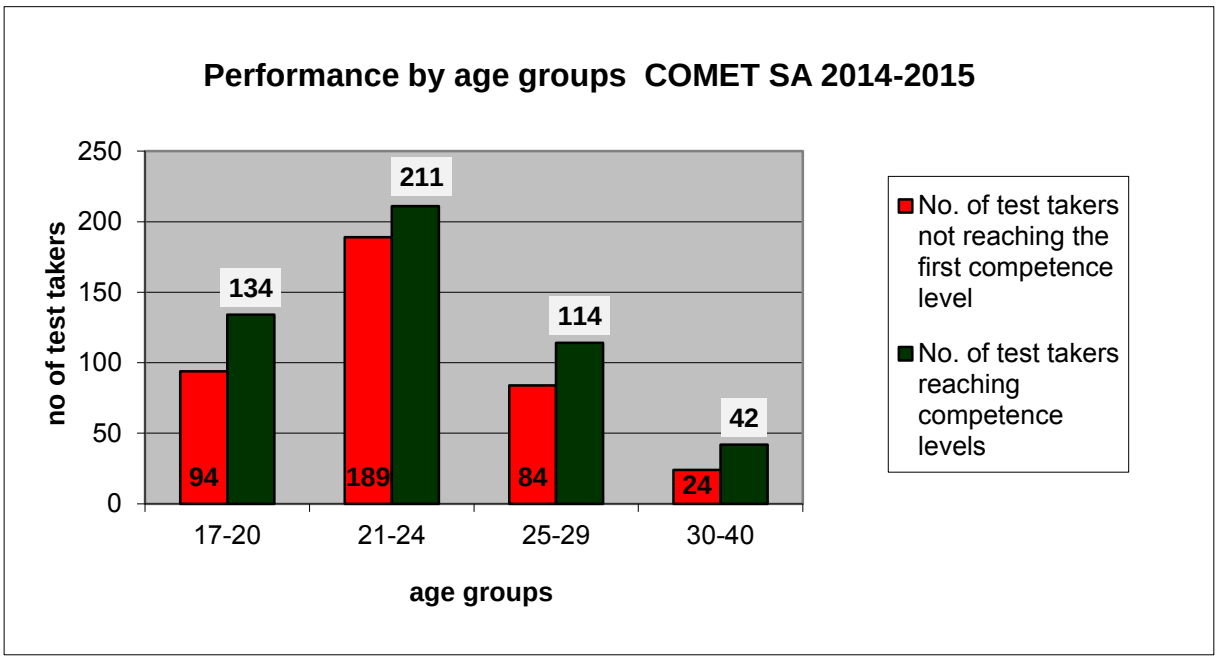


Figure 76: Competence profiles according to age groups (all test takers). Data COMET South Africa 2014 and 2015

Part VI Competence Profiles by Tasks

6.1 Electricians

6.1.1 Test task development

Ten tasks have been developed in the South African COMET project team, eight of which went into the pre-test in 2014 and two into the subsequent main test (see table 2).

Average competence profiles reached by electricians taking part in the pre-test were very weak. But the question whether the difficulty of tasks in the electrical occupation was (much) higher than the difficulty of tasks in the other two occupations of the pre-test (mechatronics, welding) could not be derived from the pre-test results at all – due to the very low number of test takers. Because this low number of test participants in the pre-test and per task tested in the pre-test, a further *pre*-test in the same occupation with a larger number of test takers per tasks was recommended after the analysis of pre-test results in April 2014. This excise did not take place before main test 2014 but looking back, this would have made much sense, notably because main test results strongly point to some deficits relating to task specific problems.

Tasks developed and introduced in Pre-Test 2014 and Main Test 2014 (Electricians)		
Tasks developed by the South African COMET Team	Tasks introduced in Pre-Test and Number of test takers per task (n)[27]	Tasks used in Main test Number of test takers per task (n)*
01_EL_Domestic upgrades	-	-
02_EL_Irrigation system	02_EL_Irrigation system (n=4)	-
03_EL_Simple control system	03_EL_Simple control system (n=2)	-
04_ELl_Airflow system	04_EL_Airflow system (n=2)	-
05_EL_Four-way traffic light	05_EL_Four-way traffic light (n=4)	- 05_EL_Four-way traf. light (n=55)
06_EL_Gate motors	06_EL_Gate motors (n=1)	-
07_EL_Earth leakage	07_EL_Earth leakage (n=2)	-
08_EL_Pump panel refurbishment	08_EL_Pump panel refurbishment (n=1)	-
09_EL_Overheated weld. m. motor	-	- 10_EL_Rock crusher (n=55)
10_EL_Rock crusher	10_EL_ Rock crusher (n=4)	- 11_EL_Skylight control (DE)(n=49)
		- 12_EL_Drying Space (DE) (n=48)

Table 2: Tasks developed and introduced in the pre-test and main test of Electricians. South Africa 2014 and 2014.
*) The actual number of test takers working on these tasks was much higher but in a majority of cases, the information was not provided by learners, so that these numbers only reflect a part of the total cohort of electrician participating in the main test.

6.1.2 Learners' performance by task

The following figure represents average results achieved on tasks 05_EL_Four-way traffic light and 10_EL_Rock crusher, which had been developed in South Africa and chosen for the main test. Moreover, two tasks from the previous the test of electricians in 2011/12 were selected for the 2014 main test. These were 11_EL_Skylight control (DE) and 12_EL_Drying Space (DE), both of which had been developed by a German COMET team and were used in a variety of COMET test in Germany and also in China. The idea was to collect data on comparative COMET projects and to find out, whether a relative weakness in the performance of electrical students in South Africa was due to a higher degree of difficulty incorporated in the electrical tasks designed in South Africa.

[27] A total of 26 electricians participated in the pre-test, 6 of them were working on task for "mechatronics", that's why they are not considered in this table.

As Figurte 72 shows, main test results of electricians working on the tasks 5 and 10 were only marginally better than compared to the pre-test results.

Average Profile Task 5 **(Pre-test** 2014)	Average Profile Task 10 **(Pre-test** 2014)
 *Total average score* = 10.42 n=4	 *Total average score* = 11.05 n=3
Average Profile Task 5 **(Main Test** 2014)	**Average Profile Task 10** **(Main test** 2014)
 *Total average score* = 12.42 *n=55*	 *Total average score* = 13.54 *n=55*

Figure 77: Pre-Test and main test results of electricians. COMET South Africa 2014 / 2014

Similar results have been obtained by learners working on the two tasks designed in Germany (No. 11 and 12). On average, total scores reached were between 12 and 14. If one compares these results with results reached in a reference project, i.e. a first main test in electronics in North Rhine-Westphalia (2013), it becomes visible, that also in Germany, a relatively high proportion of learners performed at rather low levels.

For example 47% of all learners working on task 12 (Drying Space) obtained total average scores below functional competence in Germany. Still, there is a big difference between overall results, both in terms of total average scores as well as in competence profiles and competence levels reached.

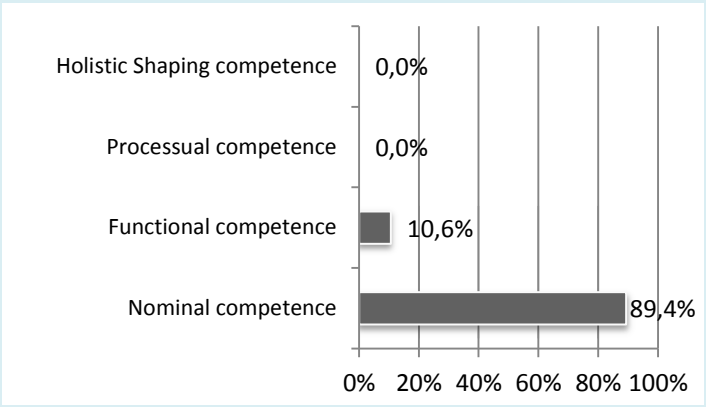
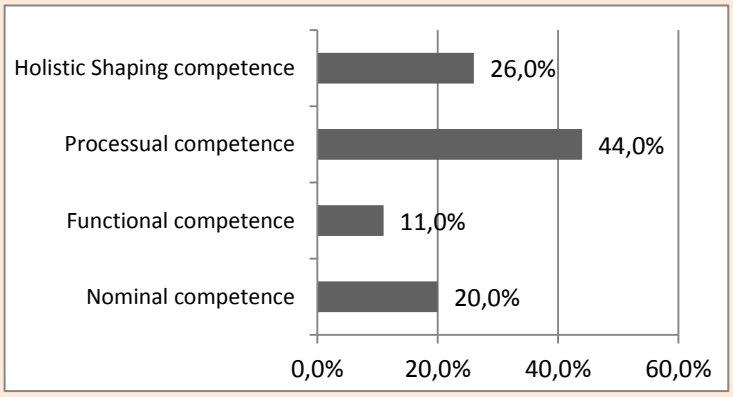
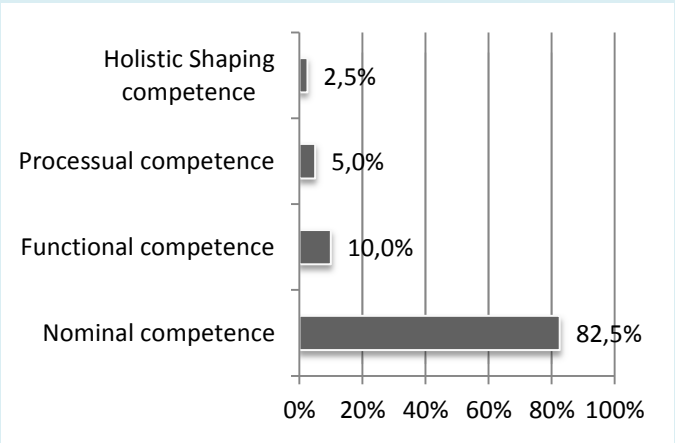
Average Profile Electricians Task '11_EL_Skylight control (DE)' **COMET main test 2014**	Distribution of competence levels of Electricians '11_EL_Skylight control (DE)' (n=47)
 *Total average score* = 12.06 *n* = 47, *V* = 0.33	
REFERENCE PROJECT – RESULTS: Average Profile Electricians Task '11_EL_Skylight control (DE)'	**REFERENCE PROJECT – RESULTS:** Distribution of competence levels of Electricians '11_EL_Skylight control (DE)' (n=47)
	

Figure 78: Main test results Electricians COMET South Africa 2014 – performance with regard to task 11 in comparison to reference results (Germany North Rhine Westphalia - 2013 first main test Electricians)

Average Profile Electricians Task '12_EL_Drying Space (DE)' **COMET Main test 2014**	Distribution of competence levels of Electricians working on test task '12_EL_Drying Space (DE)' (n=40)
 *Total average score* = 13.54 *n* = 40, *V* = 0.29	

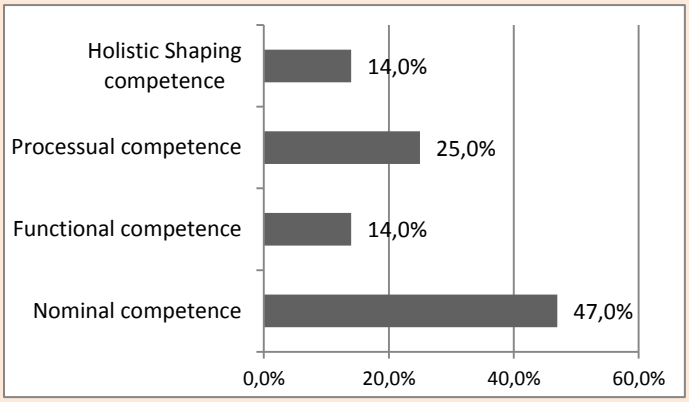
REFERENCE PROJECT – RESULTS: Average Profile Electricians Task '12_EL_Drying Space (DE)'	**REFERENCE PROJECT – RESULTS:** Distribution of competence levels of Electricians '12_EL_Drying Space (DE)' (n=56)
	

Figure 79: Main test results Electricians COMET South Africa 2014 – performance with regard to task 12 in comparison to reference results (Germany North Rhine Westphalia - 2013 first main test Electricians)

An overall picture about the distribution of results according to the different tasks designed for electricians is given in Figure 80. In this graph, also the two tasks introduced to the pre-test participants in the millwright profession are considered (no. 13 and 14) due to the fact, that they also address the electrical domain. In comparison to all other tasks, best results have been achieved with task 12_EL_Drying Space (DE). Here, 8.4% of all learners working on this task received either competence Level 3 or 2. 10% still reached functional competence (level 1), while the big majority was at nominal competence (81%). None of the learners working on the two tasks from the South African pre-test (no 5 and 10) achieved holistic shaping competence. Processual competence was reached by 5.6% of the learners working on task 10 and 1.8% of the learners working on task 5, while the very big majority of learners (more than 90%) working on these two tasks could not pass the level of risk. Tasks 13 and 14, which had been solved by only a very small number of pre-test takers in the millwright profession led to slightly better results – which nevertheless cannot be directly compared to all other results due to the fact that only a limited number of test takers had been involved and also because of learners being trained in a different profession.

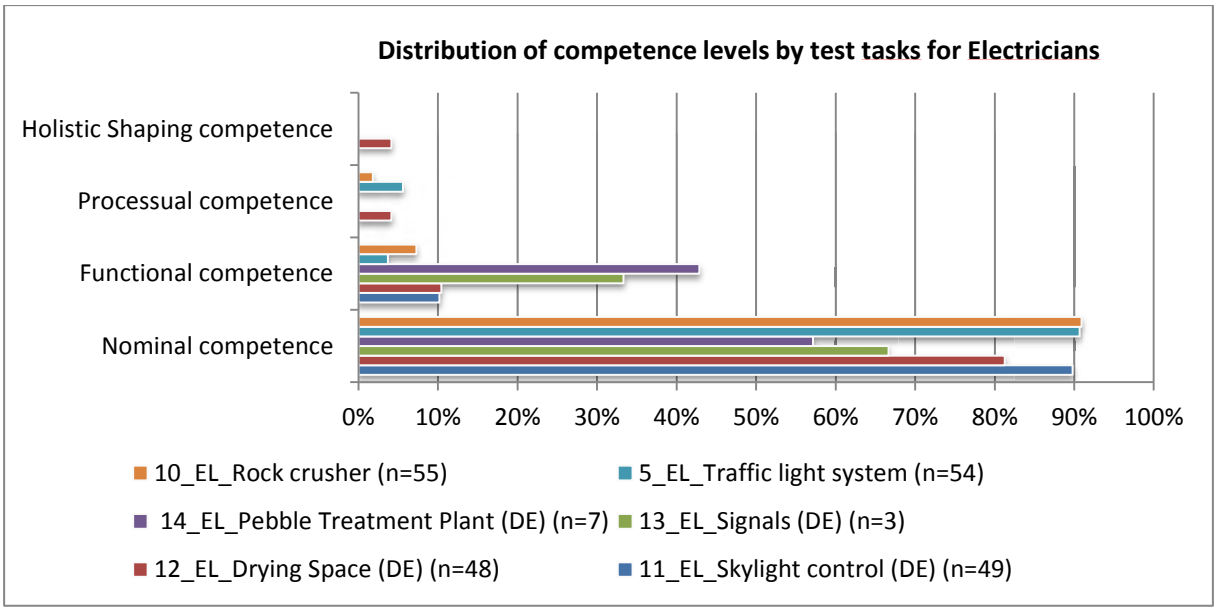


Figure 80: Distribution of competence levels by test tasks for Electricians

6.2 Mechatronics

6.2.1 Test task development

In mechatronics, out of 10 tasks developed by the South African team, seven had been pre-tested, and four were finally selected for the main test. Table 3 provides an overview on the respective tasks. Contrary to the test for electricians, no mechatronic task used in main test was developed outside South Africa. No comparison with other international COMET projects has been possible so far.

Tasks developed and introduced in Pre-Test 2014 and Main Test 2014 (Mechatronics)		
Tasks developed by the South African COMET Team	Tasks introduced in Pre-Test and Number of test takers (n)	Tasks used in Main Test Number of test takers (n)
01_MT_Alternative energy bicycle	--	-
02_MT_Automatic gate	--	-
03_MT_Automating drill press	03_MT_Automating drill press (n=9)	03_MT_Automating drill press (n=27)
04_MT_ Beverage can packing	04_MT_ Beverage can packing (n=9)	04_MT_ Beverage can packing (n=19)
05_MT_Bootlace crimping tool	05_MT_Bootlace crimping tool (n=10)	-
06_MT_ Conveyer bottleneck	06_MT_ Conveyer bottleneck (n=9)	08_MT_Robot cell safety (n=27)
07_MT_ Plan maintenance	--	-
08_MT_Robot cell safety	08_MT_Robot cell safety (n=3)	10_MT_Ventil. in workshop (n=34)
09_MT_Sorting conveyor	09_MT_Sorting conveyor (n=8)	
10_MT_Ventilation in workshop	10_MT_Ventilation in workshop (n=10)	

Table 3: Tasks developed and introduced in the pre-test and main test of Mechatronics. South Africa 2014 and 2014.

6.2.2 Learners' performance by task

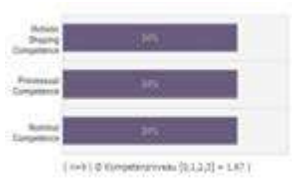
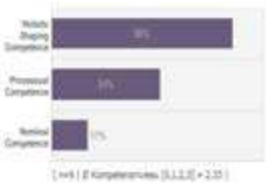
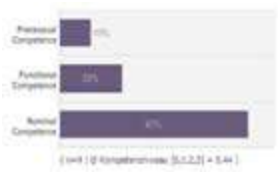
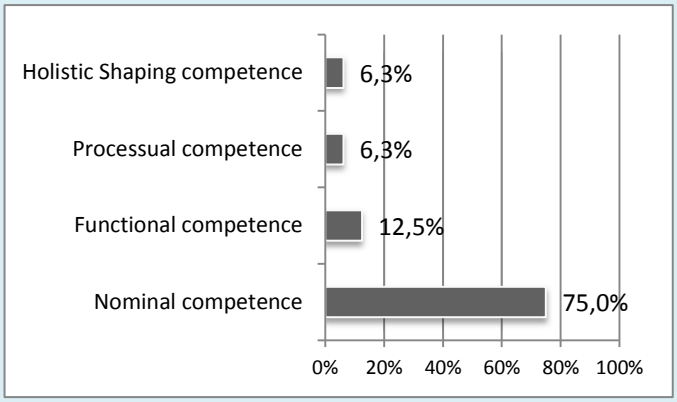
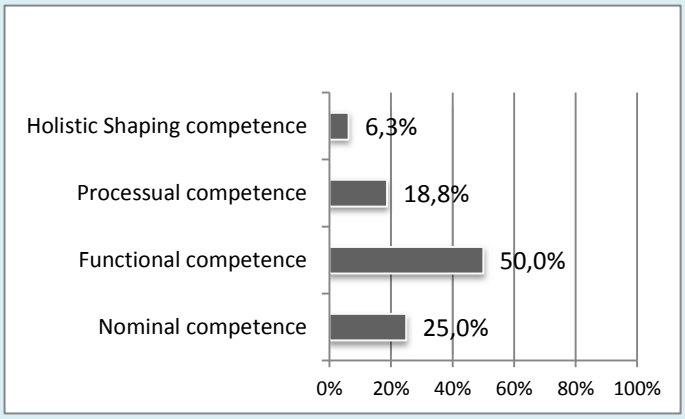
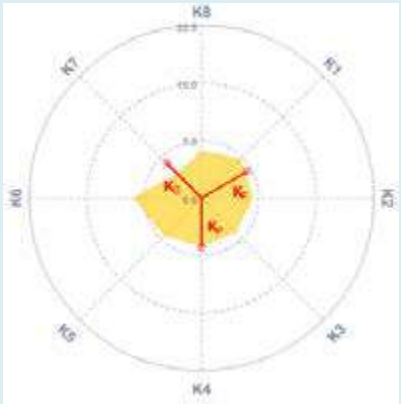
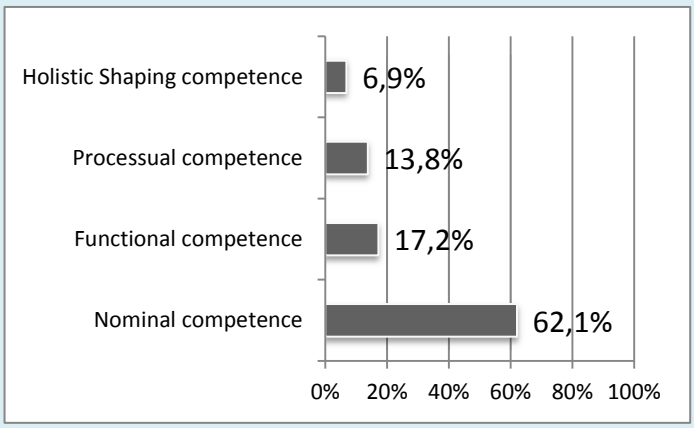
Average Profile Task 03 (Pre-test 2014)	Average Profile Task 04 (Pre-test 2014)	Average Profile Task 08 (Pre-test 2014)	Average Profile Task 10 (Pre-test 2014)
			
			

Figure 81: Pre-Test results of tasks No. 3, 4, 8, 10 in mechatronics. Pre-Test. South Africa 2014.

Average Profile Mechatronics Task '03_MT_Automating drill press ' **COMET Main test 2014**	Distribution of competence levels of Mechatronics working on task '03_MT_Automating drill press' (n=16)
 *Total average score* = 14.35 *n* = 16, *V* = 0.35	
Average Profile Mechatronics Task '04_MT_ Beverage can packing' **COMET Main test 2014**	Distribution of competence levels of Mechatronics working on task '04_MT_ Beverage can packing' (n=16)
 *Total average score* = 23.54 *n* = 16, *V* = 0.28	
Average Profile Mechatronics Task '08_MT_Robot cell safety ' **COMET Main test 2014**	Distribution of competence levels of Mechatronics working on task '08_MT_Robot cell safety' (n=29)
 *Total average score* = 19.68 n = 29, V = 0.19	

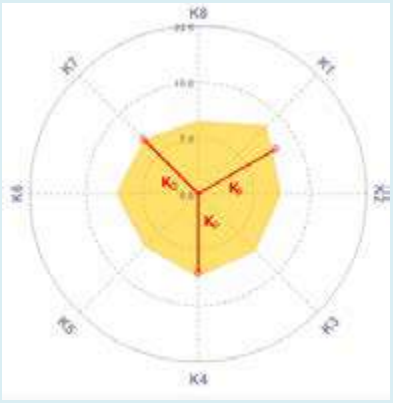
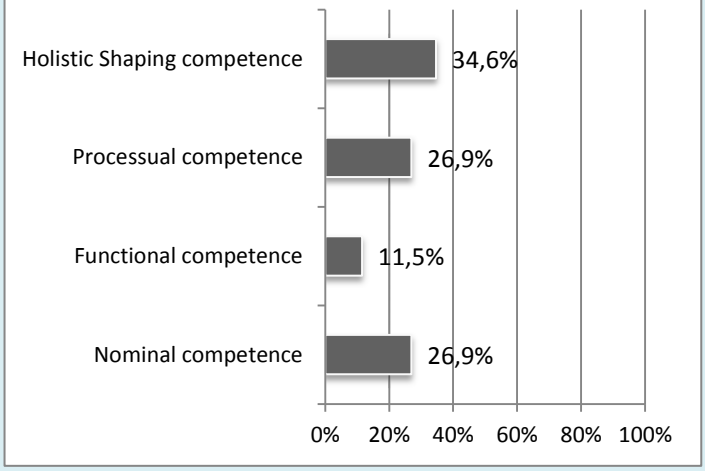
Average Profile Mechatronics Task '10_MT_Ventilation in workshop' **COMET Main test 2014**	Distribution of competence levels of Mechatronics working on task '10_MT_Ventilation in workshop' (n=26)
 *Total average score* = 32.73 *n* = 26, *V* = 0.09	

Figure 82: Main test results of tasks No. 3, 4, 8, 10 in mechatronics. South Africa 2014.

If one compares the results obtained in mechatronics by tasks in main test and pre-test (see Figure 81 and Figure 82) one has to say that the results do not resemble that much. Whereas the better results by tasks in pre-test had been on tasks 03 and 04, main test results had been much better on task 10. Participation of learners working on task 8 was too low in the pre-test to be compared with main test results but both outcomes are listed anyway.

It has to be stressed that all test tasks have been used at all different test sites. A better performance in one or the other task does not reflect better general test sites results. A comprehensive overview of learners' performances by test task and according to the different levels of competence is provided by the following graph.

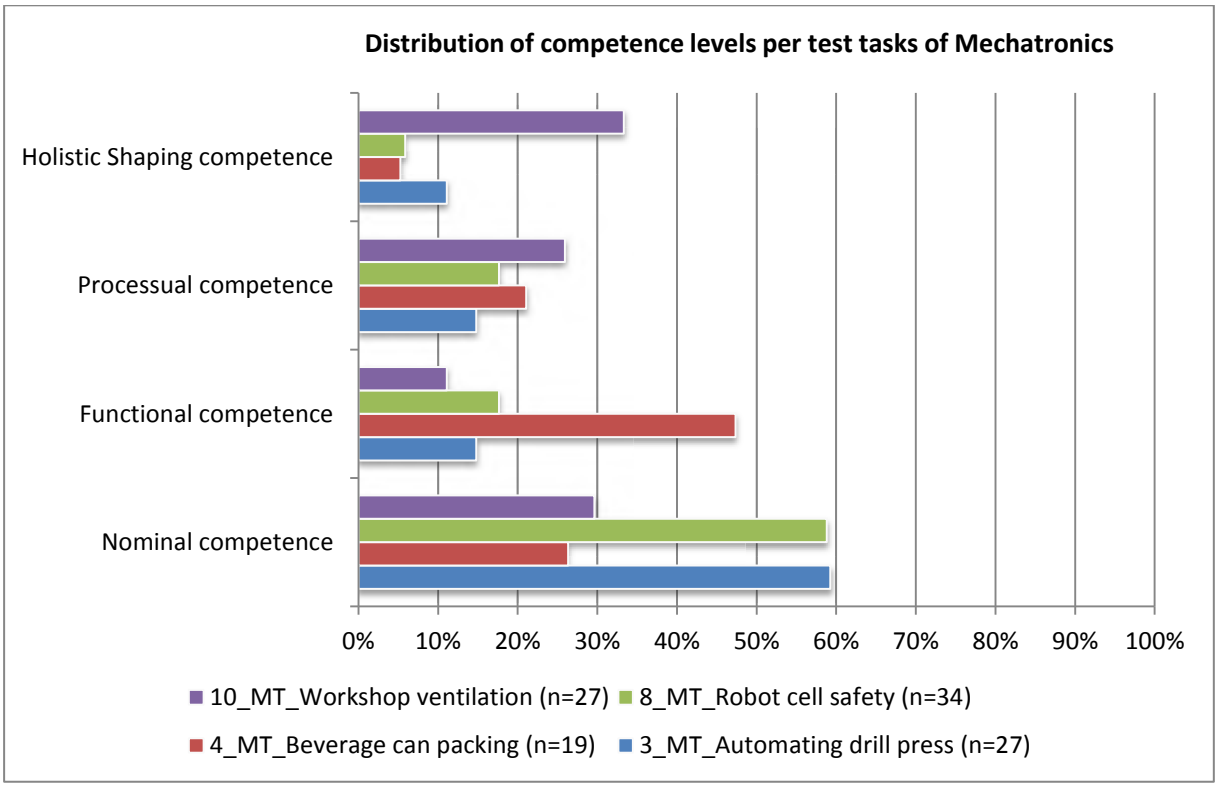


Figure 83: Distribution of competence levels by test tasks for Electricians.

6.3 Motor mechanics (incl. diesel mechanics and learners in NCV automotive)

6.3.1 Test task development

In the field of motor mechanics, eight test tasks have been developed by a team of South African curriculum experts and teachers in a two day workshop. Four of them had originally been developed within a national German project in North Rhine Westphalia and translated, partly amended and approved by the South African team. The six most promising tasks had been pre-tested, four of them were finally selected for the main test. Table 4 provides an overview on test task development.

Tasks developed and introduced in Pre-Test 2015 and Main Test 2012-2 (motor mechanics)		
Tasks developed by the South African COMET Team	Tasks introduced in Pre-Test and Number of test takers (n)	Tasks used in Main Test Number of test takers (n)
01_CMM_Engine warning light 02_CMM_Oldtimer 03_CMM_Misfire 04_CMM_Vehicle overheating 05_CMM_Vibration complaint 06_CMM_Oil consumption 07_# 08_#	01_CMM_Engine warning light (n= 29) 02_CMM_Oldtimer (n= 26) 03_CMM_Misfire (n= 22) 04_CMM_ Vehicle overheating (n= 27) 05_CMM_Vibration complaint (n= 28) 06_CMM Oil consumption (n=23)	01_CMM_Engine warning light (n=94) 02_CMM_Oldtimer (n=91) 03_CMM_Misfire (n=93) - 05_CMM_Vibration complaint (n=111 -

Table 4: Tasks developed and introduced in the pre-test and main test of motor mechanics. South Africa 2015 and 2015-2.

6.3.2 Learners' performance by task (pre-test)

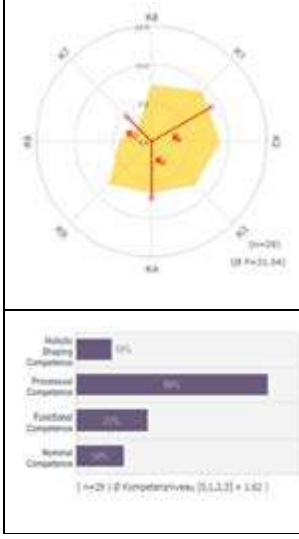
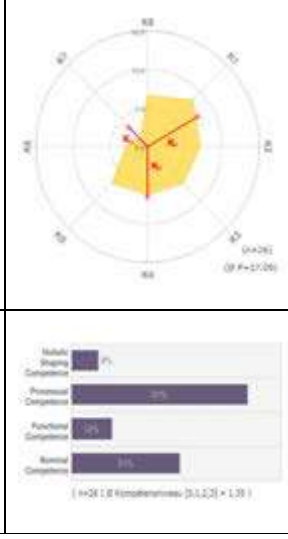
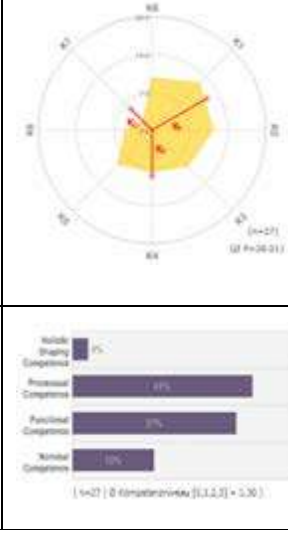
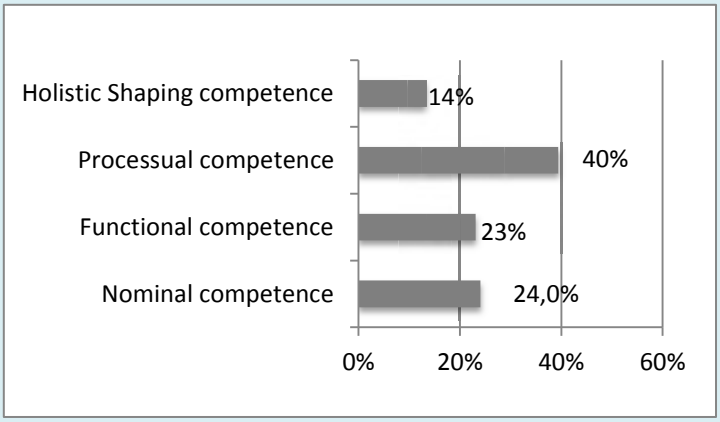
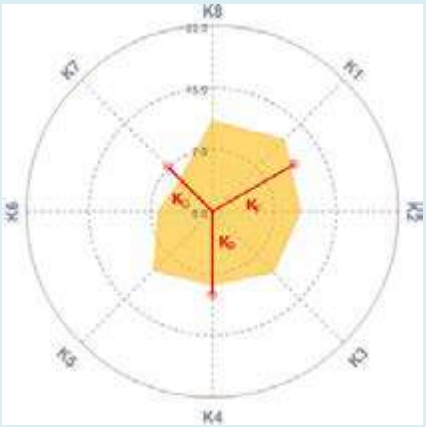
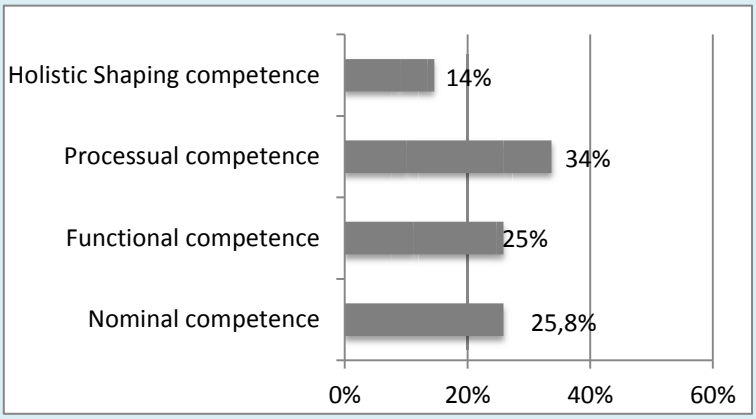
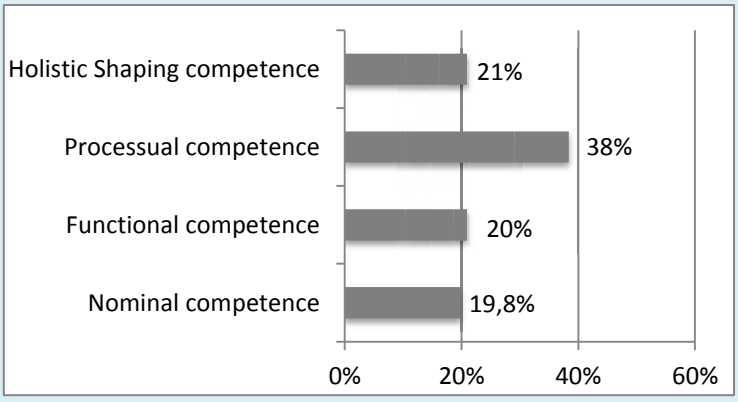
Average Profile Task 01 (Pre-test 2015)	Average Profile Task 2 (Pre-test 2015)	Average Profile Task 3 (Pre-test 2015)	Average Profile Task 5 (Pre-test 2015)
			

Figure 84: Pre-Test results of tasks No. 1, 2,3 and 5 in motor mechanics. Pre-Test. South Africa 2015.

Average Profile Motor Mechanics Task '01_CMM_Engine warning light ' **COMET Main test 2015**	Distribution of competence levels of Motor Mechanics working on task 'CMM_Engine warning light ' (n=16)
 *Total average score* = 28.70 *n* = 104, *V* = 0.35	
Average Profile Motor Mechanics Task '02_CMM_Oldtimer **COMET Main test 2015**	Distribution of competence levels of Motor Mechanics working on task '02_CMM_Oldtimer' (n=16)
 *Total average score* = 29.12 *n* = 89, *V* = 0.25	
Average Profile Motor Mechanics Task '03_CMM_Misfire ' **COMET Main test 2015**	Distribution of competence levels of Motor Mechanics working on task '03_CMM_Misfire ' (n=29)
 *Total average score* = 32.02 n = 86, V = 0.28	
Average Profile Motor Mechanics Task 'CMM_Vibration complaint ' **COMET Main test 2015**	Distribution of competence levels of Motor Mechanics working on task 'CMM_Vibration complaint ' (n=26)

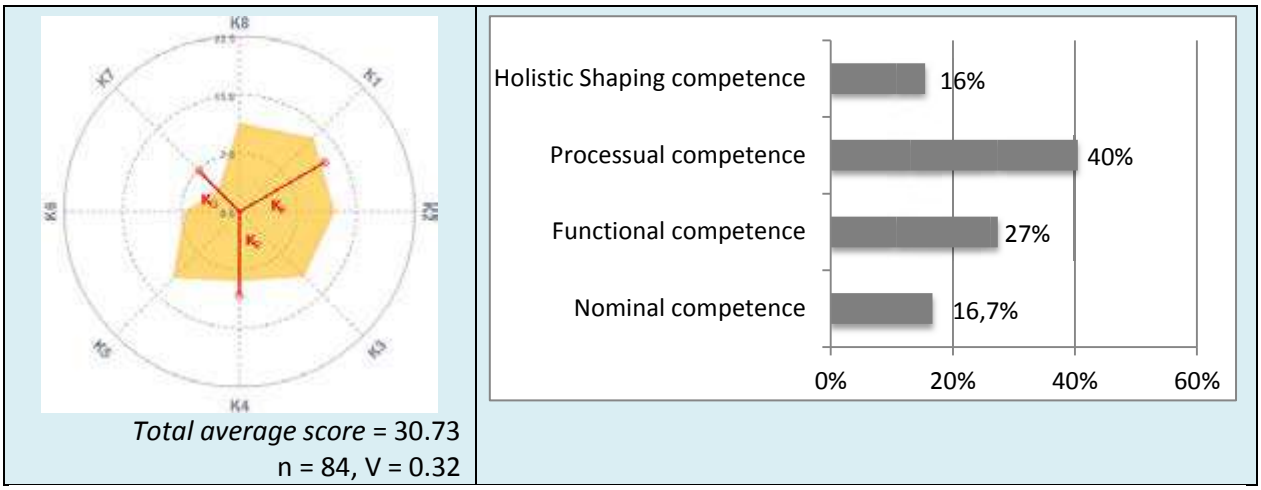


Figure 85: Main test results tasks No. 1, 2,3 and 5 in motor mechanics. South Africa 2015.

If one compares the results obtained in in motor mechanics by tasks (see the two figures above) one can see that the results do not differ that much, both in terms of the overall average scores reached and also with regard to the shapes of the competence profiles. There is a considerable lack in the domains of K6 and K7 and - to a much lower extent - in K4. The fact that the learners were not able to perform substantially better in the main test has a lot to do with the timing of the two tests. There was practically no time to further introduce learning tasks in classes of motor mechanics, so that the deficits in the above mentioned competence criteria remained unchanged at almost all test venues.

All test tasks have been used at all participating test sites, so a better performance in one or the other task does not reflect better general test sites results. A comprehensive overview of learners' performances by test task and according to the different levels of competence is provided by the following graph.

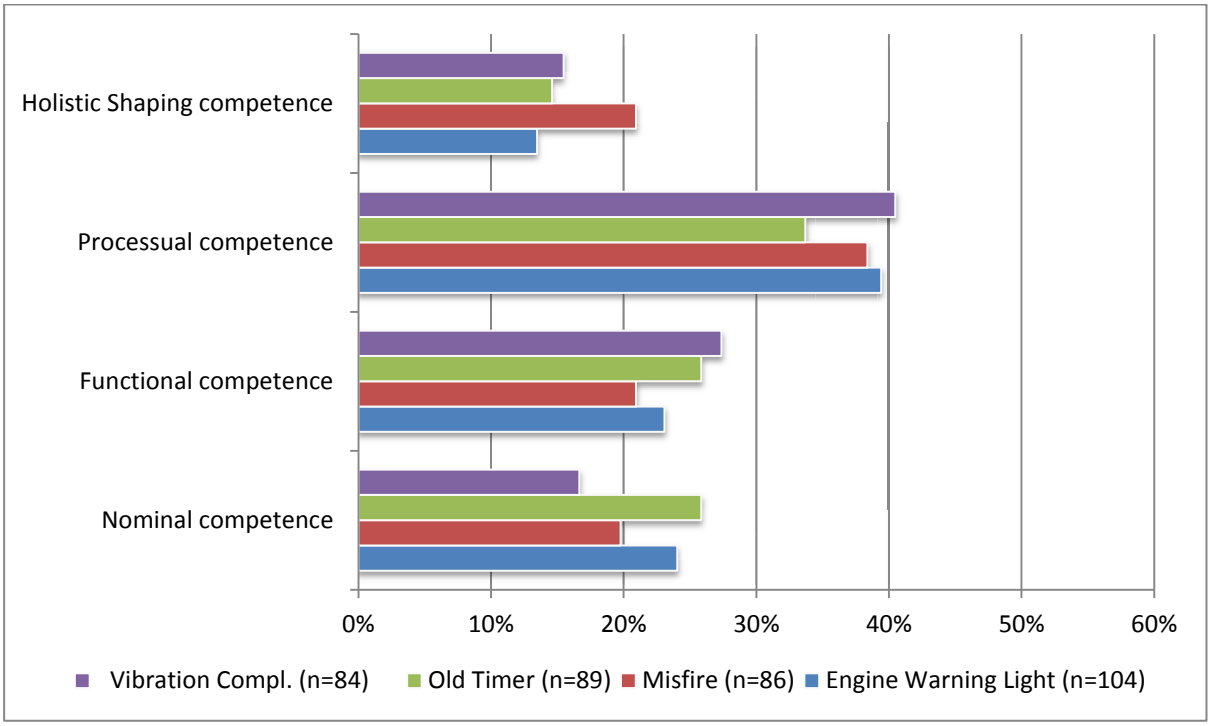


Figure 86: Distribution of competence levels by test tasks for Motor Motor Mechanics. COMET 2015

6.4 Welders

6.4.1 Test task development

In welding, seven out of ten tasks developed by the South African team had been pre-tested, four out of which were selected four the main test. Table 4 provides an overview on the respective tasks. Like in the test in mechatronics no task used in main test was developed outside South Africa. No comparison with other international COMET projects was possible so far.

Tasks developed and used in Pre-Test and Main Test 2014 (Welding and Fabrication*)			
Tasks developed by the South African COMET Team	Tasks introduced in Pre-Test Number of test takers	Tasks used in Main Test (Welding) and Number of test takers per task (n)	Tasks used in Pre-Test (Fabrication) and Number of test takers
01_WL_Boat fabrication	--	--	--
02_WL_Heat exchanger	--	--	--
03_WL_Lifting lug	03_WL_Lifting lug (n=7)	03_WL_Lifting lug (n=37)	03_WL_Lifting lug (n=11)
04_WL_Tropical storm	04_WL_Tropical storm (n=8)	04_WL_Tropical storm (n=37)	04_WL_Tropical st. (n=14)
05_WL_Wheelchair ramp	05_WL_Wheelch. ramp (n=5)	--	--
06_WL_ Steel fabrication	06_WL_ Steel fabrication (n=7)	--	--
07_WL_ Pipeline repair	07_WL_ Pipeline repair (n=7)	07_WL_ Pipeline repair (n=7)	07_WL_ Pipeline repair (n=1)
08_WL_Gearbox support	08_WL_Gearbox support (n=7)	--	--
09_WL_Baja bug sub fr.	--	--	--
10_WL_Hydraulic piping	10_WL_Hydraulic piping (n=8)	10_WL_Hydraulic piping n=13)	10_WL_Hydraulic pipe. (n=3)

Table 5: Tasks developed and introduced in the pre-test and main test of Welding. South Africa 2014 and 2014 *) Many fabricators did not give information on the tasks they were working on. The total number of test takers in fabrication was 78.

6.4.2 Welders' performance by task

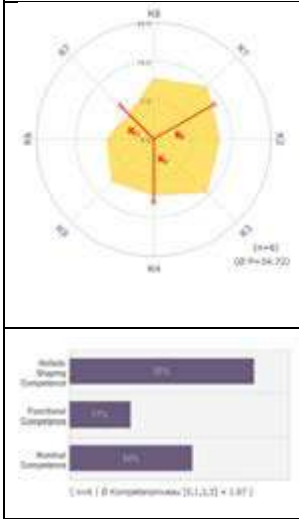
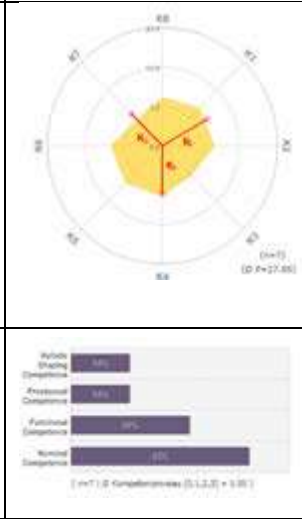
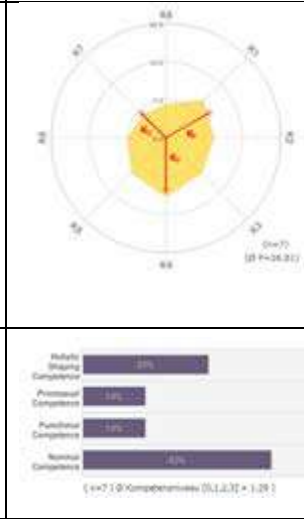
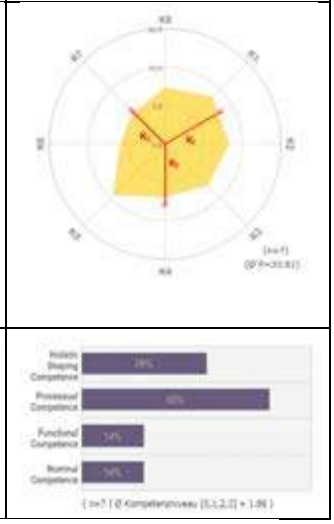
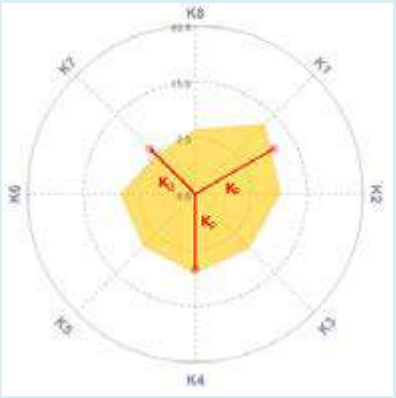
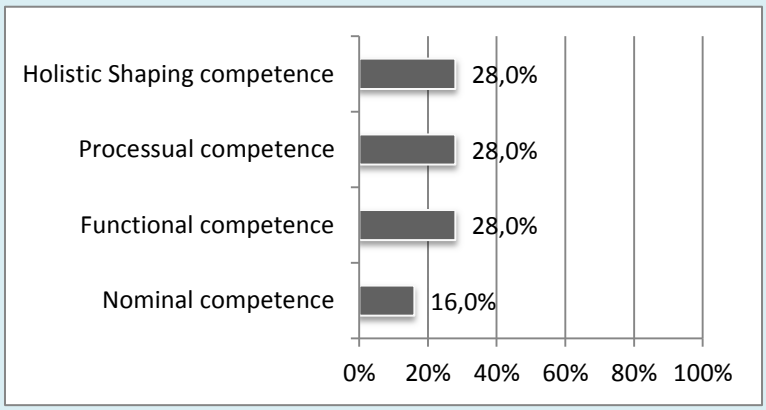
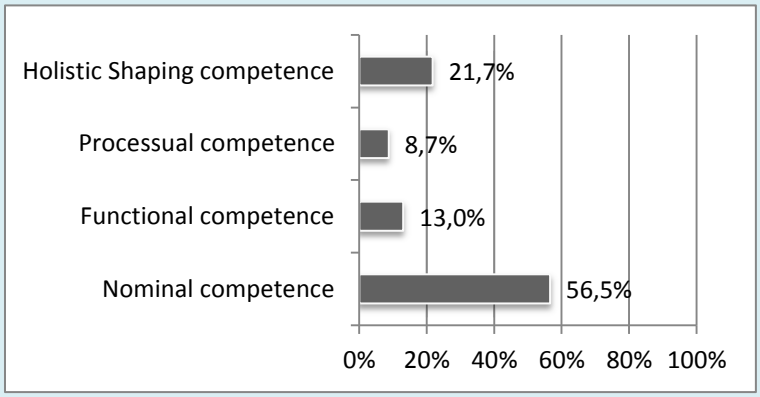
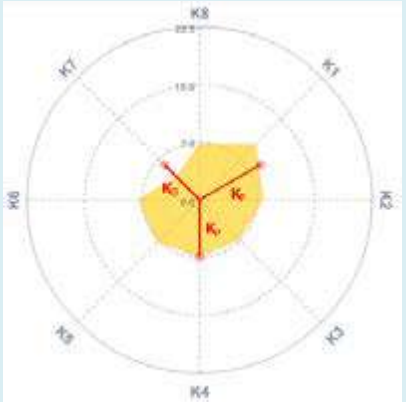
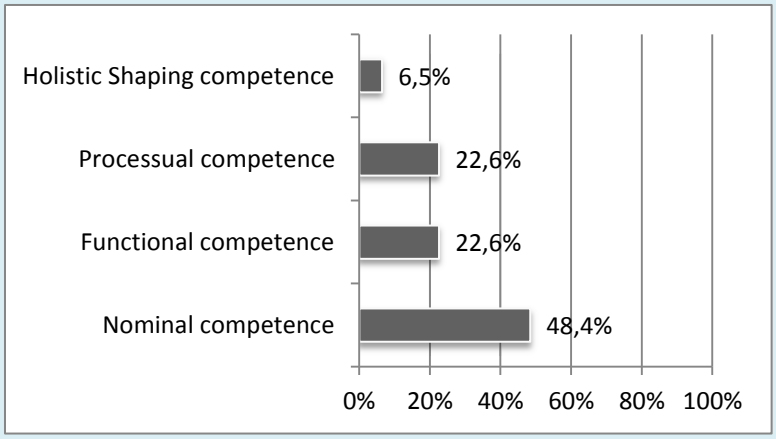
Average Profile Task 03 (Pre-test 2014)	Average Profile Task 04 (Pre-test 2014)	Average Profile Task 07 (Pre-test 2014)	Average Profile Task 10 (Pre-test 2014)
			

Figure 87: Pre-Test results of tasks No. 3, 4, 7, 10 in welding. Pre-Test. South Africa 2014.

If one compares the results obtained by tasks in mechatronics (see Figure 87, Figure 88), it has to be observed, that the relatively good average results per task could be repeated in the main test and with a larger number of participants. In the main test, only task No 10 did not lead to results as good as in the pre-test.

Moreover, it seems to be necessary to check tasks 07 with regard to its applicability to K7 as most

of the learners did not achieve good average results in this criterion (while all other criteria have been addressed much better).

Average Profile Welder Task '03_WL_Lifting lug ' **COMET Main test 2014**	Distribution of competence levels of Welders working on task '03_WL_Lifting lug ' (n=25)
 *Total average score* = 31.01 *n* = 25, *V* = 0.17	
Average Profile Welders Task '04_WL_Tropical storm' **COMET Main test 2014**	Distribution of competence levels of Welders working on task '04_WL_Tropical storm (n=23)
 *Total average score* = 25.11 *n* = 23, *V* = 0.11	
Average Profile Welders Task '07_WL_ Pipeline repair' **COMET Main test 2014**	Distribution of competence levels of Welders working on task '07_WL_ Pipeline repair' (n=31)
 *Total average score* = 23.06 *n* = 31, *V* = 0.22	

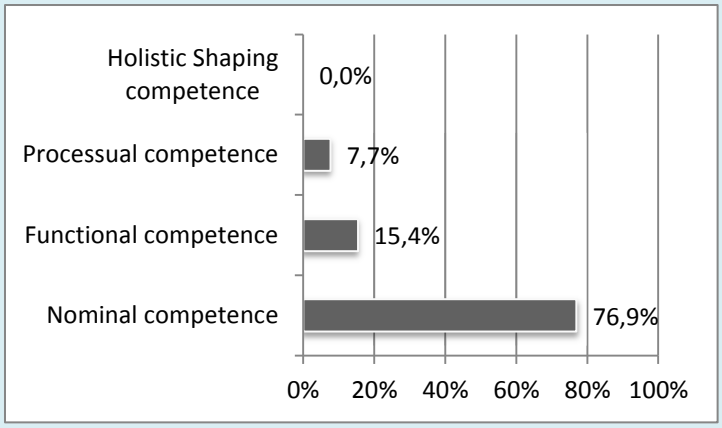
Average Profile Welders Task '10_WL_Hydraulic piping ' **COMET Main test 2014**	Distribution of competence levels of Welders working on task '10_WL_Hydraulic piping ' (n=13)
 *Total average score* = 18.37 *n* = 13, *V* = 0.24	

Figure 88: Main test results of tasks No. 3, 4, 8, 10 in mechatronics. South Africa 2014.

A complete overview of the welder's performances by test task and according to the different levels of competence is provided by the following graph.

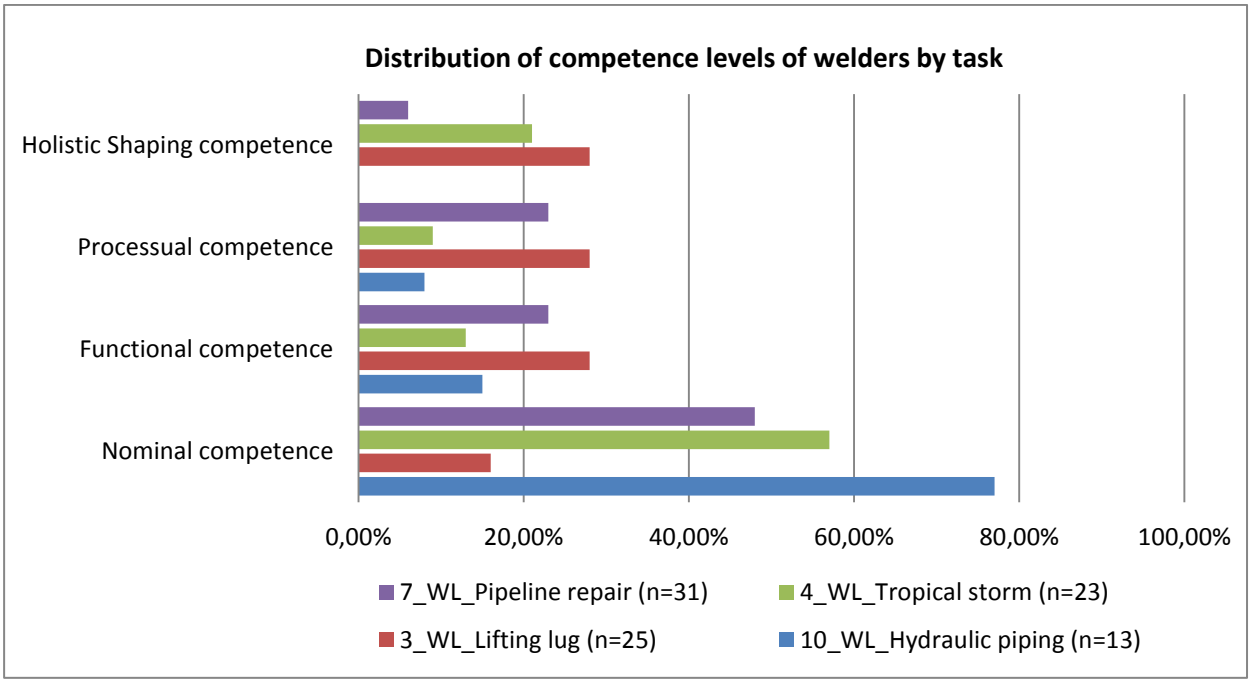


Figure 89: Distribution of competence levels of welders by test task. Comet South Africa 2014

6.5 Fabricators (pre-test)

6.5.1 Test task development

Prior to the pre-test in fabrication, the project team had taken the decision to introduce the same test tasks as elaborated in the welding profession for the first test in fabrication. Teachers and trainers had agreed to the relevance and applicability of these tasks for the fabrication domain. An overview of the tasks and the number of test takers per tasks is given in table 4 (section 6.3.1).

6.5.2 Learners' performance by task

Unfortunately, only a limited number of test takers have indicated which test task they had been working on. The analysis of competence levels and profiles reached by task was only possible for two of the tasks, which were 'Task '03_WL_Lifting lug ' (n=11) and '04_WL_Tropical storm' (n=14).

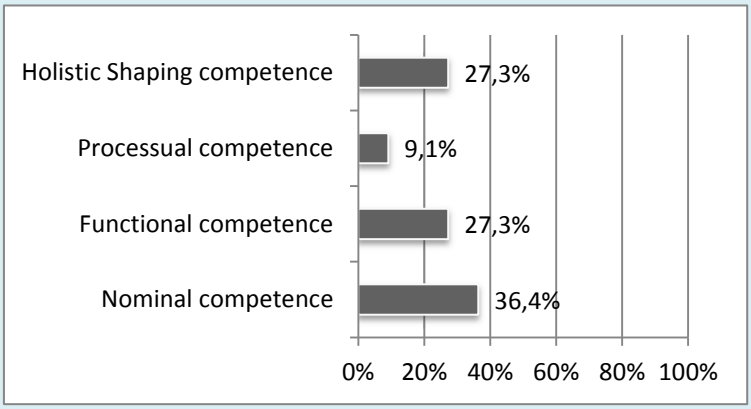
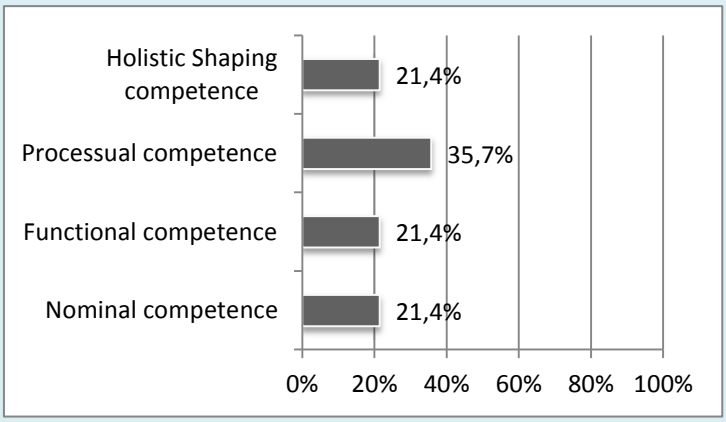
Average Profile Fabricators Task '03_WL_Lifting lug ' **COMET Pre- test 2014**	Distribution of competence levels of Fabricators working on task '03_WL_Lifting lug ' (n=11)
 *Total average score* = 29.06 *n* = 11, *V* = 0.13	
Average Profile Fabricators Task '04_WL_Tropical storm' **COMET Main test 2014**	Distribution of competence levels of Fabricators working on task '04_WL_Tropical storm ' (n=14)
 *Total average score* = 30.85 *n* = 14, *V* = 0.12	

Figure 90: Pre- test results of tasks No. 3, 4 in Fabrication. South Africa 2014.

According to this analysis and compared to the welders, fabricators performed better on these two tasks. This refers as well to the other two test tasks where a limited number of test takers did not allow for serious comparisons. Nevertheless, these very high scoring results have asked for a deeper look into the circumstances that might have had an influence on the test results.

6.5.3 Pre-test fabrication: additional remarks on test validity

One possible explanation of the very good performance of fabricators may be the fact, that fabricators were only tested at one test site and teachers and trainers did not have to opportunity to rate the learners' solutions according to the COMET test standards, i.e. as learners were rated by their own

teachers, a strict anonymous basis was not given in the pre-test in fabrication.

In order to find out, whether this assumption was relevant, the South African team decided to have a small sample of solutions provided by learners in the *fabrication* profession marked by teachers and trainers in *welding*. The analysis of this exercise[28] suggests that there are big differences in the teachers or trainers expectations regarding a professional solution. In all sample solutions of fabricators re-rated by welding teachers and trainers, the results obtained by the learners in fabrication were considered much weaker than in the original rating procedure provided by their own teachers. Four very exemplary cases are provided in the following overview:

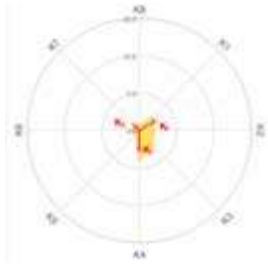
Inconsistencies between the ratings of welders and fabricators			
RSA_FB_2014_2_5033 (rating by fabricators) Total score: 61	RSA_FB_2014_2_5023 (rating by fabricators) Total score: 47.17	RSA_FB_2014_2_5009 (rating by fabricators) Total score: 40.17	RSA_FB_2014_2_5100 (rating by fabricators) Total score: 30.17
			
RSA_FB_2014_2_5033 (rating by welders) Total score: 26	RSA_FB_2014_2_5023 (rating by welders) Total score: 27.33	RSA_FB_2014_2_5009 (rating by welders) Total score: 16.5	RSA_FB_2014_2_5100 (rating by welders) Total score: 8.5
			

Figure 91: Inconsitencies between ratings of welders and fabricators. Pre-test Fabrication South Africa 2014.

This analysis does not only show that fabricators had a better estimation about their learners' solutions than their colleagues in the welding profession (huge differences between the total scores reached by learners). It is also very obvious, that there was no agreement on the relative performance of learners in the different competence criteria as the shapes of the competence profiles varied a lot For example the learner who provided solution RSA_FB_2014_2_5009 has received relatively good results in K3 and K5 from fabricating teachers, whereas the same solution had extreme weaknesses in exactly the same criteria when judged by welders.

These extreme inconsistencies in ratings have been the reason, why the project team took the decision to not include the results of the fabricator's pre-test into the overall results of the COMET test – as documented for example in the overviews provided in Figure 8 -11. The differences in the views about the learners' performance do not allow for the pre-test results being considered as valid for comparisons. Nevertheless, the learners' estimations on the test and design of the test tasks could be considered as usable. In the context of the preceding analysis, it is noteworthy that it was the group of fabricators who were not as content with the tests tasks as other learners (fabricators did not find the

[28] Sindiswa Msomi: REPORT ON THE REMARK 24 RANDOMLY SELECTED FABRICATION COMET TEST SOLUTIONS FROM THE SEPTEMBER 2014 TEST SERIES. merseta, Johannesburg.

tasks as useful as others, were not as concentrated as others, spent less time and put less effort on solving the tasks compared to other learners).

Recommendations:

1. Further test task development in the fabrication profession should take place and needs to be based on a team set up by fabricators from different learning venues.

2. Test and learning tasks in fabrication will probably need to differ from tasks developed for welders due to the different curricula and occupational profiles. The team might consider cooperation with teachers and trainers who represent the core team of welding in order to benefit from their experiences, still, fabricators should be tested according to the specific occupational profile which differs from welding.

3. Future tests in fabrication should include several test sites so that teachers and trainers will not only rate their own learners' solutions.

6.6 Millwrights (pre-test)

6.6.1 Test task development

Millwrights took part for the first time in a COMET test in South Africa. The pre-test was based on 3 tasks that were elaborated for electricians. All tasks were originally elaborated in the German COMET project for electricians and found applicable for the millwright profession by the South African COMET project team.

Tasks developed by the German COMET Team	Tasks introduced in Pre-Test and Number of test takers (n)
- - 12_EL_Drying Space (DE) 13_EL_Signals (DE) 14_EL_Pebble Treatment Plant (DE)	5_EL_Traffic light system (n=2) 10_EL_Rock crusher (n=1) 12_EL_Drying Space (DE) (n=7) 13_EL_Signals (DE) (n=3) 14_EL_Pebble Treatment Plant (DE) (n=7) No information (n=1)

Table 4: Tasks introduced in the pre-test and main test of millwrights. South Africa 2014.

6.6.2 Leaners' performance by task

Due to the very low number of test takers (n=21) there is not yet much to say about learners' performance by task. Only two tasks can be analysed in this regard, which are 14_EL_Pebble Treatment Plant (DE) and 12_EL_Drying Space (DE).

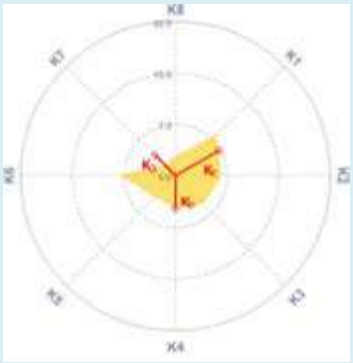
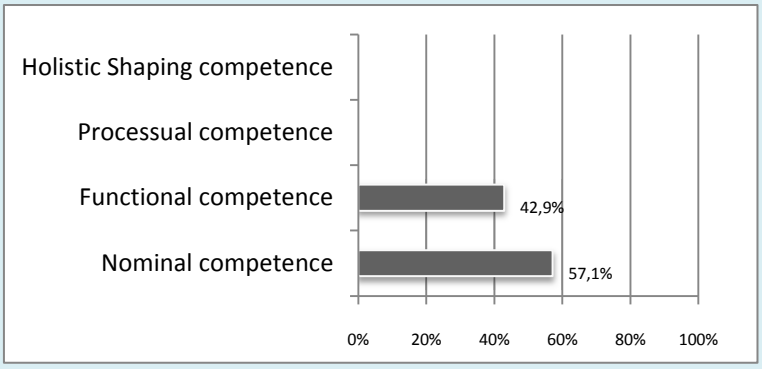
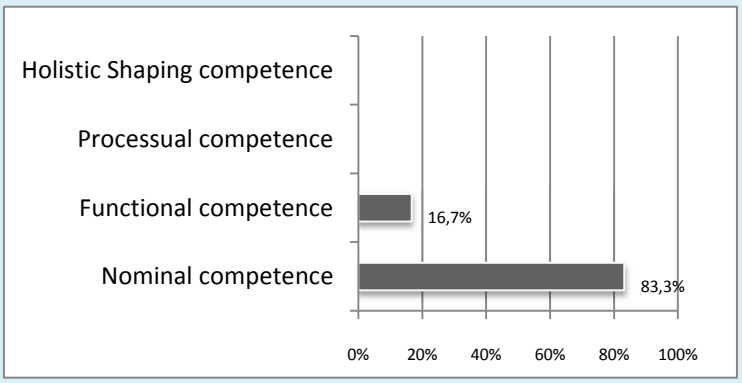
Average Profile Millwrights Task '14_EL_Pebble t. Plant (DE)' **COMET Pre- test 2014**	Distribution of competence levels of Millwrights working on task '14_EL_Pebble Treatment Plant (DE)' (n=7)
 *Total average score* = 16.26 *n* = 7, *V* = 0.44	
Average Profile Millwrights Task '12_EL_Drying Space (DE)' **COMET Main test 2014**	Distribution of competence levels of Millwrights working on task '12_EL_Drying Space (DE)' (n=7)
 *Total average score* =12.08 *n* = 7, *V* =0.60	

Figure 92: Pre-test results of tasks No. 12 an 14 in pre-test millwrights. South Africa 2014.

As already stated in earlier chapters, the performance of millwrights in this test was rather poor. Only six out of 21 test takers reached competence levels, the best one with a total score of 30.33 (Unfortunately, this was the only test in the millwright profession, where the number of the test task was not documented.) In those cases where an analysis of performance by test task was possible, the average score was rather low: 12.08 or 16.26 respectively. Due to the relatively low number of test takers general recommendations about the suitability of test tasks are still a bit risky. If one considers as well the information delivered by the learners as summarised in chapter 7, one may say, that millwrights generally had a very high test motivation, also appreciated COMET tasks for future learning. Nevertheless they found the exercise very difficult and also said that the tasks did not relate that much to the profession trained as compared to answers given by learners in other vocations. This should be interpreted as an argument for further work on test and learning task development in this domain.

Recommendations:

1. Setting up a team of millwrights (teachers, trainers, VET facilitators), maybe in cooperation with experienced team members of the electrical profession
2. Further test task development for millwrights in accordance with the vocational profile.

Part VII Analysis of Test Motivation

7.1 General analysis

The following analysis is based on the information given by 1,234 test persons, who handed in a motivational questionnaire after completing the test in 2014 or 2015. As opposed to the number of 1,138 valid COMET competence tests this number includes as well the information of those test takers whose data was excluded from the competence analysis either because it was not available (real drop-outs: people handed in a blanc paper or nothing at all, or because a test group was not meant to participate in the test (fitters and turners). Nevertheless, it has been decided to also include the estimations of these test persons into the analysis as it provided very interesting insights into the general motivation and commitment [29]of the South African learners regarding the concept of the COMET test design.

7.1.1 Average of time spent on working on the COMET test task, effort and degree of concentration

The following illustrations provide an overview about the effort test takers have been putting into the solution of their assignments. For all questions in this section (time spent, effort and degree of concentration) the percentage of learners who did not provide an answer was rather moderate, never exceeding a fifth of all test persons interrogated.

This section always sums up the result in two different manners, first as a bar diagram illustrating which time frames from less than 30 Min. to 1.5 – 2 hours (maximum time given) have been taken by the leaners to solve the task, and second in a bar chart that illustrates a bit better in which vocation it was necessary to use more time or less. Major results from the analysis are as follows:

1. The big majority of learners spent a very long time (up to 1.5 hours) or a very long (up to 2 hours) on solving their tasks. Only motor mechanics (28%) millwrights (23%) and fabricators (20%) were also relatively often able to do it or did not invest more time into it than one hour, which was not so much the case in the other professions. For millwrights this was certainly due to the fact that these learners gave up at earlier stages of their work when noticing that they would not succeed.
2. Even in those professions where a majority of learners did not reach adequate competence levels (electricians, millwrights, fitters and turners) a very big share of learners used the maximum time given to work out a solution.
3. Similar results refer to the degree of effort and concentration which was put into solving a task. Here again, it strikes that among the different groups of learners who claimed putting a high or very high degree of effort and concentration into their assignments were those with the weaker results in the competence test.
4. The overall motivation in terms of effort, degree of concentration and time spent on the COMET test can be considered as very high.

[29] Fitters and turners had mostly worked on tasks designed for electricians. They have had had only very little chances to perform well in the test, as the tasks did not relate to what was trained. Nevertheless, almost all fitters and turners did their very best to solve the problem, worked with full concentration and did not leave the place before the end of the exercise. Instead of being frustrated, they approved tasks designed like their test task to become a part of their vocational training.

TIME SPENT

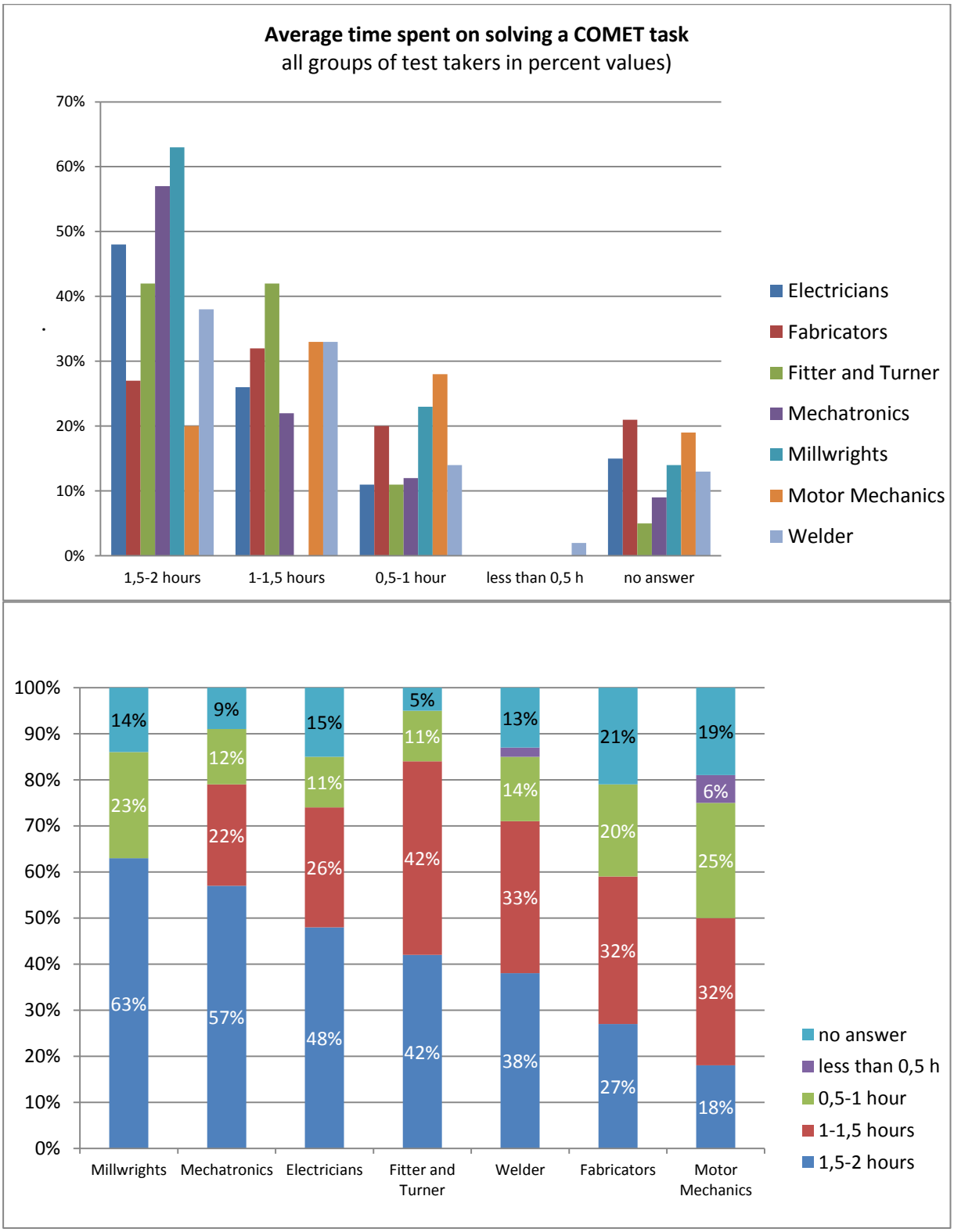


Figure 93: Analysis of test motivation: Average time spent on a task. Information according to occupations and distribution of answers in percent values. COMET South Africa 2014 and 2015.
The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

EFFORT

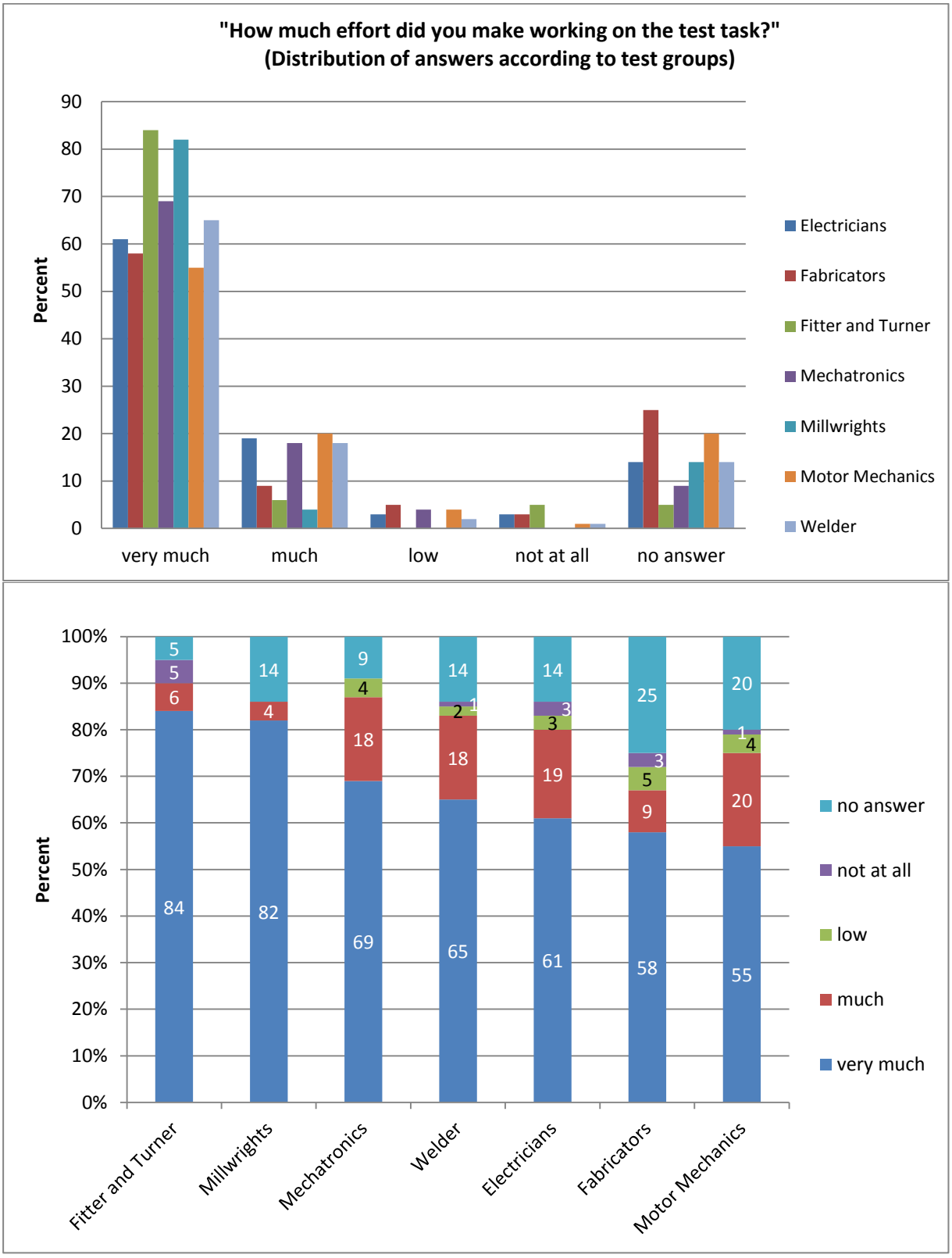


Figure 94: Analysis of test motivation: Average degree of effort given when working on a task. Information according to occupations and distribution of answers in percent values. COMET South Africa 2014 and 2015

The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

Degree of Concentration

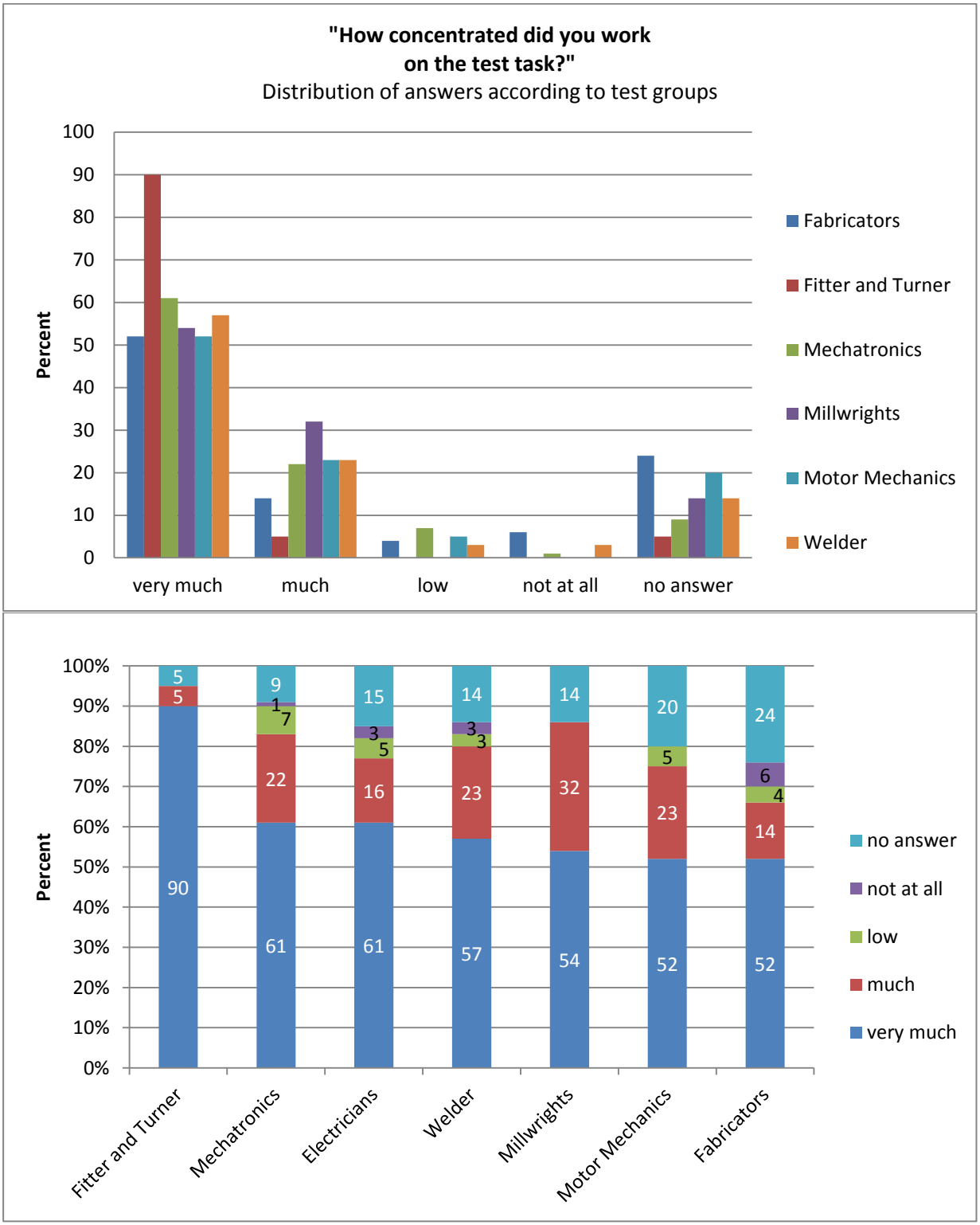


Figure 95: Analysis of test motivation: Average degree of concentration. Information according to occupations and distribution of answers in percent values. COMET South Africa 2014 and 2015
The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

7.1.2 Use value and relevance of task for the occupation learnt

The use value of a tasks and its relevance for the occupation trained is crucial for the motivation of learners to accept working on them and taking time to find an adequate solution. The two questions that cover this section of the motivational questionnaire have been answered positively by the large majority of all test participants. Between 71 % (welders) and 88% (mechatronics) of the main test participants were finding their task useful or very useful. Also participants of the pre-tests were of this opinion, while the highest marks were provided by fitters and turners (90% agreed on this).

When looking at the learners estimations about the relevance for the occupation they were taught, the degree of contentedness is still very high, but in some vocations slightly lower in comparison to the general question about the use value. For example, 17% of the electricians did not find their tasks very relevant or considered them as not relevant at all, which was as well the case for a number of test takers in the pre-test: 23% of the millwrights and 16% of the fitters and turners were of the same opinion. This result will need to be considered for future test task design in these occupations. When comparing all test takers estimations (not counting those learners who did not provide an answer to the questions) one may say that mechatronics, motor mechanics, welders and the pre-tested fabricators form the groups with the most positive feedbacks on the relevance of the test assignment for their (future) occupation. This is a very good result for those engaged in the development of tasks.

Usefulness/use value of task

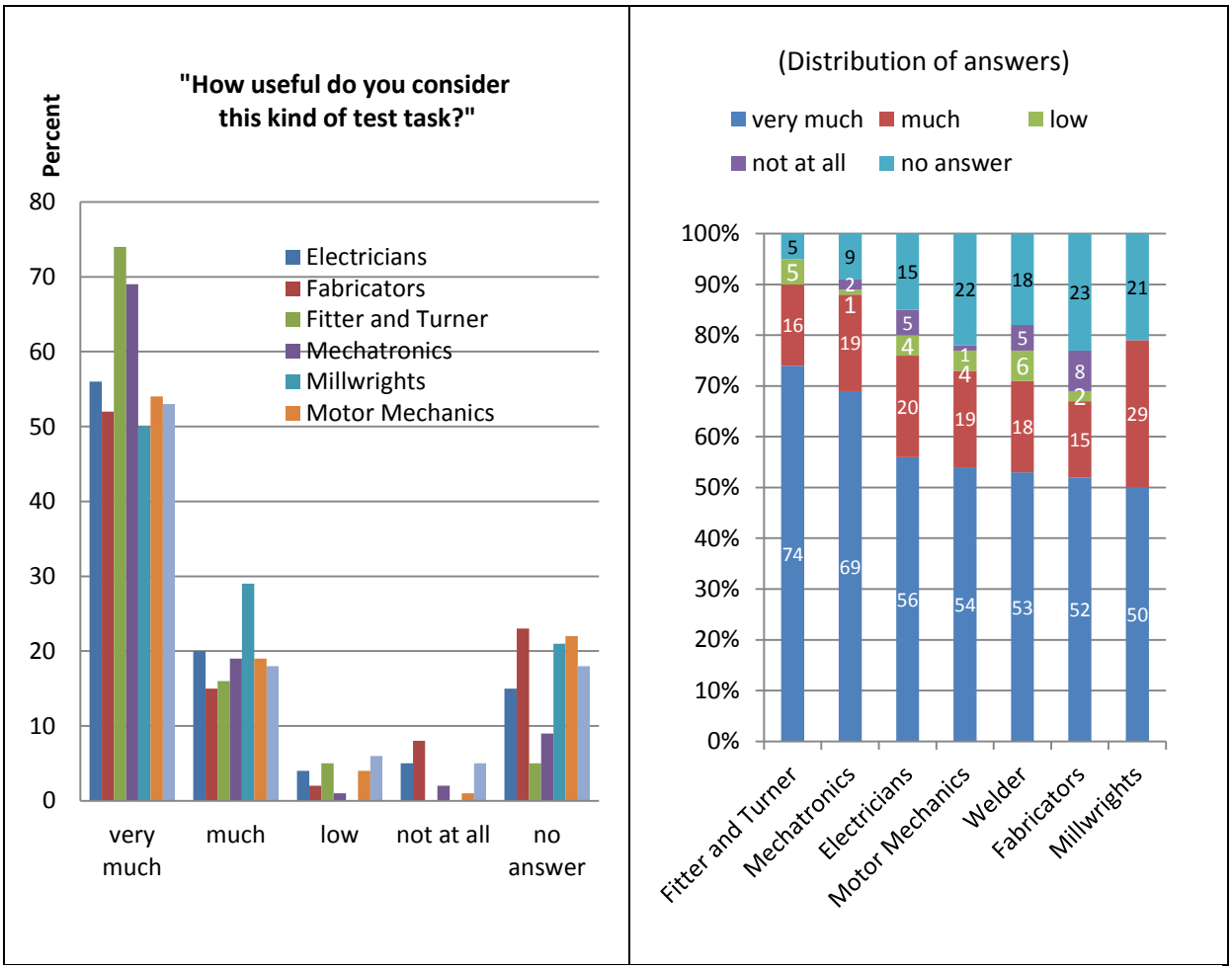


Figure 96: Analysis of test motivation: Learners' estimations on use value of task (n=1,234). COMET South Africa 2014 and 2015.The data refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

Relevance of task for the occupation learned

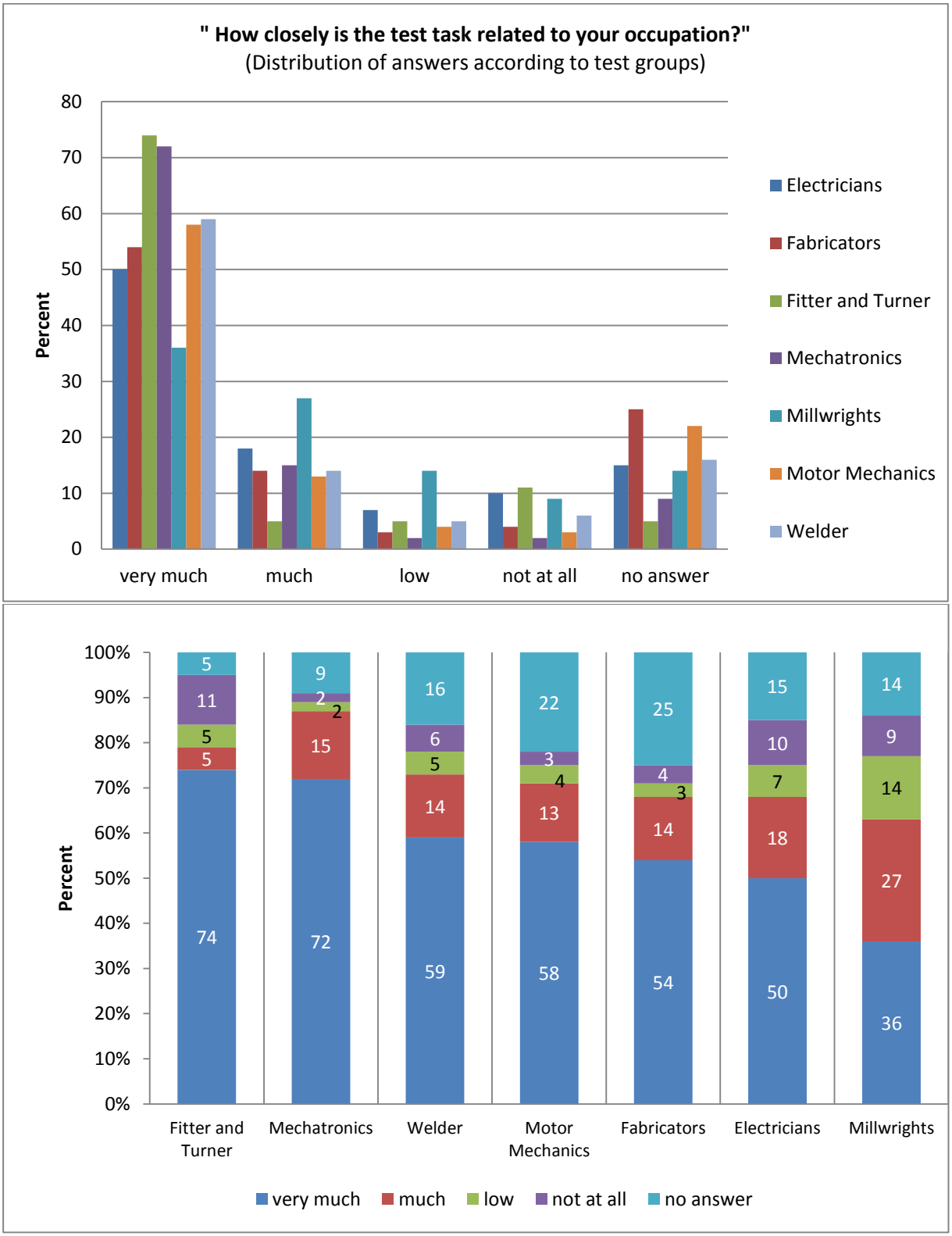


Figure 97: Analysis of test motivation: Learners' estimations on relevance of tasks for the occupation learned. Information according to occupations and distribution of answers in percent values. COMET South Africa 2014 and 2015
The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

7.1.3 The degree of difficulty

The learners' estimations on the degree of difficulty will be analysed more deeply in section 7.2.3.2. and with regard to their performance in the competence test. The following figures document however, that almost two thirds of the test persons were indicating that they have found their tasks rather or very difficult. The valuations of the main test participants in 2014 (electricians, mechatronics and welders) were almost identical with about 62% or 63% of learners thinking that their tasks were rather or very difficult, whereas this was only the case for 49% of the test takers in motor mechanics 2015. Here, 40% of the test participants even found their assignments easy or very easy, a question that only 26% or 28% of the other test takers answered accordingly in 2014.

For the participants who only took part in the pre-test exercise, the overall picture still resembles to the estimations provided by the test takers in the main test but these can only be interpreted in the light of test task development, which can still not be considered as completed.

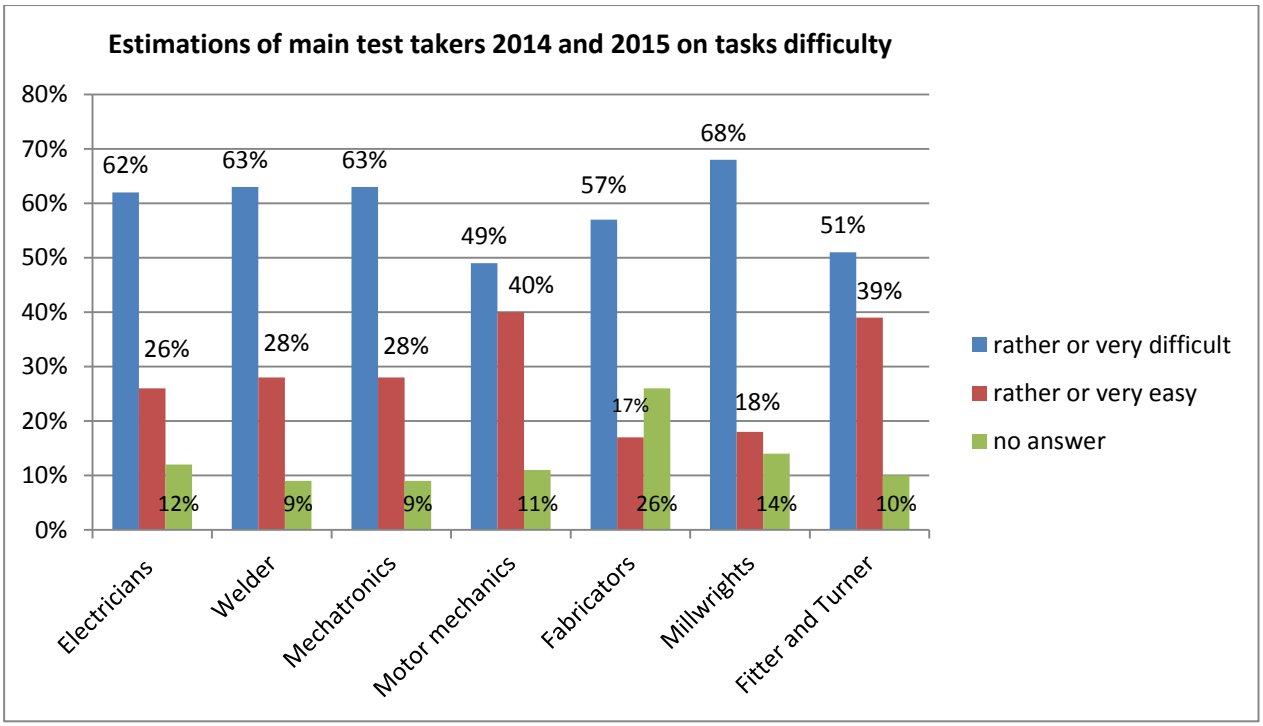


Figure 98: Analysis of test motivation: Learners' estimations on difficulty of tasks. Information according to all occupations tested in percent. COMET South Africa 2014 and 2015.
The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

7.1.4 The learner's general degree of interest and opinion on a future introduction of COMET tasks as a regular part of their training

Well in line with the answers provided on intrinsic and extrinsic test motivation as analysed in the previous two sections, the result about the analysis on the learner's general interest on working and to continue working with COMET tasks were very encouraging. The following figures document the responses regarding their general interest. Among the very few, who were not so interested (or even not interested at all) in working on their tasks were - above all – electricians (13%).

Degree of interest and the perspective: Should COMET tasks become a regular part of vocational education and training?

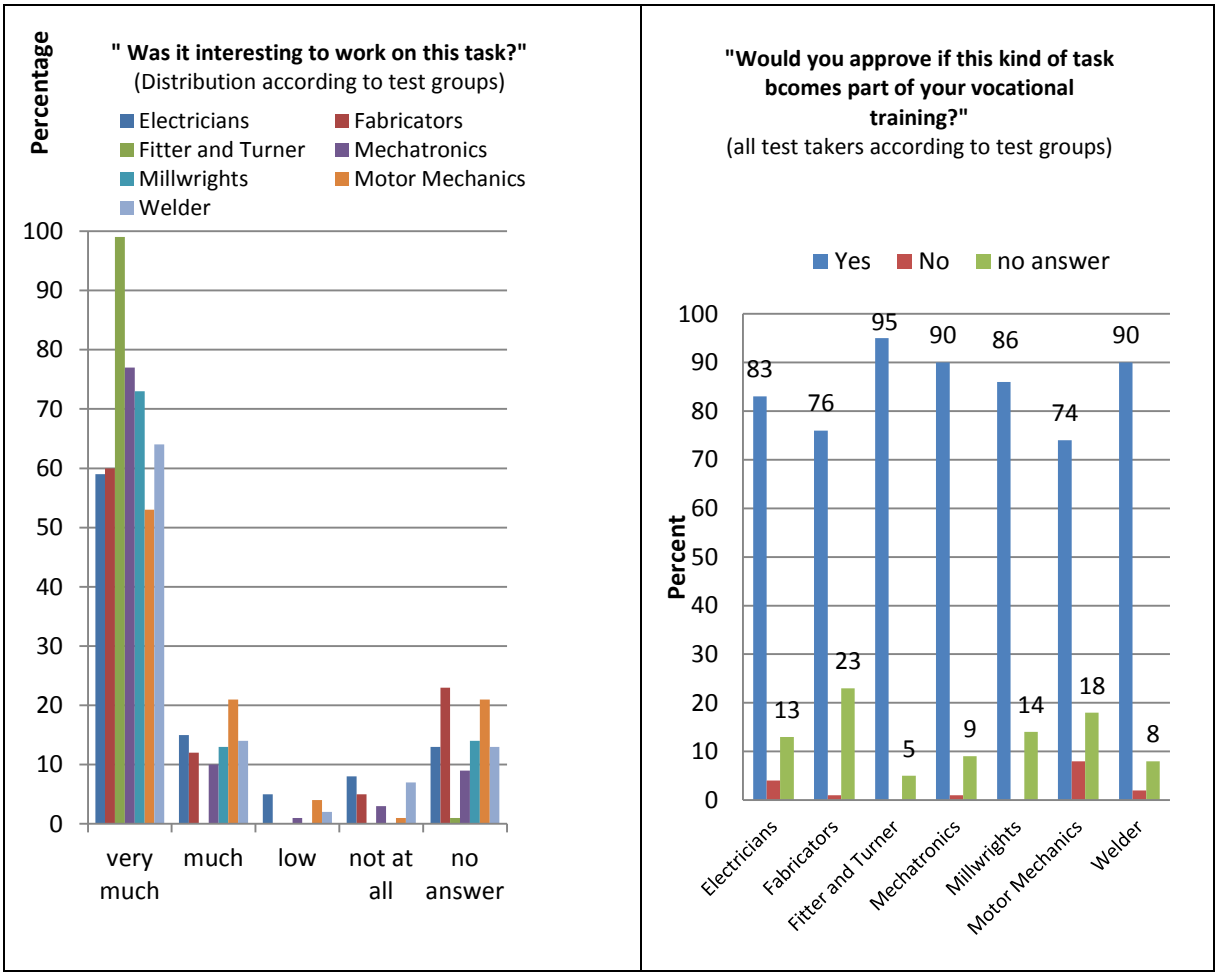


Figure 99: Analysis of test motivation: The learners' interest in working and continuing to work on COMET test tasks. Information according to occupations. COMET South Africa 2014.

The data analysis provided in this figure refers to electricians (n= 409) fabricators (n=99), fitters and turners (n=19), mechatronics (n=164), millwrights (n=22), motor mechanics (n=371) and welders (n=129).

All in all, the analysis of the estimations on the relevance of the task and of the degree of difficulty shows, that most of the learners liked this kind of tasks. They were considered as very useful or useful and very much or much linked to the profession trained. Even though the degree of difficulty has sometimes been considered as very high or high, more than 90 % of all test takes (n=1,234) would appreciate such kind of tasks becoming a regular part of their training.

… if the answer was yes: Reasons for the learner's interest.

When asked about the reasons for which they decided that continuing to work with tasks like COMET test tasks in their regular training, the learners had the possibility to provide their own ideas. Up to two aspects could be formulated. Figure 100 shows the analysis of this final section of the motivational questionnaire.

It turned out, that for most of the test takers, the reason for their decision was a "desire to learn more" and the "relevance" of such tasks for their future career. Many learners (10%) also liked the "challenge" or found that it required "creativity and holistic thinking". A first analysis of this type was made based on a sample of 850 test takers of the COMET 2014 test, including all six occupations tested (responses to this question: n=801). A second one was made in addition to these results in 2015 and only included the profession of motor mechanics. When comparing these two results (Figure 101 and Figure 102) it strikes, that for test takers in the first test the "desire to learn more" was the reason number one (19%), whereas the test takers in motor mechanics (who performed much better on average than the test cohort in 2014) indicated that it would generally be useful, interesting and innovative. With regard to these differences in the learners' explanations, one may follow, that a very large number of test takers in 2014 were very aware of the fact that their competence level was not yet adequate for being able to solve the tasks. (Again, it has to be highlighted, that the majority of the test participants in 2014 were composed by electricians who received very poor results in the competence assessment).

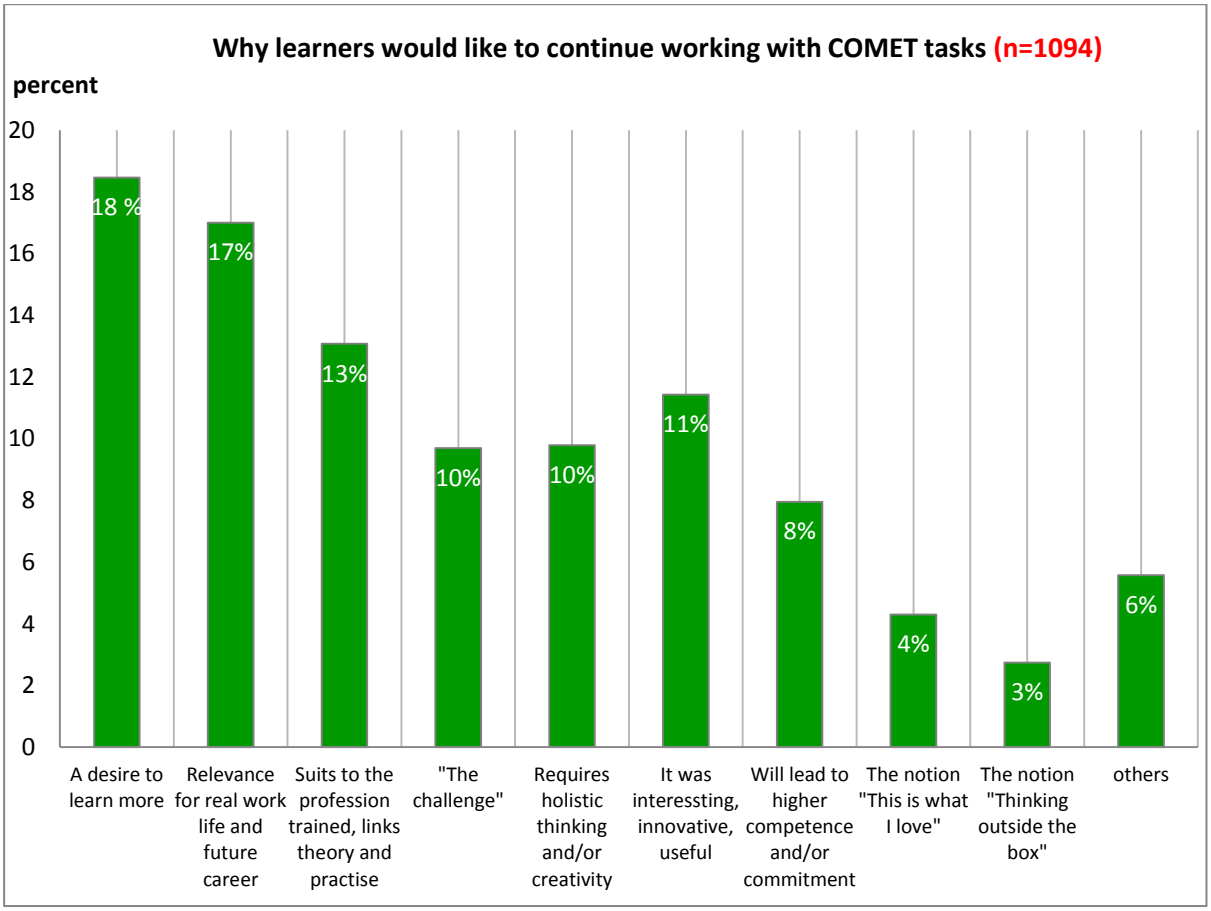


Figure 100: Analysis of test motivation: Why learners wish to continue learning according to COMET. Results are an interpretation of data provided in form of 1094 individual learners'comments. Information given in percent values. COMET South Africa 2014 and 2015
*) other resasons were mainly making parents/family happy, serving South Africa, and "change the world" or "doing anything in order to get a job"

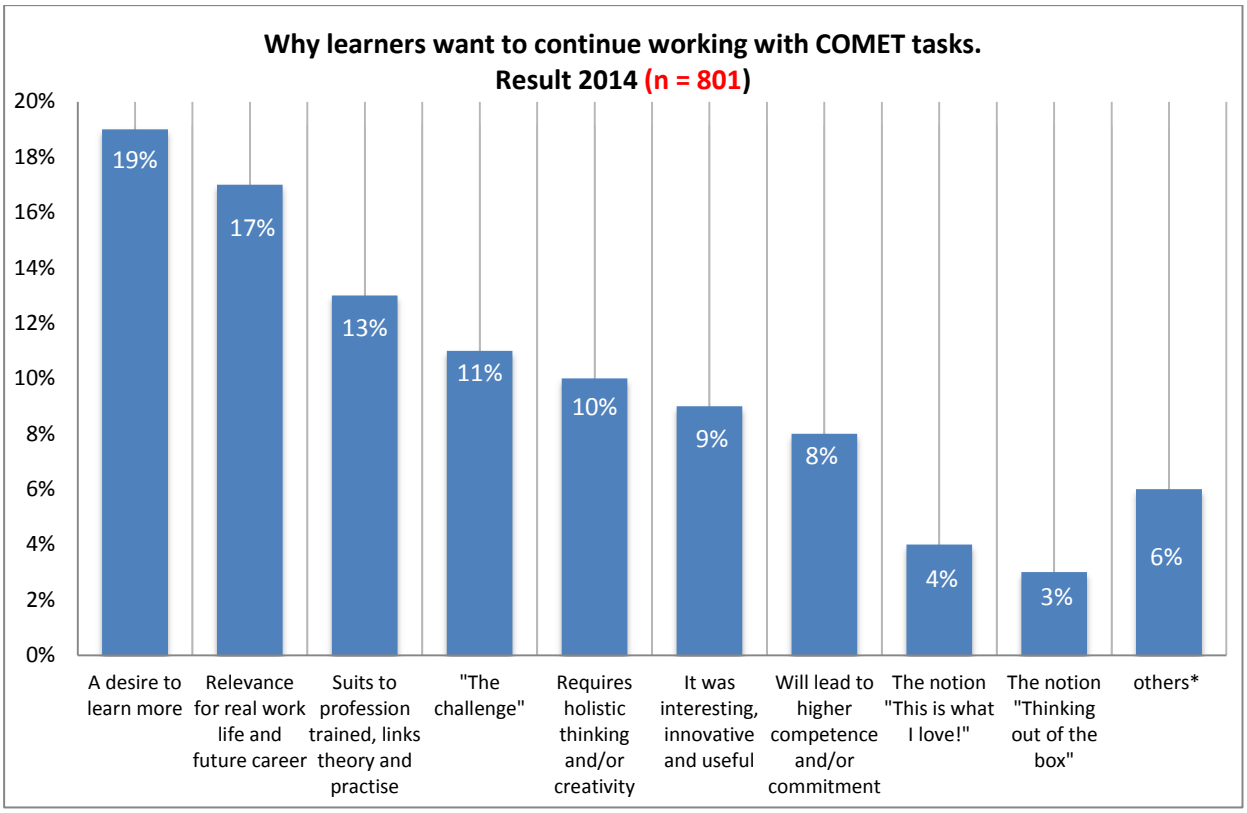


Figure 101: Analysis of test motivation: Why learners wish to continue learning according to COMET. Results COMET South Africa 2014.

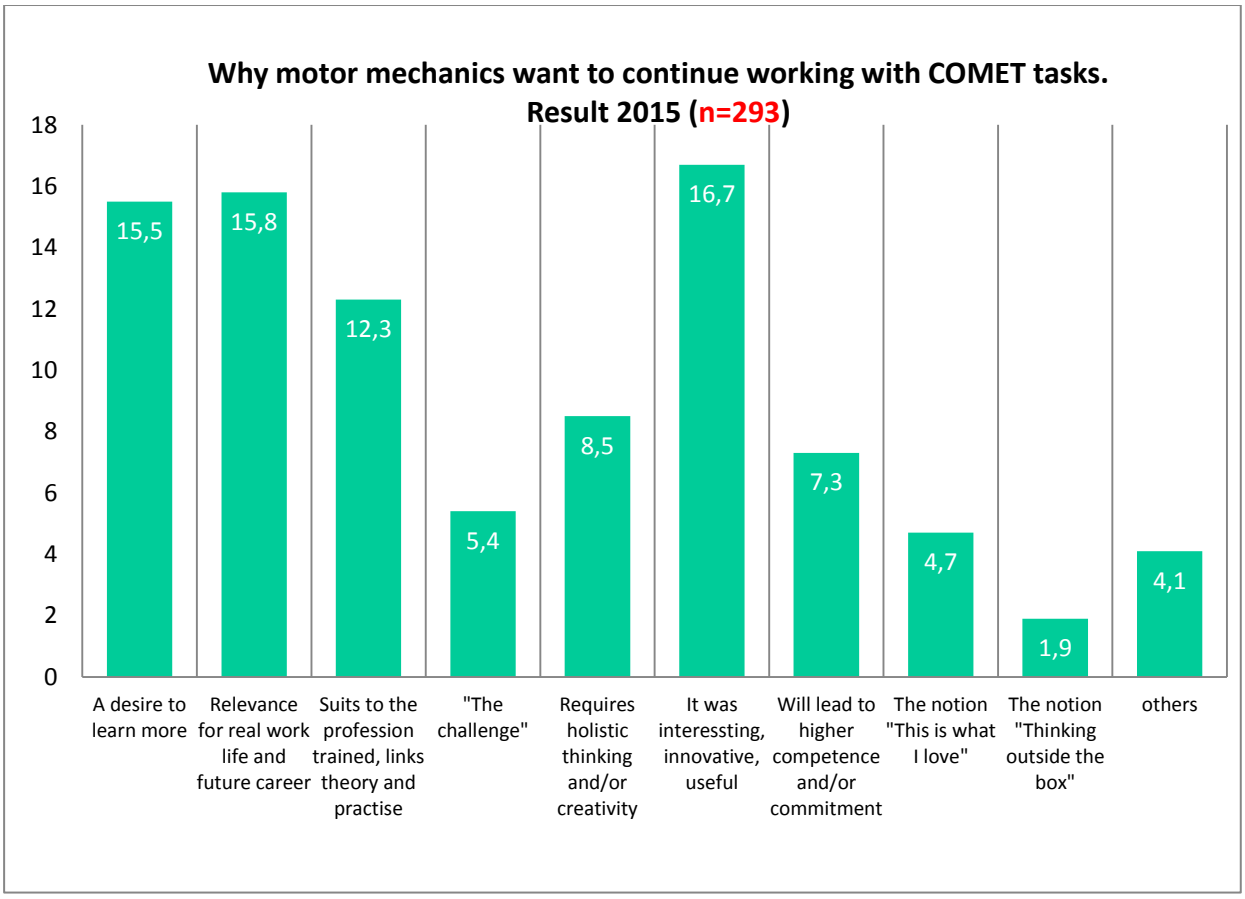


Figure 102: Analysis of test motivation: Why learners wish to continue learning according to COMET. Results COMET South Africa 2015

… if the answer was no: explanations

Even though it was just a much smaller group of persons that did not appreciate tasks like their test assignment to become a regular part of the training, the reasons for this need to be considered for a future design of tasks.

Relevant reasons were the degree of task difficulty, or if a task was not relevant. Here, one has to admit that due to some misunderstandings, some learners received a task that was not designed for the occupation they were trained in. In such cases, the responses were just correct. Some further reasons were a lack of being rewarded because COMET test were not a part of their training and some learners felt that this was a waste of time.

In view of the very positive responses, the few voices of learners who were not content with the type of exercise still represent a marginal problem.

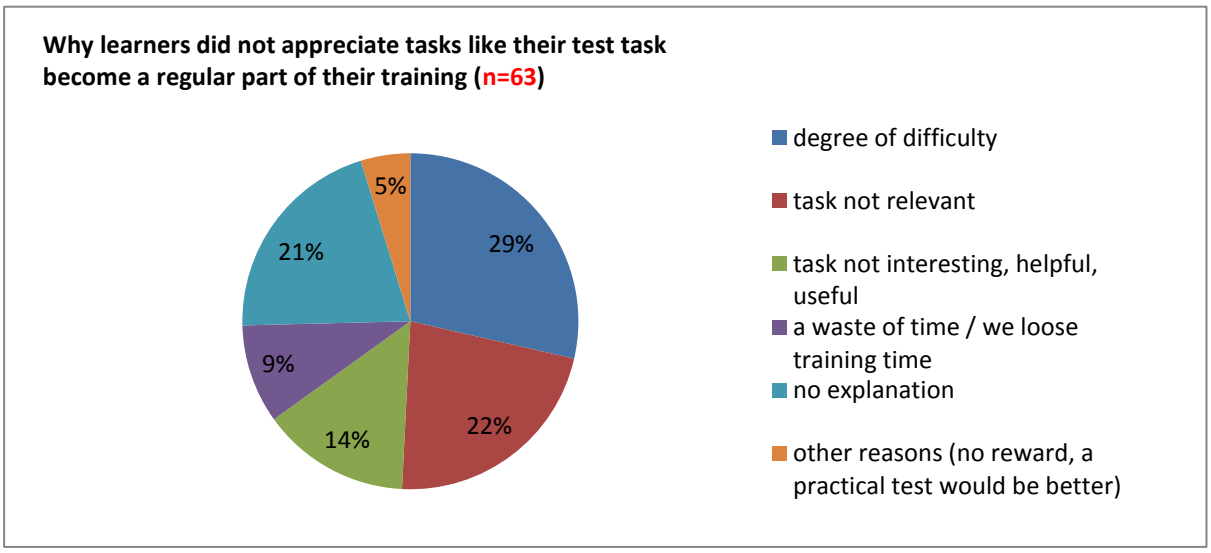


Figure 103: Analysis of test motivation: Why learners did not want to continue working with COMET tasks. Interpretation of data analysis provided in form of individual learners' comments. COMET South Africa 2014 and 2015.

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7.2 Analysis of test motivation linked to COMET test results

7.2.1 Average of time spent on working on the COMET test task, effort and degree of concentration

Time spent

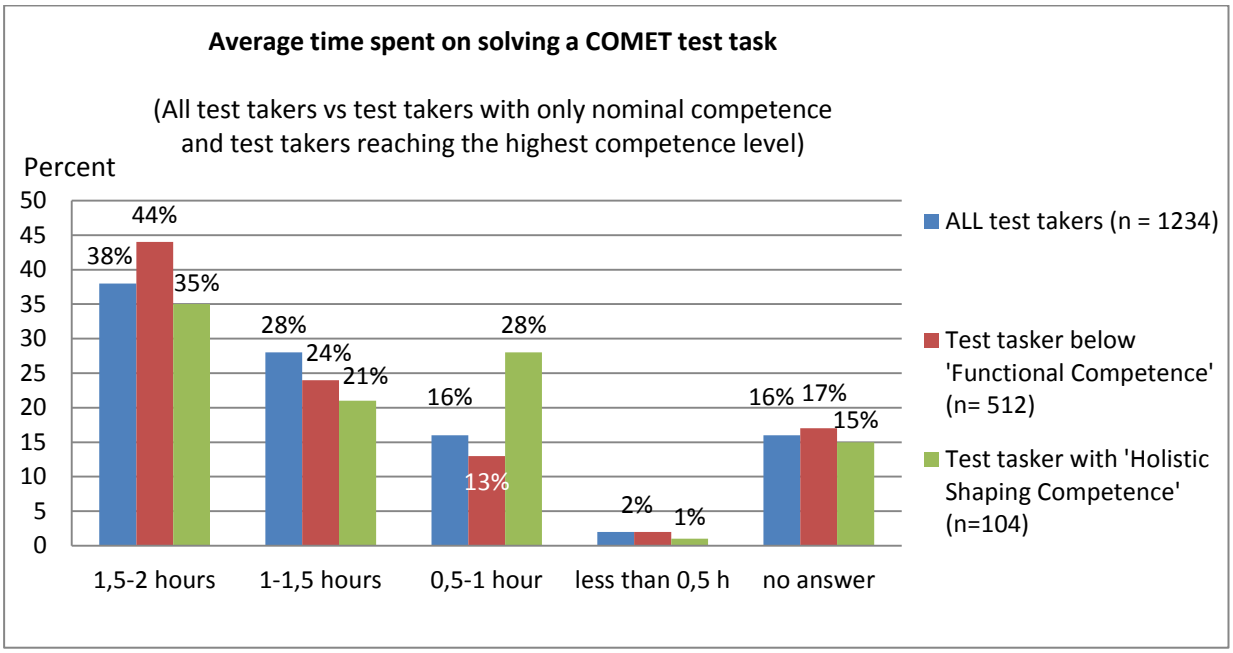


Figure 104: Analysis of test motivation: Average time spent on a task. Information related to groups of best and weakest test performers. COMET South Africa 2014 and 2015

Most of the test takers were trying their best, took as much time as possible. In all vocations, the result was as such. It is as well interesting to learn, that the general picture does not really change, if one takes into consideration the question what answers were related to best or weakest performing learners/students. The distribution of learners to the different average times spent on a tasks and reaching holistic shaping competence and of those reaching only nominal competence (test takers below 'functional competence') did not differ that much – compared to the overall results. However, test takers, reaching only poor results in the competence test more often used the full amount of time of up to two hours in order to find a solution. On the contrary, within the group of learners who were ready with their task in a relatively short time (below 60 minutes) the share of those reaching holistic shaping competence was surprisingly high. This means that there was a certain group of learners who were very sure of how to solve their task correctly. These persons did not need to spend that much time on it and also performed very well.

A differentiated analysis according to the vocations trained makes a lot of sense in order to find out whether there were differences in the respective test groups and not only according to general average performances. The following four graphs illustrate the test motivation according to the time spent on solving a task and the obtained competence levels in five occupations tested: electricians, mechatronics motor mechanics, welders and fabricators. In this analysis it becomes evident, that

1. there has not been a linear function between the amount of time spent on solving and the level of competence reached, so that in general, the amount of time spent did not necessarily correspond with the level of competence reached.
2. it was possible to reach the highest competence level in all professions (except for electricians, see remark below the graph) in a time below one hour. This especially referred to fabricators and welders where more than one third or more than one fifth of the test cohort managed to reached best results in relatively short time.

3. to reach such high competence level in the mechatronic profession was more likely when the full amount of time (up to 2 hours) was exploited while this was not the case in the other professions.
4. A very high proportion of learners who were not successful in solving their tasks (notably those who can be considered as risk group, reaching only nominal competence) spent a very long time on trying to find a solution. This observation is relevant for all vocations tested and counts for a very high motivation to perform as best as possible, even though it might have been frustrating to be faced with an unsolvable problem or a challenge that was obviously too high (this conclusion can be supported by the analysis of the learners' individual comments about their test experience, see Figure 101). This is very encouraging result, as compared to other COMET projects, where weaker students/apprentices tempt to a cut and run behaviour when confronted with a problem they cannot solve.

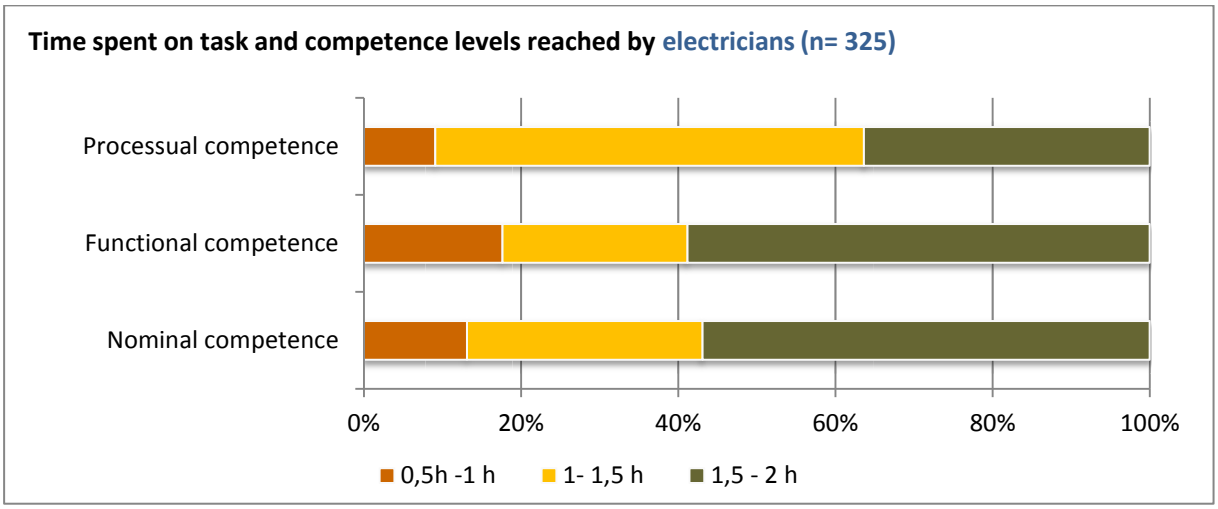


Figure 105: Analysis of test motivation: Average time spent on a task. Time psent on tasks and competence levels reached by electricians. COMET South Africa 2014.
(N.B. only one electrician reached holistic haping competence. Thus not relflected in this graph)

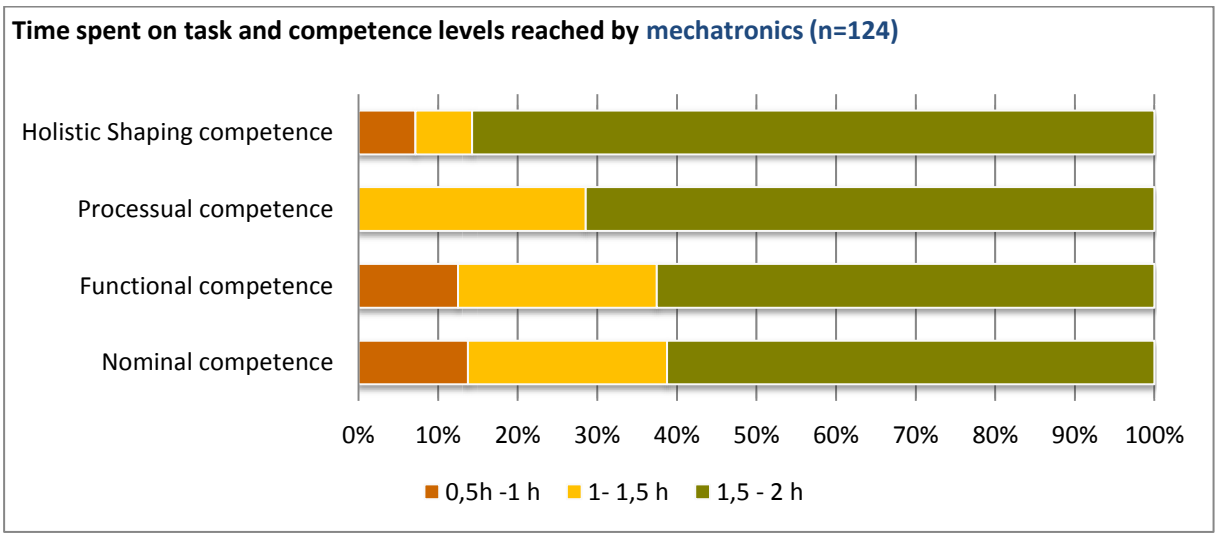


Figure 106: Analysis of test motivation: Average time spent on a task. Time spent on tasks and competence levels reached by mechatronics. COMET South Africa 2014.

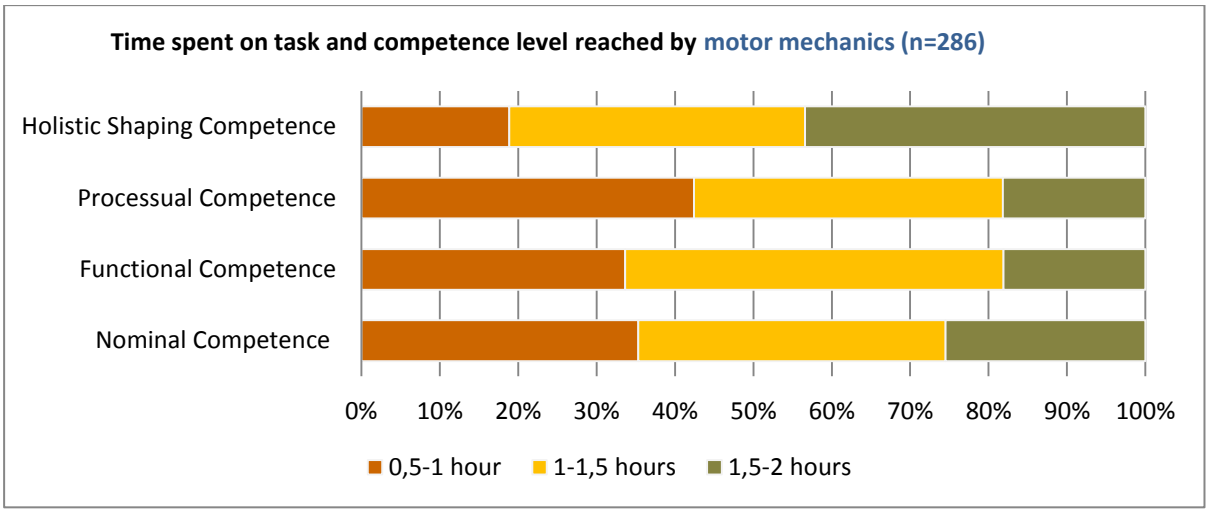


Figure 107: Analysis of test motivation: Average time spent on a task. Time spent on tasks and competence levels reached by motor mechanics. COMET South Africa 2015.

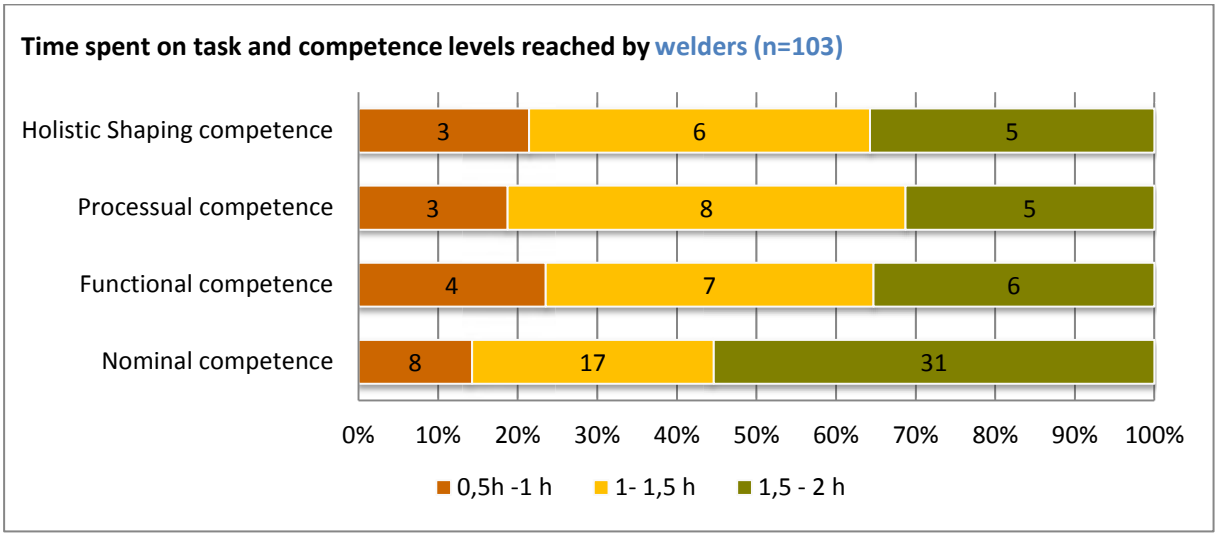


Figure 108: Analysis of test motivation: Average time spent on a task. Time spent on tasks and competence levels reached by welders. COMET South Africa 2014.

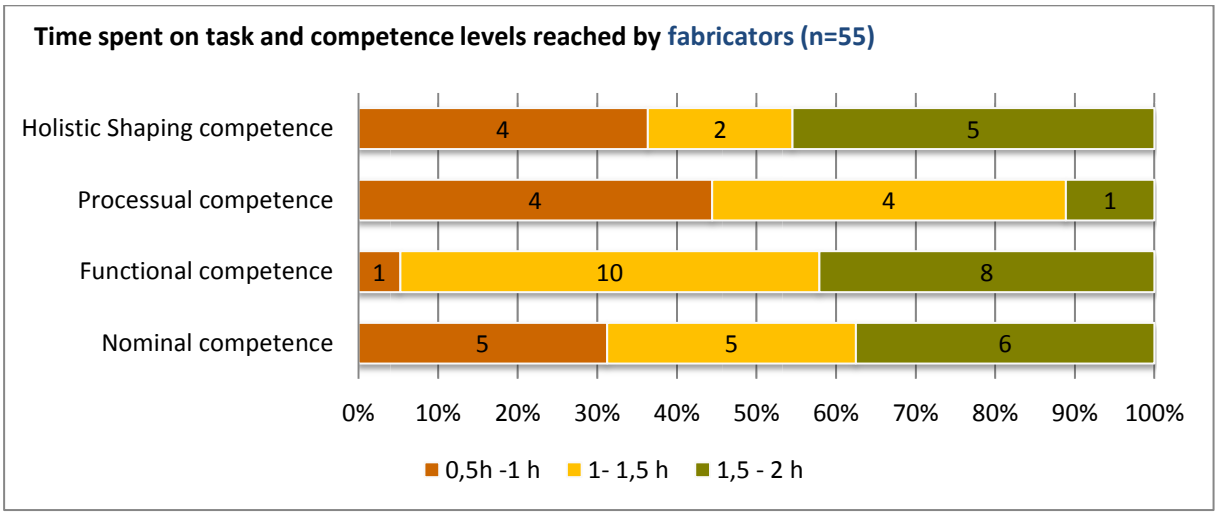


Figure 109: Analysis of test motivation: Average time spent on a task. Time spent on tasks and competence levels reached by fabricators. COMET South Africa 2014.

Degree of effort

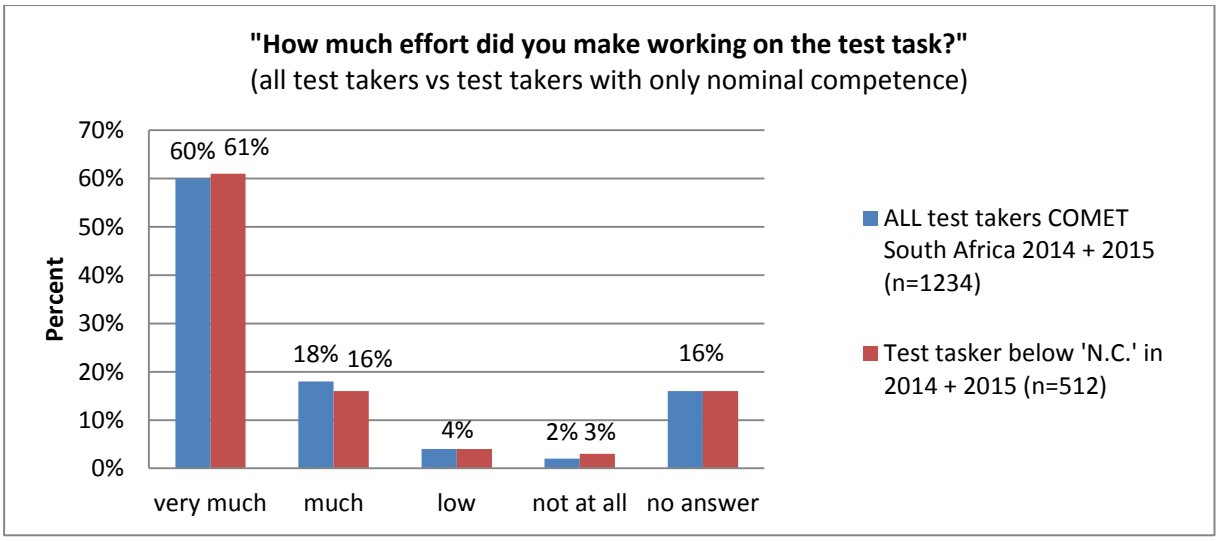


Figure 110: Analysis of test motivation: Degree of effort made. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015.

Degree of Concentration

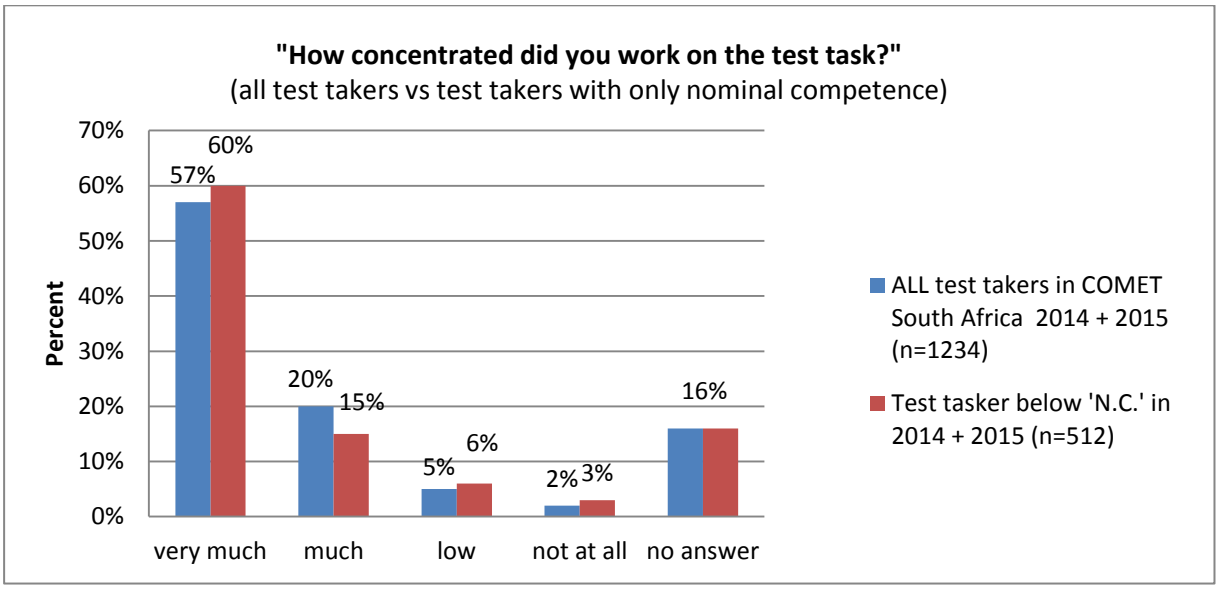


Figure 111: Analysis of test motivation: Degree of concentration. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015

7.2.2 Use value and relevance of task for the occupation learnt

Use value of task

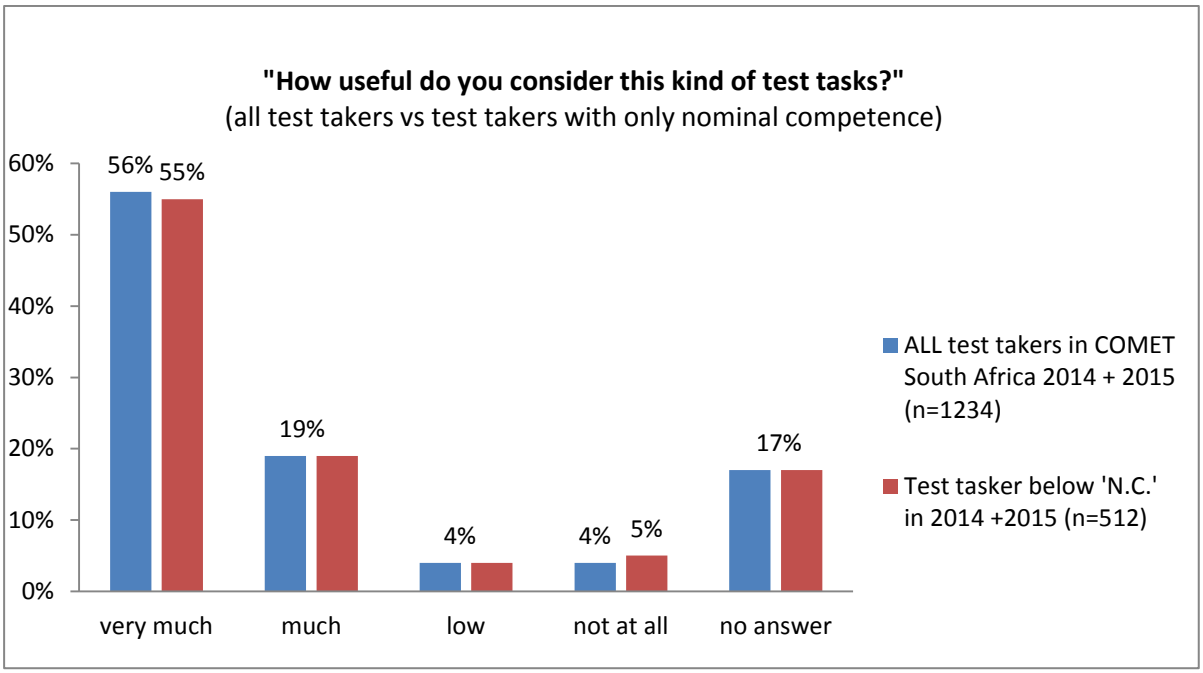


Figure 112: Analysis of test motivation: Use value of task. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015

Relevance of task

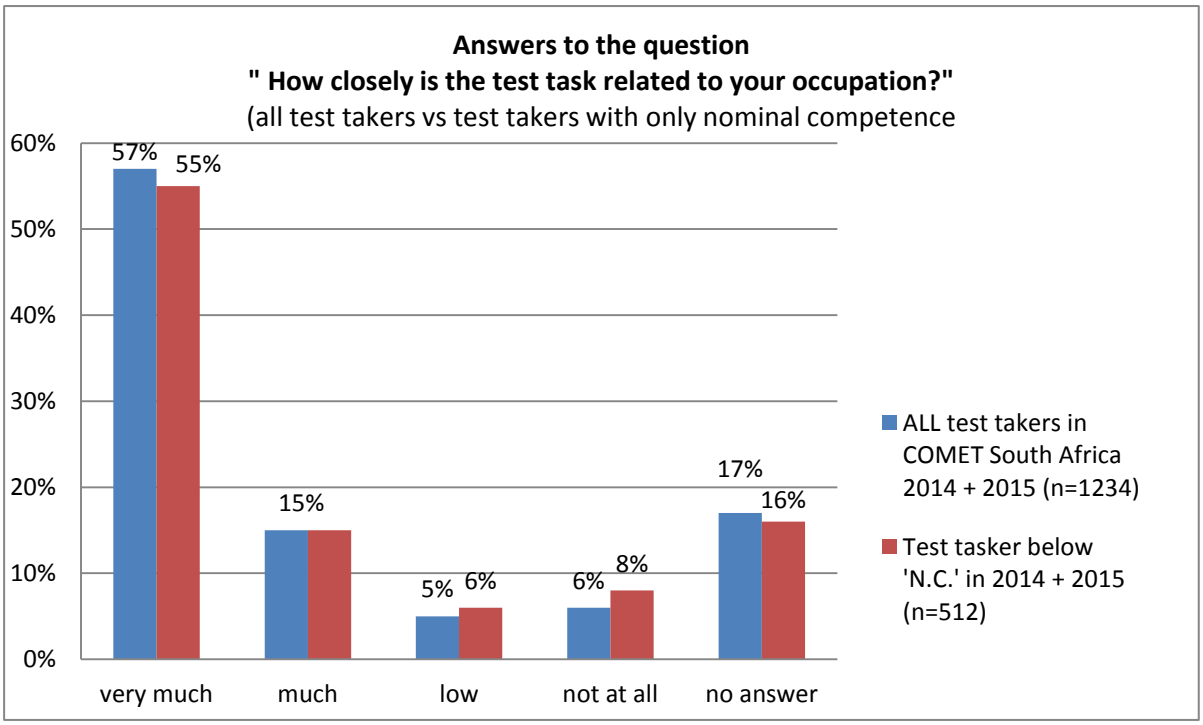


Figure 113: Analysis of test motivation: Relevance of task. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015.

7.2.3 Degree of difficulty

7.2.3.1 Pre-test analysis: Learners estimation on degree of difficulty in the light of test results

Among others the pre-test results have pointed towards some discrepancies between the learner's estimation on the degree of difficulty and their performance in the test. In other words, where learners indicated, that their task was rather or very easy, it was not necessarily the case that they also reached good test results.

Test takers with an estimation of a "rather easy" test task:
Electrician, Umfolozi PΣ: 9.16 (nominal competence) (below average)
Electrician, PE College: PΣ: 30.11 (functional competence) (above average)
Mechatronic, VW: PΣ: PΣ: 34 (processual competence) above average, time spent on task: ½ - 1h
Mechatronic, PE: PΣ: PΣ: 11.34 (functional competence) below average, time spent on task: 1h - 1½h
Mechatronic, VW: PΣ: PΣ: 0.6 (nominal competence) far below average, time spent on task: 1h - 1½h
Mechatronic, PE: PΣ: PΣ: 8.67 (nominal competence) far below average, time spent on task: 1h - 1½h
Mechatronic, PE: PΣ: PΣ: 46.11 (holistic shaping competence) above average, time spent: 1½h – 2h
Mechatronic, PE: PΣ: PΣ: 43.78 (holistic shaping competence) above average, time spent: 1½h – 2h
Mechatronic, PE: PΣ: PΣ: 14.34 (nominal competence) above average, time spent: 1½h – 2h
Mechatronic, PE: PΣ: PΣ: 47.33 (holistic shaping competence) above average, time spent: 1-1½h
Welder, West Coast: PΣ: 0 (nominal competence) far below average, time spent on task: 1-1 ½h
Welder, West Coast: PΣ: 33(processual competence) above average, time spent on task: n.a.
Welder, West Coast: PΣ: 65.66 (holistic shaping competence) above average, time spent: 1-1 ½h
Welder, West Coast: PΣ: 37 (processual competence) above average, time spent: 1½h – 2h
Welder, West Coast: PΣ: 24 (functional competence) below average, time spent: 1½h – 2h
Welder, West Coast: PΣ: 54.33 (holistic shaping competence) above average, time spent: 1½h – 2h
Welder, West Coast: PΣ: 42.66 (processual competence) above average, time spent: 1-1 ½h
Welder, West Coast: PΣ: 11.33 (nominal competence) below average, time spent: 1½h – 2h
Welder, Arcelor: PΣ: 43 (holistic shaping competence) above average, time spent on task: 1-1 ½h
Test takers with an estimation of a "very easy" test tasks:
Electrician, Umfolozi: PΣ: 13.16 (nominal competence), above average, time spent on task: 1-1 ½h
Electrician, VW: PΣ: 21.89 (functional competence) above average, time spent on task: ½ - 1h
Mechatronic, VW: PΣ: 35.89 (processual competence) above average, time spent on task: ½ - 1h
Mechatronic, VW: PΣ: 6 (nominal competence) far below average, time spent on task: ½ - 1h
Welder, Arcelor: PΣ: 43.66 (holistic shaping competence) above average, time spent on task: n.a.
Welder, West Coast: PΣ: 35.67(processual competence) above average, time spent on task: 1½h – 2h
Welder, Arcelor: PΣ: 20 (functional competence) below average, time spent on task: 1-1 ½h

Table 5: Discrepancies between learner's estimation on the degree of difficulty of test tasks and their performance in the pre-test. South Africa 2014

According to the data analysis of the pre-tests, a considerable number of test takers had either overestimated their level of competence or just gave incorrect answers to the question regarding their estimation on the degree of difficulty of tasks.

It was also noteworthy that probably welders, who performed well or very well, have estimated the tasks as rather or very difficult. These aspects gave rise to a deeper analysis with the main test data.

7.2.3.2 Main test analysis: Learners estimation on degree of difficulty in the light of test results

When asked about their estimation on the degree of difficulty of tasks, the big majority of all test takers were of the opinion that the tasks were very or rather difficult. This estimation refers to learners reaching competence levels as well as to learners below functional competence (see Figure 114). This result applies to learners of all vocations tested in the main tests 2014 and 2015 or in pre-tests.

In addition to this general finding, it is noteworthy that

- On average 28% of all learners who did not reach *any* competence level have quoted that their task was rather or very easy. One has to conclude that these test persons were either too reluctant to admit that they had difficulties to solve their task or not aware about the actual scope of their knowledge gap. As the following pie diagrams (
- Figure 115 -
- Figure 120) show, such implausible answers or "over-estimations" referred to 26% of electricians, 24% of mechatronics, 37% of motor mechanics, and 26% of electricians who did not reach any competence level. Whether "over-estimation" is a correct explanation or not can only be found out by additional qualitative interrogations. In any case, it is noteworthy that answers provided by almost a third of the weaker learners do not reflect the situation correctly.

- The fact that the estimation of learners reaching holistic shaping competence did not so much differ from the estimations of learners who reached lower levels supports a previous finding (COMET main test 2010), where it became quite obvious, that good learners had a more realistic estimation on their own competence.

- Despite the (surprisingly) good average results reached in the pre-test, 77% of the fabricators have indicated, that the difficulty of task was rather high or very high. Their share is higher than in other vocations tested and does not correspond at all with the test results on vocational competence. Even though the difference between fabricators and other learners' estimations on the degree of tasks difficulty is not extraordinarily high, this result supports the assumption, that there were some irregularities in the rating of the pre-test of fabricators (cf. 6.4.3).

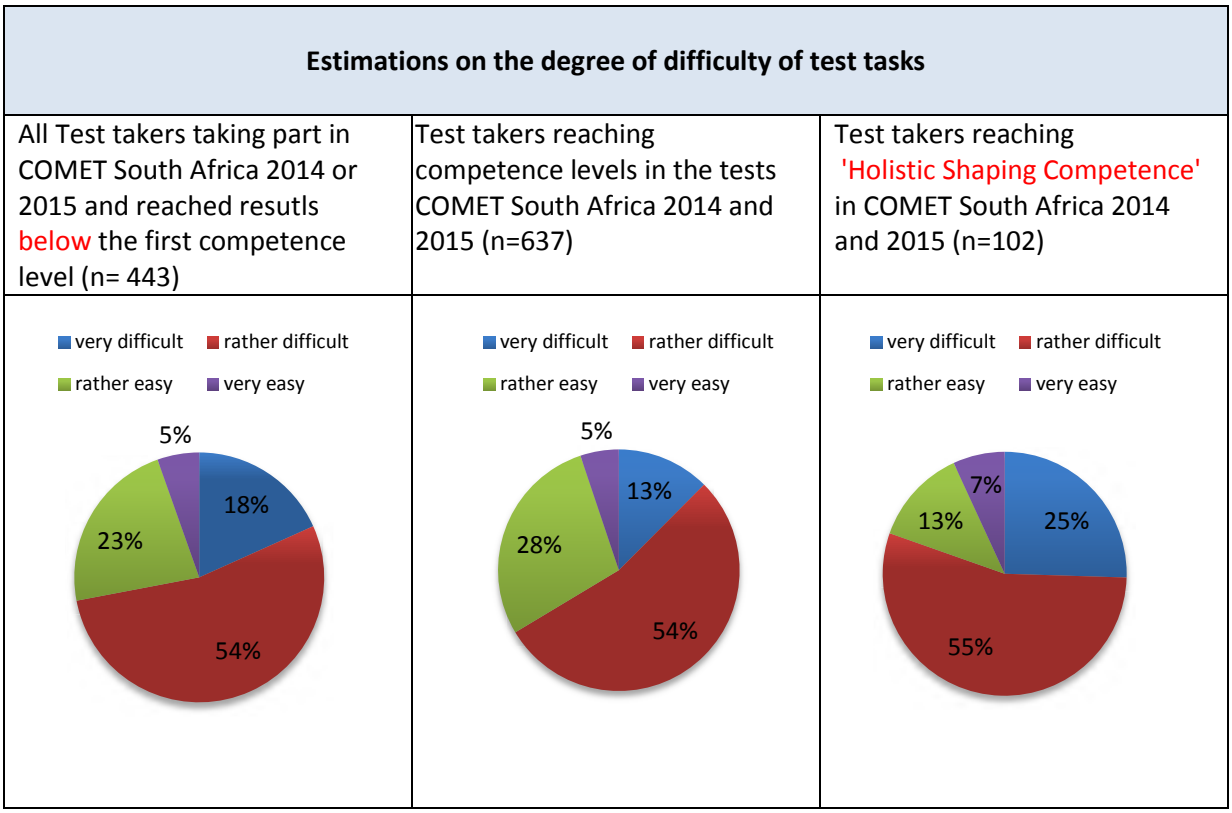


Figure 114: Analysis of test motivation: Learners' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014 and 2015. Data is based on 1,213 test takers in both test. The response rate to this question was 87.5 %, 154 test persons did not provide an answer to this question.

Degree of difficulty according to vocations tested

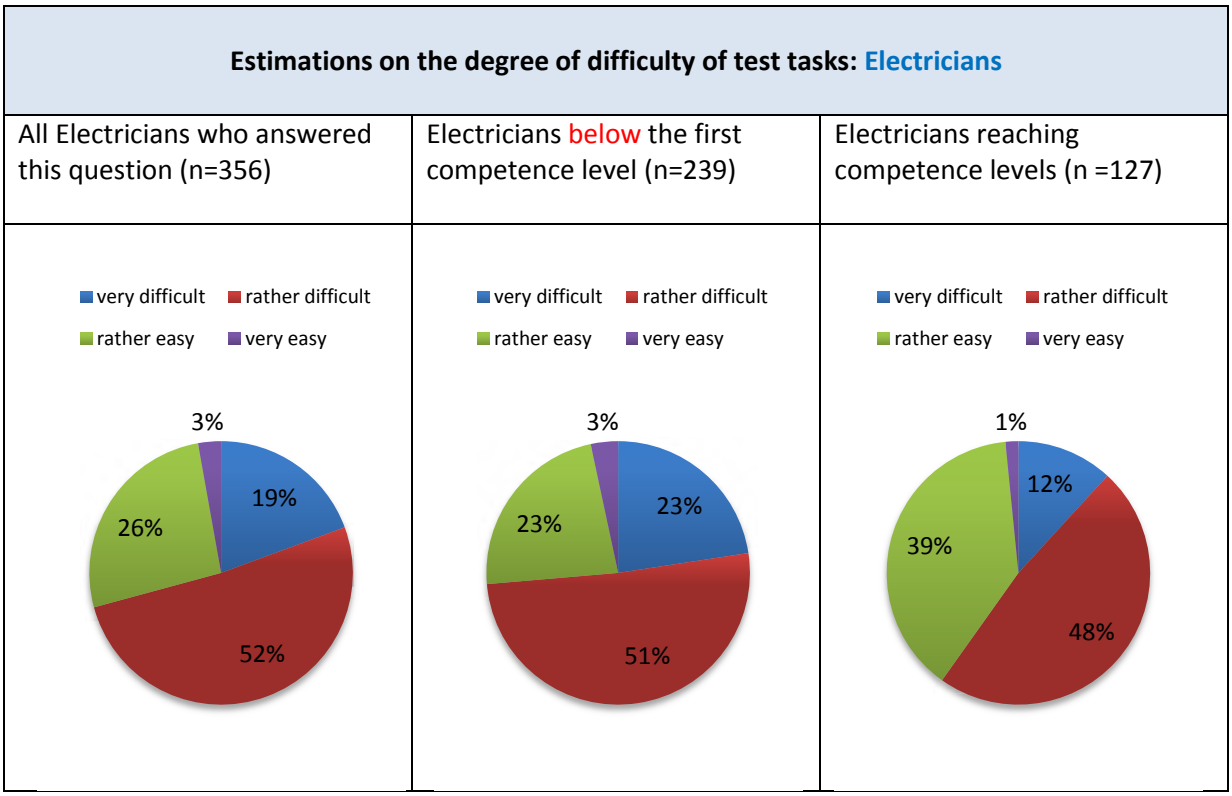


Figure 115: Analysis of test motivation: Electricians' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014.

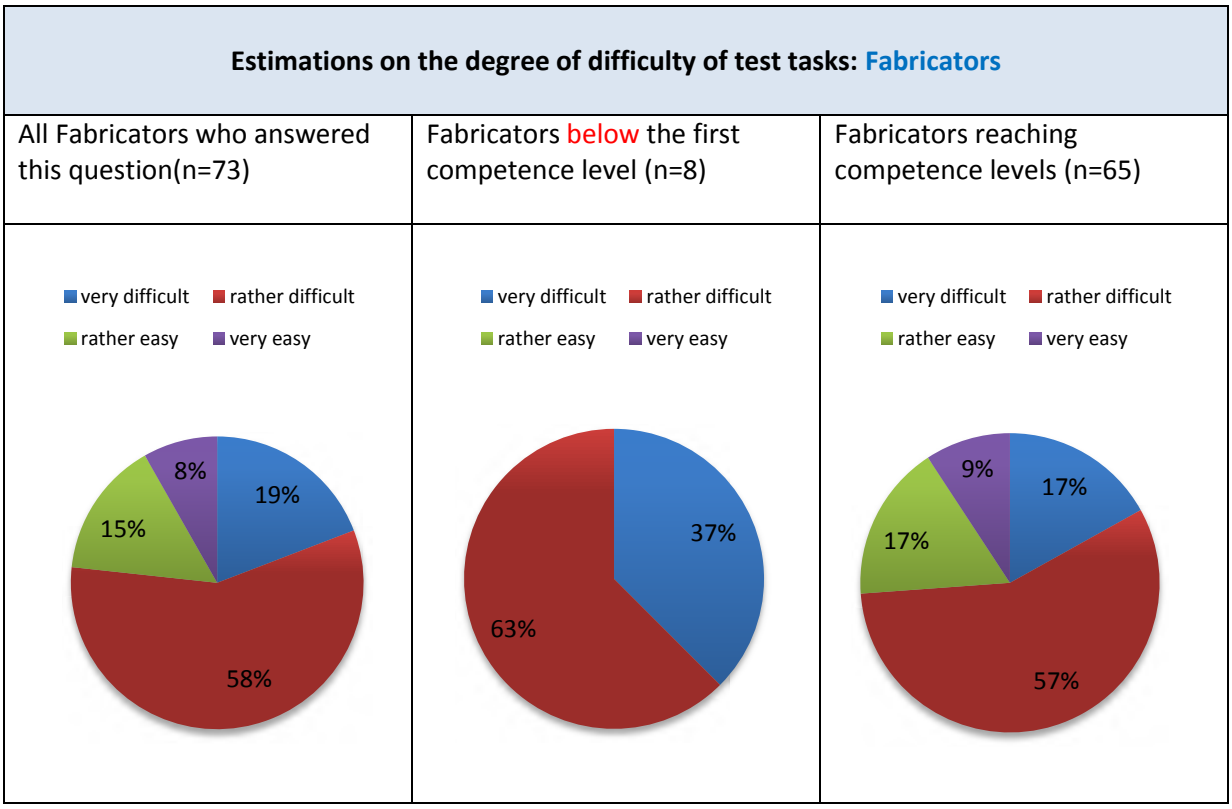


Figure 116: Analysis of test motivation: Fabricators' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014.

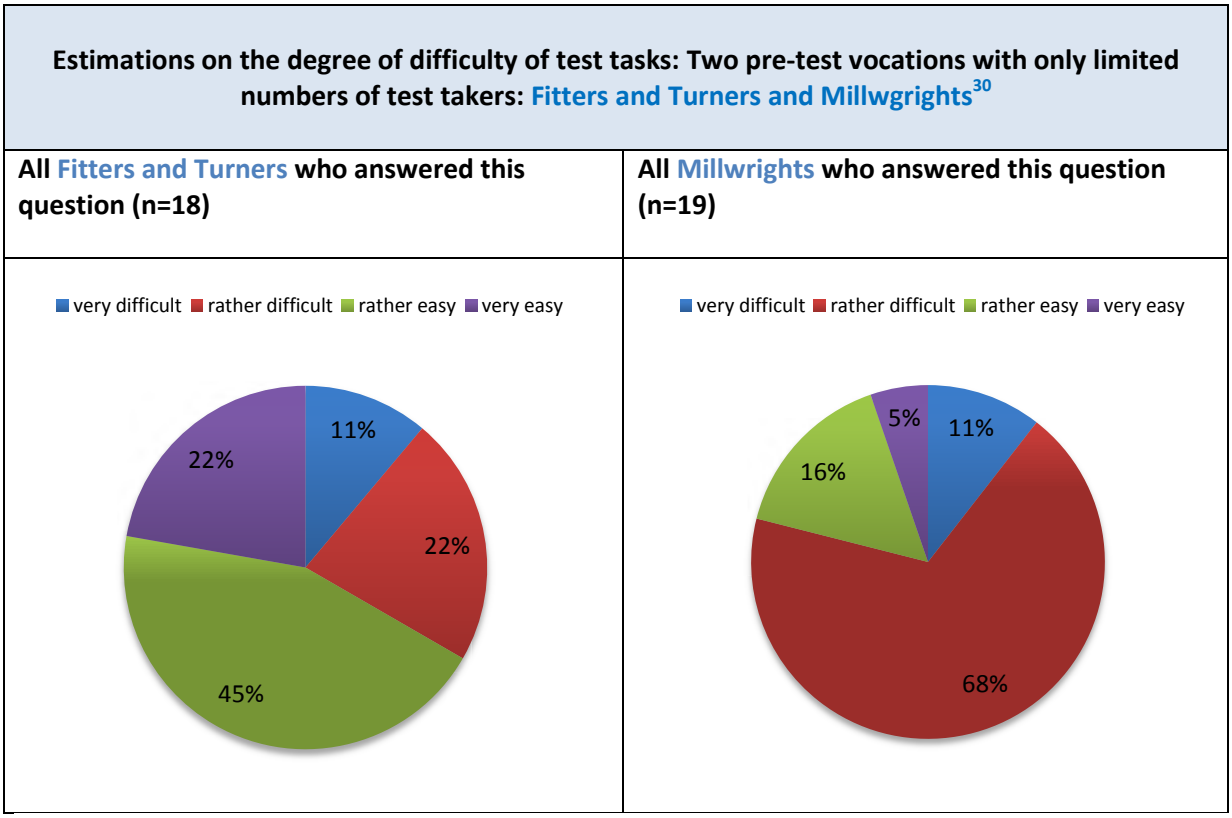


Figure 117: Analysis of test motivation: Fitters and turners' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014.

[30] -The analysis of both, fitters and turners and also millwrights only refer to very small test groups so that in these two cases, no differentiated illustration is provided.

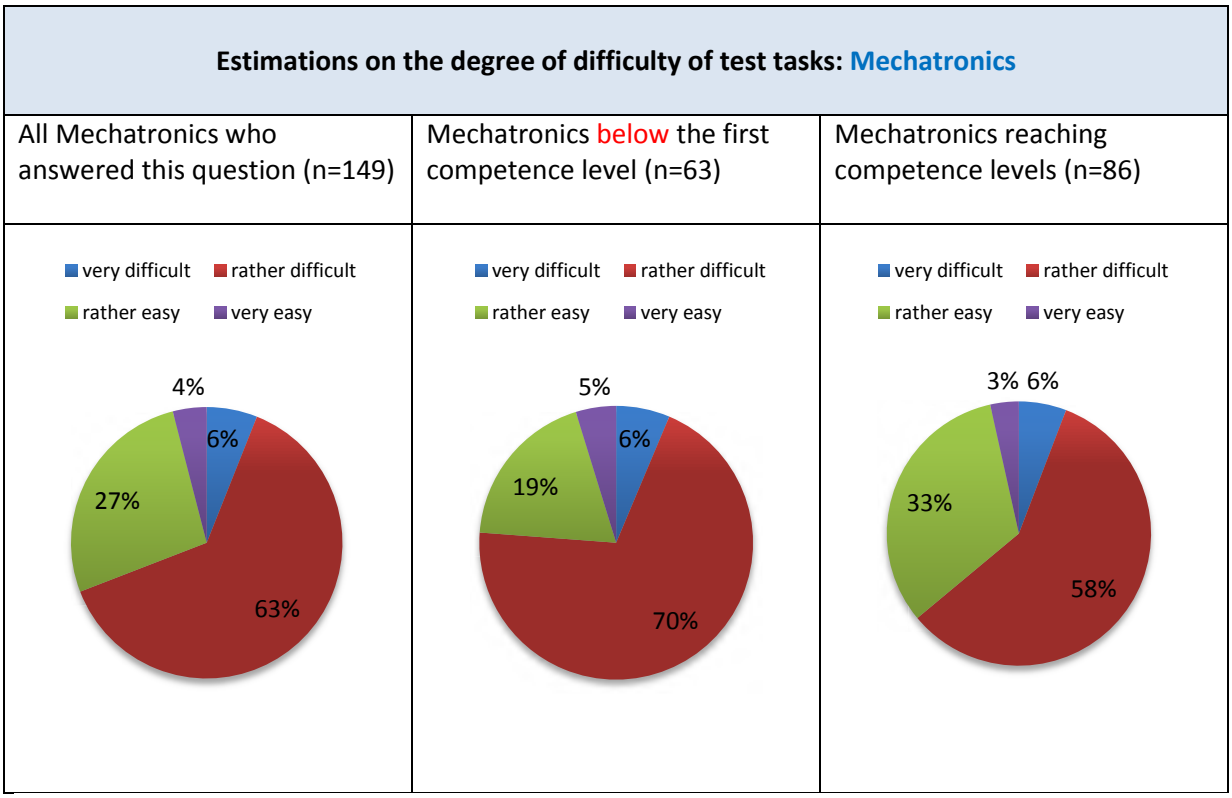


Figure 118: Analysis of test motivation: Mechatronics' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014.

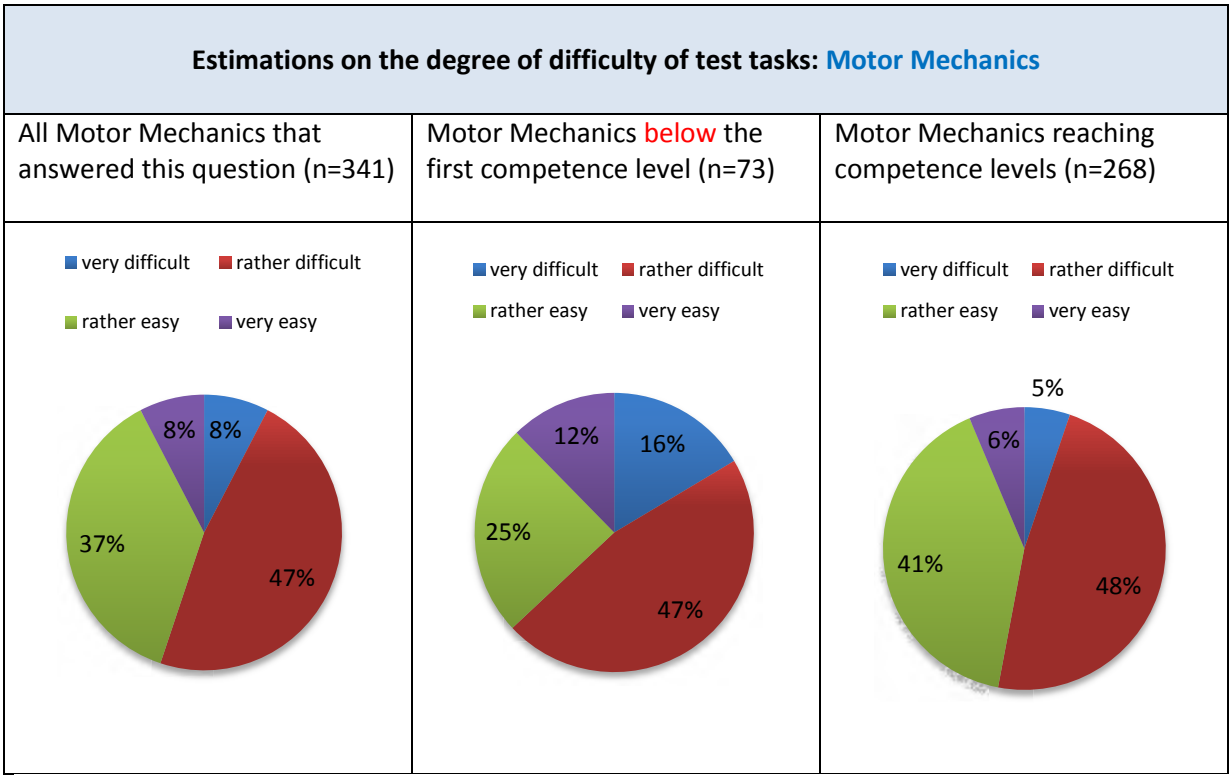


Figure 119: Analysis of test motivation: Mechatronics' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2015.

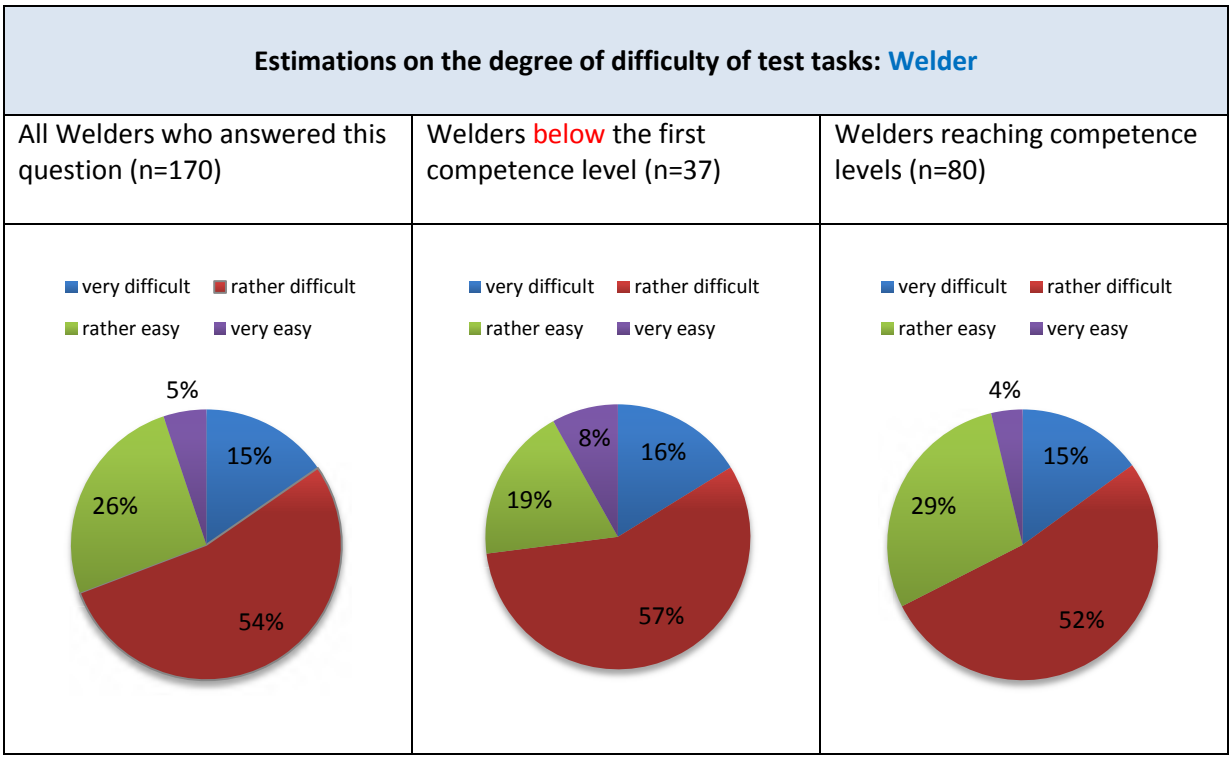


Figure 120: Analysis of test motivation: Welders' estimations on the degree of difficulty. Information according to test groups with different competence levels. COMET South Africa 2014.

7.2.4 The learners' general degree of interest and opinion on a future introduction of COMET tasks as a regular part of their training

The fact, that learners estimations and answers – whether they have reached competence levels or not – did not so much differ from each other is very evident when it comes to the questions as to whether it was interesting working on a task and if learners liked COMET tasks becoming a regular part of their training. The analysis shows, that the response to this question is almost identical. Once again, this is noteworthy because obviously a poor performance on a task does not necessarily give rise to frustration or to a lower degree of interest in the subject. This result is strongly supporting the findings analysed in 7.2.

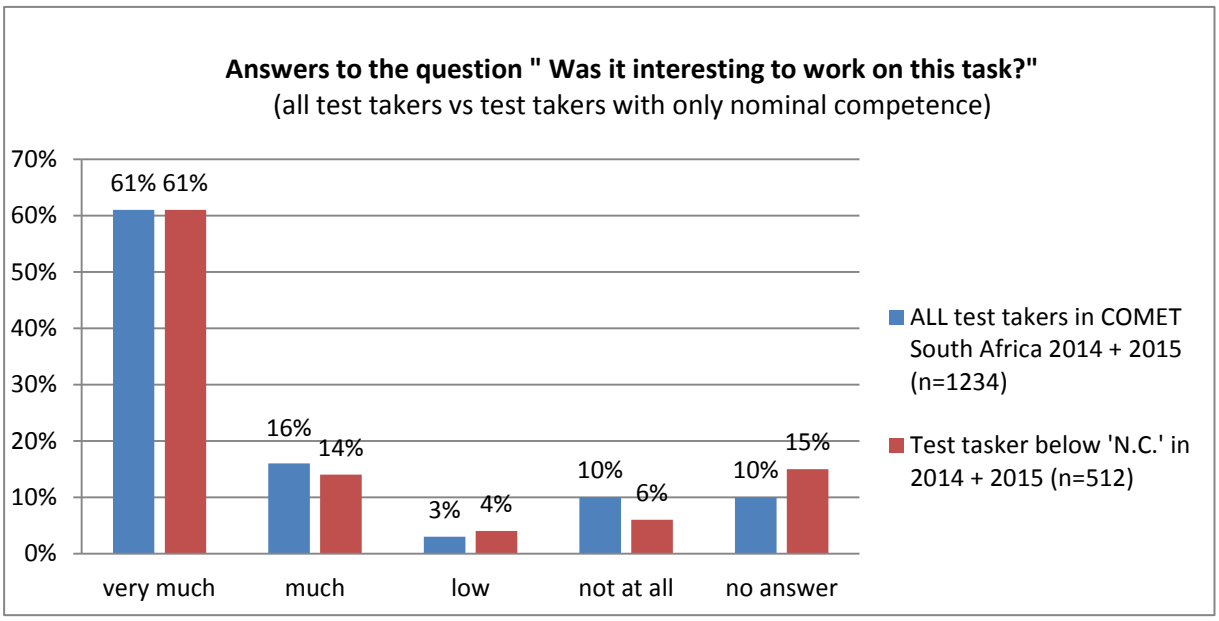


Figure 121: Analysis of test motivation: General interest. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015

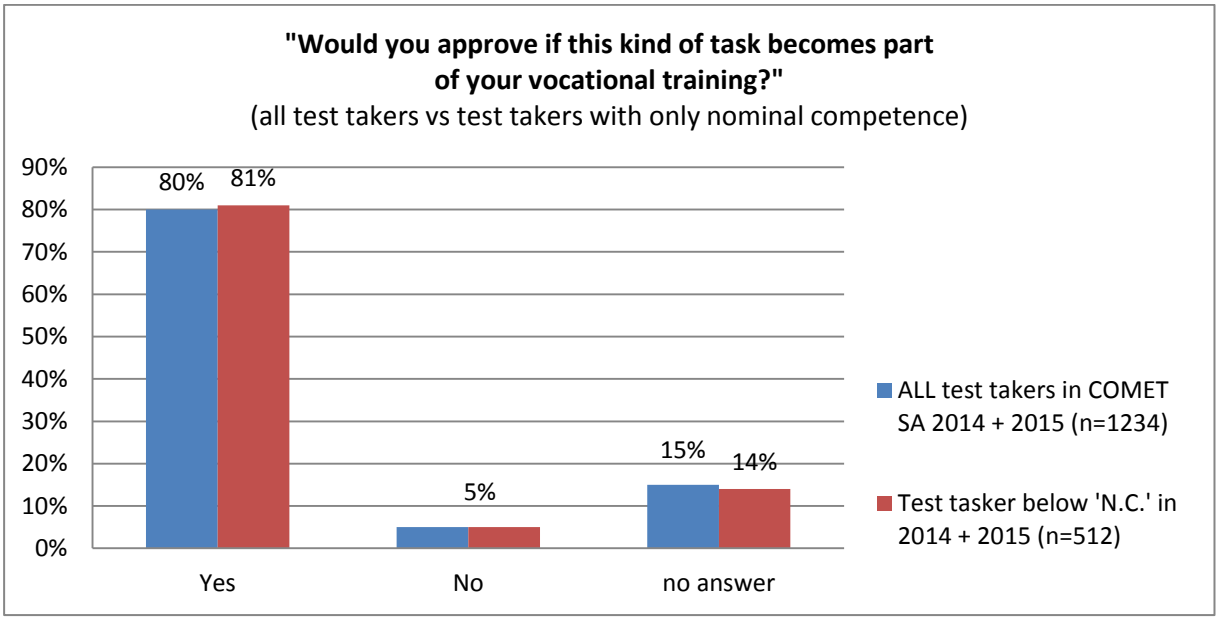


Figure 122: Analysis of test motivation: relevance of task. Average results and results of test takers below nominal Competence (N.C.). COMET South Africa 2014 and 2015.

Part VIII Vocational Identity and Commitment

This part documents the analysis of the questionnaires on vocational identity and commitment as well as some contextual issues summed up under the headline "correlations". The conclusions or of this analysis will not be further commented as the major issues have been summarised in executive summary. It should however be mentioned, that the number of test takers in the COMET competence tests often does not correspond with the number of valid questionnaires used for the commitment analysis due to a lack of feedbacks received from the learners. Only where the analysis could be completed, the data was used for analysis and comparisons.

8.1 Analysis according to test sites

8.1.1 Occupational identity and commitment

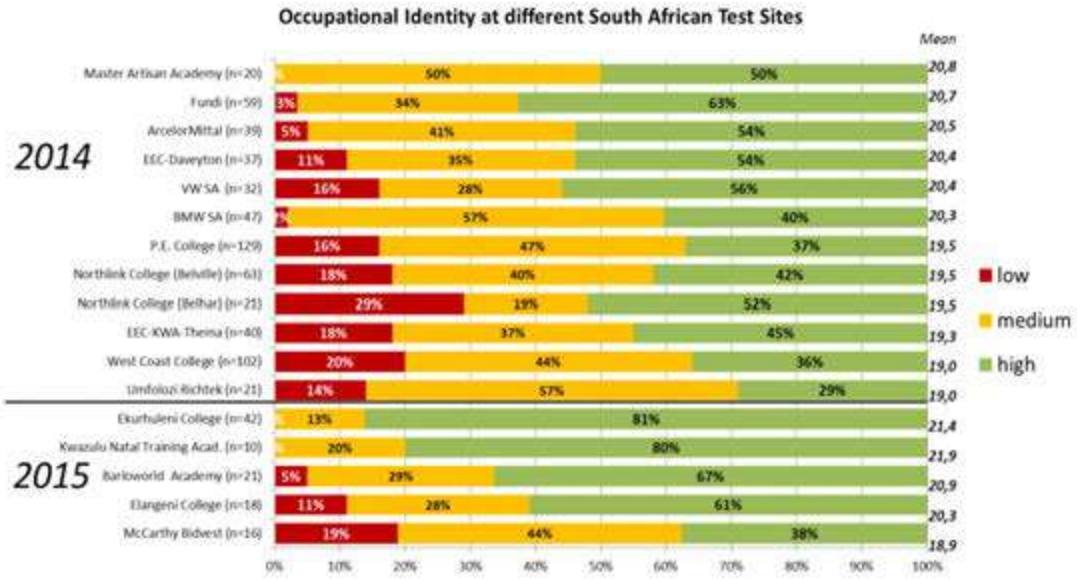


Figure 123: Analysis of VI Questionnaire: Occupational identity according to test sites. Results of COMET South Africa 2014 and 2015.

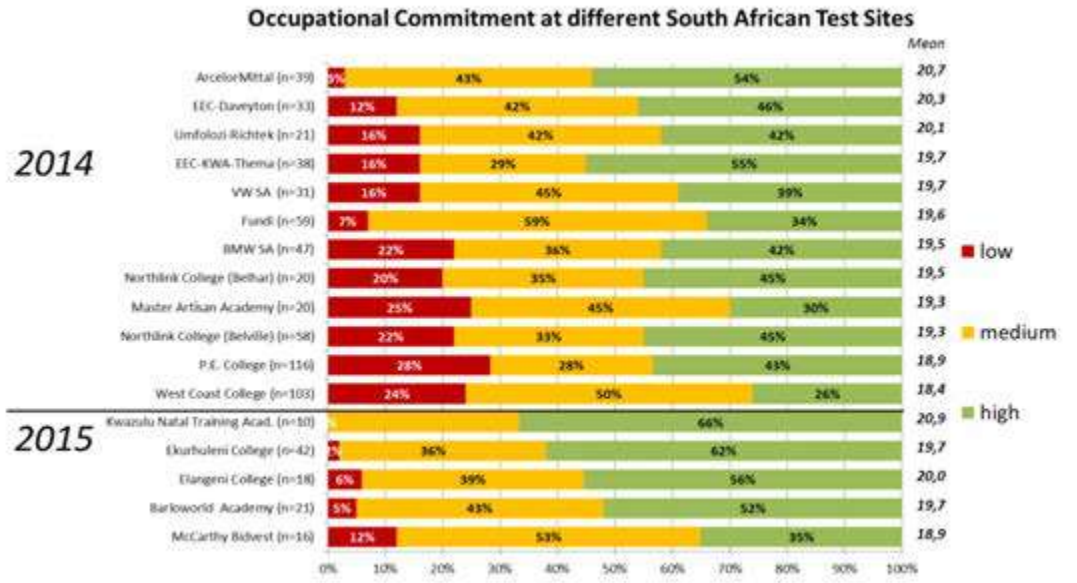


Figure 124: Analysis of VI Questionnaire: Occupational commitment according to test sites. Results of COMET South Africa 2014 and 2015.

8.1.2 Organisational identity and commitment

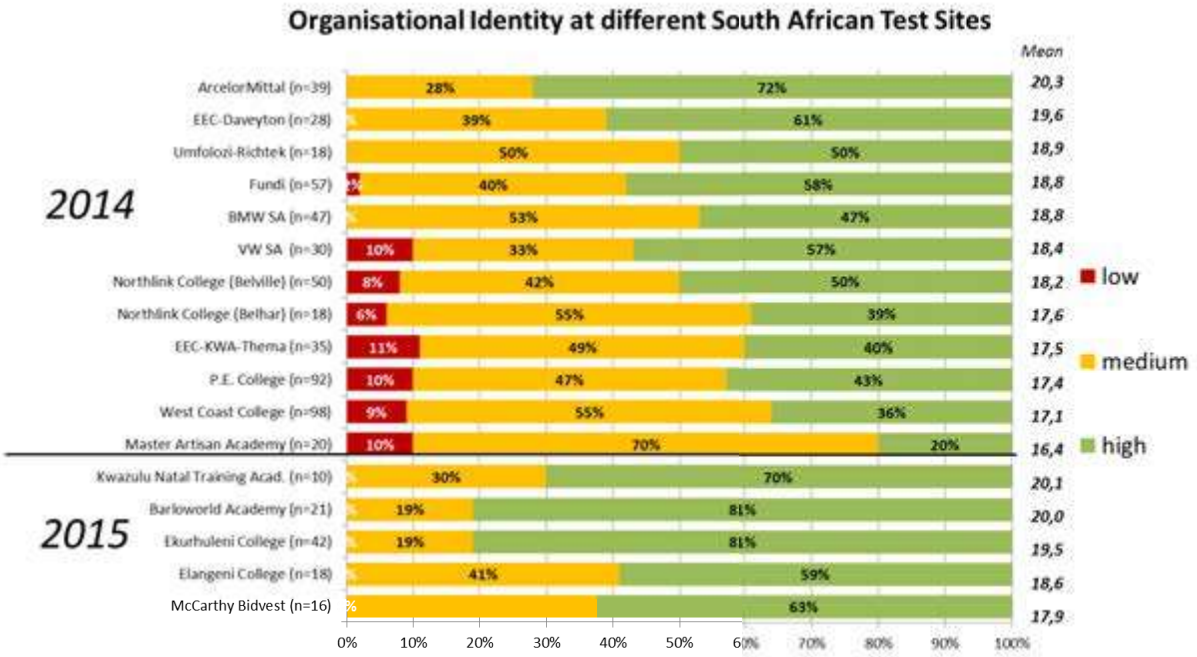


Figure 125: Analysis of VI Questionnaire: Organisational identity according to test sites. Results of COMET South Africa 2014 and 2015.

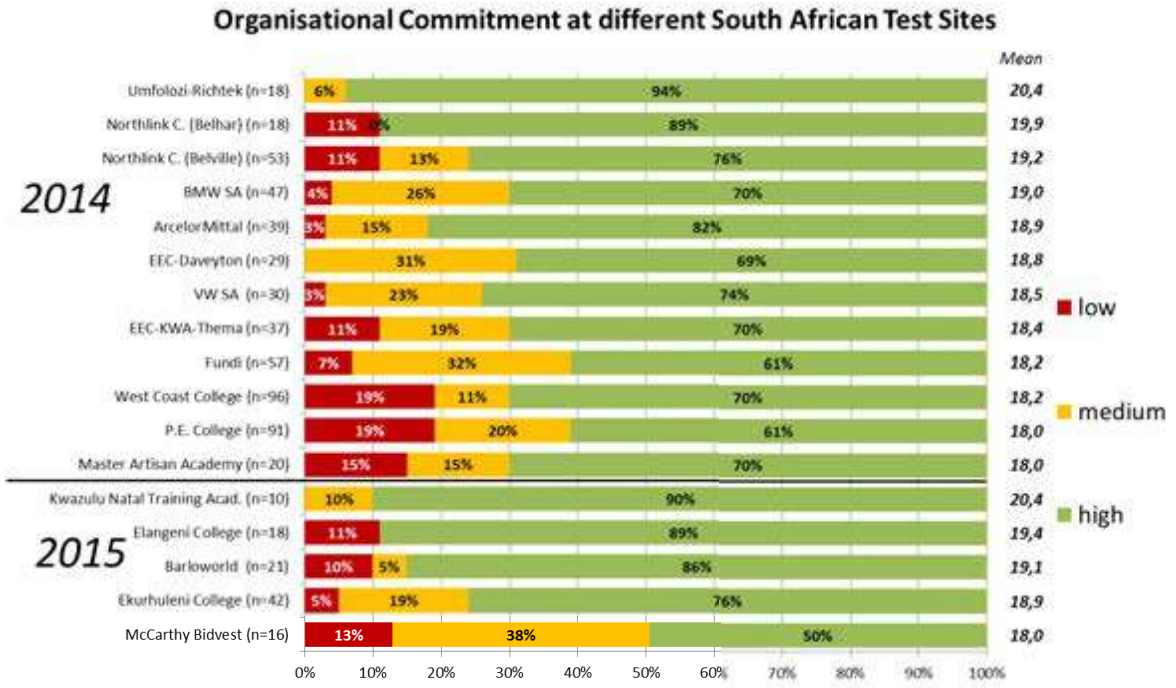


Figure 126: Analysis of VI Questionnaire: Organisational commitment according to test sites. Results of COMET South Africa 2014 and 2015.

8.1.3 Work Morale

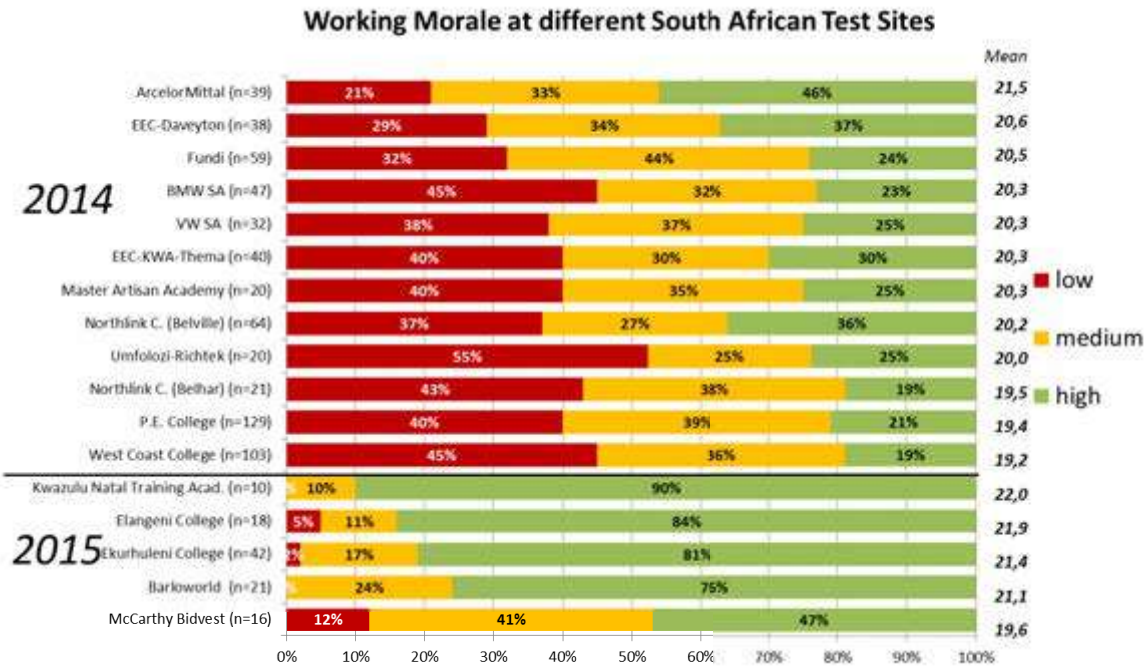


Figure 127: Analysis of VI Questionnaire: Work morale according to test sites. Results of COMET South Africa 2014 and 2015.

8.2 Analysis according to occupations trained

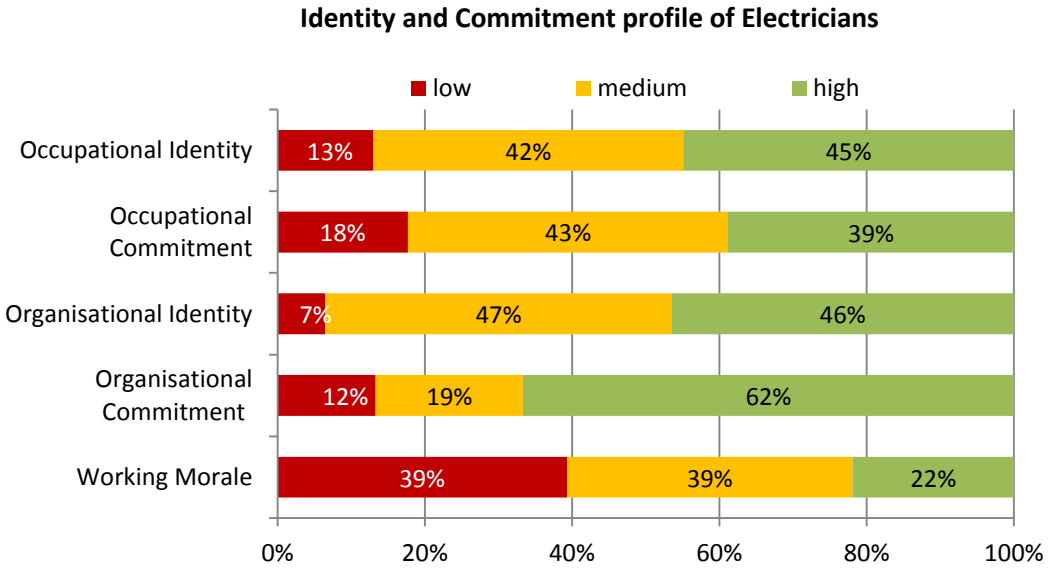


Figure 128: Analysis of VI Questionnaire: Identity and Commitment profile of Electricians. Data Source: COMET South Africa2014

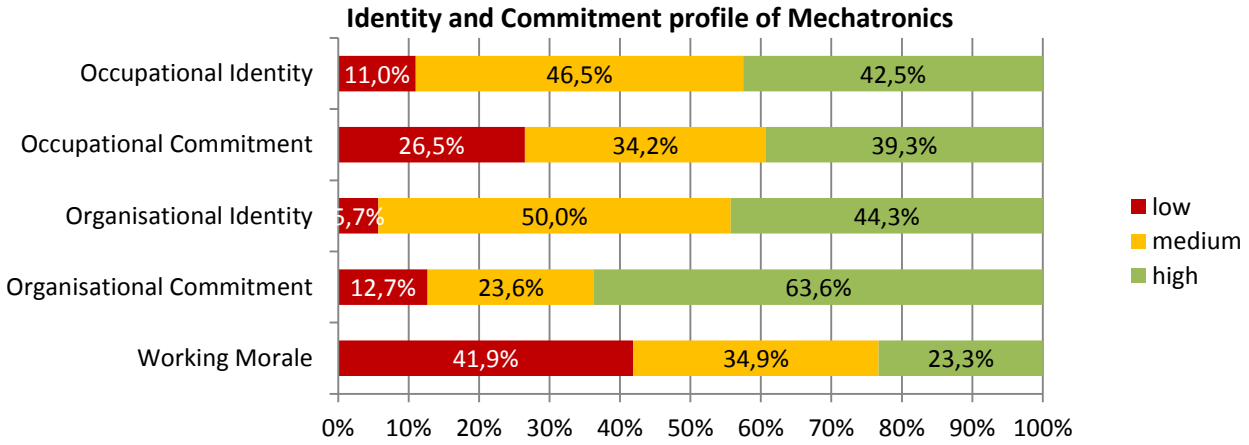


Figure 129: Analysis of VI Questionnaire: Identity and Commitment profile of Mechatronics.
Data Source: COMET South Africa2014

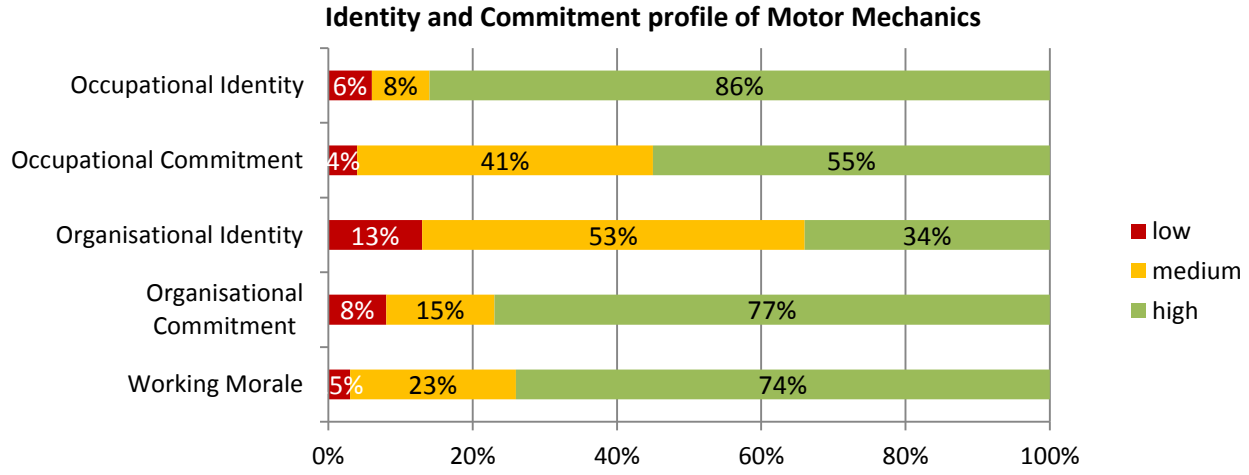


Figure 130: Analysis of VI Questionnaire: Identity and Commitment profile of Motor Mechanics.
Data Source: COMET South Africa2015

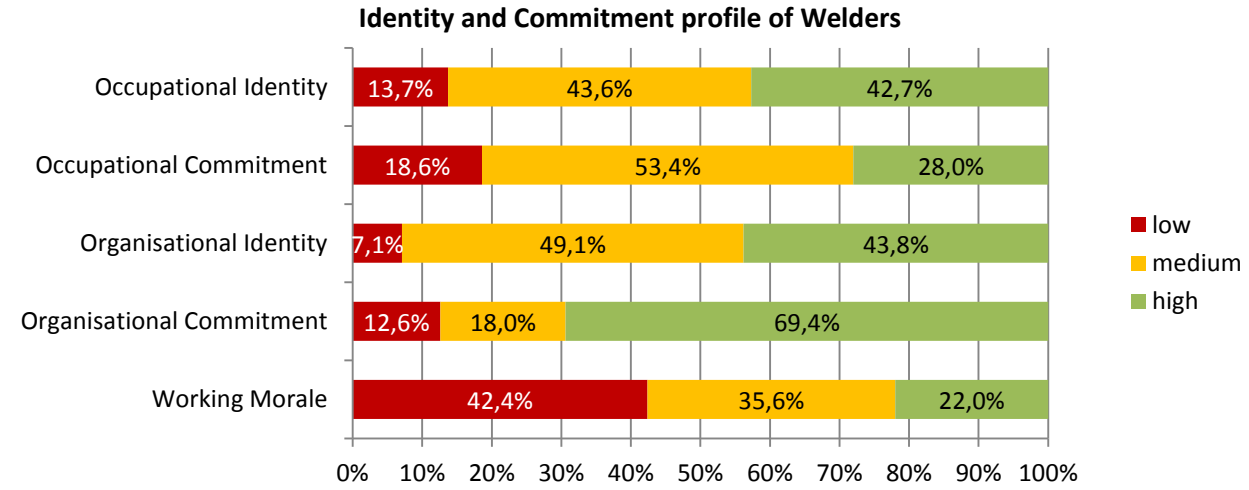


Figure 131: Analysis of VI Questionnaire: Identity and Commitment profile of Welders.
Data Source: COMET South Africa2014

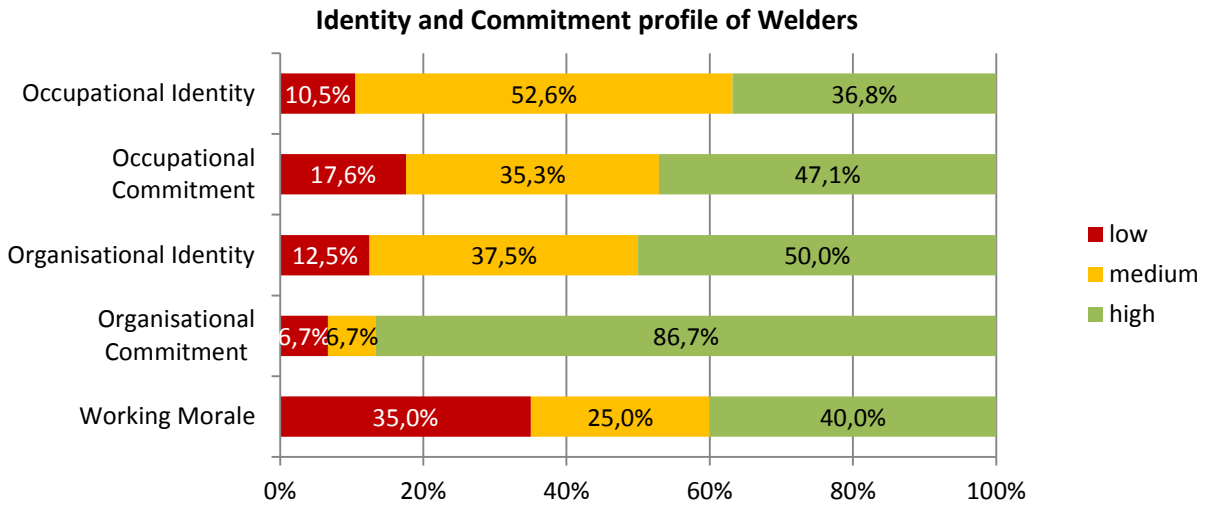


Figure 132: Analysis of VI Questionnaire: Identity and Commitment profile of Fabricators.
Data Source: COMET South Africa2014

Occupational vs Organisational Identity and Commitment in different learning environments

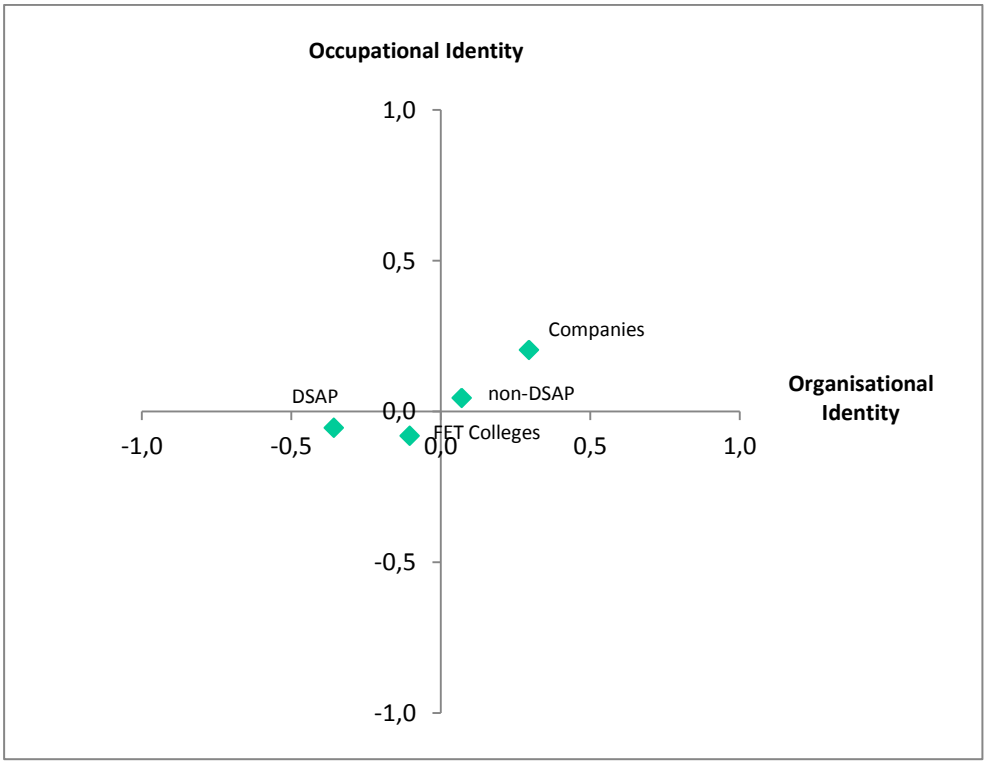


Figure 133: Analysis of VI Questionnaire: Occupational vs Organisational Identity
Data analysis of companies and colleges, DSAP and Non-DSAP programs.
COMET RSA 2014

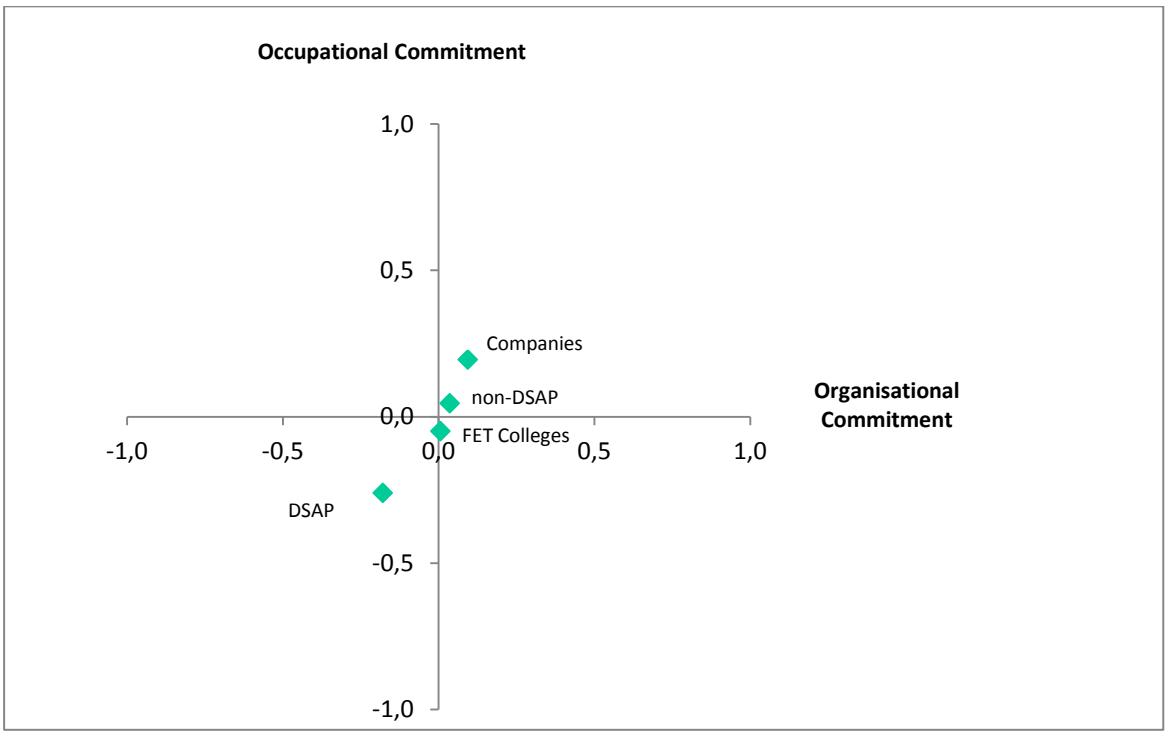


Figure 134: Analysis of VI Questionnaire: Occupational vs Organisational Commitment
Data analysis of companies and colleges, DSAP and Non-DSAP programs.

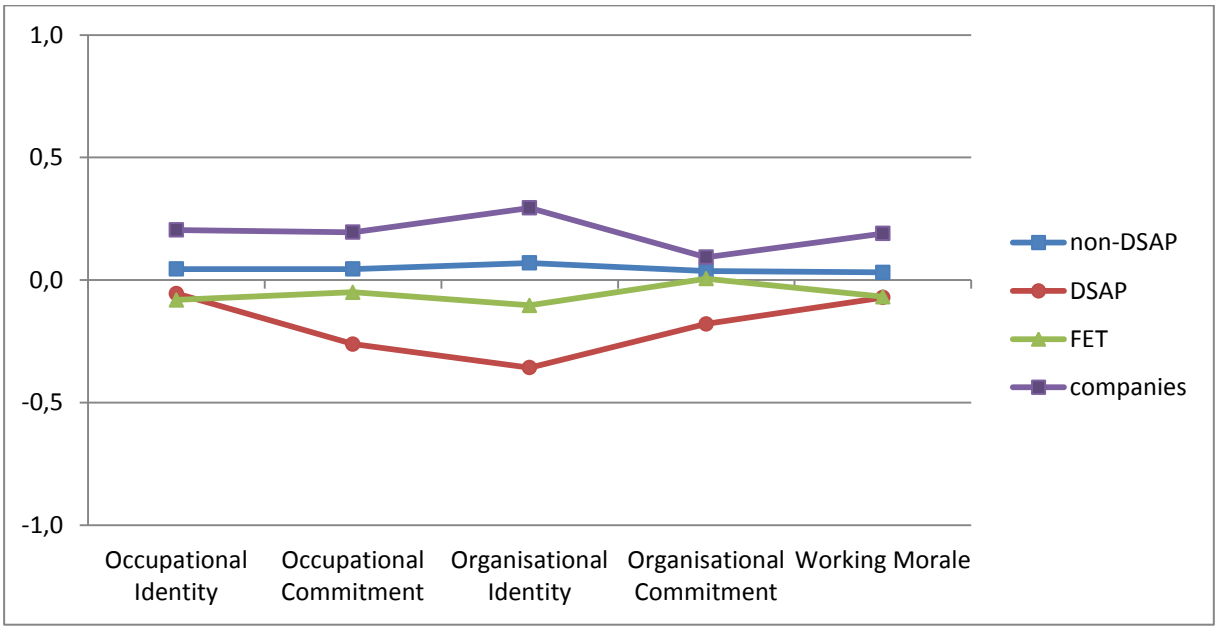


Figure 135: Analysis of VI Questionnaire: Identity and Commitment profiles in different learning environments.
Data Source: COMET South Africa2014

Correlations

Importance of task quality – Effect on Occupational Commitment

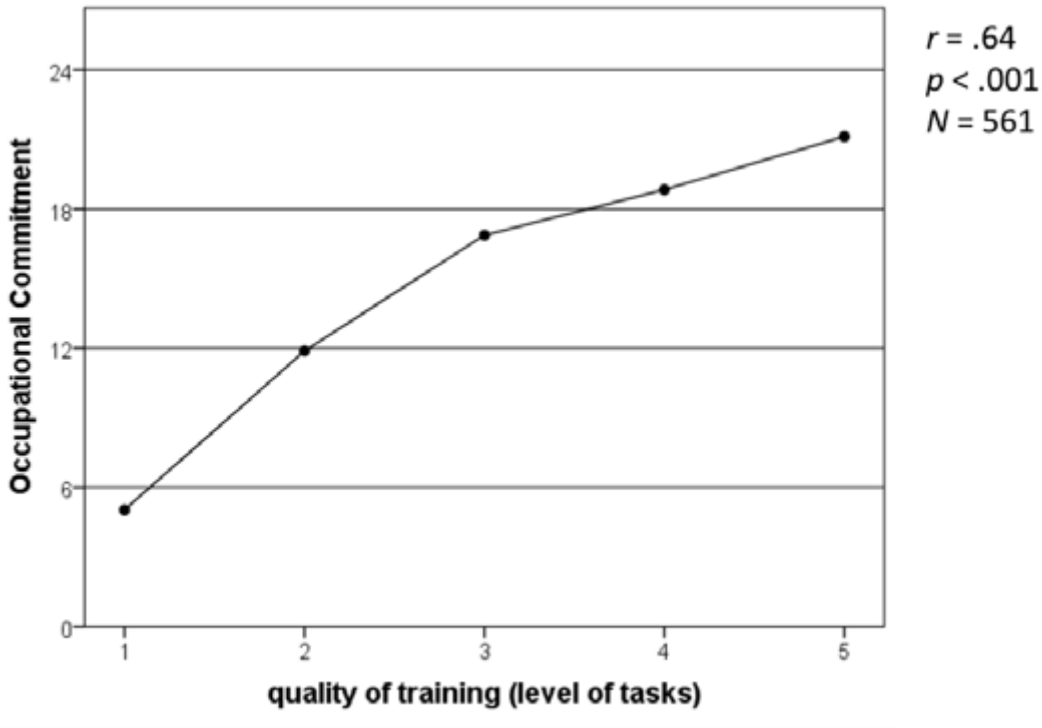


Figure 136: Analysis of VI Questionnaire: Correlation between occupational commitment and quality of training (level of tasks).

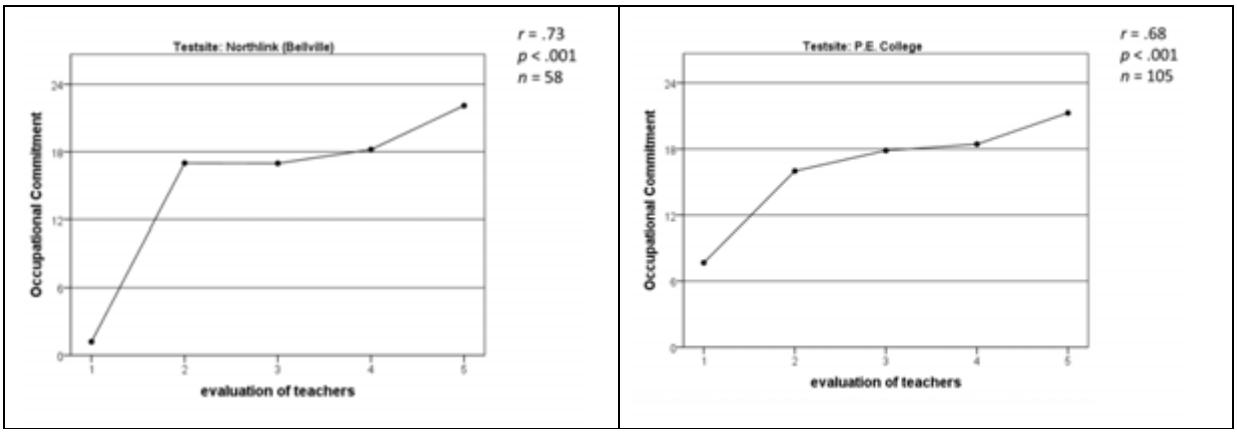


Figure 137: Analysis of VI Questionnaire: Correlation between occupational commitment and teaching quality (evaluation of teachers). Examples of Northlink College (Belville) and P.E. College.

Importance of business process orientation – Effect on Occupational Identity and commitment

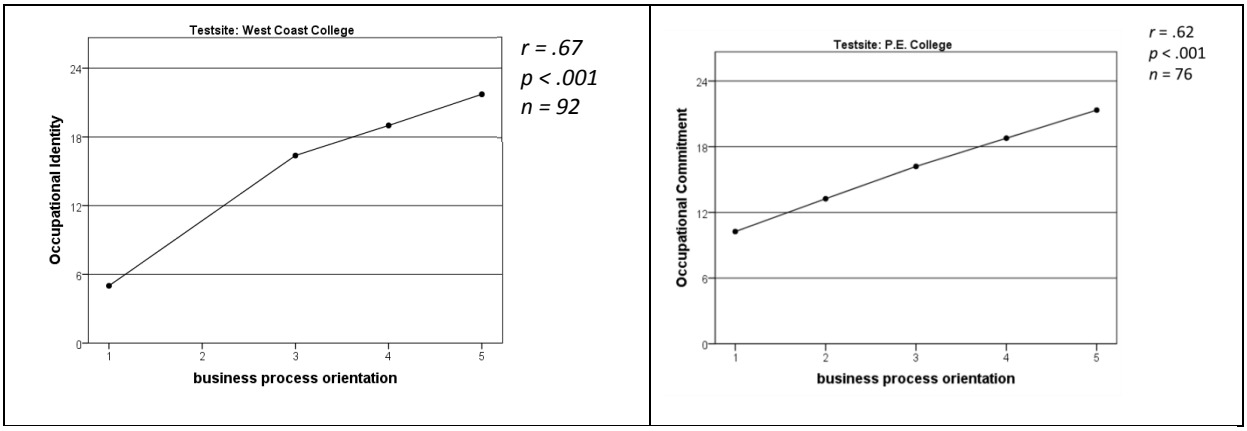


Figure 138: Analysis of VI Questionnaire: Correlation between "business process orientation" and "occupational identity". Examples of West Coast College and P.E. College

Importance of learning venue cooperation – Effect on Occupational and organisational

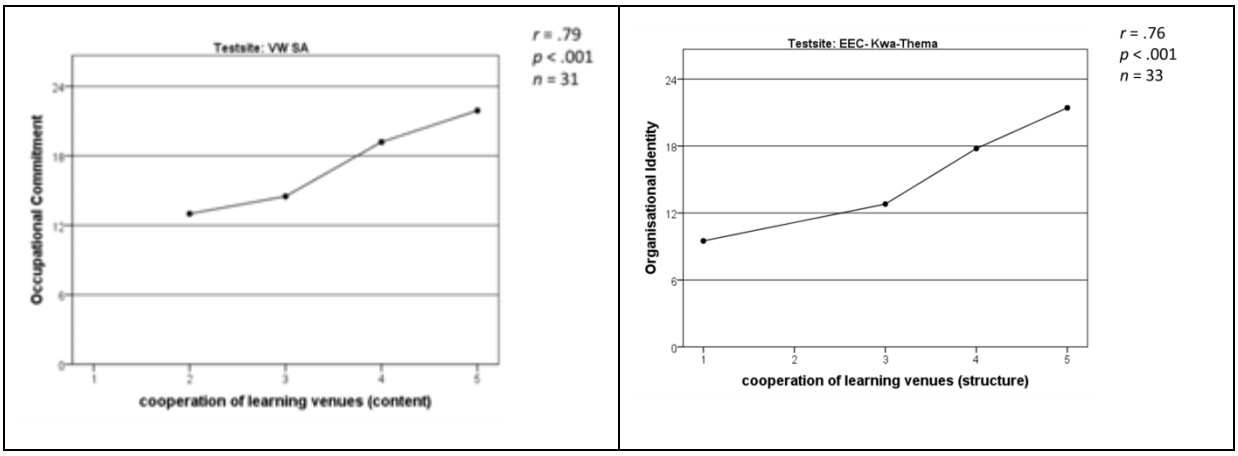


Figure 139: Analysis of VI Questionnaire: Correlation between "learning venue cooperation" and "occupational commitment". Examples of VW and EEC Kwa Thema

The quality of training supervision – Effect on occupational identity and commitment

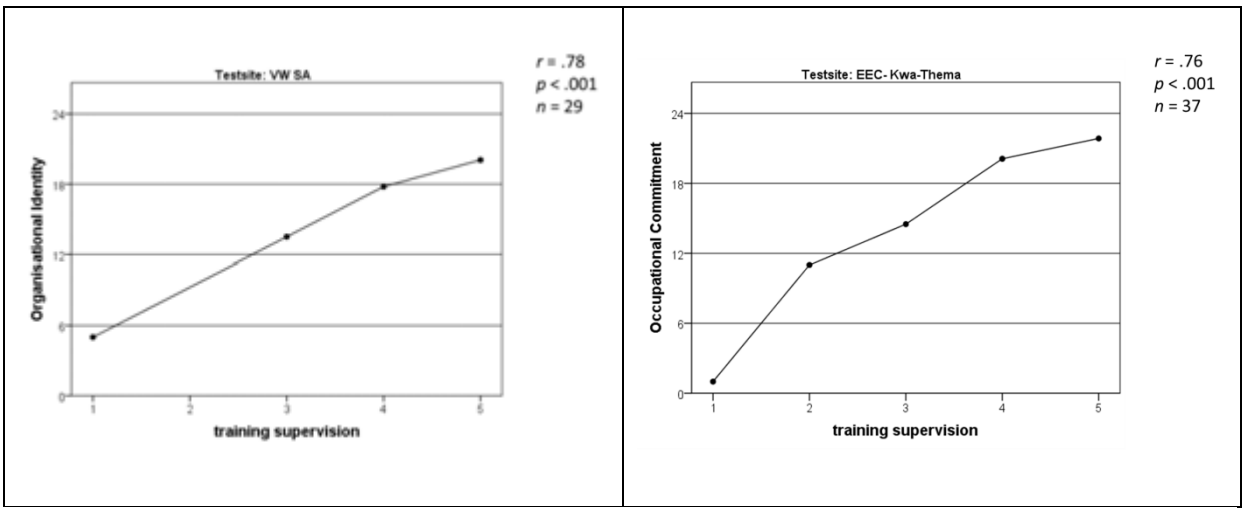


Figure 140: Analysis of VI Questionnaire: Correlation between "training supervision" and "occupational identity or commitment". Examples of VW and EEC-Kwa Thema

Image of a vocation (Social acceptance or reputation) – Effect on Occupational Identiy

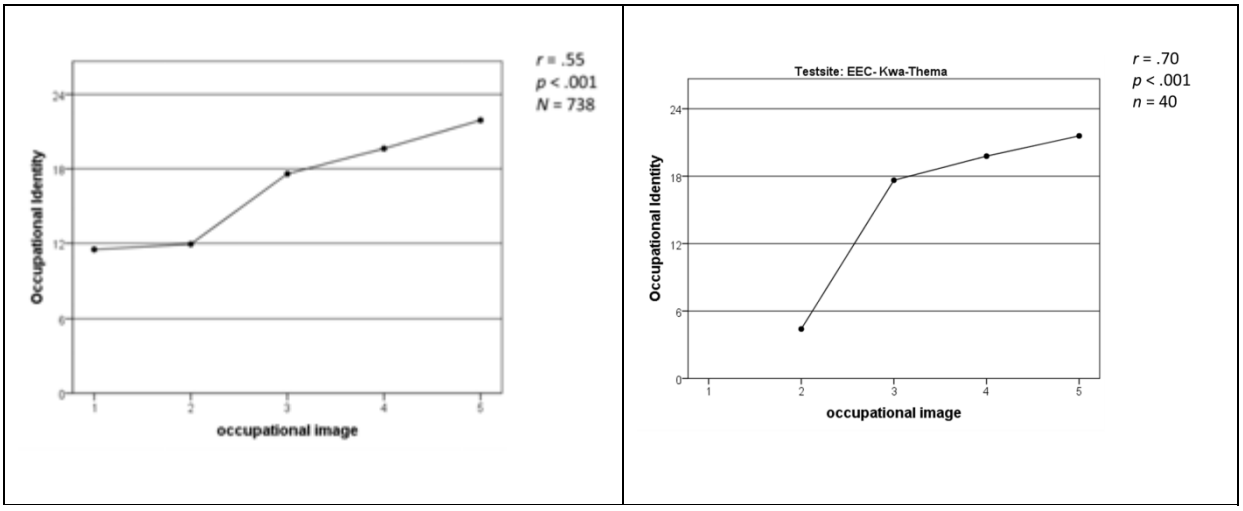


Figure 141: Analysis of VI Questionnaire: Correlation between occupational identity and the image of the occupation learnt. Total sample (COMET SA 2014) and the example of EEC-KWA Thema

The dimension and importance of EMPLOYMENT PERSPECTIVES

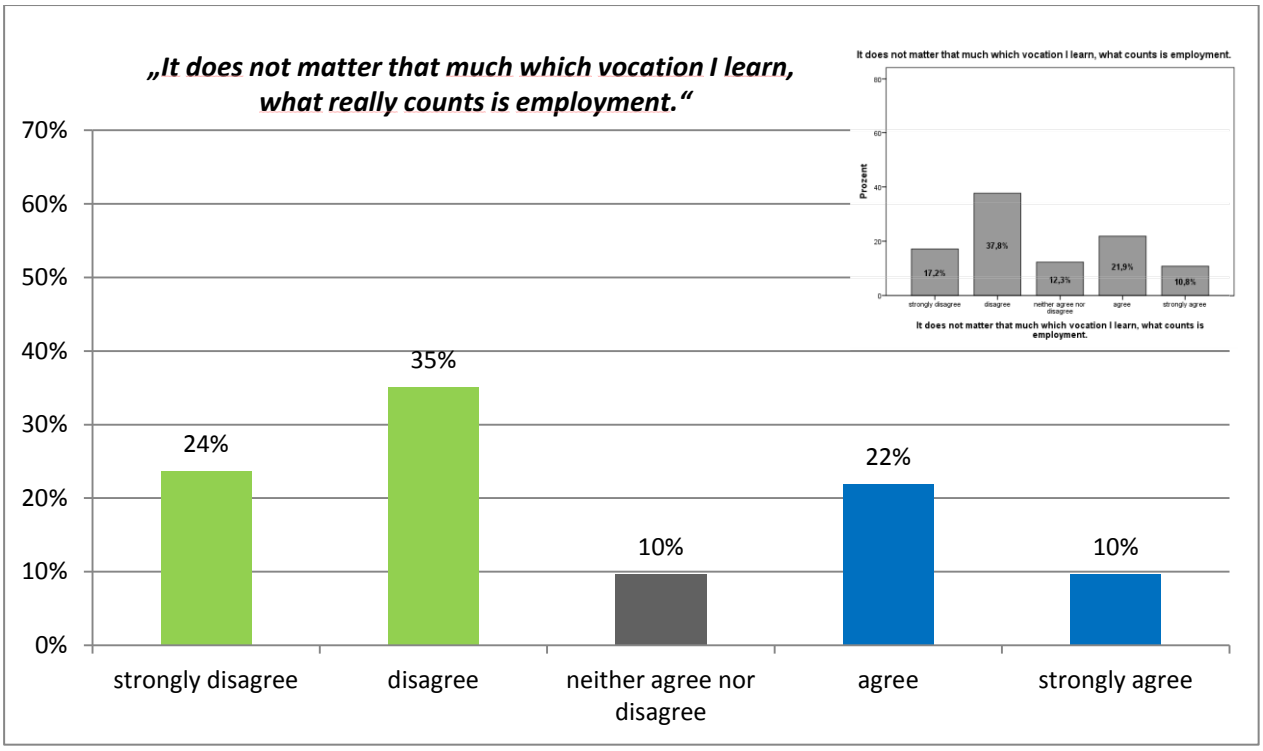


Figure 142: Analysis of VI Questionnaire: Comments of test takers on the sentence “It does not matter which vocation I learn, what really counts is employment”. COMET South Africa 2014 (n=741 small picture) and 2015 Motor Mechanics (n=114)

Part IX Teachers and Trainers

9.1 Competence Levels reached (average results)

In both test years 2014 and 2015, TVET teachers and trainers took part at the COMET test, i.e. they participated in a learner's test.

In the main test 2014, a first cohort of 14 teachers or trainers participated in the learners' test[31]. The results from this very small group of 14 teachers consisting of six electricians, six technicians, one welder and one boilermaker (teaching the welding profession) could by far not be considered as representative. Nevertheless, the result shall be documented in this report as it suggested some further work on this issue and led among others to a second test involvement of teachers and trainers in the test of motor mechanics in 2015.

Figure 143 provides an overview on the competence levels reached in the first group, tested in the 2014 main test. How much the teachers' competences differ from each other, when allocated according to the bottom, medium and top five performers is shown in Figure 144.

At first sight, it strikes, that only nine persons reached the advanced competence levels of processual or holistic shaping competence. The remaining five teachers or trainers did not perform better than a big share of the learners who only reached functional competence or were at the level of "risk" (nominal competence). Among those who did not perform well were three teachers in the electrical field and two teaching mechatronics. Public training providers were equally concerned like companies offering in-company training.

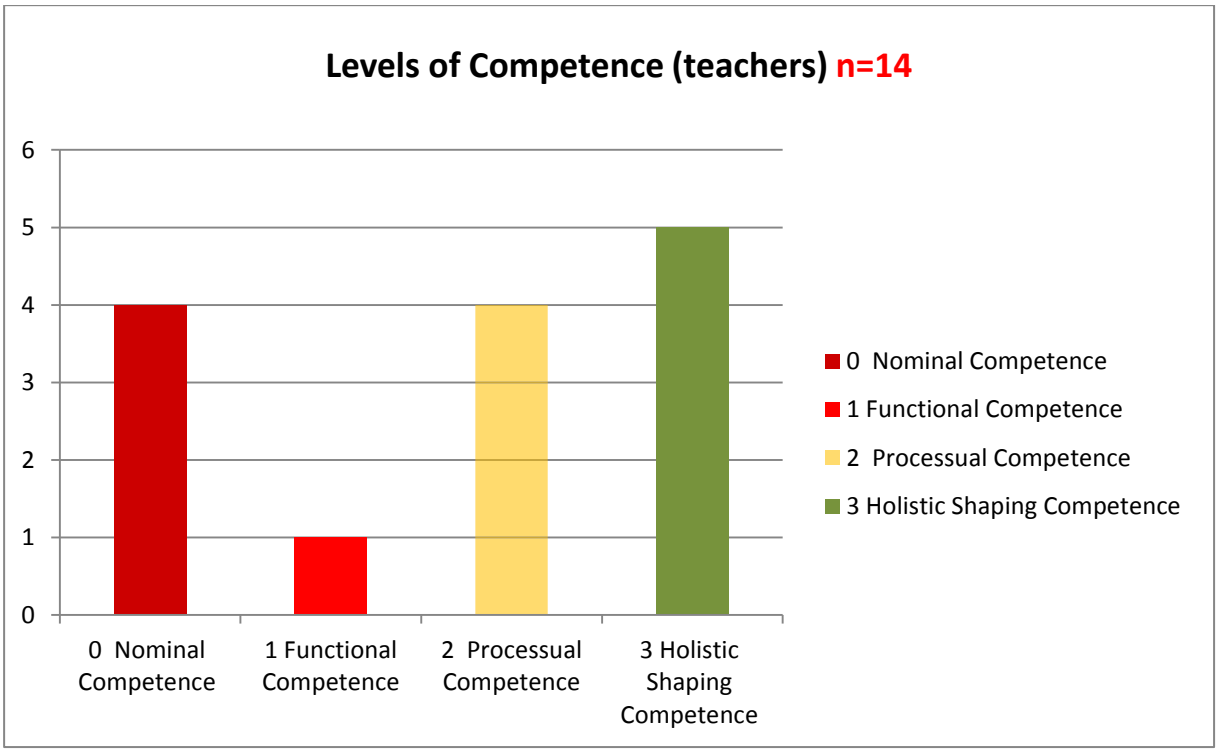


Figure 143: Levels of competence reached by teachers and trainers participating at COMET South Africa 2014.

[31] A COMET test designed especially for the vocation of a teacher or trainer is a different exercise where also the didactical concepts and knowledge of a teacher in a given vocation is addressed. (see Rauner, F. (2013): Messen beruflicher Kompetenz von Berufsschullehrern. A+B Forschungsberichte, Nr. 11/2013. Bremen, Heidelberg, Karlsruhe, Weingarten: A+B Forschungsnetzwerk. www.ibb.uni-bremen.de, www.ibp.uni-karlsruhe.de,www.ph-heidelberg.de/org/technik/index.htm, www.ph-weingarten.de)

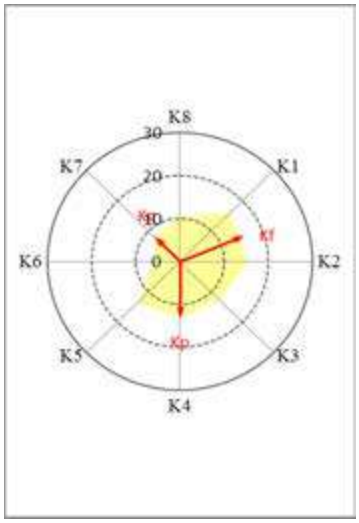
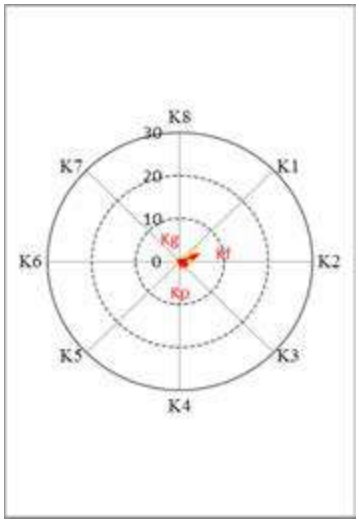
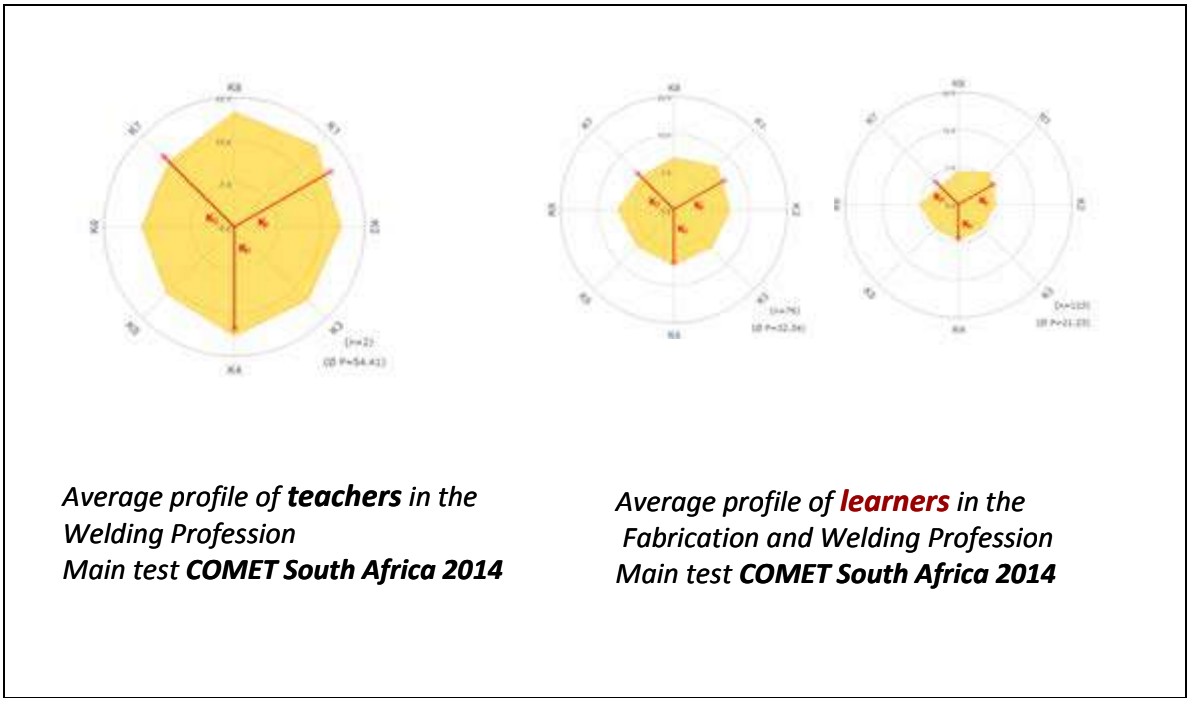
Competence profiles of teachers and trainers (result of top five)	**Competence profiles of teachers and trainers** (result of medium four)	**Competence profiles of teachers and trainers** (result of bottom five)
		

Figure 144: Competence profiles of teachers and trainers participating at COMET South Africa 2014.

Even though this result was only based on a very small group of participants, it was seen as an alarming signal because teachers are very likely to transfer their own competence profile onto their students or learners (see as well Figure 145).



*Average profile of **teachers** in the Welding Profession*
*Main test **COMET South Africa 2014***

*Average profile of **learners** in the Fabrication and Welding Profession*
*Main test **COMET South Africa 2014***

Figure 145: Comparison of teachers and learners' competences in welding and fabrication. COMET South Africa 2014.

These results encouraged the South African project team to further investigate teachers' and trainers' competences in the subsequent test in motor mechanics 2015. This time, the experiences were based on a test group consisting of a total of 20 persons who participated the learner's test. 15 persons were employed as trainers, five as teachers. The following graph shows how the teaching and training staff was performing on average and in comparison to the average profile reached by the total cohort of motor mechanics tested 2015.

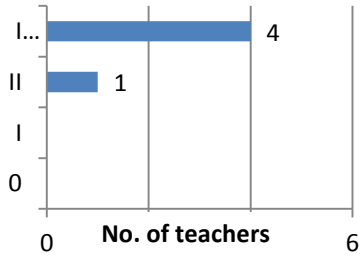
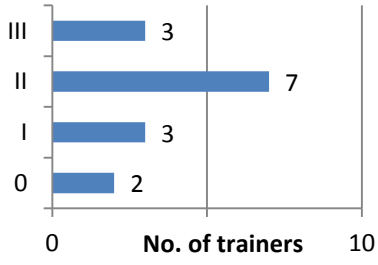
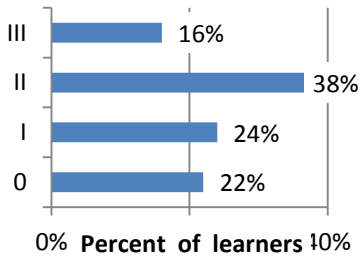
Teachers (n=5)	Trainers (n=15)	Learners (n=364)
		
GPW = 46.13, V = 0.27	*GPW = 37.06, V = 0.33*	GPW = 30.02, V = 0.30
Results according to competence levels reached: 	Results according to competence levels reached: 	Results according to competence levels reached: 

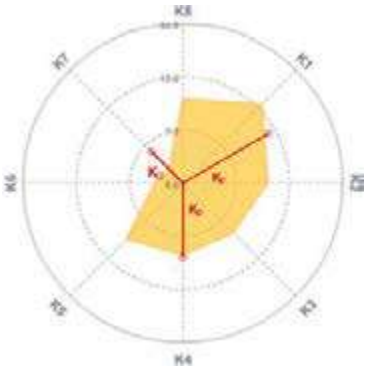
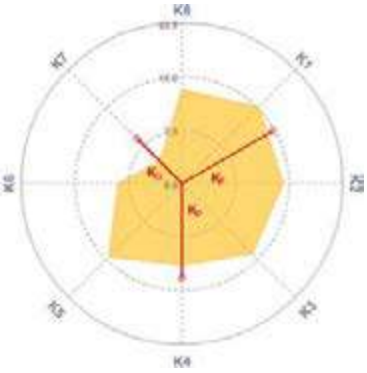
Figure 146: Comparison of teachers' trainers' and learners' competences in motor mechanics. COMET South Africa 2015.

From this data analysis, it seems as if teachers are reaching better results than their colleagues who work as trainers, even though one has to bear in mind that the number of teachers and trainers was also too small to derive general findings. It is also very interesting, that – despite the fact, that both teachers and trainers were reaching higher average results compared to the average of their learners, the shape of the competence profile of all test groups also shows similar difficulties in K7 and K6 (the latter being less relevant for teachers tested).

Such results could therefore support the hypothesis, that the training personnel transfers its problem solving horizon onto their apprentices, but the figures presented in this overview are of course average results that need to be looked at more carefully, in other words, not all of the 15 trainers were responsible for training the entire cohort of 364 learners. In fact and when looking at single classes and the corresponding teachers/and or trainers, it becomes visible, that there are indeed different patterns of how problem solving may be taught and transferred to a group of learners.

The following pictures illustrate the training staff performance compared to the average results of a class on the one hand and to the performance of a best (or a group of best) learner(s) in the same class.

Whereas the teacher at test site A, who reached a very homogenous competence profile at highest level and has been able to transfer this to a great extent to a group of 13 learners out of which two also reached highest levels and addressed all competence criteria in a relatively balanced manner, this was not that much the case at the second test site, where the group of learners received lower results, but on the other hand a single learner performed well in the rather critical domains (K6 and K7).

Teacher at test site A	Class result at test site A:	Best performing learners (at A)
		
Average total score =64 n = 1, V = 0.12	Average total score =37.59 n = 13, V = 0.22	Average total score = 52.5 n = 2, V = 0.2
Teacher (test site B)	**Class result at test site B:**	**Best performing learner (at B)**
		
Total Score: 48.0 n = 1, V = 0.3	Average total score = 30.6 V = 0.44, n = 9	Total score = 38.33 n = 1), V = 0.19
Trainer (test site C)	**Class result at test site C:**	**Best performing learners (at C)**
		
Average total score = 50.33 n =2, V=0.18	Average total score = 36.74 n = 17, V = 0.31	Average total score = 62.08 V= 0.3, n = 2

Teacher/trainer at test site D	Class result at test site D:	Best performing learners (at D)
		
Average total score = 45.38, n=2, V = 0.12	Average total score = 30.73 n = 18, V = 0.32	Average total score = 44.1 n= 4, V = 0.08

Figure 147: Teachers and trainers: Different ways of transferring problem solving horizons to learners. COMET South Africa 2015.

Very interesting are also the results provided at test sites C and D, where 2 or 4 learners reached higher average scores than their teachers and in case of test site D, also had a very homogenous problem solving pattern, with a Variation coefficient of =0.08.

Summarising the information provided in Figure 147, three different patterns can be observed:

d) Teachers/trainers have a *very strong* influence on their learner's competence: The shapes of their competence profiles and the average scores reached in a test resemble a lot. Best test takers and averages obtained by a class only marginally differ (Figure 147 A). But best test takers may as well reach higher results as their teachers/trainers (Figure 147 D).

e) Teachers/trainers have a *relatively strong* influence on their learner's competence: The shapes of their competence profiles and the average scores reached in a test resemble a lot, but the overall results are much weaker. Best test takers and averages obtained by a class differ more. (Figure 147 B).

f) Teachers/trainers have *no strong* influence on their learner's competence, but do not manage equally address all COMET competence criteria: The shapes of the competence profiles and the average scores reached in a test differ between teachers and learners but not necessarily the shapes of the competence profile of best and average test takers within a class. (Figure 147 C).

So, while the overall analysis that started with the first introduction of test tasks to teachers and trainers in 2014 and was continued in the 2015 test still supports the idea, that the training personnel has a very important influence on learners' competences and problem solving patterns of teachers and trainers may be transferred to their students of apprentices, the few examples provided in Figure 147 demonstrate that it would not be enough to test teachers or trainers with a same tasks as elaborated for learners.

Teaching and training is a profession as such, so the quality of teaching does not only refer to the problem solving capacity a teacher or trainer has, when it comes to professional tasks in a given domain. Equally important are the didactical competences of teachers and trainers, which can be tested in different manner (see Rauner, 2013 and Zhao 2014).

In this regard, it has as well to be pointed out, that the fact that a teacher has to deal with classes that are often characterised by high degrees of diversity also needs to be considered. While in some cases, a teacher might be able to easily pass up to 100% of his knowledge on to a learner this might be much more difficult with regard to another apprentice sitting in the same class.

9.2 Further steps

In order to address the need for further teacher and training qualification, the results of the main test that showed considerable deficits in leaners and possibly as well in teachers/trainers competences, the following three steps are recommended.

(1) Securing a better data base on teachers' competences
In order secure a more representative result, a larger test group of teachers or trainers would need to be addressed in a further (test) exercise. In addition to a larger number of participants (who should take part voluntarily and on an anonymous basis) the project team will need to make sure, that the vocations addressed in the South African COMET project will be equally represented by this new test group.

(2) Further work with / implementation of COMET as a didactical concept
In the meantime the local project steering committee including the working groups in the vocations addressed in the test should discuss and further elaborate COMET learning tasks and intensify their work according to the didactical concept of the COMET methodology. These measures can be taken before a further teacher and trainer qualification program (see (3)) is introduced.

(3) Introduction of a further teacher/trainer qualification program
Moreover, a teacher and trainer qualification program can be implemented in order to offer further qualify and train the trainers. Such program might be linked to a COMET TT certificate as suggested within the frame of the project deliverables.

The following paragraphs summarises the main idea. The course would address a target group of VET teachers and trainers involved in the practical part of vocational education and training but also VET specialists or curriculum experts involved in the theoretical planning, organisation, and design of VET courses or programs. The COMET TVET TT educational program consists of 5 subsequent modules:

Module I:	Introduction into the COMET methodology I and II
Module II:	Test and learning task development in one occupation
Module III:	Ratertraining in one occupation
Module IV:	Participation in a COMET test for learners
Module V:	Participation in a COMET test for teachers
Module VI:	Seminar on test and learning results: Interpretation and conclusions, demonstration of an individual project

Modules I, II, III and VI are based on a seminar or workshop, some of which is followed by a practical learning and implementation phase (for example teachers engaged in learning task development introduce such tasks into their regular lessons). Modules IV and V are individual competence assessments of teachers or trainers, followed by a personal feedback focussing on strengths and weaknesses of a) a personal problem solving horizon relating to a typical vocational task in the profession trained and b) addressing the pedagogical competences as a teacher for example

regarding the planning, development and design of a most favourable learning environment for a vocational topic. It would be fundamental for a successful completion of the requirements of the COMET Teacher/Trainer Certificate, that the participants have time for reflexion and documentation.

The linkage between the theoretical construction of the COMET methodology on the one hand and practical implementation phases as well as individual assessments one the other are an essential requirement for a final award. Figure 148 shows the construction of the TVET TT Certificate components without naming the modules but reflecting their theoretical and practical concepts.

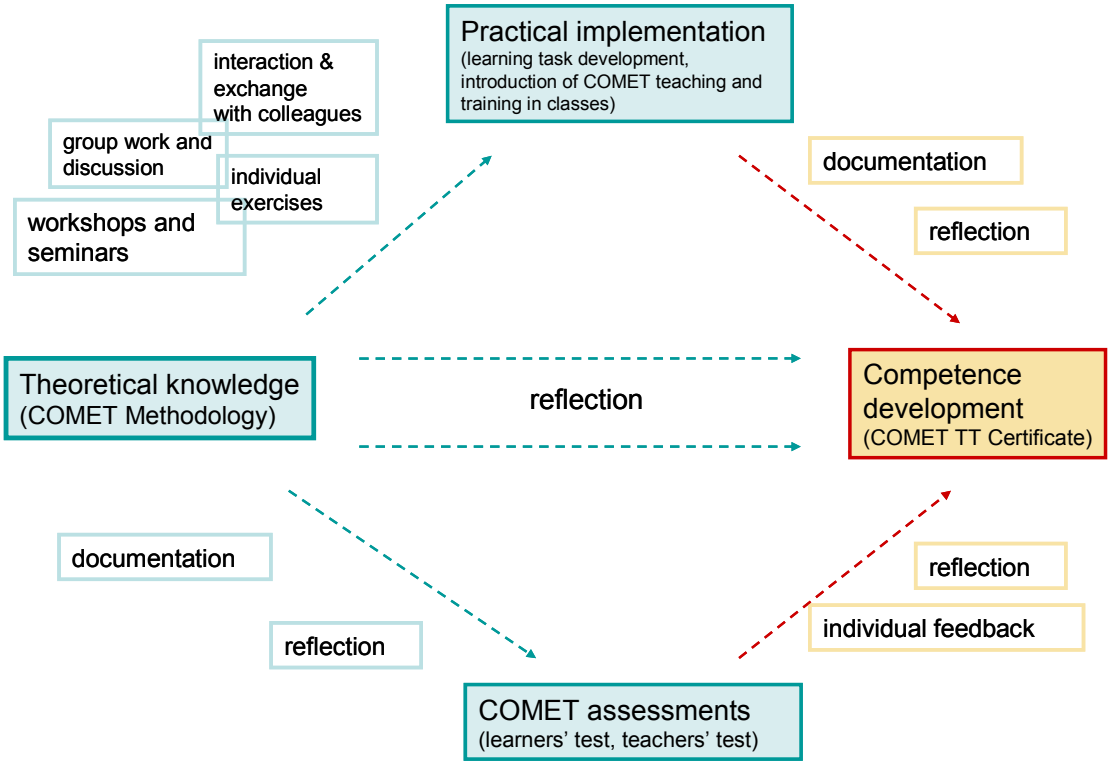


Figure 148: Interaction of theoretical and practical components of the COMET TT certificate
(Source: Hauschildt, U. (2015): COMET TT – COMET Teacher / Trainer Certificate. Conceptual note. Bremen. IBB.)

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Appendix I

I-I Competence levels differentiated into low, medium, high

In the following, the competence levels reached will be analysed according to the differentiated competence level of high, medium and low. This analysis shows in more detail, where competence levels reached were of higher or lower average total scores. The analysis shows at first an overall result of the entire test group cohorts in 2014 and 2015, also considering the number of drop-outs in 2014. Thereafter, an analysis will be made according to the different test sites.

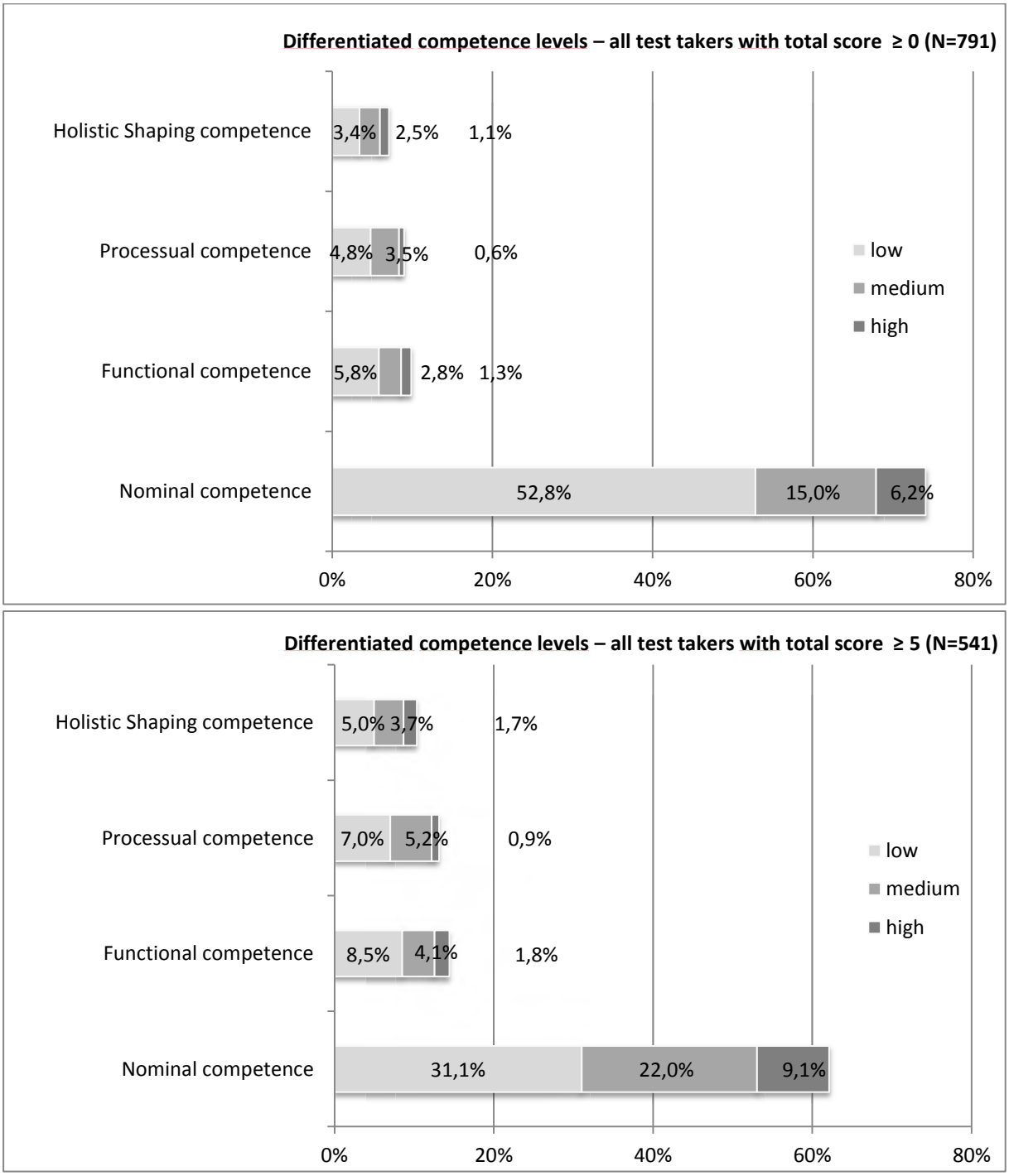


Figure 150: Distribution of competence levels differentiated into low, medium, high. All test takers with and without drop-outs. COMET South Africa 2014.

In this overall analysis of the 2014 data including all test sites and vocations it strikes, that in all

competence levels, the proportion of test takers reaching this level is on a rather low level. Also if the group of drop-outs is left out of the calculation, the share of test takers reaching nominal competence at low level is higher (30%) than the number of those test takers reaching this level with comparatively high scores (9.1%). This also refers to the higher competence levels starting with functional competence and reflects the very weak average result of the main test.

The analysis of the 2015 data also suggests that competence levels reached were more often reached at lower than on higher performance levels. But this general and overall result does not equally refer to the different years of training (see I-3 for the differentiated analysis).

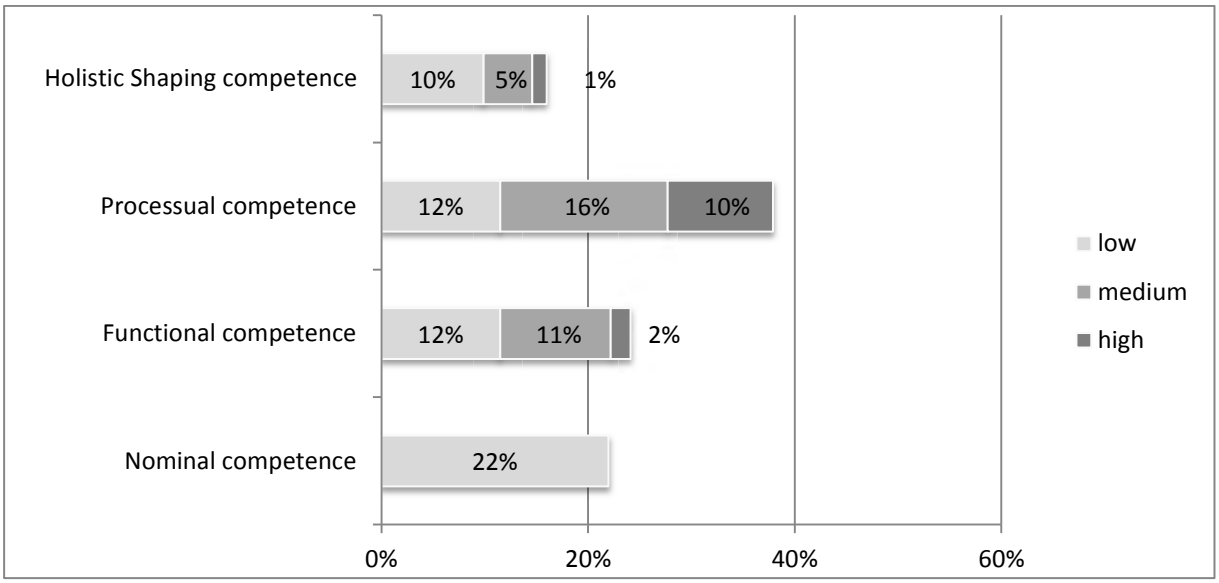


Figure 151: Distribution of competence levels differentiated into low, medium, high. All test takers (n= 364) without drop-outs (n=7). COMET South Africa 2015.

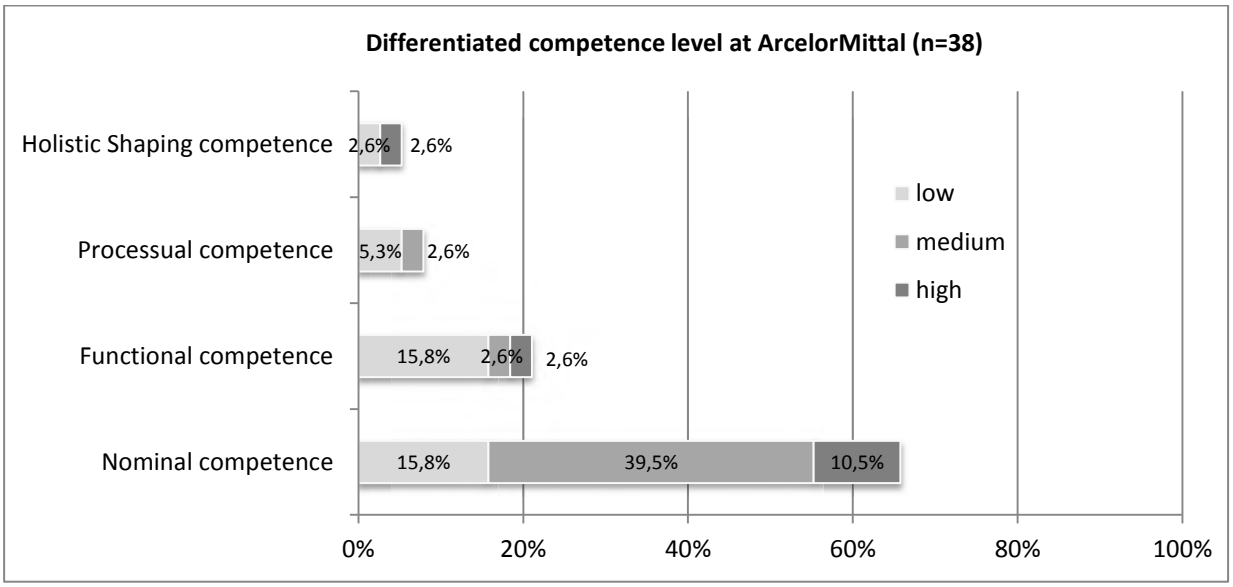
I-2 Competence levels differentiated into low, medium, high according to test sites

In the following, the competence levels reached at the different test sites will be analysed in the same manner. All graphs that follow are based on a calculation leaving out the lowest performers reaching an average total score below 5 points.

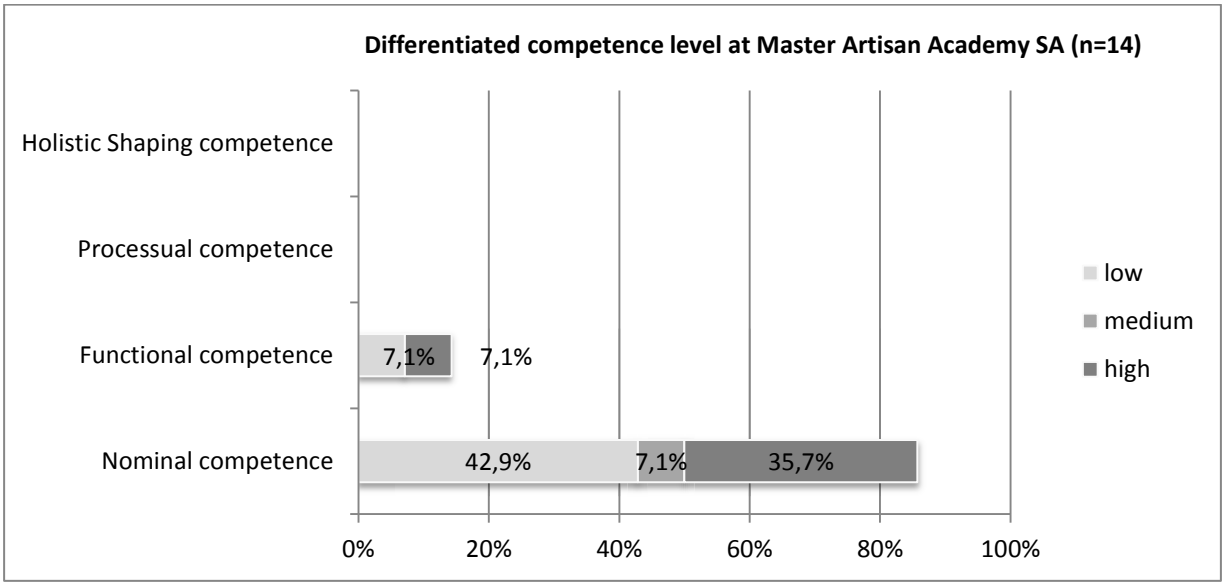
It has to be stressed, that a direct comparison of test sites should not be made without taking into consideration, that these average results at test sites refer to different vocational test groups, electricians, fitters and turner and millwrights being the ones with the lowest average results and trained with a great proportion at ArcelorMittal, EEC-KWA Thema, EEC-Daveyton, Umfolozi and P.E. College (cf. Part I).

Without further commenting the following graphs in detail, one can find out that the results from the different test sites widely differ from the overall picture in Figure 150. For example, the majority of test takers at ArcelorMittal, were competence levels predominantly at medium or high level which was not the case in most of the other test sites.

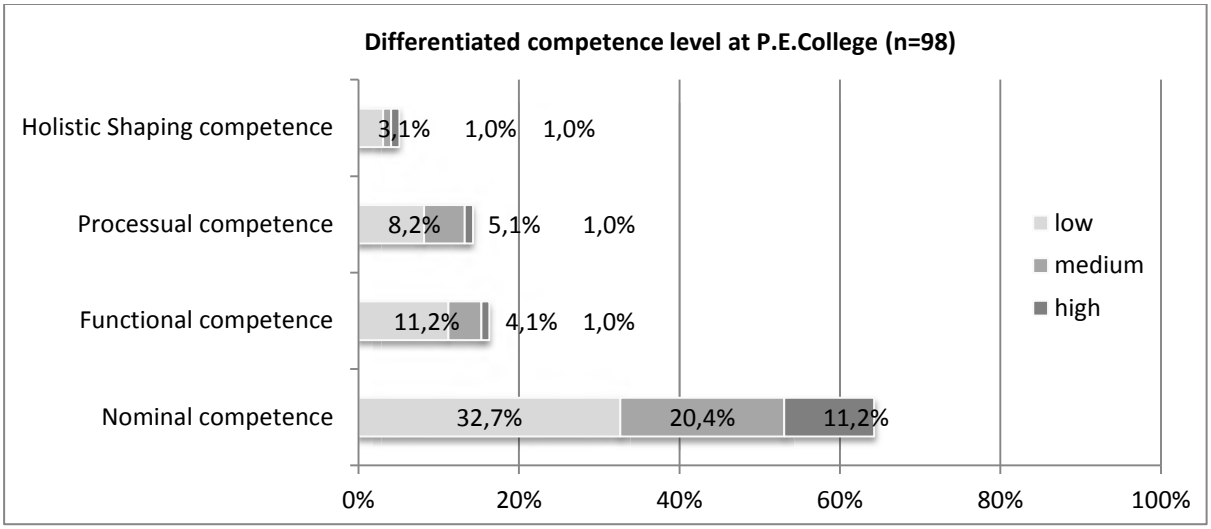
I-2.1 ArcelorMittal (2014)



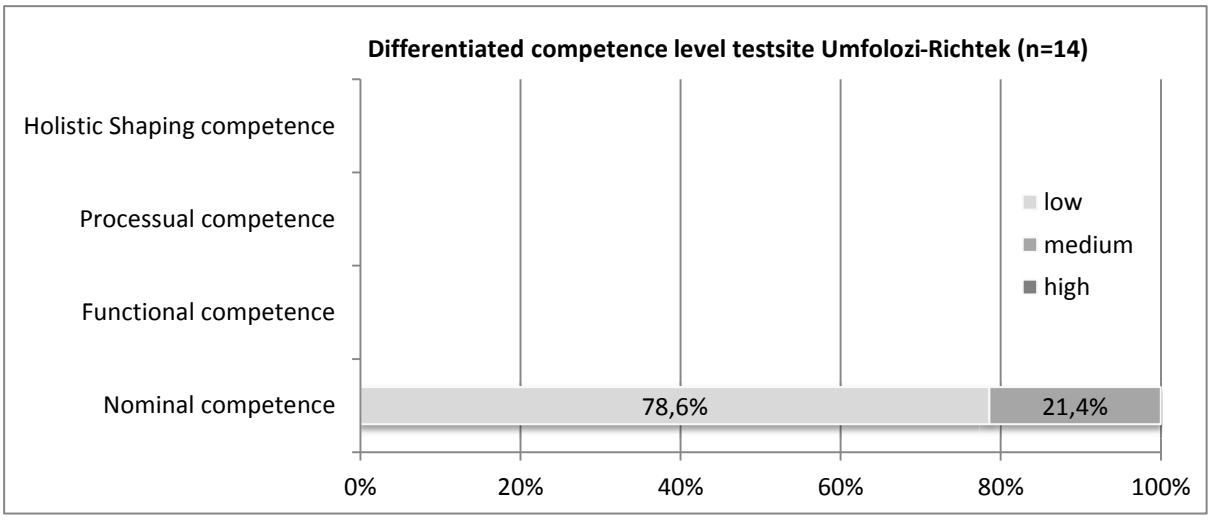
I-2.2 Master Artisan Academy (2014)



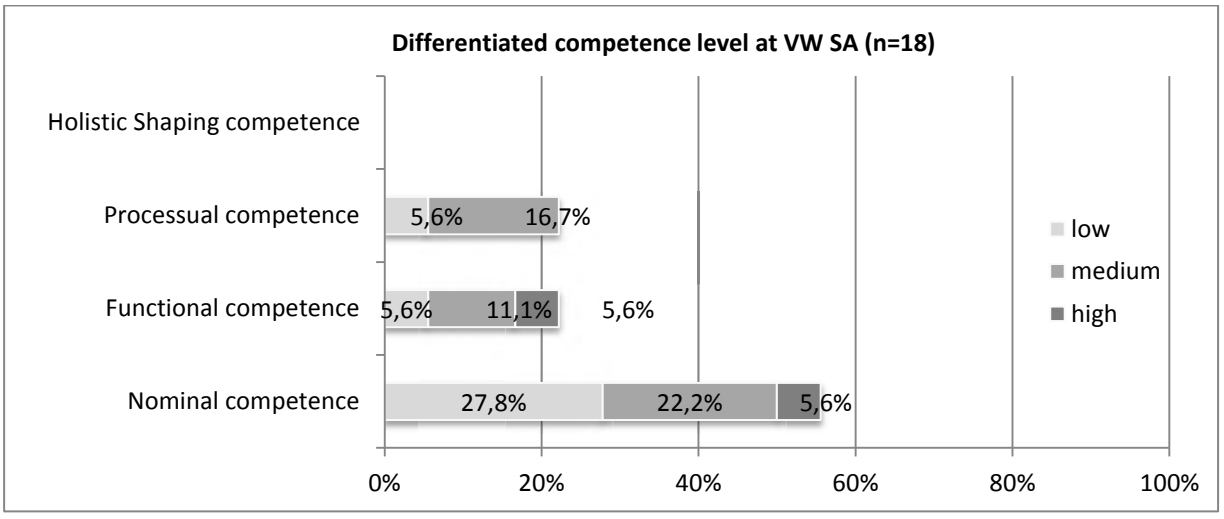
I-2.3 P.E. College (2014)



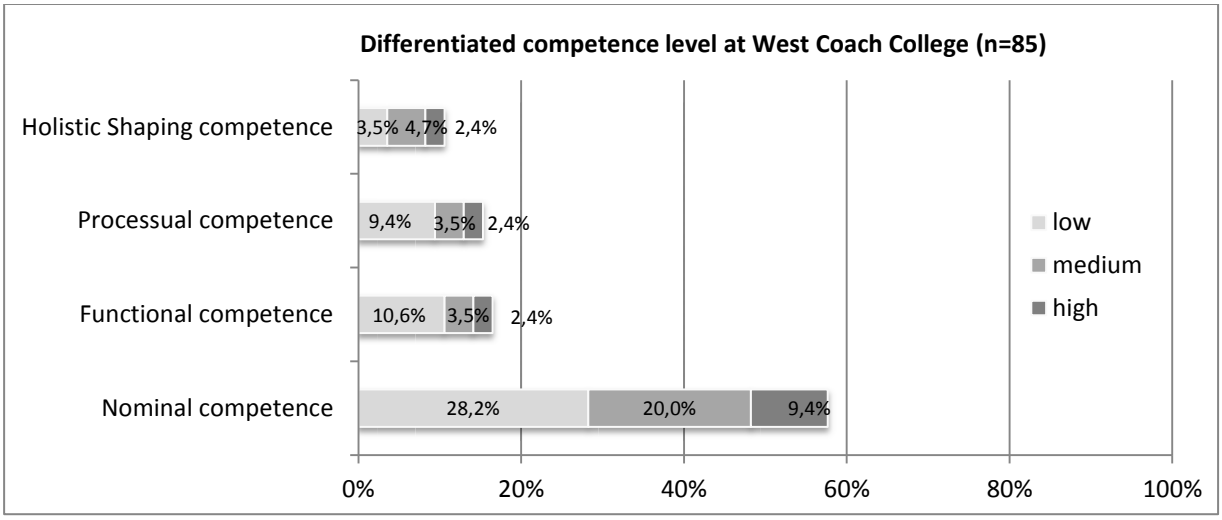
I-2.4 Umfolozi-Richtek (2014)



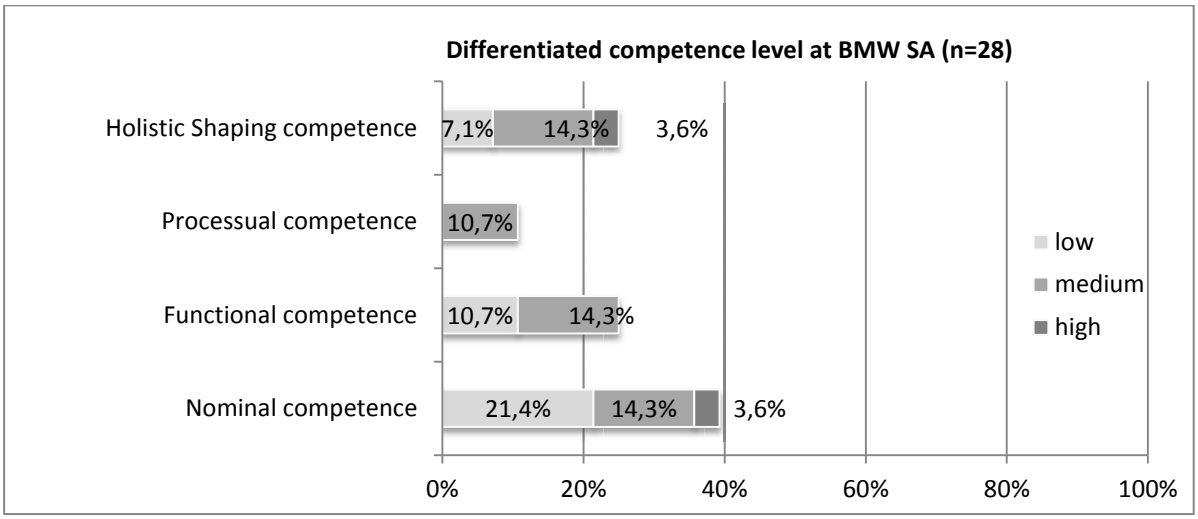
I-2.5 VW (2014)



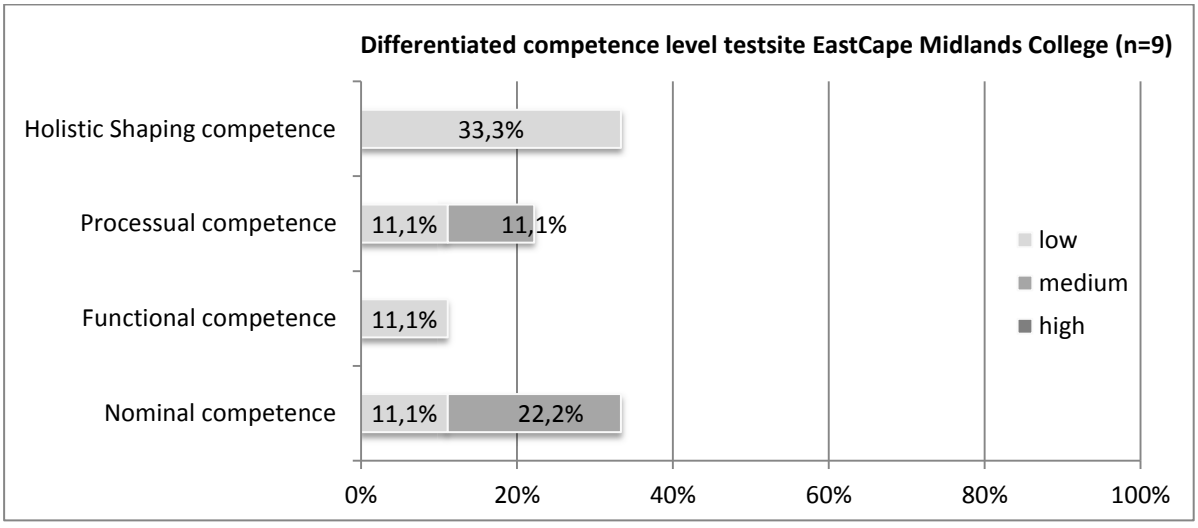
I-2.6 West Coast College (2014)



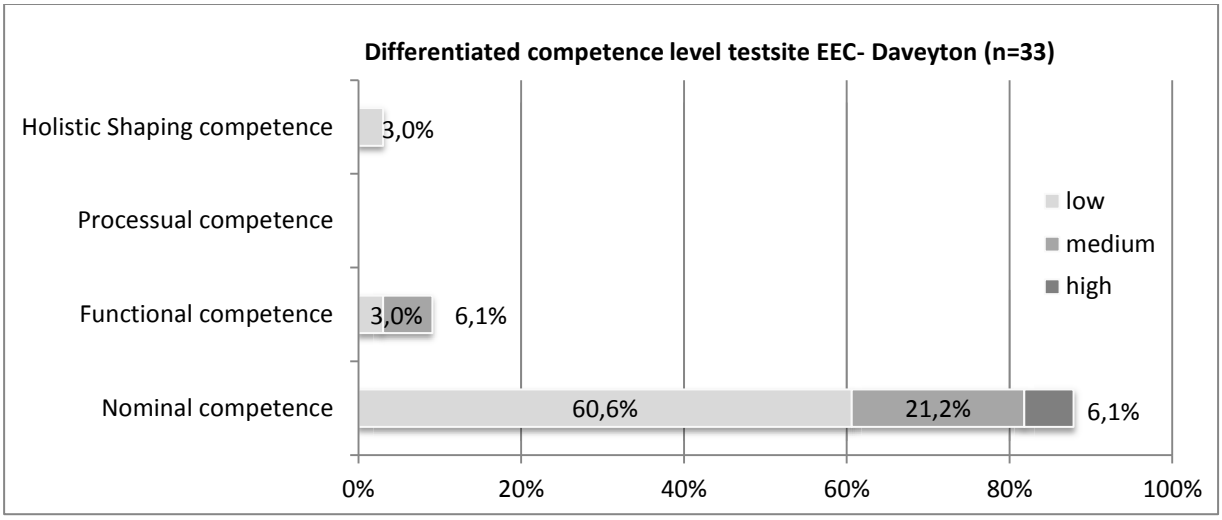
I-2.7 BMW (2014)



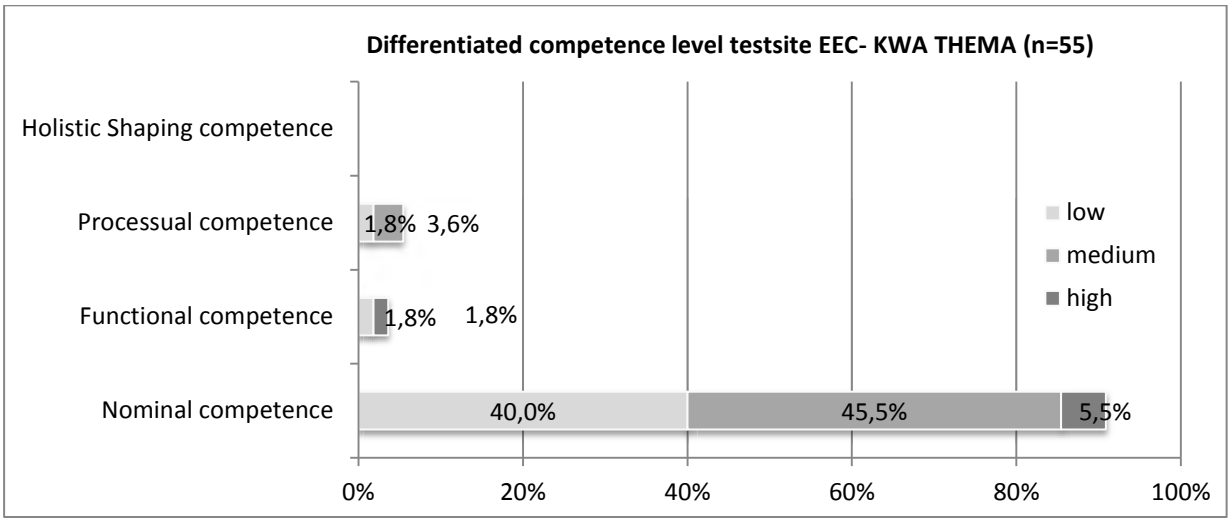
I-2.8 EastCape Midlands College (2014)



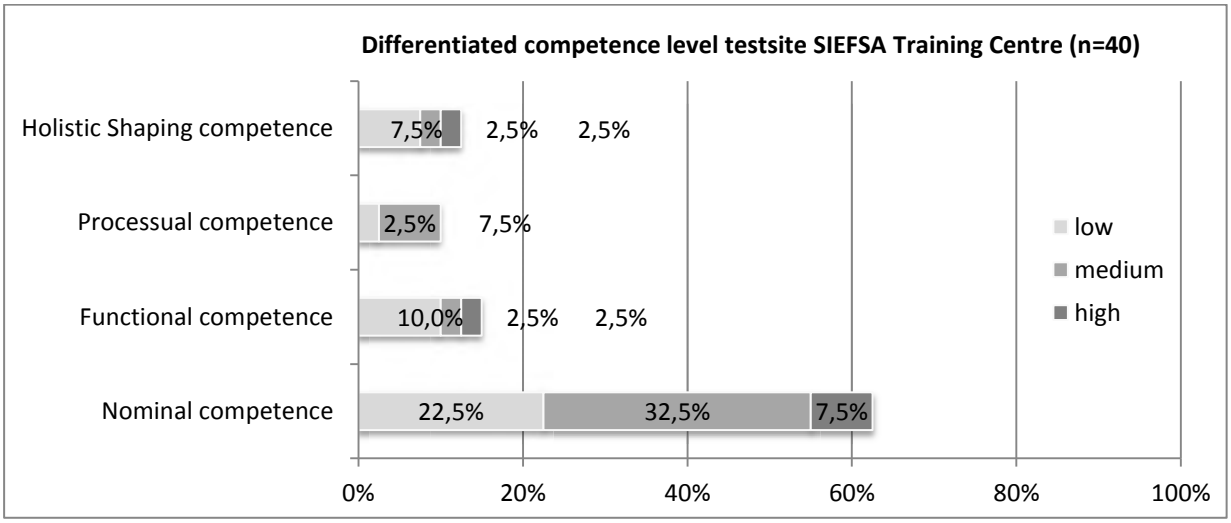
I-2.9 EEC Daveyton (2014)



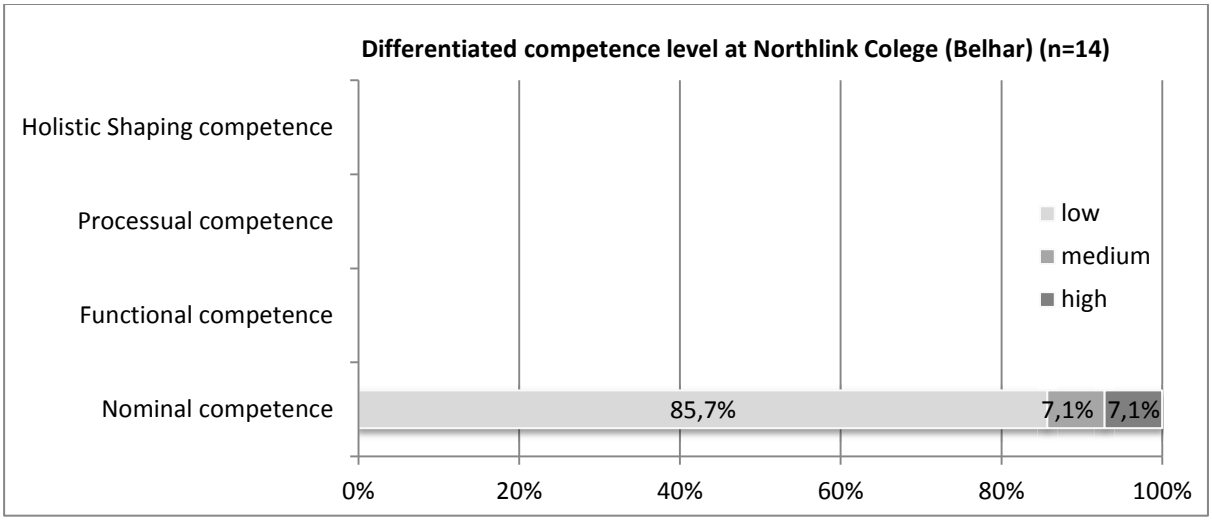
I-2.10 EEC KwaThema (2014)



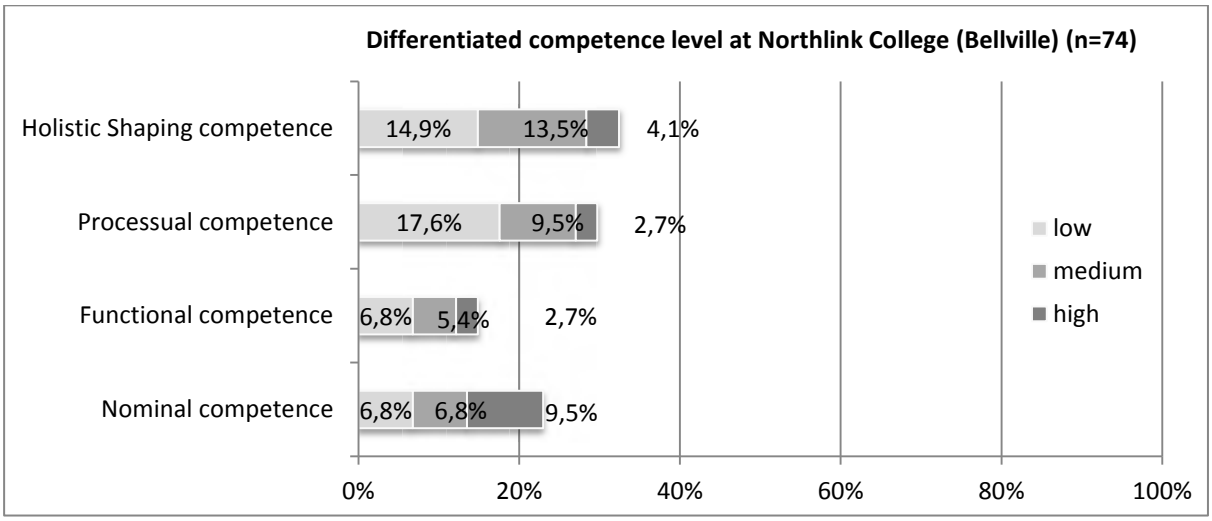
I-2.11 SIEFSA (2014)



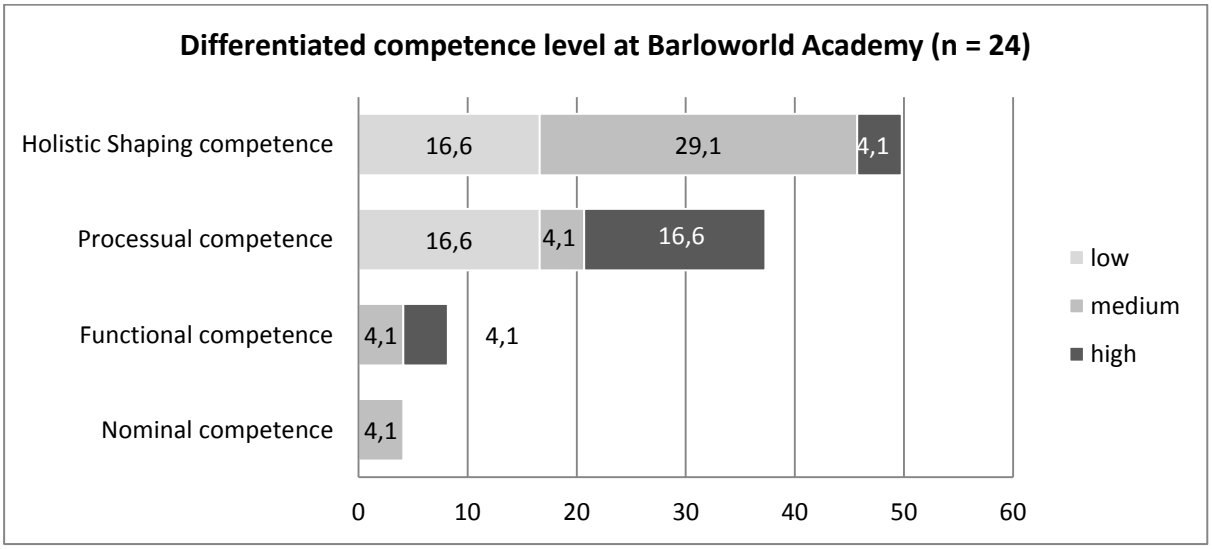
I-2.12 Northlink College Belhar (2014)



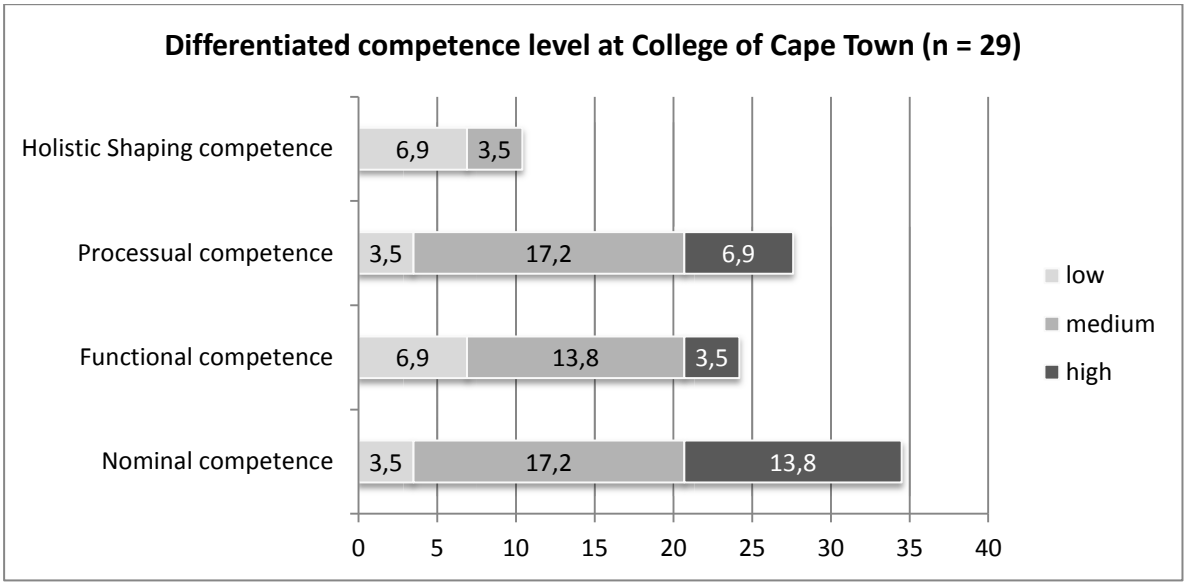
I-2.13 Northlink College Bellville (2014)



I-2.14 Barloworld Academy (2015)

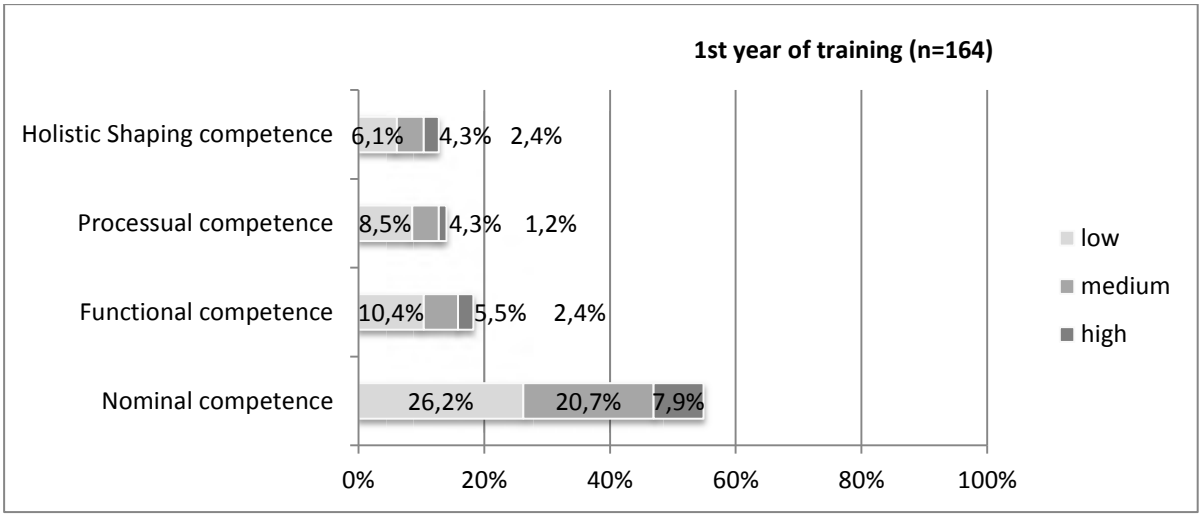


I-2.15 College of Cape Town (2015)

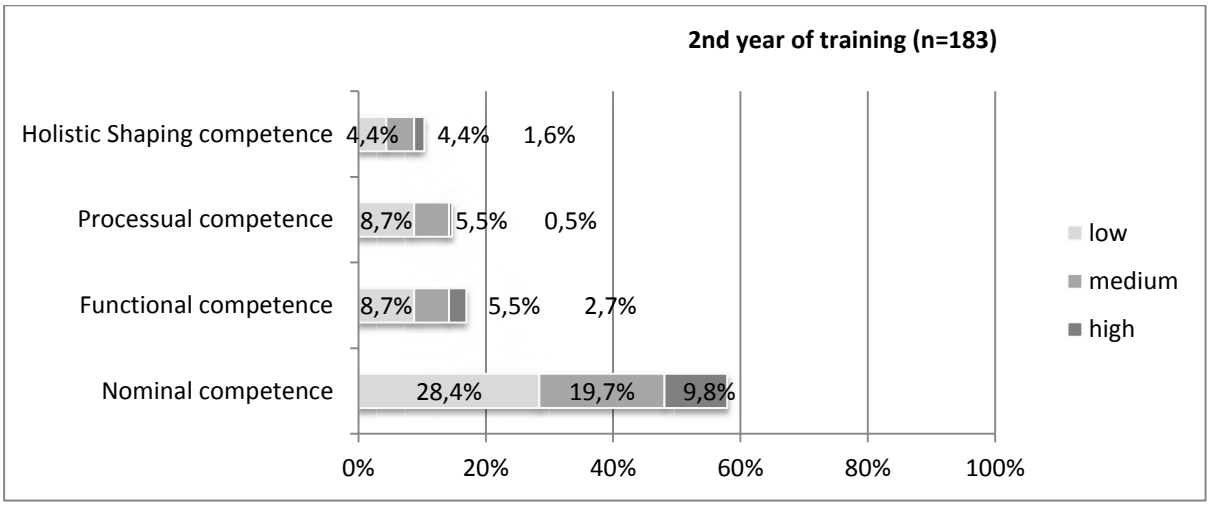


I-3 Competence levels differentiated into low, medium, high according to year of training

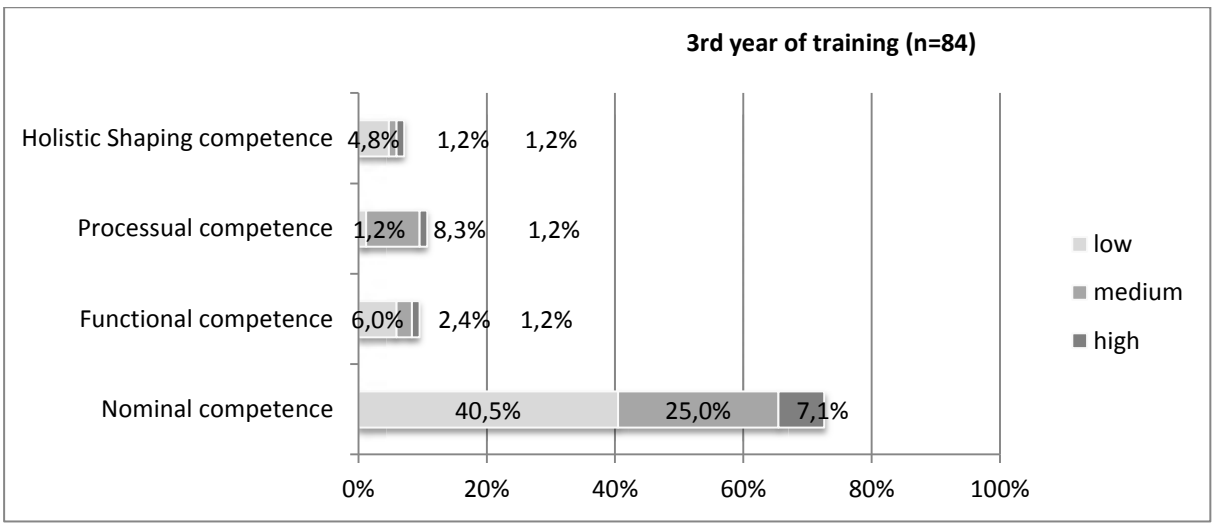
I-3.1 1st year of training (COMET 2014)



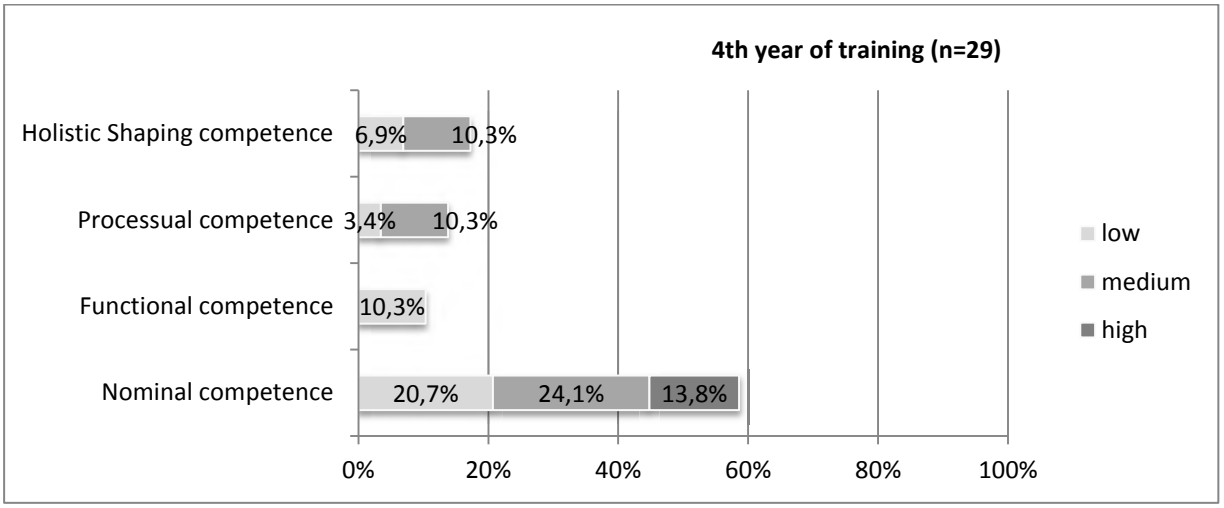
I-3.2 2nd year of training (COMET 2014)



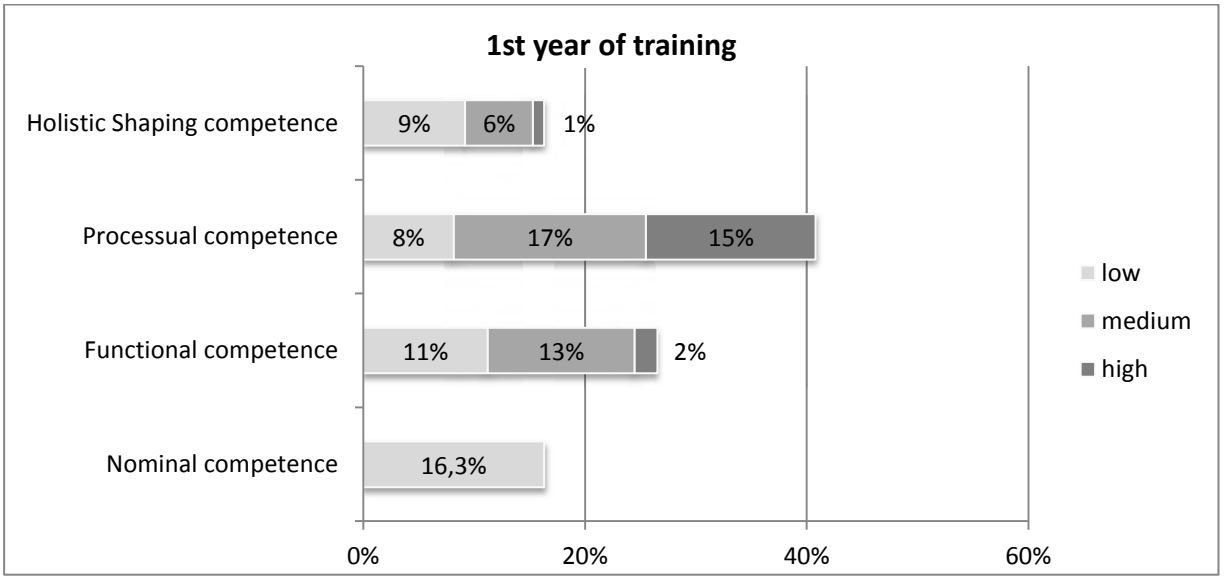
I-3.3 3rd year of training (COMET 2014)



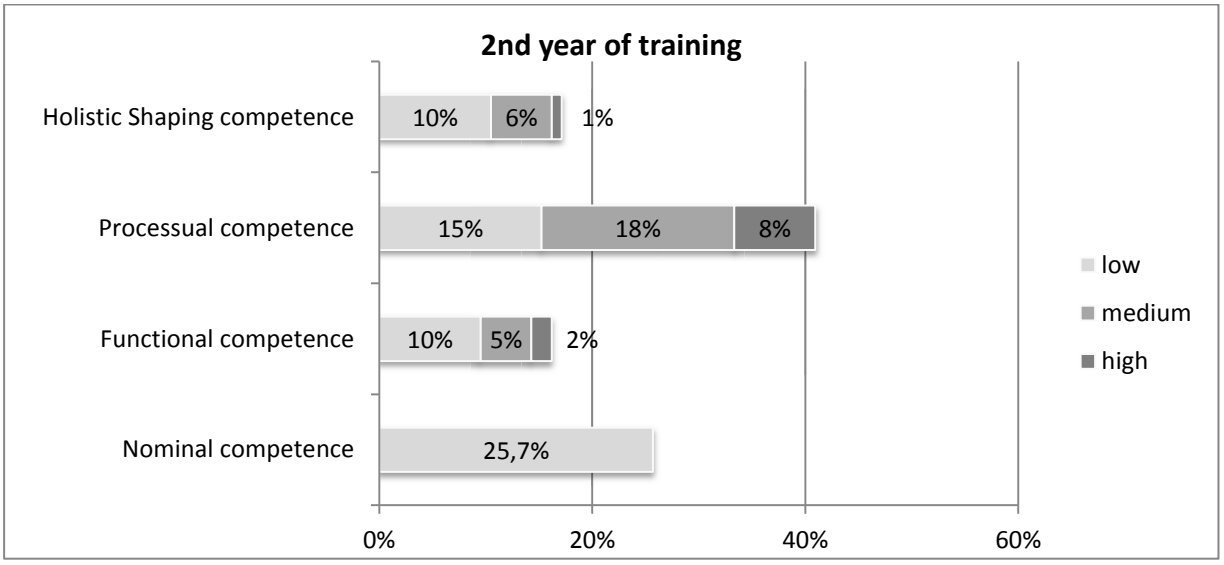
I-3.4 4th year of training (COMET 2014)



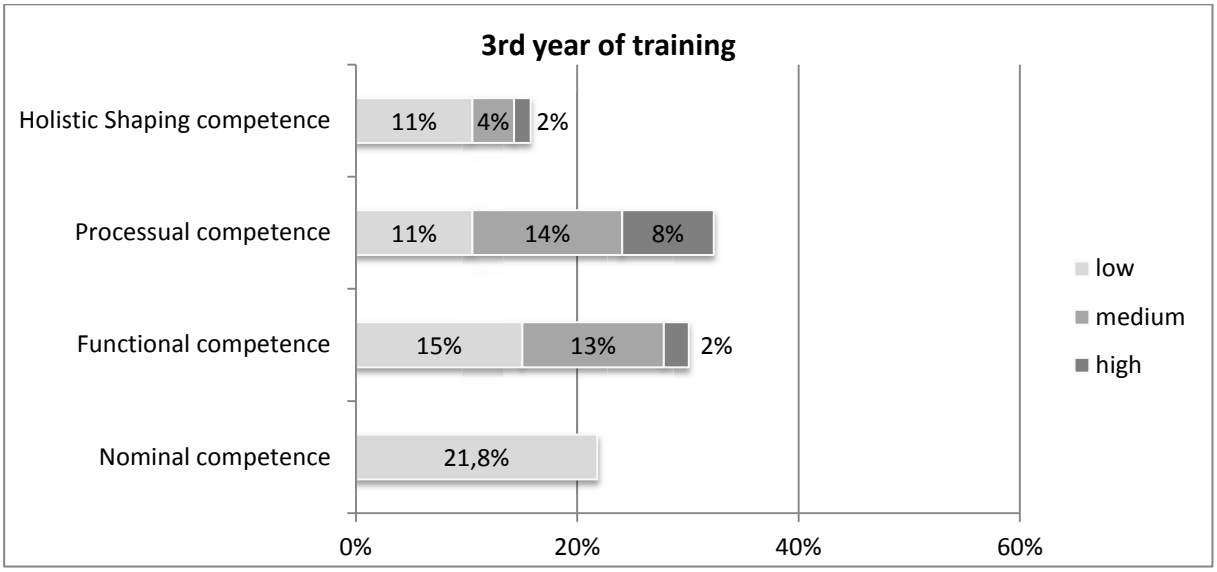
I-3.5 1st year of training (COMET 2015)



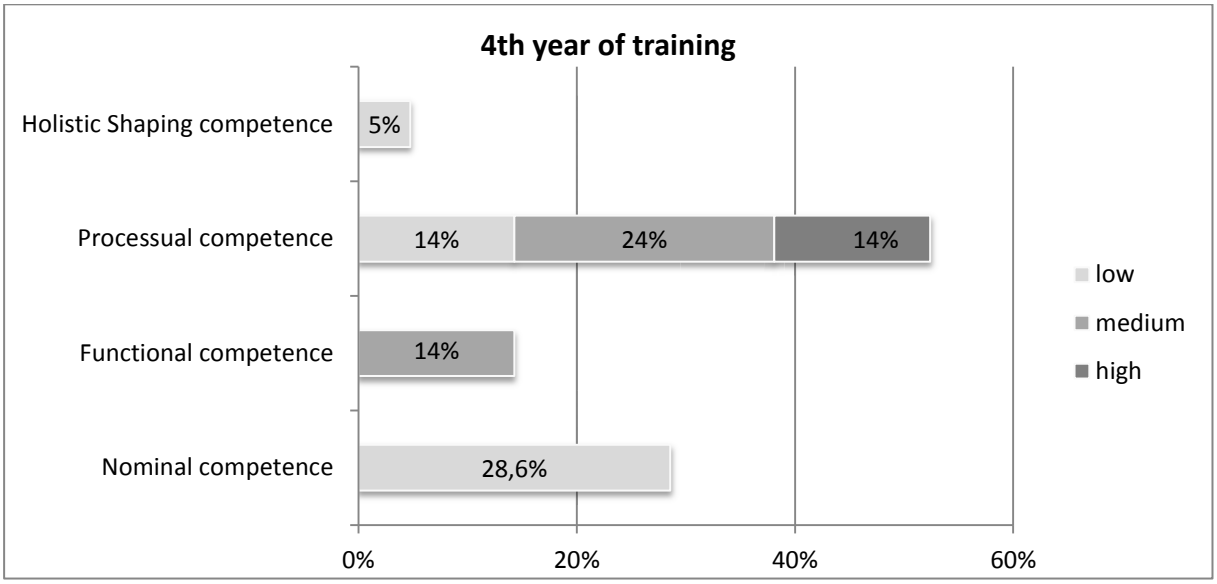
I-3.6 2nd year of training (COMET 2015)



I-3.7 3rd year of training (COMET 2015)



I-3.8 4th year of training (COMET 2015)



Appendix II

II-1 Additional illustrations (not used in the main analysis)

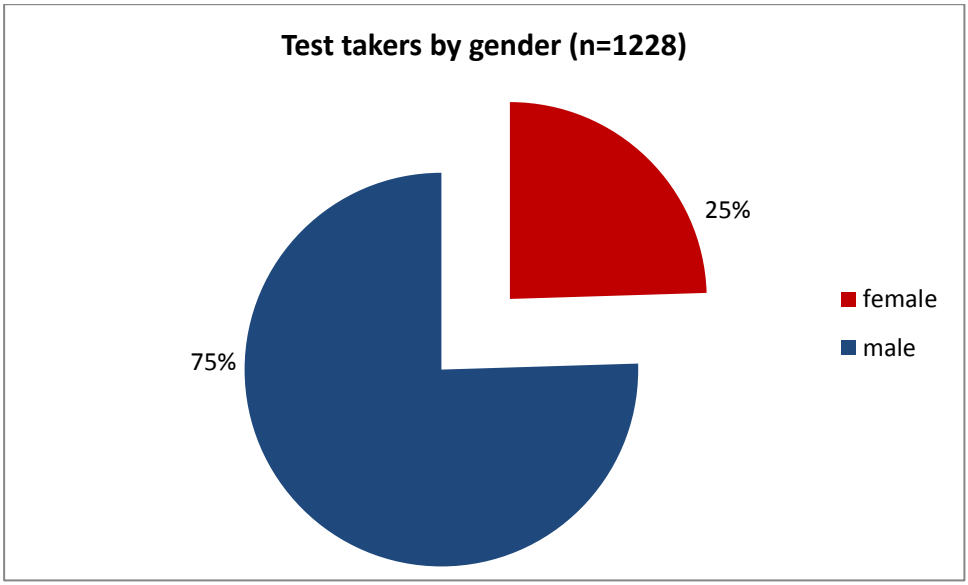


Figure 152: Test takers by gender (COMET South Africa 2014 -2015)

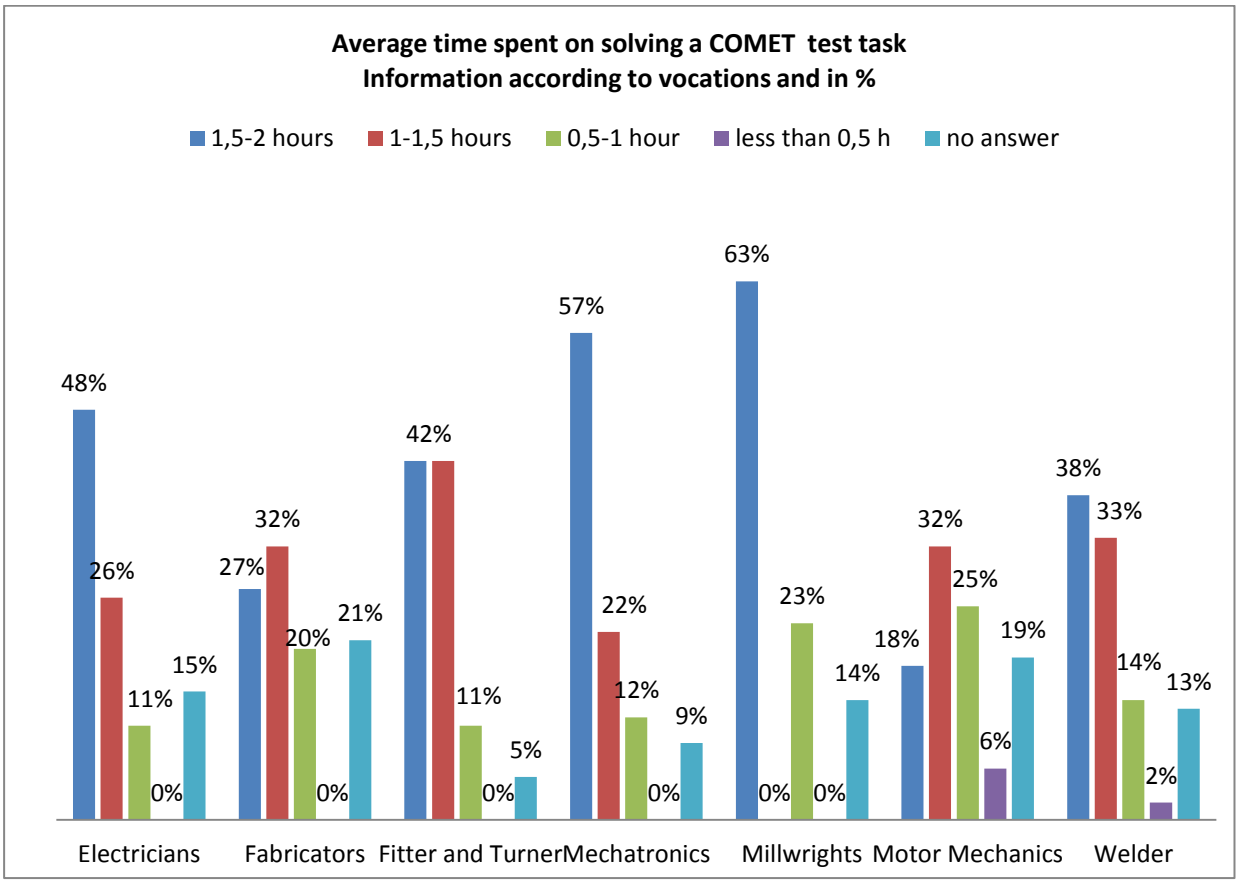


Figure 153: Analysis of test motivation: Average time spent on a task. Information according to occupations. COMET South Africa 2014 and 2015

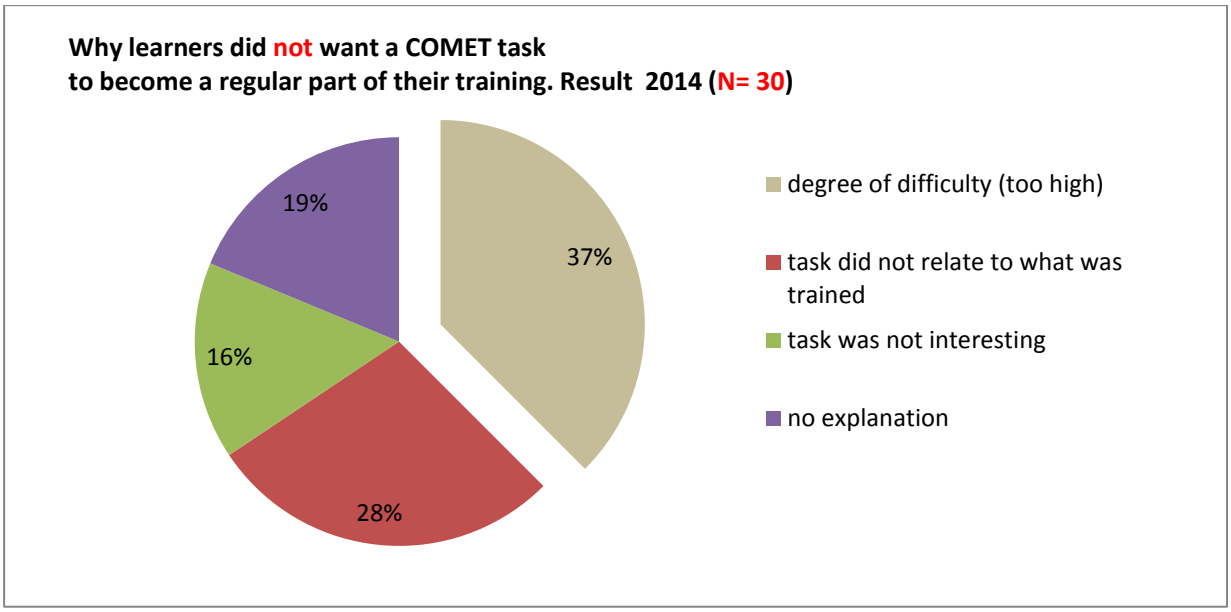


Figure 154: Analysis of test motivation: Why learners did not want to continue working with COMET tasks.. COMET South Africa 2014

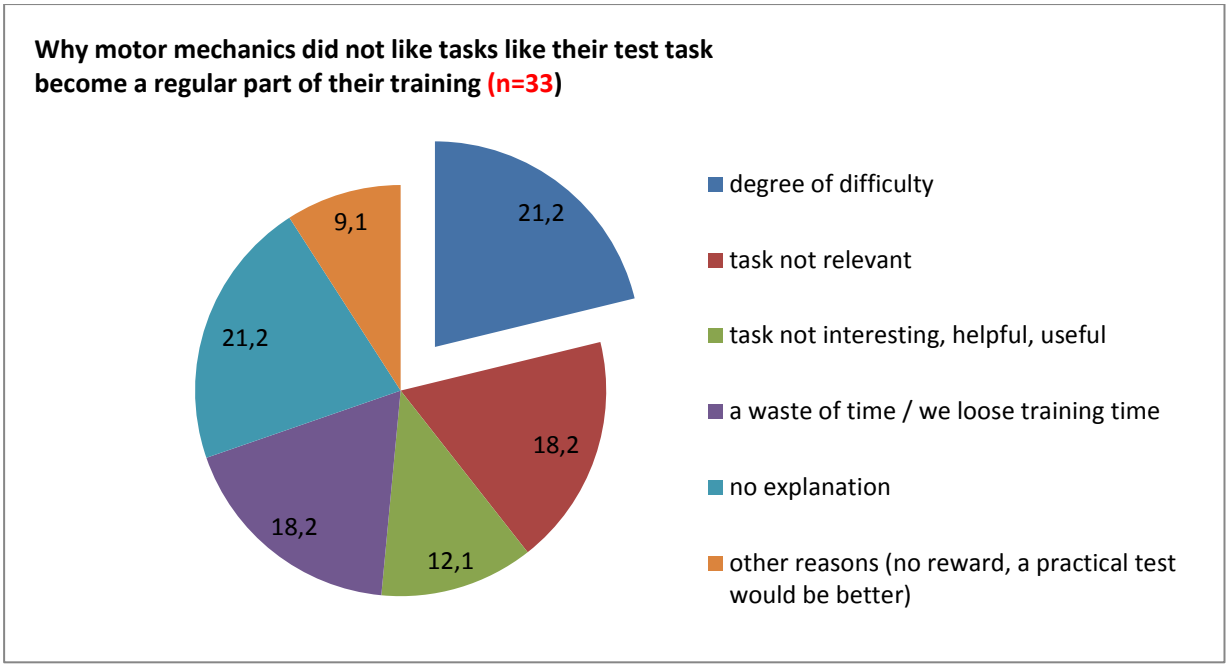


Figure 155: Analysis of test motivation: Why learners did not want to continue working with COMET tasks. COMET South Africa 2015

Appendix III

III-1 Rating Sheet as used in the tests COMET South Africa 2011 - 2016

Rating Sheet COMET South Africa 2011 - 2016	**Requirement is…**			
Code: Teacher:	**not met at all**	**rather not met**	**rather met**	**fully met**
(1) Clarity/Presentation				
Is the solution's presentation understandable for the client/orderer/customer/employer?				
Is the solution presented on a skilled worker's level?				
Is the solution visualised (e.g. graphically)?				
Is the presentation of the task's solution structured and clearly arranged?				
Is the presentation adequate (e. g. theoretically, practically, graphically, mathematically, causative)?				
(2) Functionality				
Is the solution operative?				
Is the solution state-of-the-art?				
Are practical implementation and construction considered?				
Are the relations to professional expertise adequately presented and justified?				
Are presentations and explanations right?				
(3) Use value/Sustainability				
Is the solution easy to maintain and repair?				
Are expendabilities and long-term usability considered and explained?				
Is countering susceptibility to faults considered in the solution?				
How much user-friendly is the solution for the direct user?				
How good is the solution's practical use-value (e.g. of some equipment) for the orderer/client?				
(4) Cost effectiveness/Efficiency				
Is the solution efficient and cost effective?				
Is the solution adequate in terms of time and persons needed?				
Does the solution consider the relation between time and effort and the company's benefit?				
Are follow-up costs considered?				
Is the procedure to solve the task (work process) efficient?				

	Requirement is…			
	not met at all	**rather not met**	**rather met**	**fully met**
(5) Orientation on Business and Work Processes				
Is the solution embedded in the company's work and business processes (in company/at the client)?				
Do the solutions base on work experiences?				
Does the solution consider preceeeding and following work/business processes?				
Does the solution express skills related to work processes that are typical for the profession?				
Does the solution consider aspects that go beyond the particular profession?				
(6) Social Responsibility				
To what extent does the solution consider possibilities of a humane work organisation?				
Does the solution consider aspects of health protection?				
Does the solution consider ergonomical aspects?				
Does the solution follow the relevant rules and regulations regarding work safety and prevetion of accidents?				
Does the solution consider social consequences?				
(7) Environmental Responsibility				
Does the solution consider the relevant environmental regulations?				
Do the materials used comply criteria of environmental compatibility?				
To what extent does the solution consider an environmentally friendly work organisation?				
Does the solution consider recycling, re-use, and sustainability?				
Does the solution address possibilities of energy saving and better energy efficiency?				
(8) Creativity				
Does the solution include original aspects in excess of the solution space?				
Have different criteria been weighted against each other??				
Has the solution some creative quality?				
Does the solution show awareness of the problems?				
Does the solution tap the task's leeway?				

III-2 MQ – Motivational questionnaire for learners (students/apprentices)

First name (given name): _____
last name (surname): _____

Year of apprenticeship: ☐ 1 ☐ 2 ☐ 3 ☐ 4

Sex: ☐ male ☐ female Age: ___ years

Apprenticed profession (Please indicate the occupation you are learning):

☐ electrician ☐ mechatronic ☐ welder ☐ Other (please indicate)

Test site:

1	*Sample test site 1*	☐
2	*Sample test site 2*	☐
3	*Sample test site 3*	☐
4	*Sample test site 4*	☐
5	*Sample test site 5*	☐
6	*Sample test site 6*	☐

1. Which task did you work on?

_____

2a. How difficult did you find the solution of the task?

- ☐ very difficult
- ☐ rather difficult
- ☐ rather easy
- ☐ very easy

2b. Why? _____

_____

_____

3. How long did you work on the test task?

- ☐ less than half an hour
- ☐ ½ - 1 hour
- ☐ 1 – 1½ hours
- ☐ 1½ - 2 hours

3a

	very much			***not at all***
Was it interesting to work on the test task?	☐	☐	☐	☐
How useful do you consider this kind of test tasks?	☐	☐	☐	☐
How closely is the test task related to your occupation?	☐	☐	☐	☐
How concentrated did you work on the test task?	☐	☐	☐	☐
How much effort did you make working on the test task?	☐	☐	☐	☐

3b. Would you approve if this kind of task would become part of your vocational training?

☐ yes ☐ no

3c. Why?

_____

_____

_____

_____

_____

Thank you for your help!

III-2 VI Questionnaire on Vocational Identity and Commitment

Part 1:
Personal data and general questions regarding your training company:

Given name, first name: _____

Year of apprenticeship: 1 2 3 4

Sex: ☐ male female Age: ___ years

Apprenticed profession (Please indicate the occupation you are learning):

☐ electrician ☐ mechatronic ☐ welder ☐ Other (please indicate)

Test site:

If you are trained in a company:
Please name the branch:

Industry ☐
Crafts ☐
Trade ☐
Service ☐
Public service ☐

Where does the practical training take place?

within one company ☐
in various companies ☐
in an FET college ☐
in an FET college and in a company ☐
in a private training centre ☐
in a public training centre ☐
elsewhere (where?) _____ ☐

Post code of your home town: _____

Which language do you and your parents usually speak at home?

☐ Africaans	☐ English
☐ IsiZulu	☐ IsiXhosa
☐ Ndebele	☐ Sepedi
☐ Sesotho	☐ Setswana
☐ Siswati	☐ Tshivenda
☐ Xitsonga	☐ another:

Which entry qualifications did you obtain before applying for this apprenticeship?

☐ Some credits from University based on an engineering qualification	☐ Technical Grade 12 with maths and science Vocational (NCV) – Level 4
☐ NQF 2 to 4	☐ NTC 1 +2
☐ NTC 3 + 4	☐ NTC 5 + 6
☐ Grade 10 – 11 with Maths and Science	☐ Grade 9
☐ another (please indicate) :	

What were your grades at general school...

	more than 75	**70 -75**	**65 - 70**	**60 - 65**	**55 - 60**	**50 - 55**	**less than 50**
in English?	☐	☐	☐	☐	☐	☐	☐
in Maths?	☐	☐	☐	☐	☐	☐	☐
in foreign languages	☐	☐	☐	☐	☐	☐	☐

My parents…

	strongly disagree	disagree	neither agree nor disagree	agree	Strongly agree
are interested in my apprenticeship.	☐	☐	☐	☐	☐
are supporting me in my apprenticeship.	☐	☐	☐	☐	☐
are proud of me doing this apprenticeship	☐	☐	☐	☐	☐

	yes	**no**
My father is working in a similar profession.	☐	☐
My mother is working in a similar profession.	☐	☐
One of my relatives is working in a similar profession.	☐	☐

What is your father's/mother's school degree? (Multiple answers possible)

Mother: ☐no fomal education ☐elementary school ☐secondary school ☐high school ☐college or university

Father: ☐no fomal education ☐elementary school ☐secondary school ☐high school ☐college or university

Please comment the following:

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
The notions 'occupation', 'profession', 'vocation' and 'job' have more or less the same meaning.	☐	☐	☐	☐	☐
It does not matter that much which vocation I learn, what counts is employment.	☐	☐	☐	☐	☐
It is true, that one can change jobs easier than an occupation.	☐	☐	☐	☐	☐
An occupation is a part of one's identity.	☐	☐	☐	☐	☐
A job is a part of one's identity.	☐	☐	☐	☐	☐

Which of the following statements regarding the reason you choose this occupation are the ones that describe your motivations best?

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I always wanted to take up the occupation that I am learning now.	☐	☐	☐	☐	☐
I rather wanted to learn a different occupation but did not get a position.	☐	☐	☐	☐	☐
If another, which occupation did you originally prefer?					
It was important for me to do the training at this college (if relevant)	☐	☐	☐	☐	☐
It was important for me to do the training at this company (if relevant).	☐	☐	☐	☐	☐
My training company is likely to offer me employment after I have finished my apprenticeship.	☐	☐	☐	☐	☐
Later (after finishing apprenticeship), I will be able to earn a lot of money in my vocation.	☐	☐	☐	☐	☐
My friends think my profession is ok.	☐	☐	☐	☐	☐
My profession has a good reputation in society.	☐	☐	☐	☐	☐

Part 2
What is your opinion? Please comment on the following statements:

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I like to tell others about the profession I am learning.	☐	☐	☐	☐	☐
I like to tell others about my training company.	☐	☐	☐	☐	☐
I ‚fit' to my **profession**/my profession suits my personality	☐	☐	☐	☐	☐
I ‚fit' to my **company**.	☐	☐	☐	☐	☐
I feel motivated no matter what my work tasks are.	☐	☐	☐	☐	☐
I am not that interested in my **profession**.	☐	☐	☐	☐	☐
I do not feel much "attached" to my **company**.	☐	☐	☐	☐	☐
I am proud of my **profession**.	☐	☐	☐	☐	☐
I am proud of working in/for my **company**.	☐	☐	☐	☐	☐

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I am reliable in all tasks I get.	☐	☐	☐	☐	☐
I want to continue working in my **profession** after training, it could as well be in another company.	☐	☐	☐	☐	☐
I want to continue working for my training **company** after training – even if I have the opportunity to go to another company.	☐	☐	☐	☐	☐
I feel kind of ‚at home' in my profession.	☐	☐	☐	☐	☐
I feel kind of 'at home' at the company.	☐	☐	☐	☐	☐
I am always on time – whether my work tasks require this or not.	☐	☐	☐	☐	☐
I am taken up in my profession/ I am merged in my profession	☐	☐	☐	☐	☐
I am deeply involved in my profession	☐	☐	☐	☐	☐
I care about my company's future.	☐	☐	☐	☐	☐
In order to get a job in this company, I would have taken up an apprenticeship in another profession than the one that I learn now.	☐	☐	☐	☐	☐
I am interested in how my work contributes to the overall company's workflow.	☐	☐	☐	☐	☐
'Profession' means to provide good work quality.	☐	☐	☐	☐	☐
I really like to occupy myself with professional tasks also in my spare time	☐	☐	☐	☐	☐
I like the work in my profession (as electrician, welder or mechatronic)	☐	☐	☐	☐	☐
I know what the correlation is between my tasks and my profession.	☐	☐	☐	☐	☐
I sometimes think of ways how to improve my work or its quality.	☐	☐	☐	☐	☐
I am interested in the contents of my apprenticeship	☐	☐	☐	☐	☐
In my company, I like to accept liability/responsibility.	☐	☐	☐	☐	☐
With my work, I wish to contribute to the company's overall success.	☐	☐	☐	☐	☐

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
The work in my company is so interesting, that I often do not realise how fast time is passing by.	☐	☐	☐	☐	☐
For my company, I always want to submit quality.	☐	☐	☐	☐	☐
In am interested in contributing to the employee suggestion system of our company	☐	☐	☐	☐	☐
I want to have a say about my work content.	☐	☐	☐	☐	☐

Part 3:
Questions about vocational training in your training company:
(This section is only relevant, if you are trained in a company or if you participate in a dual apprenticeship program at an FET college including practical training modules in a company.)

Please tick where applicable

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
All in all, I am content with my vocational training in the company.	☐	☐	☐	☐	☐
At the beginning of my training, my motivation was lower than what it is currently.	☐	☐	☐	☐	☐
Colleagues at work do support each other.	☐	☐	☐	☐	☐
There is a climate of confidence between employees	☐	☐	☐	☐	☐
I can learn a lot from my trainer in the training company.	☐	☐	☐	☐	☐
I can always ask someone if there are any problems.	☐	☐	☐	☐	☐
When I carry out tasks, I get expert help and feedback if necessary.	☐	☐	☐	☐	☐
In my company we have regular discussions on how apprentices get along with their training.	☐	☐	☐	☐	☐
The co-operation with other company employees has a positive impact on my training.	☐	☐	☐	☐	☐
I would not criticise the instructions of my trainer or foremen.	☐	☐	☐	☐	☐
Learners get to know the whole occupational profile.	☐	☐	☐	☐	☐

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
Learners get to know many different work tasks and fields of activity of other employees.	☐	☐	☐	☐	☐
Ultimately, the trainees' work tasks are of importance for the company.	☐	☐	☐	☐	☐
The trainees have responsible jobs (works tasks).	☐	☐	☐	☐	☐
To carry out my tasks satisfactory, I need to pay attention to a lot of different things.	☐	☐	☐	☐	☐
I have an overview on what is done in the other departments.	☐	☐	☐	☐	☐
I am aware of my tasks' role in the overall company's work processes.	☐	☐	☐	☐	☐
The tasks that I carry out in the company fit with my knowledge.	☐	☐	☐	☐	☐
If there are different ways to carry out my tasks I decide which one is the best.	☐	☐	☐	☐	☐
If there are different ways to carry out my tasks our trainer decides which one we have to take.	☐	☐	☐	☐	☐
I like clear and precise instructions.	☐	☐	☐	☐	☐
I follow the instructions of the superiors without further discussion - even if they do not make sense to me.	☐	☐	☐	☐	☐
Staff members mostly ignore the trainees.	☐	☐	☐	☐	☐
As a learner one is not really a part of the company.	☐	☐	☐	☐	☐
The training in my company does not challenge me at all.	☐	☐	☐	☐	☐
My work load at the company has a negative impact on my training.	☐	☐	☐	☐	☐
I would like to have the same responsibility as my colleagues.	☐	☐	☐	☐	☐
I prefer being flexible rather than concentrating on the skills central to my profession.	☐	☐	☐	☐	☐
The work tasks I have to carry out in the company correspond to the profession I am learning.	☐	☐	☐	☐	☐
I perform my work like a skilled worker.	☐	☐	☐	☐	☐

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
In my company, apprentices mostly work in separate training workshops	☐	☐	☐	☐	☐
A huge amount of training is linked to real factory orders.	☐	☐	☐	☐	☐
I am able to carry out new and complicated work tasks by building upon what I have already learned.	☐	☐	☐	☐	☐
I have a considerable freedom when carrying out my work tasks.	☐	☐	☐	☐	☐
Most of my tasks I carry out autonomously.	☐	☐	☐	☐	☐

Part 4
Some questions on the situation at your college
(only relevant for students at FET colleges)

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I feel comfortable at college.	☐	☐	☐	☐	☐
Mostly, I find the lessons interesting.	☐	☐	☐	☐	☐
Interaction between students and Teachers is friendly and trusting.	☐	☐	☐	☐	☐
Class-/Schoolmates are often disturbing the lessons.	☐	☐	☐	☐	☐
Class-/Schoolmates do not show much respect for other students.	☐	☐	☐	☐	☐
Schoolmates sometimes vandalise.	☐	☐	☐	☐	☐
Schoolmates often skip school.	☐	☐	☐	☐	☐
Our teachers….					
In the lessons, our teachers consider the students interests.	☐	☐	☐	☐	☐
Our teachers present interesting lessons.	☐	☐	☐	☐	☐
Our teachers take students seriously.	☐	☐	☐	☐	☐
The teachers have a good picture of the real work life/the reality in the companies.	☐	☐	☐	☐	☐
The teachers co-operate with trainers from my company.	☐	☐	☐	☐	☐
The teachers take care of individual students.	☐	☐	☐	☐	☐
The teachers are co-coordinating their lessons among each other.	☐	☐	☐	☐	☐
Cooperation between learning venues (FET college / apprenticing company)					
My college and the company offering in-company training are co-ordinating the training.	☐	☐	☐	☐	☐

The FET college and the training company are conducting learning projects together.	☐	☐	☐	☐	☐
The college only co-operates with the training companies if students do not show up or if there are other serious problems.	☐	☐	☐	☐	☐
I think that the training company is pleased with the education at the FET college.	☐	☐	☐	☐	☐
The significance that my training company attaches to the role of the college is very high.	☐	☐	☐	☐	☐
I think that the FET college is pleased with the training at the company.	☐	☐	☐	☐	☐
What I learn in the vocational school and what I learn in the company fits well.	☐	☐	☐	☐	☐
I learn more during my training in the company than at college.	☐	☐	☐	☐	☐
At the college, I can make good use of what I learned at the company.	☐	☐	☐	☐	☐
At the company, I can make good use of what I learned at school.	☐	☐	☐	☐	☐
Lessons at the college can be applied to real world issues within the company.	☐	☐	☐	☐	☐
Further estimations:					
I feel confident to have a good command of what is trained at college.	☐	☐	☐	☐	☐
I am sure that I can achieve good results in my tests at college.	☐	☐	☐	☐	☐
What I learn at vocational school is important for my profession.	☐	☐	☐	☐	☐
I am certain to understand even the most complicated things I have to learn at college.	☐	☐	☐	☐	☐

5. Communication / cooperation / team work

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I like to work autonomously.	☐	☐	☐	☐	☐
I like to work in teams.	☐	☐	☐	☐	☐
I like to take over responsibility for my work tasks.	☐	☐	☐	☐	☐
I feel good when I work autonomously.	☐	☐	☐	☐	☐
I feel good when I work in teams.	☐	☐	☐	☐	☐
I feel good when I take over responsibility form my tasks.	☐	☐	☐	☐	☐
Whenever possible, I avoid working autonomously.	☐	☐	☐	☐	☐
Generally, I am good in working in teams.	☐	☐	☐	☐	☐
Generally, I succeed when I take over responsibility for work tasks.	☐	☐	☐	☐	☐

	very seldom	rarely	some-times	often	very often
How often do apprentices work in teams during the **theoretical** part of your training / in VET colleges?	☐	☐	☐	☐	☐
How often do you work in teams during the **practical** part of your training, i.e. in a training company?	☐	☐	☐	☐	☐
	not enough	rather not enough	just right	rather too much	too much
What is your estimation on the amount of team work in the **theoretical** part of your training?	☐	☐	☐	☐	☐
What is your estimation on the amount of team work in the **practical** part of your training?	☐	☐	☐	☐	☐
	not at all	rather not	fairly well	well	very much
How do your teachers support or facilitate team work in **VET colleges**?	☐	☐	☐	☐	☐
How do your trainers in your **training companies** support or facilitate team work with other apprentices or colleagues?	☐	☐	☐	☐	☐

Appendix VI: Project Consortium and Team Members of COMET South Africa

A: The South African Team

Project Coordinator:
Helen **Brown**, merSETA

Support to the project coordinator & test management:
Sibusiso **Shlubi** & Tsholo **Mungoni**, merSETA

Rater trainings:
Helen **Brown**, merSETA; Patricia **Jacobs** and Mark **Corneilse**, Northlink College.

Rating of Tasks and/or Test Tasks Development:

COMET Pre-test for Millwrights:

Frank **Gilbert**, Port Elizabeth College; Barry **Lotze**, West Coast College; Simphiwe **Masinga**, Ekurhuleni East TVET College; Primrose **Modisane**; Ekurhuleni East TVET College; Nontombi **Ngwenya**, Richtek-Umfolozi College; Joshua **Philip**, Richtek-Umfolozi College; Jan **Schallies**, Richtek-Umfolozi College; Thami **Shabangu**, Richtek-Umfolozi College; Steve **Van Heerden**, Ekurhuleni East TVET College; Colin **Eksteen**, Port Elizabeth College; Flikkers **Ferreira**, Master Artisan Academy SA; Saadik **Ismail**, Port Elizabeth College; David **Pinches**, Port Elizabeth College; Johan **Riekert**, ArcelorMittal Academy SA; Herman **Schwarz**, Master Artisan Academy SA; Phumeza Tywakadi-**Qutywa**, Master Artisan Academy SA.

COMET Tests for Mechatronics:

Shane **Botha**, BMW SA; Lourens **Coetzer**, BMW SA; Aaron **Mphuti**, BMW SA; Ronald **Nel**, VWSA; Nabeel **Rasdien**, VWSA; Daniel **Van Wyngaard**, BMW SA; Andries **Weyers**, Continental Tyres.

COMET Tests for Welding:

Andre **Atherton**, Northlink College; Colin **Brown**, Northlink College; Gerhard **Coetzee**, West Coast College; Michael **Jass**, West Coast College; James **O'Connor**, Northlink College; Ben **Ritter**, West Coast College; Marinus **Engelbrecht**, West Coast College.

COMET Tests for Motor Mechanics:

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Mechanics:

Academy, Isando: Roy **Luthuli**, Elangeni College; Junias **Makgoale**, Ekurhuleni West TVET College – Tembisa Campus; Charles **Meyer**, KwaZulu Natal Automotive Training Services (KATS); Tshililo **Mushoma**, Ekurhuleni West TVET College – Tembisa Campus; Happy **Ngwira**, Ekurhuleni West TVET College – Tembisa Campus; Sean **Reynolds**, McCarthy Training Centre Midrand; Noel **Slade**, Northlink TVET College – Bellville Campus; Shaun **Thomas**, Imperial Technical Training Academy, Germiston; Werner **Wandrey**, The AA Training Academy, Midrand; Glenville **Williams**, Northlink TVET College – Bellville Campus; Colin **Wilson**, Barloworld Motor Retail Academy, Cape Town; Godfried **Zungu**, Elangeni College.

COMET Pre-Tests for Fabricatiors:

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B: The German Team

Managerial Direction and Project Design:
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Project Coordinator:
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Support to the project management and coordination:
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Consultancy Test and Learning Tasks (for Electricians, Mechatronics and Welders)
Gerald **Hubacek**, Heinrich-Emanuel-Merck-Schule, Germany; Thomas **Scholz**, FES Wiesbaden Germany; Torsten **Uhlstein**, FES Wiesbaden Germany

Rater Trainings:
Ursel **Hauschildt**, Lars **Heinemann**, Joy **Schumacher**

Conduction of Training Seminars on COMET Methodology, and Calculation of Results:
Felix **Rauner**, Nele **Bachmann**, Jenny **Franke**, Ursel **Hauschildt**, and Lars **Heinemann**

Conduction of Training Seminars on COMET Test Managemenat:
Ursel **Hauschildt**, Dorothea **Piening** and Kai **Wagnik**

Calculation of Project Results:
Ursel **Hauschildt**, supported by Nele **Bachmann** (vocational identity and context, main test 2014)