Social inequality as an enduring phenomenon of general and vocational education

– characteristics in the Federal Republic of Germany and international perspectives

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Social inequality and vocational education; individual educational opportunities in an international context; social selectivity in national educational systems; encouraging weaker students in vocational education; educational claims and reality

SUMMARY

This paper seeks to (1) provide an overview, from a macroanalytical perspective, of the characteristics of unequal educational opportunities within an international perspective, (2) set out problems related to social selectivity, in particular within the vocational educational system in Germany and (3) describe examples of the interaction between selection and vocational learning on the basis of empirical investigations. The intention is to illustrate the fundamental problems associated with social inequality at different levels in the educational field and to extract the correlations between selection and vocational learning.

Preamble

Unequal educational opportunities afforded to children and young persons of differing social origins are a phenomenon that is relatively resistant to change in most countries. Despite the considerable expansion in education that has taken place in many countries over the past few decades, the highly prevalent inequality of opportunity remains a serious problem.

From an international perspective, serious national differences in access to education are immediately evident, and these are expressed in varying levels of participation in education, in educational expenditure and in the results achieved. This inequality from an international perspective is carried into national educational systems: in the Federal Republic of Germany for example, this is to be found in the educational expenditure and educational level attained in individual German Länder, and in the highly differing degrees of participation in education by different social groups within the Länder themselves. According to the comparative studies of Blossfeld and Shavit, the effects of social origin prove to be especially influential at the start of one's educational career (Blossfeld and Shavit, 1993), although they continue to act during subsequent phases, as is broadly confirmed by more recent data (see below). In addition to the studies in relation to participation in education and inequality of opportunity based on a more macroanalytical perspective, other studies have analysed inequalities in the actual teaching/learning situations. Among other things, these examine different strategies in relation to teaching and encouragement, which are relevant to the development of stronger and weaker students, and also to the skills development of students who achieve different degrees of success. There is therefore less focus on the effects of social origin on educational biography than on the development of weaker students, the greater proportion of whom come from less academic social strata.

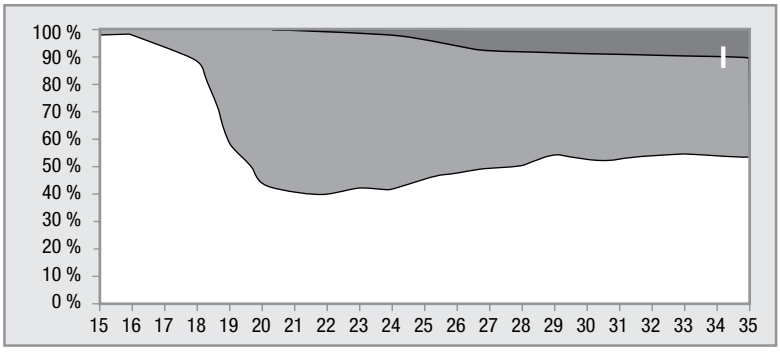
This paper seeks to (1) provide an overview, from a macroanalytical perspective, of the characteristics of unequal educational opportunities from an international perspective, (2) set out problems related to social selectivity, in particular within the vocational educational system in Germany and (3) describe examples of the interaction between selection and vocational learning on the basis of empirical investigations. The intention is to illustrate the fundamental problems associated with social inequality at different levels in the educational field and to extract the correlations between selection and vocational learning.

Nationality and its consequences on individual educational opportunities

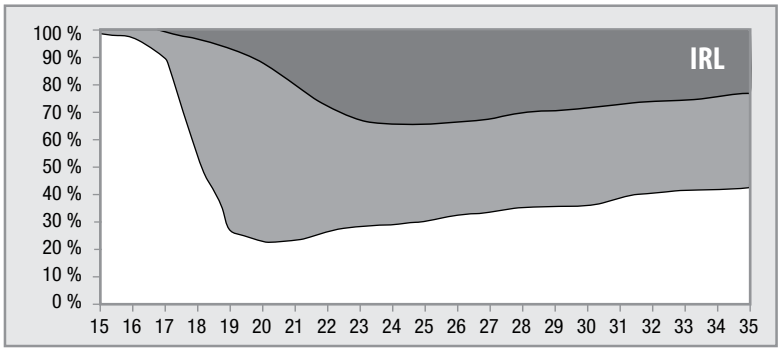
The analyses presented by the OECD powerfully demonstrate the effect of nationality on individual educational opportunities. This is highlighted for example by the comparative data in relation to educational achievements in individual countries, which indicate a high degree of heterogeneity despite the fact that comparisons are very difficult owing to structural differences.

The curves reproduced as examples in Fig. 1 for Italy, Finland, Poland, Ireland, Germany and France illustrate the fact that measured against the standard qualification ([1]) (International Standard Classification of Education) developed by UNESCO, in these countries, individuals have highly varying opportunities of actually attaining levels ISCED 3 or ISCED 5-7 (i.e. secondary level II or higher education degree), dependent on their nationality (Couppié and Mansuy, 2003).

Figure 1. **Proportions of 15 to 35-year-olds in leading industrial nations without higher secondary school leaving qualification (2001).**



([1]) Those who have not yet attained any general or vocational education standard at secondary level II are assigned to level ISCED 0-2, level ISCED 3 includes those who have attained secondary level II but have not yet gained a higher educational degree, and level ISCED 5 to 7 includes graduates. In countries such as Germany, Switzerland and Austria, the allocations of those who have graduated at the tertiary level are viewed with a critical eye, since courses allocated in these countries to levels ISCED 3 and 4 are allocated to the higher educational level in other countries.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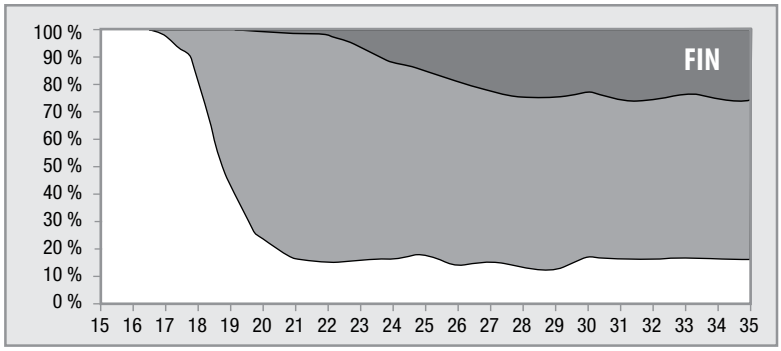
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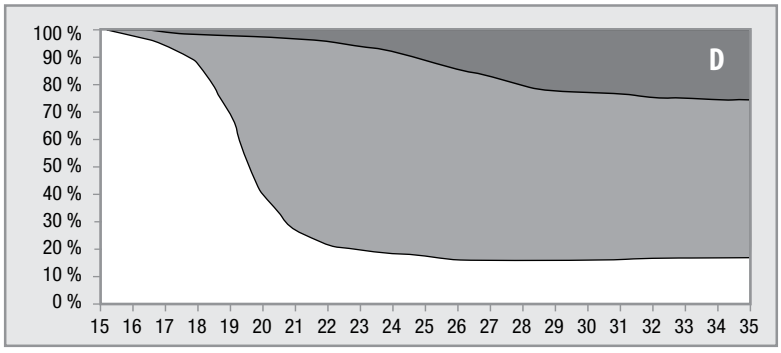
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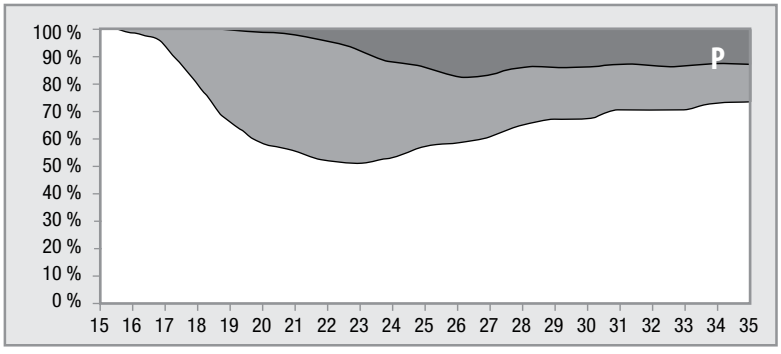
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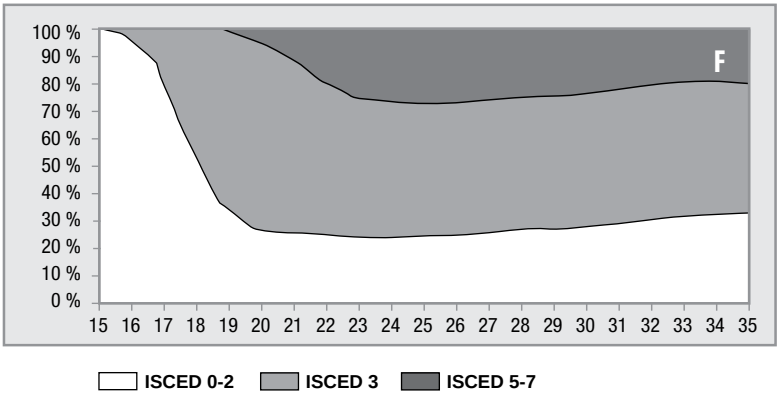


Note to aid understanding of the graphs: for every age range, the graphs break down the entire population according to educational level attained. They are based on average data and provide an impression of how a (simulated) peer group acquires its educational attainments.

Source: Couppié and Mansuy, 2003.

This phenomenon is confirmed by more recent data. As an example, the 2007 OECD education report still shows that extremely varied proportions of the population have attained tertiary and secondary qualifications in the OECD countries (see 'Education at a glance. OECD – 2006 indicators'). Within the EU, only 12 % of the population in both Slovakia and the Czech Republic have gained a higher education qualification, a very low proportion. Germany attains the average of the OECD countries at 25 %, whereas proportions in Denmark (32 %) and Sweden (35 %), for example, are much higher. Expenditure on education also varies considerably in the individual countries ([2]).

Out of the European countries, Norway, Denmark, Austria and Sweden in particular report higher than average expenditure on education per student, with educational expenditure in some of the countries in Eastern and South-Eastern Europe being well below average ('OECD, Education at a glance 2006', p. 191 et seq.), with considerably different circumstances in the primary, secondary and tertiary field. Whereas Finland, for example, which attained consistently above-average results in international studies of performance, stands at around the OECD average at all three levels for educational expenditure per student, Germany is below average at primary level, which is especially significant when it comes

([2]) The results are based on data from 1995-1997. Couppié, Mansuy 2003 gives an overall view of the former EU countries.

to further learning. Among the European countries for example, Norway is consistently above the OECD average and Greece and Poland below it. The inequality of educational opportunities offered to subsequent generations that is becoming evident in individual countries is unquestionably also related to some extent to the financial resources available in each country, although the nature of distinctive national preference structures appears to be just as important.

The effect of nationality on individual educational opportunities is also evident in international comparative studies (such as PISA) which show that, depending upon nationality, the opportunities for attaining a desirable level of basic skills, which are in turn extremely important for learning success in vocational education, vary, while social selectivity also varies significantly (OECD, 2007a).

Social selectivity in national educational systems

The structures of the national educational systems can be traced back to the individual qualification requirements of the employment system, which themselves underwent fundamental change during the 19th and 20th centuries. Alongside social change, growing demand for highly qualified workers was and is one of the core reasons for the ever-advancing expansion of education and the incorporation of all social classes into formalised educational processes. The opportunities offered to members of the lower social strata to participate in educational schemes are traditionally relatively unfavourable. Although the social selectivity of the educational systems varies considerably between individual countries, this phenomenon is generally observable with the OECD countries.

What is remarkable is not only the universality of the phenomenon of social inequality, but also the high degree of variation between countries. Whereas Portugal, Sweden and Finland, for example, demonstrate relatively little social selectivity, the educational systems of Belgium, Hungary, Germany and Slovakia are highly selective. Varying degrees of social selectivity are also evident from the mathematical performances of students with a migrant background, with above-average differences between students with and without a migrant background in Belgium and Germany as well as in Sweden and Switzerland (OECD 2007b, p. 104 et seq.).

Intergenerational elasticity of earnings, as a measure of both differences in the earnings levels of parents and their children as well as private return on education, are significantly different between individual countries (OECD, 2007a, p. 81). Whereas generational differences in earnings are relatively small in Italy, France, the United Kingdom and the USA, for example, they are well above average in Denmark, Norway, Finland, Australia and Canada. Although the private return on education is not directly linked to these differences in earnings, there are significant differences in the private return on education within this group of countries having relatively high intergenerational differences in earnings (ibid.).

The social selectivity of the general educational systems continues into vocational education ([3]). This is internationally well documented, not only in terms of involvement in further education, but also in terms of the vocational status attained by subsequent generations as a function of the social status of their parents (see for example European Group for Research on Equity, 2005). However, here too there are major differences between individual countries.

If one looks at countries with dual educational alternatives (which are examined more closely in Section 4 on the basis of new empirical studies) to determine how 'weaker' and 'stronger' students develop over the course of their vocational education, it is evident that far-reaching selection mechanisms come into play as early as the transition between school and vocational education. In the final analysis, students demonstrating better cognitive (and social) skills enter the more demanding vocations which especially promote personal development (Häfeli, Kraft, Schallberger, 1988; Nickolaus, Knöll, Gschwendtner, 2006; Seifried, 2006). Selection and socialisation effects reinforce one another during the course of education or, in other words: the 'haves' get more advantages (Seifried, 2006). However, these initial threshold selection processes, with their implications for individual development which are at first glance oriented towards performance criteria, are accompanied by social selection processes. Thus studies in relation to educational choice and vocational decisions that are based on value-expectancy theory show that cost/benefit considerations in relation to education are made in different ways according to social class. As an example,

([3]) However, some studies show that vocational educational facilities mitigate educational disadvantage (see for example Preston, Greeno, 2008). In Germany for example, the vocational secondary schools prove effective in this respect (Maaz et al., 2004).

parents from higher social classes attach relatively heavy weight to the risk of a fall in status, which may accompany a reduction in educational costs, whereas parents from lower social strata tend to overestimate educational costs (Becker, 2000; Schneider, 2004). This finding is also supported by empirical examinations of studies in relation to the theory of educational choice by Linda Gottfredson (cf. Ratschinski, 2006). Other studies document the migration background of the applicants for educational places, as a further relatively important social selection factor, based on the example of Germany (Friedrich, 2006). In market-dependent educational systems at least, considerable influence is exerted by regional and peer affiliation, which is in turn linked to economic constraints (Friedrich, 2006).

The fact that these selection mechanisms interact with educational and socialisation processes, as noted above, and that there is an inherent risk within the educational system of them reinforcing inequalities that already existed at the start of the educational process, rather than offsetting them, appears important.

Inequality/unequal encouragement during teaching

The fact that children from more educationally-deprived backgrounds sometimes enter the institutionalised education system with less favourable learning prerequisites, and generally receive less support from home, is not disputed. This raises the question of how teachers deal with heterogeneity, and whether it is possible to more or less balance out unequal initial opportunities. During classes, most teachers are confronted by varying degrees of obvious heterogeneity amongst learners. Findings indicate that this heterogeneity is greater in the field of vocational education than it is in academic education (Achtenhagen, Grubb, 2001; Schmidt, Hunter, 2004).

This heterogeneity presents a challenge to teachers, because meeting the need for adaptivity as a core quality feature of teaching in heterogeneous learning groups is difficult, and sometimes not very successful. Following on from the studies of Brophy and Good (1976) in relation to individualisation strategies of teachers, other studies in vocational educational research have examined the question of the extent to which proactive, reactive and even over-reactive teacher behaviour is encountered. Proactive teacher behaviour, which is encountered

relatively seldom, is characterised by the differential distribution of learning opportunities, which is directed towards the encouragement of those students deemed to be weaker, and may result in a reduction of the differences in performance within the class ([4]).

Over-reactive behaviour, which actually aggravates differences, is characterised by a focus on those students who are perceived to be higher performers, and in fact reflects the behaviour of around 15 % of teachers. Reactive behaviour is the most widespread, and is characterised by reactions to interaction, albeit without any specific strategy of encouragement, which also seems incapable of mitigating differences in performance. Added to this, the fact that the Pygmalion effect must be presumed to still be in operation (cf. for example Sembill, 2007), and for example causes judgements by teachers in relation to student performance assessment, in combination with relationship qualities, results in the systematic disadvantaging of 'rejected students' (ibid. p. 70 et seq.). These research results make it clear both that teachers do develop different strategies in order to avoid heterogeneity, and also that they run the risk of unnecessarily widening differences through their teaching behaviour.

By implementing more constructivistically orientated teacher/learner arrangements, it will hopefully be possible to achieve greater adaptivity in heterogeneous classes and learning groups than is possible in traditional teacher-centred teaching. The next section deals with the manner in which the performance of weaker and stronger trainees actually develops in a number of educational alternatives practised throughout Germany, measured against their prior knowledge, this being the strongest predictor of learning success.

The development of stronger and weaker trainees in dual and full-time college training courses

Data relating to the skills development of vehicle mechatronics engineers and in two electronic engineering vocations ([5]), based

([4]) Van Buer's studies for example reported a proportion of around 28 % of proactive teachers, with the greater proportion being more reactive (58 %), and 14 % actually being over-reactive (van Buer, 1990; Ziegler, 2006).

([5]) These educational vocations are very popular in Germany. The majority of vehicle mechatronics engineers work in industrial technology (22 115 initial trainees in 2006), and production engineers make up the largest proportion of electronics engineers, of whom there are a total of 9 828 initial trainees in all specialist fields (BMBF, 2007).

on three successive and related research projects, is set out below ([6]). These projects studied the question of whether better skills development can actually be demonstrated in teacher/learner arrangements that are characterised to a greater extent by self-monitoring and active teaching/learning, as is generally assumed in vocational and business teaching, rather than in more directive teacher/learner arrangements (Nickolaus, Heinzmann, Knöll, 2005; Nickolaus, Knöll, Gschwendtner, 2006; Nickolaus, Knöll, Gschwendtner, 2007). These studies clearly demonstrate that this assumption does not bear scrutiny. The question of how the subgroups of weaker and stronger students develop during the first year of training will now be examined in more detail. Allocation to the lowest and highest performance quartile in the entry test will be used to determine the subgroups, against the background that subject-specific prior knowledge is generally the strongest predictor of learning success (Helmke, Weinert, 1997).

Following the aptitude-treatment-interaction research (ATI research), the presumption was that weaker trainees benefit more from guided learning while stronger trainees benefit more from more open forms of teaching. The sought-after learning goals are also likely to produce dependencies, because more directive forms of teaching prove more beneficial in establishing specialist knowledge, whereas project-based, active learning is more beneficial for the acquisition of application-related knowledge (Weinert, 2000). Based on the assumption described above, that open forms of learning afford more opportunity for internal differentiation and thereby make it easier to meet the core quality criterion of adaptivity, it makes sense to examine the question of whether full advantage is taken of this opportunity and whether this potential is evident in the skills development of the learners. Given the results of international comparative studies (TIMSS, PISA), which are sobering as far as Germany is concerned since they lead one to assume that around 20-25 % of a year group is unable to cope with the requirements of a training course owing to inadequate basic knowledge (Baumert et al., 2001), this poses the general question of what performance developments are possible for weaker students. However, within the context of this paper, one must take account of the fact that as far as industrial technology in Germany is concerned, it is generally above-average trainees who enter the training vocations considered in this

([6]) The projects were promoted by the German Research Association.

paper (Lehmann, Seeber, 2007; Nickolaus, Knöll, Gschwendtner, 2006). However, a substantial heterogeneity of performance must be expected within the vocations under consideration, because it is mainly general secondary school leavers who take up the electronics trade vocation under consideration, while mainly intermediate secondary school leavers are recruited in industrial electronics ([7]). A similar situation applies to vehicle mechatronics engineers. Under consideration are homogeneous company groups from the car industry which underwent a performance-based selection process, and also 'trade groups' which are taught in a full-time college situation. This latter group also included trainees who did not yet hold a subsequent contract to continue their training at specialist level.

Initial threshold selection mechanisms and their effects on the take-up of stronger and weaker trainees

Despite clearly varying between individual vocational areas, the attractiveness of the electrical vocations is relatively high. Combined with selection procedures that are specific to training vocations, this lead to marked differences in the trainee entry criteria. This applies in relation to cognitive criteria, entry motivation and also the assessment of the vocation selected as the vocation of choice, which correlates positively ($r \sim 0.2$, $p \sim 0.02$) ([8]) with entry motivation (see Nickolaus, Knöll, Gschwendtner, 2006).

There are also significant differences in relation to knowledge at entry, which is especially important as regards future learning success. In relation to declarative prior knowledge ([9]), with approximately 33 % of the maximum points score, electronics engineers achieve a value that is more than double that of electrical fitters (MVI = 14.6 % of maximum

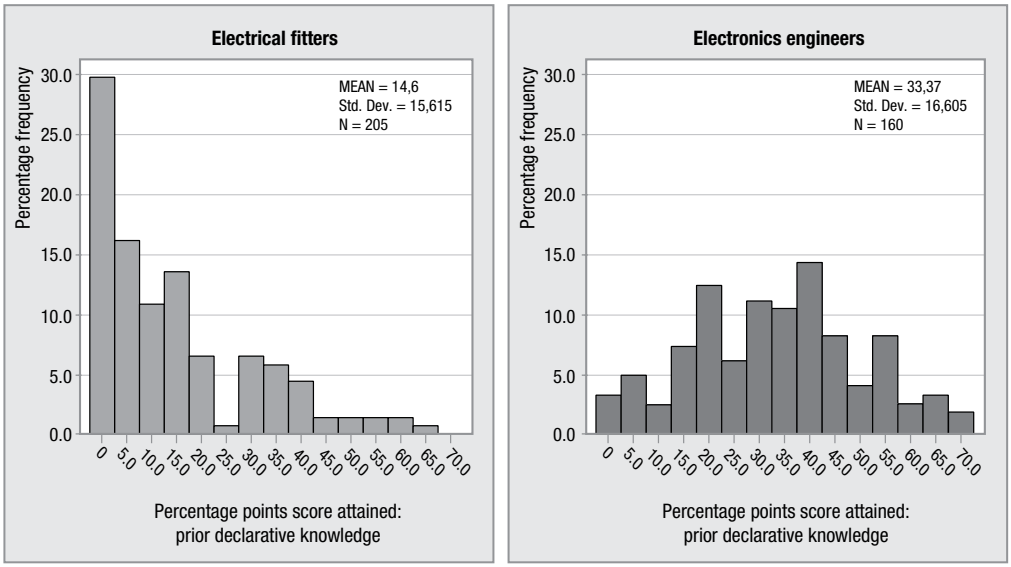
([7]) In trade situations, in-service training is normally undertaken full-time, although in some vocations and regions, training during the first year is undertaken in a full-time college situation with integrated workshop training. In heavy industry, at least large proportions of company training during the first year of training is conducted systematically in teaching workshops.

([8]) Among electronics engineers (industry), there are significant positive correlations between meeting the need for the vocation of choice and the introjected, identifying, intrinsic motivation and the interest; in the case of fitters (trade), the correlations are the same, but are however only significant in the case of intrinsic motivation ($r = 0.19$, sig. = 0.01).

([9]) Declarative knowledge was for example surveyed in relation to questions concerning electrical measurements/values. For example, in easy exercises only simple reproduction was required (sample exercise 1: in what groups can materials be classified in terms of their electrical characteristics?), whereas in difficult exercises, correlations had to be recognised (sample exercise 2: a conductor through which electricity is flowing becomes hot at a clamped joint. Give possible causes and state how this can be eliminated.)

points score), with a significantly similar difference in the mean for procedural knowledge ([10]) (MVE = 22.2, SD = 16.75; MVI = 10.1, SD = 9.47) ([11]).

Figure 2. **Frequency distributions in relation to prior declarative knowledge of the vocations of electrical fitter (left) and electronics engineer (right)**



([10]) Procedural knowledge was firstly surveyed using specific tasks which required the calculation of electrical variables, and secondly, tasks were used in which the trainees had to explain the procedures they would use. In easy tasks, for example, they were asked to convert units (sample task 3: convert into the units indicated: a) length: L1=350mm=___ m; b) voltage: U=230V=___ kV; c) current: I=0.53A=___ mA). The next level of difficulty involved tasks in which for example simpler calculations had to be undertaken in a few steps, involving the use of contextual knowledge and specific process knowledge (sample task 4: what is the resistance of a copper wire with a conductor length of 24m and a conductor cross section of 1.5mm^2?). At the next degree of difficulty were tasks in which solutions had to be reached in several steps, in which trainees had to use contextual and process knowledge (sample task 5: calculation of the overall resistance of a mixed circuit (resistance network) comprising 6 ohm resistances). The highest level involved tasks in which a range of contextual knowledge and several rules had to be applied in order to produce a solution in several steps (sample task 6: a trainee has rented a room and wants to roughly calculate the electricity costs (energy consumption costs) he will incur. His room is fitted with a ceiling light, a television, a refrigerator and a hot plate. What values must he calculate and how should he do it?).

([11]) The test instruments for both vocations were identical.

As shown by the frequency distributions reproduced in Fig. 2, the fitter groups include a large number of relatively weak trainees ([12]) who have very little prior knowledge upon which to build, despite the fact that the lower secondary school curriculum includes a relatively large number of exercises.

This data generally impressively confirms the assumption that, dependent on their 'level of attractiveness', the various vocations attract trainees with extremely different entry criteria. The cognitive criteria in particular differ considerably, while heterogeneity is very marked in both vocations. The fact that those who gain apprenticeships with significantly better cognitive skills also bring with them higher levels of motivation leads one to expect increasing differences in the course of future developments ([13]).

Similar effects were observed in the training vocation of vehicle mechatronics engineers, which is one of the most attractive in the field of industrial technology in Germany. This means that a significantly different 'clientele' gains the training places offered by the car industry from those who gain trade training places. The differences in mean IQ are highly significant (MVI=115.8; SD=15.9; MVT=101.9; SD=15.9); the same applies for subject-specific prior declarative and procedural knowledge (prior declarative knowledge: MVI =47.3; SD=12.0; MVT=31.4; SD=16.1; prior procedural knowledge: MVI=24.9; SD=13.4; MVT=10.0; SD=9.6).

Data in relation to mathematical skills and reading ability at the start of their training is also available for the vehicle mechatronics engineers; the same applies to a survey group of electronics engineers for energy and building services engineering comprising 203 trainees (formerly electrical fitters), who are included in a current survey that is still in progress (2008).

This data reflects the situations documented above in relation to IQ and subject-specific prior knowledge. There are thus serious differences between industrial and trade apprentices.

Since subject-specific prior knowledge, mathematical ability and reading fluency prove to be key predictors of learning success (see below), these differences are of outstanding importance.

([12]) For example, over 50 % of electrical fitter trainees gained less than 10 % of the possible points score.

([13]) The interaction between selection mechanisms ascertained in vocational socialisation research and the encouragement practices that serve to reinforce the differences (Häfeli, Kraft, Schallberger, 1988) were confirmed in this research.

Figure 3. **Comparison of entry (skills) values (mean values, standard deviations) of two industrial technology training vocations**

	Vehicle mechatronics engineers (industry/trade) N=305	Electronics engineers for energy and building services engineering N=235	Effect sise d
IQ	**106.7** (SD=17.2)	**103.7** (SD=16.6)	**0.18** (p=0.06)
Mathematics	**11.0** (SD=2.9)	**10.1** (SD=2.9)	**0.30** (p=0.001)
Reading comprehension	**14.9** (SD=3.3)	**14.2** (SD=3.2)	**0.22** (p=0.01)

Comparison of the development of stronger and weaker trainees
The comparative data set out below originate from three surveys. The first compared stronger and weaker electrical fitters who received trade training. The second was conducted among electronics engineers who were trained in the industry. This study not only enables a comparison to be made within the vocation between strong and weak trainees, but also seeks to make a comparison with electrical fitters; as demonstrated above, the latter's entry conditions when they take up their apprenticeship are significantly worse. The third survey again involved electrical fitters, and also vehicle mechatronics engineers, some of whom are training in the trade and some in industry.

We apply successively more demanding methods of comparison:

- survey 1: we primarily use mean value comparisons based on total points scores attained;
- survey 2: some of the comparisons are based on skills levels; although theoretical principles were applied, they have not yet been the subject of Rasch scaling and were generated by item difficulty characteristics tested through regression analysis; and
- survey 3: partial use of a Rasch-scaled skills model is possible.

Survey 1: Stronger and weaker electrical fitters (trainees in the trade)

Out of the total of 205 trainees who sat the entry test, 53 were allocated to the lower quartile and 51 to the upper quartile, measured on the basis of all their prior knowledge. As anticipated, the failure rate prior to the final test at the end of the first year of train-

ing was higher among the weaker group than among the stronger group (53-30; 51-37). Also in line with expectations, the weaker group consisted mainly of lower secondary school students (with and without a school leaving certificate) (93.7 %), whereas the stronger group comprised approximately equal proportions of lower secondary school leavers and trainees with a secondary school leaving certificate (HSch: 46.6 %; RSch: 48.9 %; FH-Reife/Abitur: 4.4 %) ([14]). The IQ values also differ quite considerably (MV_{weak}= 96; MV_{strong}= 110; p= 0.00).

The weaker trainees managed to reduce the gap between themselves and the stronger group in relation to the development of declarative knowledge. At the end of the school year, around half of the weaker trainees attained more than 40 % of the prescribed points score, and based on a linear grading scale, would attain a grade of 'satisfactory' or higher. The differences in performance based on teaching method proved insignificant.

The relatively positive overall picture in relation to declarative knowledge clearly contrasts with the development in procedural knowledge, where there was a serious increase in the differences in performance. Using the same grading scale as above, only three of the weaker trainees would attain a 'satisfactory' performance. Qualitative analyses demonstrate that in relation to declarative knowledge, the weaker trainees mainly succeed in exercise types that can be successfully tackled purely through reproduction, whereas in relation to procedural knowledge, exercises that require simple algebraic transformations (conversion of equations) or the combination of several procedural stages seem to represent serious barriers to the weaker students (for more detail, see Nickolaus, Ziegler, 2005, p. 167 et seq.). The feeling of being overburdened also increased among the weaker group during the course of the first year of training, which has a knock-on effect on motivation.

Survey 2: Comparison of stronger and weaker electronics engineers (trainees in industrial enterprises)

Starting from the qualitative analyses referred to above, 2 and 4 skills levels were distinguished in relation to the subscales of declarative and procedural knowledge respectively in the second survey. As regards the development of skills levels, it is critical that the higher level was designed to represent a higher degree of

([14]) HSch = lower secondary school; RSch = secondary school; FH-Reife = leaving certificate giving access to a technical university

complexity a) of system understanding and/or b) of the application of the rules required to tackle the exercise. Assumptions in relation to the familiarity (routine) of students with the contexts of the exercises were also used as design criteria ([15]).

Based on the distinct skills levels, it becomes even more evident that the weaker students are able to make substantial learning progress, particularly in the lower skills levels.

Specifically:

Skills level 1 of declarative knowledge (D1, lowest level, primarily reproduction, see sample exercise 1 in footnote 12):

- at this skills level, the stronger trainees already attain around 74 % of the points score in the entry test, and achieve slight improvements in the interim and final tests (83.2 %/79.6 %). The slight reduction in performance between the interim and final tests could be due to the fact that the content was dealt with quite a long time ago during the course;
- the weaker trainees attain around 34 % of the points score in the entry test and are able to increase significantly in the interim and final tests (60.8 %/59.6 %). The difference in comparison with the strong students remains significant;
- at this skills level, the teaching method is insignificant as regards the learning results among both stronger and weaker trainees.

Skills level 2 of declarative knowledge (D2, contextual knowledge, see sample exercise 2 in footnote 12):

- in this case, the strong trainees attained 20.4 % of the points scores in the entry test, and 35.7 %/39.7 % in the interim/final tests;
- with 14.6 % in the final test, the weaker students had not yet reached the same level that the stronger students had attained in the entry test. At the beginning of their training, this group proved unable to cope with this level of demand (3.7 % solution rate);
- the difference between more directively taught trainees and those taught more actively becomes successively greater, and in the final test it came out as significantly in favour of those taught directively.

Skills level 1 of procedural knowledge (P1, e.g. simple, one-stage, subject-specific mathematical operations, see sample exercise 3, footnote 13):

- at this skills level, both the strong and weak students attain high

([15]) For more details in relation to the design of the skills model, see Nickolaus, Gschwendtner, Knöll, 2006

solution rates (91.7 %/68.3 %) in the entry test; these fall slightly for the strong students (interim test: 89.3 %, final test: 87.0 %), but rise slightly for the weak students (approx. 74 % in both tests);
- the effects of the teaching method on the skill attained cannot be ascertained.

Skills level 2 of procedural knowledge (P2, simple exercises with a few steps requiring contextual knowledge, see sample exercise 4, footnote 13):
- in this case, the strong students already attain relatively good performance levels (52.5 % solution rate), and are able to improve to 71.7 % by the interim test. No significant changes are reported by the time of the final test;
- the weaker students enter this skills level with low performances (18.4 %), but are able to achieve significant increases (interim test: 55.8 %, final test: 49.9 %);
- the effects of the teaching method also cannot be ascertained at this skills level.

Skills level 3 of procedural knowledge (P3, more complex exercises involving several steps, see sample exercise 5, footnote 13):
- although the strongest trainees attain significantly worse results than expected in the entry test at this skills level (30.5 %) than at skills level 2, they attain similar solution rates (72.5 %/69 %) in the interim and final tests as they do at skills level 2;
- the weaker trainees only attain 2.7 % in the entry test and they only increase to a limited extent in the subsequent tests: (interim test: 26.9 %, final test: 41.7 %). Measured against requirements, a significant proportion of these trainees perform insufficiently, although the difference is less marked than at skills level 2 of declarative knowledge;
- here also, the teaching method has no significant effect, although when strong, directively-taught students are compared with strong students who have been taught more actively, the latter teaching method would appear to be more successful.

Skills level 4 of procedural knowledge (P4, complex exercises with several steps requiring a range of contextual knowledge and the application of various procedural rules, see sample exercise 6, footnote 13):
- as expected, the entry performance of the strong students is lowest (entry test: 20.6 %) and remains below the 50 % mark in the subsequent tests (interim test: 40.7 %, final test: 44.0 %);
- the weaker students start at a similar level to that of skills level

3 and achieve relatively modest increases (interim test: 17.1 %, final test: 28.3 %);

- it would appear that teaching method has a significant effect in relation to the group as a whole at the time of the interim test in favour of those taught more directively, whereas by the final test, these differences have evened out over the whole group; instead, contrary to expectations, both the stronger and weaker directively-taught students tend to benefit more than both the stronger and weaker students who are taught actively.

Overall, these surveys demonstrate that among industrial apprentices in the electrical trade who have relatively strong cognitive skills, it is the weaker trainees who primarily achieve satisfactory performances at the lower skills levels. The effects of the teaching method are no longer demonstrable on the basis of the overall scores of these trainees, contrary to the situation in relation to cognitively weaker electrical fitters. However, if one divides up the exercises by level of difficulty, then here too, contrary to expectations, those taught more directively perform better at the higher skills levels. The gaps between the stronger and weaker students can best be narrowed at the lower skills levels, whereas more evident differences are still found at the higher skills level.

If one conducts global systematic regression analyses in relation to individual skills levels, the modelling finds prior knowledge of the skills level and motivational variables in relation to situation and conditions to be virtually consistent; this includes, at skills level D2, teaching method (2.1 %). Contrary to other trends, no levelling and no parallel courses of development occur at skills level D2 during the first year of training. Even if other methods indicate no significant treatment effects ([16]) at this point, the findings do give cause to suspect that the acquisition of fundamental and contextual knowledge is better taught to the relatively strong classes of electronics engineers in directively taught classes. In contrast, univariate covariance analyses confirm the trend (p=0.07 or 0.08) that actively taught weak students at skills level P4 and actively taught students at P3 do slightly better in the final test. In variance analyses, class membership has a greater effect sise than teaching method (η2 ranges between 0.11 and 0.17, dependent on the time of measurement and skills level).

([16]) Univariate covariance analysis with the covariant of prior knowledge of the skills level.

Survey 3: Stronger and weaker vehicle mechatronics engineers and electrical fitters and an explanatory model for the skills development of the subgroups

As in the first survey of electrical fitters, significantly higher drop-out rates by the weaker students are initially found among the vehicle mechatronics engineers included in the third survey, and the reduction in the performance difference in relation to declaratory knowledge and a broader spread of procedural knowledge are confirmed. If one examines which significant factors of influence come into play as regards the development of specialist knowledge, the results differ between the weak and strong students. Among the weak vehicle mechatronics engineers, reading ability proves to be the most important factor, while among the strong students, for whom reading ability is less of a barrier, mathematical ability, prior specialist knowledge and teaching methods are important factors (Geißel, 2008; Gschwendtner, 2008; Nickolaus, Gschwendtner, Geißel, 2008). The drop-out rate among weaker electrical fitters is also significantly higher, and the pattern of an increasing breadth of performance in relation to procedural knowledge is repeated, while declarative knowledge runs more or less parallel in the subgroups of strong and weak students. Factor analyses show that the development of specialist knowledge amongst the weak students is primarily affected by their mathematical abilities and far less by motivation. Among the strong students, both mathematical skill and also the quality of the work-based training, prior knowledge and identified motivation are all explanatory factors. The stronger trainees are presumably better able to establish links between school-based and work-based training. It is also conceivable that the stronger students are given exercises that promote learning in the work context.

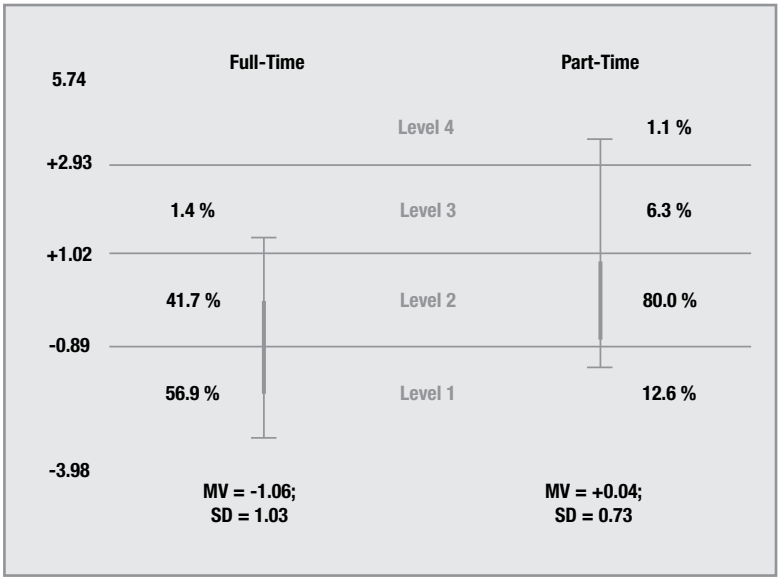
Practically speaking, the results may be summarised as follows:

- weaker and stronger performing trainees require different forms of encouragement;
- among weaker performing students, gaps are particularly evident in more demanding exercises, i.e. at the higher skills levels;
- the dual training method tends to be better than the full-time college-based training method, this however appears to be strongly affected by the fact that it is trainees without a subsequent technical university place who are taken on in full-time college-based training courses;
- the quality of work-based training is also relevant for the development of theoretical knowledge.

The Rasch scaling undertaken for the vehicle mechatronics engineers at the time of the final test produces a one-dimensional scaling (i.e. declarative and procedural knowledge are not shown as separate dimensions) with four levels.

The graph below compares the performances of the trade trainees and those from the car industry at the time of the final test. This shows that the greater proportion of the trade apprentices (full-time students) ([17]) only attain skills level 1, while the trainees from the car industry (part-time students) attain skills level 2 on average.

Figure 4. **Skills levels of full-time and part-time students**



In concrete terms, 56.9 % of trade apprentices attain level 1, 41.7 % level 2 and only two subjects attain level 3. Among the industrial apprentices, 12.6 % stay at level 1, 80 % reach level 2, 6.3 % level 3 and one subject attains level 4.

Measured against the curricular standards, which include level 4, all the trainees are actually below requirements, which is probably primarily due to the excessively high standards set in the curricula.

([17]) In many vocations and regions of Germany, the trainees from small businesses are trained in full-time colleges during their first year of training. Training is only truly dual as from the second year of training.

Summary

This paper demonstrates that the opportunities offered to individuals to participate in training/vocational training depend on nationality, regional and social origin, teaching methods, and additional class characteristics and the strategies of teachers to deal with heterogeneity. The data in relation to the development of weaker students shows that serious deficits persist, particularly in relation to more demanding exercises. The interaction between selection, educational and socialisation processes appears to increase rather than diminish the differences between high-performing and low-performing students. Since prior knowledge is a key predictor of further learning development and inadequate basic skills prove to be a barrier, vocational training will in future increasingly be required to at least help to mitigate the problems through relevant remedial programmes.

It is noticeable that according to the results of our survey, the 'constructive turnaround' that is at least discussed in many countries, with its emphasis on self-directed and active learning, is not meeting the high expectations. Possible causes include:

- domain-specific features (in the field of industrial technology), since the findings in the commercial field are in line with expectations;
- the fact that the survey relates to basic training, during which basic knowledge must initially be established, on the basis of which the anticipated effects may possibly be achieved at the specialist level;
- the pre-existing cognitive levels of the learners, since our surveys also indicate that the performance development of the cognitively stronger industrial trainees is less dependent on method-related decisions; and
- the quality of implementation of the method-related arrangements.

Further analyses (Nickolaus, Gschwendtner, Knöll, 2006) show that, in particular, the insufficient ability of weaker trainees to adapt and the excessive demands made on them have negative effects on their performance development. Account must also be taken of the fact that studies conducted internationally on the effects of decisions in relation to method produced at least on average somewhat modest measurable effects, and that directive instruction proves very beneficial, in comparison with other teaching methods, for large teaching groups and weaker students (cf. e.g. Brophy, Good, 1986). In this context, the finding made by Shulman (1982), namely that directive instruction does not, as frequently assumed,

conceptualise learners as passive recipients of knowledge (ibid. p. 97 et seq.), appears to be important. In fact, this method entails the instructor setting reasonable learning targets, dividing the material into manageable and appropriate learning units, conveying the necessary knowledge or generating it through dialogue, setting exercises of differing levels of difficulty, ensuring adequate practice, supporting as necessary and monitoring the individual learning progress in a spirit of encouragement (cf. Weinert 1996, p. 30). In the vocational field, there is only a modest amount of research available on this topic, even internationally (Achtenhagen, Grubb, 2001). Achtenhagen and Grubb state in summary: 'The competencies required by changes in work often require instruction that integrates both academic and vocational competencies, work-based learning, and more constructivist and system-oriented teaching in place of the didactic, sequential, skills-centred methods that have dominated in the past' (cf. ibid., p. 631).

As regards topics associated with social selectivity, the findings do not lead to the assumption that the currently preferred didactic concepts of self-directed and active learning are also an especially good means of encouraging weaker students during standard teaching. The stronger students appear to benefit most from this method of teaching/learning. The development of weaker students generally remains unsatisfactory. It is not certain to what extent this is also reflected in the long term in their vocational performance, since the data from the life study (lives up to early adulthood) show that social origin constitutes an important predictor not only of educational level attained, but also for the transition into vocational positions (Fend, 2006; Preston, Green, 2008). In summary, at least for the slice of reality examined here, it is evident that the cognitive differences that exist when students enter the educational system are not substantially mitigated.

It is worth noting that discrimination against women still exists in vocational education and in the employment system, despite having by now been overcome in the German general educational system (Fend 2006, in particular pp. 274-276). Among the OECD member countries, Germany reports a well above-average wage differential between men and women (OECD 2007, p. 79). In Germany, men are more likely than women to progress further during the course of their lives (Fend, 2006). Although this may also apply to the survey group examined here, which comprises mainly men, no empirical data is available on the subject.

When compared at international level, we consider it interesting to note that in Germany, in periods of time when it is difficult to make the transition to training in the vocations surveyed, the stronger trainees are more often found in the dual forms of education than in the full-time college-based forms of the first year of training, so that the proportions are completely the reverse of the situation in France, for example. This may primarily be the result of the better opportunities in Germany to move from in-work training to dual training alternatives.

Finally, what are the consequences of the survey results? In our opinion, provisions need to be made in order to better support the weaker students in their development, which presupposes both better diagnostics and also better teacher training. This needs to be accompanied by the allocation of necessary resources for support programmes. Particularly among the weaker students, the promotion of reading skills would appear to be an important starting point. These students also need more support or guidance and appear to require more individual attention. The primary use of teaching/learning arrangements that feature self-direction and active learning may only be justifiable for this group provided they remain adaptable. Generally speaking, our results indicate that the preferred methods currently used in the basic education in regard to industrial technology are seriously lacking in legitimacy.

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