Lorenz Lassnigg (lassnigg@ihs.ac.at)

Some insights about VET from Large-Scale-Assessments[1]

Abstract:
Some prominent researchers have argued that attention to VET programmes might reduce the level of aggregate achievement in basic academic competences because of the selection of "less gifted" students, and less emphasis on academic competences. The paper addresses this question by looking on the cross-country relationship between enrolment in VET and achievement measures in large scale assessments (e.g. PISA). The data do not support the suspected negative relationship; rather a slight positive relationship is indicated. Hypotheses about a "backward influence" from the selective mechanisms at later stages of ET systems to the primary level are not supported by the descriptive analysis.
Steps towards the comparative analysis of VET structures show a distinction of two different kinds of VET systems, one based on early selection into VET programmes and one based on a comprehensive system with postponed selection. The expectation, that VET would be a substitute for higher education seems not to hold against the data about VET structures. In addition, more in-depth analysis about the achievement in VET-programmes in Austria is conducted, showing the big impact of the selective structure of the school system on achievement. However, this system seems rather an exceptive case than being typical for VET structures.
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Authors and/or co-authors short biographical statement: 150-200 words
Lorenz Lassnigg: head of research group equi (Employment-Qualification-Innovation) at the Sociology department of the Institute of Advanced Studies (IHS), Vienna. Education in pedagogies and political science at University of Vienna, postgraduate course in sociology at the Institute for Advanced Studies in Vienna. Visitor and guest researcher at Social Science Research Centre Berlin (WZB), University of California (Berkeley, Centre for Studies of Higher Education, CSHE), CEDEFOP Thessaloniki.
Expertises for national and international authorities (EU, OECD, ILO), e.g., member of a reviewing team evaluating the system of vocational training of Minas Gerais, Brazil; OECD consultant (rapporteur of the OECD reviewing team evaluating Finland as a part of the project "Transition from School to Working Life"); various lectureships at universities in Vienna, Klagenfurt, Graz, Barcelona, and at Vienna University of Economics and Business Administration.
Main areas of research: sociological research of education and training at the interface of social, political and economic interests, especially regarding the coordination of vocational training and employment; evaluation research in the field of labour market policy, organisation theory.

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Paper

1. Introduction

There are quite opposite and conflicting views about the overall value of VET systems in recent discussions about ET-policy. A strong tendency prevails towards the growth of general education and higher education (HE) that might put the VET systems aside. From economic reasoning there are arguments that the innovation towards the knowledge economy would put demands on graduates from higher education, whereas VET would represent rather traditional economic practices. Young people also prefer to attain higher education, and the tracks that prepare for it. On the other side of the dispute we find a kind of reasoning that points to the practical side of competencies and to incremental innovation by diffusion of otherwise created innovations. The possibly motivating practical aspects of VET for young people are also often mentioned.
One issue in these discussions concerns the question what and how much is actually learned in different kinds of ET programmes. The results of the various large-scale assessments (LSA) try to address these kinds of questions by defining and measuring kinds of competences that are acquired in ET systems. Recent research has underlined the economic value of the basic competences measured by the LSAs. However, these analyses and results are not very much related to VET and VET programmes, despite there seems to be an underlying topic concerning the value of the competencies produced by VET programmes, and, in particular about the relation of VET and the basic and general competences.
Some prominent researchers have argued that attention to VET programmes might reduce the level of aggregate achievement in basic academic competences because of the selection of "less gifted" students, and less emphasis on academic competences in VET programmes. Eric Hanushek (2006, 460f) has put these questions in the following way:

> *„Looked at from the different perspective of enhancing school-to-work programs, the evidence suggests that alternative programs must be very highly effective if they involve a loss in cognitive skills. In other words, if there is a trade-off between more vocationally oriented programs and academic results, the former programs must be sufficient to compensate for any losses through reduced academic skills. Of course, there does not have to be a trade-off. If in fact more vocationally rich curriculum provides better motivation to a segment of students and this motivation pays off in better academic skills, the potential concerns go away."*

The paper explores these questions by some descriptive analyses, and by some more in-depth statistical models.

2. Questions and methodology

The questions asked are to some degree inspired from views and analyses about the working of the Austrian and to some extent also the German system, and less so the Swiss one. The Austrian system comprises three tracks of VET at the upper secondary level besides the academic track that are clearly layered by achievement levels (apprenticeship at the bottom, medium VET schools, and upper VET colleges), and those tracks build on a tracked system at the lower secondary level, with the first selection point already at age 10, after four years of comprehensive

primary schooling. There has been always a strong "practice-theory"-split in the system between apprenticeship and schooling, with no formal academic requirements for access to apprenticeship, and mainly vocational inputs given in the system. Consequently, the conditions for further progression in ET have been poor, as the very low intake into the *Fachhochschule*-Sector of higher education from apprenticeship shows (Winkler 2008). More recently, a strong policy initiative tries to bridge this split by creating the opportunity for apprentices to acquire the academic credentials of the upper level Matura-Examination in parallel to their enterprise training. Baethge (2006) has addressed a similar split between the practice-oriented Dual VET system and the academic system in Germany, calling it the German "*Bildungs-Schisma*". In Switzerland, this split is less marked, since the Polytechnics are built more clearly on top of apprenticeship, however, there have also been some conflicts between establishment of full-time schooling vs. Apprenticeship.

As there are more or less marked tracks through the system, from lower level achievement tracks in lower secondary school to apprenticeship without further progression on the one extreme, and the academic track and upper achievement tracks via academic schools and VET colleges to higher education on the other extreme, we can infer that a certain distribution of expectations and incentives for all actors (parents, pupils, teachers, etc.) might be produced that can reduce learning of academic competences already at the primary level because there are alternatives where they are not "needed" in the first place for progression: the "practical" alternative of an apprenticeship seems available anyway. Consequently, there is a high proportion of young people, who show poor results in the PISA-assessment, who are concentrated in apprenticeship. We may call this mechanism "backward influence". More recently, however, the demands for competences seem to rise also in this system, leaving a part of the young population outside of ET at the upper secondary level, or requiring strong support measures for intake into apprenticeship.

There is also a deep feeling of difference between what is learned in VET and what is learned in academic schooling, resp. in apprenticeship as compared to full-time VET schooling, in the ET policy discussions, e.g., expressed in the longstanding notion about parity of esteem, and also in the ideas about the difference between practical competences and academic knowledge in different kinds of occupations (e.g., Rauner 2008). Somehow, there are notions that practical and academic competences might exclude each other to some degree, what is reflected in the Anglo-Saxon discussions about vocationalism and skills (e.g., Ryan 2003, Pring 2004, Clarke/Winch 2006). However, there is rather theoretical and ideological debate than empirical research about these issues so far.

Consequently it seems worthwhile, to look at these issues from an empirical point of view, trying to exploit the existing LSAs with respect to VET. Comparative research and analysis of the data has not explicitly included VET so far. The ET systems are mainly classified according to the ISCED levels that are not very instructive about the structures of VET systems. Moreover, there are many ET systems that do not comprise substantial VET at the age where the LSAs collect their data. This study makes a step towards an analysis of the relationship between VET and the achievement measured by LSAs by combining the country level information about achievement with the country level information about VET systems. This step is mainly explorative, in trying

to work out some basic relations between VET structures an achievement. The following questions are addressed:
- Is there a systematic descriptive relationship between available information about VET structures and achievement results by level and distribution in recent LSAs? Here results from PISA and TIMSS at grade 8 are analysed.
- Is there a systematic descriptive relationship between VET structures and achievement at the primary level? Here results from PIRLS and TIMSS at grade 4 are analysed.
- Is there a systematic relationship between VET structures and higher education structures? Here transition data from VET to HE would be feasible, however, are not available on a comparative basis. Thus only the proportion of HE can be analysed with respect to VET structures.
- How can we describe VET structures by the available comparative variables? VET structures are analysed by combining the information about the proportion of VET at age 15, the number of ET tracks and institutions/programmes at upper secondary level, and the first selection point in the ET systems.
- How is VET involved in the selective structure of a certain system, and what can be generalised from these structures? In-depth results about the selection structures in the Austrian system are used to show, how the system works, and these results are related to the aggregate results of the comparative analysis.
The methodology is simple and straightforward for the comparative part. We look at the relationships by using scattergrams that combine the available countries with the achievement variables. We also construct a classification of VET structures by using the available variables. That classification shows mainly the extent to which the proportion of VET is related to early selection and the differentiation of systems by tracking and main institutions/programmes. The in-depth analysis of the Austrian structure is based on multi-level modelling of PISA data.

3. Results

3.1. VET structures

The context information collected in PISA allows some comparative analysis of VET structures. There are three variables available, the share of VET at age 15, the number of distinct school types or basic programmes at age 15 (in the following called number of programmes), and the age at which the first selection point between programmes occurs. We can observe certain empirical relationships between those variables:
- the more differentiation of systems by programmes, the earlier selection occurs;
- the more early selection into VET occurs, the more programmes are available;
- *however, some systems with low VET are also strongly differentiated*;
- the more early selection into VET occurs, the earlier the 1st selection point is situated;
- *however, also with a low share of VET early selection occurs*.
Thus VET systems are related to early selection and high differentiation by programmes, however, this relationship is not a clear and straightforward one. If we relate those structural variables to achievement measured by the means (level of achievement) and standard deviation (variation of achievement) of PISA scores we get a first impression about these relationships:

- the *more programmes* are available at age 15, the more variation in achievement is measured, at least in reading and math;
- the achievement level shows a slight tendency to decrease, however, we see rather non-linear relation to achievement level, with the comprehensive systems (one programme) and the systems with four programmes showing higher mean scores;
- with early selection the relation is clearer: there is less achievement and more variation with earlier selection.

For further analysis, the structural variables are combined to a first classification of VET structures at age 15 (when PISA-testing occurs). The classification is shown in box.1 Countries with similar traditions or locations group to some extent to certain categories. We can see that the majority of systems are comprehensive until age 16 (which comprise mainly the Anglo-Saxonian countries and the Nordic countries), and that on the other hand the systems with high VET are a minority. Mediterranean countries group by low VET and rather early selection, and new member states o the EU group by early selection and low VET.

Box 1: A first classification of VET structures (PISA 2006)

1: one programme, 1st selection 16, no VET at 15
- AUS, CND, NZ, UK, US (liberal Anglo-Saxonian countries)
- DK, FIN, IS, N, S (Nordic countries)
- PL, E, LV (other)

2: 1st selection 13-15, low VET at 15 (below 20%)
- EL, IT, PT, LUX, EE, LT

3: 1st selection 13-15, medium VET at 15 (20-40%)
- IRL, JP, KOR, RO

4: 1st selection 10-12, low VET
- CZ, HU, SK, BG, MEX, TR

5: 1st selection 10-12, medium VET
- B, GER, CH

6: high VET
- A, NL, SI

Source: own classification based on PISA 2006

Another Variable about the proportion of VET at the upper secondary level (not only early VET at age 15) is available from Education at a Glance (EAG). In this variable the VET proportion is much higher than at age 15 in most countries, moreover, some countries switch from low VET to high VET proportions. In particular this is the case with comprehensive systems (unfortunately the Anglo-Saxonian countries except Australia are missing in the EAG variable, and also some new member states). Box 2 shows a second classification that is comprised mainly from the first selection point and the VET proportion at upper secondary level.

This classification comprises some mixed categories of countries; however, we can identify a distinction between early VET systems (the classical continental apprenticeship countries, BENELUX, and two central European countries) and comprehensive VET systems (mainly the Nordic countries). And those can be compared to two categories with low or medium upper secondary VET, and earlier or later selection.

Box 2: VET structures at upper secondary level (EAG 2006)

1: early selection and low/medium VET
- HU, MEX, TR

2: late selection and low/medium VET
- EL, IT, PT,
- IRL, JP, KOR

3: early selection and high VET
- A, GER, CH
- B, LUX, NL
- CZ, SK

4: late selection and medium/high VET
- DK, FIN, IS, N, S,
- AUS, PL, E

Source: own classification based on PISA 2006 and EAG. Most Anglo-Saxonian countries and some new member states are missing in the EAG-classification

3.2. VET structures and achievement at upper secondary level

Here the descriptive relationship between the VET structures and the aggregate achievement in the large-scale-assessments is explored, mainly data from PISA 2006 are used, and some comparisons with TIMSS 2007 are made.
There is a clear observation that a high proportion of VET does not reduce aggregate achievement levels, however, there are indications that VET might increase the variation of achievement. More specifically we can see the following relationships:
- taking first the share of VET at age 15 as the criterion for comparison, we get a similar picture for reading, math, and science. Concerning the PISA mean-score, there is medium level achievement in early VET systems and much more differentiation towards the high as well as the low end in systems with low VET attainment and a comprehensive structure. The variation of achievement is not systematically related to the criterion. The selection of EU countries gives similar results to the whole of OECD;
- taking the VET proportion at upper secondary level from EAG as the criterion, we get rather a slight increase of PISA-scores with the increase of the VET proportion, however, there are also signs for an increase of the variation in achievement (measured by the standard deviation of scores) with an increase of VET;
- the comparison with results of TIMSS at grade 8 is limited by a selection of countries that took part in this assessment. There are consistent results to PISA with the VET share at age 15; however, a clear difference occurs with the VET share at overall upper secondary level, as the achievement goes down with an increase of VET. This might be partly due to the selection of countries by TIMSS; however, if we select countries in both assessments, the picture from PISA results also changes. This underlines, that the two assessment measure different aspects of achievement.
- relating the differences between scores of males and females, as well as the proportion of the 75^{th} to the 25^{th} percentile as certain aspects of the achievement variation to the VET proportions,

there is no difference visible with the increase of the VET proportion at age 15 and at upper secondary level.
The two classifications of VET structures at age 15 and at overall upper secondary level can provide a summarizing picture of the relationship of VET to aggregate achievement.
With the first classification based on VET at age 15 we see a tendency of higher means for comprehensive systems *and* for early VET systems, however, the intermediate categories (3 and 4 with medium and low VET) show rather heterogeneous results. Consistent with the earlier observations, there is still a tendency of an increase of the variation of scores with the increase of VET (at least in reading and math, less so in science).
The second classification shows that the two types of VET structures (early VET and comprehensive VET) give similar results with mean scores, the range of mean-scores being somewhat wider in the comprehensive type. Also consistent with the earlier results, the variation of achievement measured by the standard deviations of scores is rather higher in the early VET structure, with some differences between reading, math, and science.

3.3. VET structures and achievement at primary level

Here the relationship between primary level achievement and the proportion of VET is analysed, exploring the question whether the existence of VET programmes that might not put so much emphasis on academic competences might influence the expectation towards the necessary level of academic achievement in primary education ("backward influence").
The PIRLS 2006 reading assessment at primary level, and the TIMSS 2007 math and science assessments at grade 4 can be analysed for this purpose. The results indicate that this kind of „backward-influence" does not hold: there is no relation from the VET classifications to achievement levels in both assessments and to distributions in TIMSS in primary education. There are indications that the systems *without* VET show much more variation than systems with VET, which goes contrary to the "backward influence"-hypothesis and to the achievement results at the secondary level.

3.4. VET structures and higher education

Here we could ask the question about "backward influence" in the other direction, whether a closer linkage of VET to higher education (HE) might increase aggregate achievement. Unfortunately there is a lack of data in comparative datasets about the transition from VET to HE. Only entry rates for HE Types A (theoretically oriented to research or upper level professions, minimum 3-years, normally 4-years), B (practically and vocationally oriented, minimum 2-years), and C (postgraduate, research oriented) are available. Thus we can ask for structural relationships between VET and entry to HE.
Frequently in the discussion about ET policies there is a silent assumption that VET and HE would be substitutes. VET provides practical and vocational qualifications and competences, HE theoretical or theoretically based professional qualifications and competences. It is also familiar from some strong VET systems (e.g., in Austria or Germany), that the graduates from HE are in a comparatively low supply. There is also a strong conviction in the (macro)-economic literature

about education, growth, and innovation that VET and HE would be feasible for different kinds of sources for growth.[2]

If we compare the entry rates between the different types of HE, we can see that high rates of Type A correspond to low rates of Types B and C. There seems to be a substitutive relation to some extent between those types (that owes partly to the "restriction" of 100% of course). However if we compare VET and entry into HE, the assumption of a substitution does not hold. There are different patterns with VET at different points of observation:

- VET at 15: Here we see a high variation of entry rates into HE Type A and B, and a medium level of Type C;
- VET at upper secondary level: Here a high proportion of VET often corresponds with high entry rates into HE Type A, and there is also a positive relation of VET to HE Type C, however, substitution occurs with HE Type B.
- VET classifications: Here we observe no strong patterns with entry to HE; however, there are some hints. Comprehensive VET systems show slightly higher rates of HE Type A than early VET systems, but the latter also show high rates, and the early VET systems show higher rates of Type C.

The relationship between HE Type A access rates and PISA scores is slightly positive, similar to participation in VET at upper secondary level, with respect to mean-scores of achievement, however, the variation (S.D.) of achievement shows a different pattern: with high VET participation there is an increase of variation, whereas with high entry rates into HE there is a decrease of variation. This might reflect a kind of "backward influence".

3.5. VET and selection structures in the Austrian system

In this section the Austrian data are analysed more deeply in order to get more insight about the structures of selectivity in the system, and the positioning of VET. The Austrian system has three specific characteristics, that are important in this respect: First, the point of tracking is very early at age 10; second, the VET system is tracked by three levels, the upper level still providing general access to universities; third, the completion of the upper level tracks (VET and academic) have provided the full entitlement to university access until recently. Multi-level modelling has shown that there is a very strong relationship between social family background and achievement in this system. However, the upper-level VET colleges that provide university access are working towards upward mobility of students from a less privileged background. An important insight of this analysis also shows, that several hypotheses of how governance variables should work in relation to achievement are contradicted in the Austrian system (e.g., attention of schools to achievement, specific interventions for support of students, or exposition to competition do have

[2] „*Consider two economies A and B. Suppose that (...) in economy A, 30% of the workers have a primary level of schooling, 20% have a secondary level of schooling and finally 50% have a tertiary level of schooling. (...) If in economy B, the distribution of the workers between the different levels of schooling is 10%, 60% and 30%, this economy will have the same average years of schooling. Following Benhabib and Spiegel, the impact of education on the growth of TFP will have the same magnitude in economies A and B if they are at the same distance to the technology frontier, despite the fact that the fraction of high-skilled workers is much higher in economy A.*
(...) Vandenbussche, Aghion and Meghir (2006) and Aghion and Cohen (2004) (...) argue that the creation of new technologies and their absorption require different types of human capital. They assume that a high-skilled workforce is better suited to the creation of new technologies while a low-skilled workforce is more appropriate to their absorption. These authors conclude that economies close to the technology frontier need to focus on the creation of new technologies by concentrating their efforts on tertiary education. Conversely, economies far from the technology frontier should concentrate more on absorption by giving particular importance to primary and secondary education." (EIE 2006, 184).

negative relations to achievement). There seems to be an overall pattern in place, where the practices within educational institutions try to work against the strongly selective system structure, and try to attenuate the selectivity (Lassnigg/Vogtenhuber 2009).
We can summarize the key points of the Austrian profile as follows:
- there is clearly an early VET system with 1st selection at 10, 4 programmes at 15, about 40% of a cohort are in VET at age 15, this is increasing to about 70% at overall upper secondary level;
- achievement shows overall mean scores near the average, however, a comparatively high variation of achievement scores that is also reflected in a high 75th to 25th percentile difference in reading and math, and the gender difference in math and science is also high;
- in primary education the mean scores and the variation of scores are near the average, and also the gender and percentile differences;
- in higher education the entry rates in HE Type A and B are low, however, entry in type C is high
- the achievement scores are rather above average, as compared to countries with similar entry rates into HE.
Thus we can see that the specific type of very early selection in combination with selective and tracked early VET does not lead to a reduction of the aggregate mean achievement level below the country average, and does not show a negative "backward influence" of the selective structures to the primary level. However, the structure is related to an increase of the variation of achievement scores at the (selective) secondary level, as compared to the (comprehensive) primary level. The above average percentile and gender differences of scores underline the variation. The low entry rates in HE and the above achievement at this relationship might indicate an "underuse" of competences at tertiary level.
Overall, the Austrian system seems rather an exceptional case among VET systems, and the diversity and complexity of structures seems markedly higher than expected by the assumptions underlying the discussions about VET structures.

4. Summary and discussion

We started the reasoning with the contention that the analyses and discourses around the LSAs do not take notice of VET: the impact of VET is not very much included in the analyses, despite there are assumptions and questions about effects of VET on achievement in the ET policy debate. We will get much new information about this topic with the new PIAAC study of course, however, while waiting for these data we can take a look at the available LSAs.
Some explorative analysis of aggregate relations on country levels has been made in this paper, by using some variables about VET structures, and relating these to the achievement results from some LSAs (PISA, TIMSS, PIRLS). The following variables about VET are used:
- %VET at age 15
- number of school types (programmes) at age 15
- age at the 1st selection point
- %VET at upper secondary level.

We used those variables to identify VET structures, and showed that there is no dichotomous alternative of comprehensiveness and VET, but we can identify rather a distinction of early VET and comprehensive VET structures.
Concerning the possible impact of VET structures on achievement, three preliminary statements can be made:
- early VET does not seem to structurally reduce achievement levels, neither those at secondary level (PISA) nor in primary education by „backward influence";
- however, early VET structures might increase the variation of achievement scores within countries.
With respect to higher Education there is a lack of comparative data about transition from VET to HE, thus we can use only entry rates in different types of HE. The structural relationships do not point to a substitutive relation of VET and HE (to some extent substitution might occur with HE Type B). An increase of entry to HE is related to a similar increase of achievement scores as of an increase of VET, however, the variation seems rather to go down with an increase of HE, whereas it increases with an increase of VET.
The Austrian case fits well in the picture of early VET systems, with average mean achievement and increased variation, the strong selectivity by background variables seems increased and reduced at the same time by the particular VET structure. The relation between the HE share and the comparatively high achievement level points to an underutilisation of potential competences by the comparatively low HE access.
In sum the particular structure of the Austrian system cannot be taken as an example that would refer to "typical" impacts of similar strong VET structure. VET systems have turned out as being too diverse and complex in order to make such inferences or generalisations.

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