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Framework of Measuring Economic Competencies

How to model economic competencies with the objective of empirically testing them? This question has been discussed for many years now without a conclusive measurement model having been presented thus far. Taking an in-depth analysis of the definition of competency proposed by Weinert (2001) as a starting point, we will derive a framework for the necessary complexity of competency assessment, which finds its graphical representation in a competence octagon. After discussing existing empirical work in the field of economic education and classifying it using the categories of the competence octagon, we will then propose a new model of economic competency that allows for empirical testing.

Die Frage der Modellierung ökonomische Kompetenz zur empirischen Erfassung einer Economic Literacy wird seit vielen Jahren diskutiert, ohne dass bisher ein überzeugendes Modell für die empirische Erfassung vorgelegt wurde. Dies verdeutlicht der nachfolgende Beitrag, indem er ausgehend von einer detaillierten Synthese der Kompetenzdefinition von Weinert (2001) ein Schema der notwendigen Komplexität von Kompetenzmessungen entwickelt, das graphisch in einem Kompetenzoktagon zusammengefasst wird. Anschließend werden existierende empirische Arbeiten im Bereich der ökonomischen Bildung diskutiert und mittels der Kategorien des Kompetenzoktagons klassifiziert, bevor ein neues Modell für die Modellierung ökonomischer Kompetenz vorgestellt wird, das ökonomische Kompetenz für empirisches Testen öffnet.

Keywords

economic competency, economic literacy, economic education

1. Introduction

For the purpose of evaluating educational systems, standardized tests that allow for testing large numbers of test persons under unchanging conditions are essential. But whereas the areas of testing have been primarily focused on the domains of mathematics, language and sciences so far, this contribution discusses possibilities for assessing economic competencies and their respective requirements. One key problem with modelling economic competencies is that – unlike in the case of the above-mentioned school subjects – the subject of economic education is either heterogeneous or sometimes even non-existent in schools.

As a consequence, considerable academic discussions have not yet led to a homogeneous starting point for modelling economic competence. This is shown not only by the following overview of existing empirical work but also by the anatomy of the term itself (Beck 1989). Up until today it remains unclear which kind of benchmark should be used for a model of economic education. Should the role-concept be used, or rather a categorical approach? If so, which one? What are the central categories for economic education? Which categories allow for insights into the fundamental structures of economic thinking? What is its elementary content?

The following contribution will not be able to answer all these questions. But we will present a new coherent theoretical model for economic literacy and compare it to the results of previous empirical work. This model is based on the idea of literacy as it was developed in the OECD-PISA study, meaning there

that students should reach at least a basic level of reading and writing skills. To derive our model we started with a single similar normative pre-assumption: To participate in society nowadays, students need not only verbal literacy and mathematical numeracy but also economic literacy. Salemi (2005) defines the term as follows: “Students attain economic literacy if they can apply basic economic concepts years later, in situations relevant to their lives and different from those encountered in the classroom,” (Salemi 2005). As the authors have stated elsewhere (see Macha and Schuhen 2010) economic literacy means the application of economic concepts or knowledge in situations relevant to a person’s life.

To be very clear about this point: In our model, economic literacy is the normative starting point. We can speak of economic literacy if a person (a student) is in command of the necessary economic competencies that will be defined in chapter 5. Together these competencies make up the construct of economic competence. The distinct difference between competency (plural: competencies) and competence (plural: competences) lies in potential versus actual ability. In other words, competence can be understood as a general characteristic whereas competency is a skill demonstrated when performing an actual task (Sadler 2011).

Theoretically, our model of economic literacy is based on a cognitive psychological perspective, referring to the competence definition by psychologist and educational researcher Franz E. Weinert that can nowadays be regarded as a standard. Starting with Weinert’s definition we develop a competence octagon (a graph with eight corners) with eight measurement dimensions which should be incorporated in an assessment of competencies in view of the current scientific forefront. Specifically, these dimensions are:



- A. problem solving
- B. aspects of actions
- C. requirement
- D. content
- E. task design
- F. situations
- G. rôles
- H. motivation / volition

At least any reader with an economics degree will bring up the question of the benefits and costs of our approach. What exactly do we get that we cannot get from the strict measurement of knowledge? The answer is threefold, but rather simple:

1. By incorporating previously uncontrolled measurement dimensions we can achieve a much broader understanding of what students know economically and can apply in solving new economic problems.
2. In our model we make the decisive step from knowledge to competence that was made with the OECD-PISA study and other related studies before, but was widely ignored in the economic domain.
3. As a result we get assessments that are superior in the deciding measurement categories of validity, reliability and objectivity.

Since no one has yet tested the construct economic competencies, it is useful to collect these individual dimensions and combine them into one overall construct. The cost of such an approach is very low in the sense that only the type of test questions (or items) must be modified to fit all the categories described later. Which of the categories will be represented in the “brains” of the students is then left to them and not previously determined by any experts.

In that sense we see our contribution as part of the fundamental research that is very much needed in the area of economic education. Its concrete applicability in the small and in the large is currently being assessed in a pre-study named “ECOS – Economic Competencies Study” at the University of Siegen, Germany. The results of ECOS will hopefully give deeper insight into the structure of economic competencies of 8th grade students, at least in German schools. While this is not our primary goal, the assessment framework we propose is able – in a second step – to generate evidence that economic (and/or financial) education in schools actually influences students’ behavior because its measurement does not only contain the knowledge dimension but also a dimension of action.

To start with a short overview, the paper is organized as follows: In section 2 a scheme is developed for the purpose of showing the desirable complexity of measurement. In section 3 we give a tabular overview of relevant existing empirical work. In section 4 the relevant studies are classified in our scheme to show a research desideratum. In section 5 we outline the definition of economic competency and the competen-

ce model of our pilot study ECOS, that we are currently running, before we draw some conclusions in section 6.

2. Classification Scheme for Knowledge or Competency Tests in the Area of Economic Education

In the following we will derive a framework of components necessary for economic competency tests that is based on a cognitive psychological perspective. Whereas there are other interesting contributions to the field the authors do strongly believe that only a cognitive model can offer a chance to really look behind the deeper structures of the construct economic competency. Therefore we will develop a competence octagon that is based on the competence definition by psychologist and educational researcher Franz E. Weinert, which can nowadays be regarded as a standard. But before proceeding to Weinert’s definition we will shortly describe the circumstances that led to its widespread reception. Franz E. Weinert was one of the psychologists whom the OECD (Organisation for Economic Cooperation and Development) asked in 1997 to work on a project named “Definition and Selection of Competencies: Theoretical and Conceptual Foundations (DeSeCo)”. In a first publication based on the project (Weinert, 1999) an overview was given of different pedagogical, psychological and even linguistic understandings of competence. A second famous contribution (Weinert 2001, 27f., original in German, translation from the authors) defines competence as “the readily available or learnable cognitive abilities and skills which are needed for solving problems as well as the associated motivational, volitional and social capabilities and skills which are in turn necessary for successful and responsible problem solving in variable situations”.

The preceding statement makes use of some technical terms of psychological research and therefore needs to be explained in more detail. First, the word “cognitive” or its noun “cognition” are understood in the field of psychological research as “generic terms for all higher mental functions, especially thinking, perception, recognition and understanding” (Tewes, Wildgrube 1992, 183, original in German, translation from the authors). A similar definition by Zimbardo and Gerrig (1999) describes cognition as a global term for all forms of knowledge and its plural “cognitions” as structures or processes of recognising and knowing. This includes e.g. processes of perception, reasoning, remembering, thinking and deciding as well as the structures of these terms and of memory itself.

But interestingly, in his definition Weinert (2001) does not refer to the concept of “cognition”, but to “cognitive abilities and skills”. “Cognitive abilities and skills” can be understood as globally existing human skills related to memory, language, percep-



tion, attention etc. while “cognitive skills” describe rather recurrent, automatic cognitive processes, as for example mental arithmetic, calling someone on the telephone or getting dressed.

To understand the concept of “competence” the psychological term of “problem solving” is of vital importance. All actions that aim at a certain target state can be understood as “problem solving”. According to this there are (at least) three steps required for problem solving (cf. Newell, Simon 1972):

1. Grasping the status quo and/or the problem
2. Applying solution approaches
3. Attaining the desired target status.

Typical examples of problem solving processes are the chess game, the planning of a holiday or the writing of a research article. One of the difficulties concerning problem solving processes is the fact that most of the time the problem itself is complex. Such cases are called “complex problem solving”. It “occurs to overcome barriers between a given state and a desired goal state by means of behavioral and/or cognitive, multi-step activities. The given state, goal state, and barriers between given state and goal state are complex, change dynamically during problem solving, and are intransparent. The exact properties of the given state, goal state, and barriers are unknown to the solver at the outset” (French, Funke 1995, 8, original in German, translation from the authors).

In school-related studies one normally limits oneself to simple problems, but it is nevertheless possible to make use of more complex problems if the related kinds of competences are the target of the investigation. If we consider everything we have said so far, we get a crucial criterion for cognitive competence. This competence exists if new problems are solved with the help of prior knowledge. A survey question which only asks for prior, inert knowledge (e.g. “What was last years’ inflation rate?”) could therefore never be used for measuring cognitive competence according to the definition of Weinert (2001). Thus, we have derived category A. of the competence octagon, the problem solving dimension.

But before we consider further requirements concerning the actual measurement of competence we shall illustrate the second part of Weinert’s definition.

Besides the cognitive aspects we have described so far, Weinert (2001) states that there are other constructs in the human psyche that play an important role in a person’s individual competence in a certain area, namely the “motivational, volitional and social capabilities and skills which are in turn necessary for successful and responsible problem solving in variable situations”. For a rather long time, motivation and volition were not considered as separate items in psychological research. Nowadays they are separated as follows: motivation has an effect on the global target (i.e. which target is chosen by the person), whereas

volition is the major impetus concerning the chosen target (i.e. which strategies are chosen and which efforts are made). Both motivation and volition have an immediate effect on the measurable competence, if e.g. a performance test is heavily prolonged, the participants’ motivation will be reduced drastically, which in turn reduces their competence. Or, in the context of the same example, a participant’s overall motivation will remain sufficiently high whereas his or her volitional willingness to make an effort and exert him- or herself will decrease during the test. Thus, we have just derived a second category of the competence octagon, the motivational and volitional dimension (H).

In summary, one can specify the definition by Weinert (2001) as follows:

“[Competencies are] the readily available or learnable cognitive [structures or processes of cognition and knowledge] abilities [memory, language, perception, attention, etc.] and skills [actions which are applied in recurring tasks] which are needed for solving problems [overcome barriers between a given state and a desired goal] as well as the associated motivational [concerning the motives which have an impact on the action or decision], volitional and social capabilities and skills which are required for successful and responsible problem solving in variable situations”.

Thus the existence of competence relies on three crucial dimensions:

1. cognitive abilities and skills = knowledge which is needed in order to
2. solve new problems and
3. the necessary motivational, volitional and social capabilities and skills.

The goal of this chapter is to derive a competence octagon.

For this purpose the competence definition by Weinert (2001) has been specified. If one really wants to go into the field and conduct a competence survey in a certain area, complexity increases considerably. For the application of a standardized test a theoretical model is needed which adequately operationalises the competences to be measured.

Such “competency models” are classified into two categories by Hartig and Klieme (2006):

1. competency structure models
2. competency level models

Both approaches (and all types of competency measurement) make use of a content-related dimension that finds representation in dimension D. in the competence octagon. The competency structure model tries to grasp the inner structure of the competences to be measured, e.g. they deal with the question of which sub-competences form which main competences. An example of the examination of a competency structure model is the DESI study (Klieme, Beck 2007). In this study English language competence was subdivided into three main competence dimensions



“reception”, “awareness” and “production”), which in turn were subdivided into subdimensions. This measurement dimension can be found in the competence octagon as dimension B. aspects of actions.

In competency level models, on the other hand, the focus is on the question of “ [...] which specific requirements a high competence person can master and which requirements a low competence person barely masters and which ones not at all,” (Hartig, Klieme 2006, 133, original in German, translation from the authors).

Such models deal with the exact measurement of requirement levels and their respective accomplishment by a participant. In such studies results are related to abstractly defined and theoretically based ideas about requirements a certain group of people in a specific area should meet.

This approach is closely related to the idea of “literacy” and/or “numeracy” and was pursued by the OECD in its PISA studies. These studies used it for the purpose of deriving competences which students should have in order to be able to meaningfully participate in today’s society.

In the competence octagon the requirement dimension (C.) represents the different levels of achievement.

The linking of both approaches (competence level models and competence structure models) in one common so-called “three-dimensional competence model” presents a kind of “silver bullet” in current research. An example of this kind of research is the Har-moS-study (Adamina, Labudde 2008). Here the dimensions of content and action (competency structure model) and multi-stage requirement levels (competency level models) are combined and assessed simultaneously. The disadvantage of this approach is the exponentially growing complexity and, as Weinert (2001) points out, the more abstract, intellectual and brilliant a competence is defined as being, the more problematic is its scientific psychological validation. On the other hand, the more specific and pragmatically useful a competence model is, the less satisfactory it becomes when considering its intellectual side.

In order to derive two additional dimensions (concerning specific task design) of our competency octagon we refer back to Weinert’s (2001) definition:

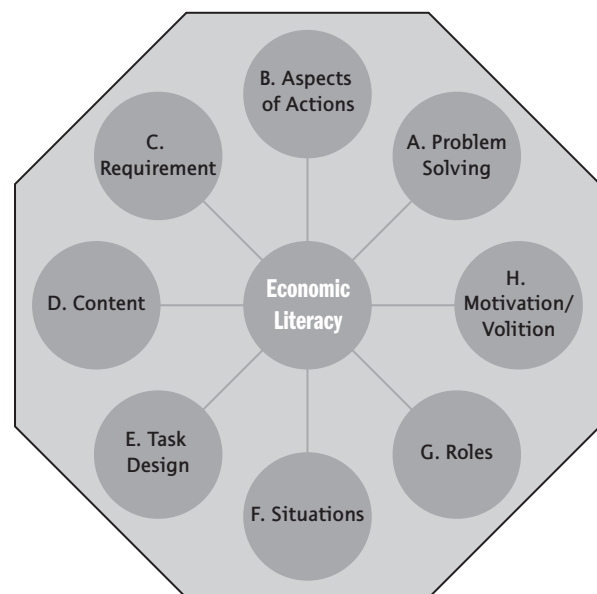
Weinert speaks of “variable situations” in which problems should be solved. This requires a variable design and different contexts of the tasks which the test participants will be solving. For the competence octagon this results in dimension F. situations. Concerning the measurement of economic competencies the relevant literature also suggests different roles to be of specific importance. For instance, Jung (2006, 7) developed a model which is based on the assumption of life and learning environment sensitive challenges within domain-specific roles. Starting with economically characterized life situations Jung (2009) proposes four roles

that are relevant to a student’s life: consumer, young person in search of occupation, employee, and economic citizen. Schlösser and Schuhen (2006) criticize the sole focus on the role concept and focus therefore on the relative importance of economic content. Whether it can be dispensed with the concept of roles or whether they exist as a construct, are to be worked out. Therefore we think that for the purpose of a coherent measurement model of economic competencies, roles are of indispensable importance and we include them in our competence octagon in dimension G. roles.

The last remaining dimension of the competence octagon is taken from Klieme (2004), who states that the tasks in competency tests should have different formats. Besides multiple choice tasks there should be open answer questions, work samples and oral formats etc., because it is crucial to minimize the bias of results that could be traced back to the familiarity of parts of the participant group with specific questionnaire formats. Accordingly, in our competence octagon the last dimension is E. task design.

The eight dimensions that a competence measurement should fulfill in view of the current scientific standard are summarized in the following competence octagon.

Figure 1: Competency Octagon



3. Studies on Economic Knowledge and Literacy in the Light of the Dimension

In a statement on economic education of German students, Beck (1989, 579) speaks of a “cloudy shapelessness” that has yet to be defined. Today this is not fully true anymore because several studies have been carried out in the meantime that deal with the assessment of economic knowledge or literacy. In the following overview we will intentionally pick out some of the existing surveys to

mark the characteristics of the field thus far. First, we briefly introduce the different studies before we categorize them based on the requirements developed in the previous section to a competency test in the field of economic education.

3.1 Economic Knowledge of Young Adults in Baden-Württemberg (Germany)

The study by Würth and Klein (2001) evaluates economic knowledge of students of all three types of secondary schools in Baden-Württemberg, Germany. 6380 students in the eighth grade (age group approx. 15 years) and in the senior year of the respective school type were interviewed. The starting point of the survey was the hypothesis that schools do not contribute enough to the students' knowledge of economic interactions and to the promotion of an open-minded and positive attitude towards professional life. "Economic knowledge" was gathered in terms of "accumulated knowledge of economic facts and interactions [...]. Not the subjective level of economic information of a person or a group of persons in comparison to others is the main focus [...] but the content and valences of the construct 'economic knowledge', which has yet to be defined." (Würth and Klein 2001: 127)

In conclusion, Würth and Klein (2001) mainly question and discuss topics related to business and economics, entrepreneurial versus private household perspectives or textbook knowledge versus everyday experience, but essential requirements such as problem solving, task variable formats and action aspects are found in the test design again.

3.2 Youth Study of the Federal Association of German Banks (Bundesverband deutscher Banken)

The Youth Study 2009 has the title "Economic understanding and financial culture", and is commissioned every three years by the Federal Association of German Banks. In 2009, 753 teenagers and young adults between 14 and 24 years were interviewed by telephone on the topics "youth and economy", "financial culture among young people" and "young people and banks". The survey is inadequate for measuring "economic competency" or "economic understanding" because most of the time it collects the appraisal of a certain term (e. g. "In view of the term 'social market economy' I associate... nothing specific, something good, something bad"). Only two

sections contain items on economic knowledge in the content areas of "supply and demand" and "inflation rate". This study met only one of the identified requirements.

3.3 Test of Economic Literacy (TEL) and the Studies of NAPS

The Test of Economic Literacy tries to identify elementary concepts of economic thinking – in spite of all scientific controversy. In essence, Soper and Walstad have obtained 22 concepts that can be divided into fundamental micro- and macroeconomic as well as international terms. Beck, Krumm and Dubs (1998) have adopted this test for Germany and tested its validity to students and trainees. Beck and Krumm (1994) attribute the fact that this canon of economic education has only a macroeconomic perspective and dismisses any business-related content to the mindset that microeconomic points of view and problems should be dealt with in professional specializations. However, the authors point out that this assessment is worthy of discussion (Beck 2000, 216), as there are some elementary concepts which can for instance be found in accounting and marketing as well. The approach of hierarchically ordered cognitive operations – borrowed from Benjamin Bloom's model of taxonomies – cannot be maintained within the TEL. Therefore Witt (2006) proposes to consider the taxonomy levels borrowed from Bloom as categorical levels but not as a fixed hierarchy. A major criticism of the TEL are the missing variable task sizes and the non-consideration of motivation and volition.¹

3.4 Competency Models for Vocational Education

Approaches to modelling professional competence in commercial apprenticeships (cf. among others Seeber 2008; Winther, Achtenhagen 2008; Winther, Achtenhagen 2009) most often refer back to the fundamentals of economic education in their competence models.

The longitudinal and cross-sectional study "Investigation on learning progress, motivation and attitudes of students in Hamburg" (ULME) assesses context-specific cognitive performance dispositions. Context-specific relates here to the specific requirements and situations during professional training in vocational schools and in the respective apprenticeship (Lehmann, Seeber 2007).

All in all, 51 tasks were created, being composed of 112 individual items: multiple choice, single choice,

1 We know that there are huge studies such as the National Assessment of Educational Progress Economics 2006 test of 12th grade students in the U.S. that have been left out. The reason for this approach is on one hand a practical one, to keep the list short. On the other hand, although the test itself is well-constructed and incorporates existing standards in the measure-

ment of economic knowledge or understanding, the authors do not see a major theoretical improvement in the assessment model that is used. The theoretical starting point is in principle the same as the one of the Test of Economic Literacy (TEL) that we have discussed already.



assignments and open answer format. Tasks with divergent requirements that needed constructive and argumentative steps in the solution process were disregarded. The items were placed in different situational contexts and were supposed to allow for analyses of dimensionality, required levels of qualifications and the hierarchical structure of professional competence. However, it became clear that the classification characteristics which were used for defining the cognitive dimension (reproduction, understanding/usage, criticism/reflection) were mostly invariant to the respective difficulty of the task. Nevertheless, this classification framework has been an important starting point for the development of the test itself because it prevented an unbalanced distribution of factual knowledge and the reproduction of contents (Seeber 2008, 77). Major results in the context of this paper are that approximately 38% of the variance related to the performance in the dimension “business performance processes, economics and law” can be traced back to common cognitive abilities, mathematical and rea-

ding skills. This was ascertained by the CFT. The percentage of the variance related to accounting was substantially smaller, namely 13 %. In this area, specific professional knowledge and the usage of professional concepts, terms and procedures are apparently more important and can only be partially traced back to the overall cognitive performance, like e. g. logical thinking or the mastery of mathematical relationships. These findings were confirmed by Winther and Achtenhagen (2008), who discovered that general skills for problem solving were replaced by specific professional knowledge if the situation became more specialized. In view of this fact they distinguish between domain-specific and domain-affiliated conceptual knowledge, whereas “economic literacy” and “economic numeracy” are regarded as part of domain-affiliated knowledge for the commercial-administrative area (Winther, Achtenhagen 2010, 19).

Combining now the dimensions of competence octagon with the presented studies it becomes clear that so far only the ULME study met all the requirements.

Table 1: Measurement of Competence with Desirable Degree of Complexity

Dimension	A. Problem solving	B. aspects of actions	C. requirement	D. content	E. task design	F. situations	G. roles	H. motivation/volition
Derived from	Weinert (2001)	Hartig/Klieme (2006)	Hartig/Klieme (2006)	Hartig/Klieme (2006)	Klieme (2004)	Weinert (2001)	Jung (2006)	Weinert (2001)
Study								
(a) Economic knowledge of young adults in Baden-Wuerttemberg, Würth and Klein 2001	No	No	Yes	Yes	No	No	No	Yes
(b) Youth Study 2009, Federal Association of German Banks	No	No	No	Yes	No	No	No	No
(c) Test of Economic Literacy, Soper & Walstad	some items	No	Yes	Yes	No	No	No	No
(d) ULME-study, Lehmann & Seeber 2007	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Siegen model of economic competency, Macha and Schuhen 2011	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes



This table shows that the previous approaches, having their origins in the areas of business, academic economics, economics education and the didactics of economics (Würth and Klein, Federal Association of German Banks, Soper and Walstad), merely conduct a subcomplex measurement. In studies such as the one we picked out from the Federal Association of German Banks the measurement of – in that case – the construct “economic knowledge” is conducted in a semi-scientific way where the items are reminiscent of a TV game show like “Who wants to be millionaire?”. The approach is orientated on inert knowledge or mere attitudes. In their study Würth and Klein (2001) also focus on economic knowledge as a relevant cognitive construct. But while they meet existing scientific standards a look at their items shows again that inert or fact knowledge is in focus. Whereas the theoretical measurement model behind the two studies just mentioned is rather simple, the Test of Economic Literacy by Soper and Walstad offers at least a two-dimensional measurement model. Adapting Bloom’s taxonomy of cognitive learning objectives they try to expand the measurement of inert knowledge with the more elaborate knowledge categories of “comprehension”, “application”, “analysis”, “synthesis” and “evaluation”. Therefore, to measure the construct “economic literacy” in this study it is possible to speak of a really valid measurement. But today the approach of Soper and Walstad (2001) is (no longer) cutting-edge, because it measures only knowledge and not fulfilled all the necessary dimensions of a competency assessment..

The approaches of Lehmann and Seeber, as well as Achtenhagen and Winther, in contrast, are complex, up-to-date competency models, which are able to measure the constructs in the area of vocational, mostly training-related competences in a valid, reliable and objective way. Although these models are rather elaborated, they can – with no exception – be assigned to the context of vocational and business education and are able to measure competences that are relevant and important to a future employer.

But they are neither able to capture nor are they interested in representing stand-alone economic competence in the sense of economic action and economic understanding.

Therefore, we are convinced that a large-scale assessment of economic competencies of students should fulfill the requirements of the competence octagon and that such an assessment is highly desirable. As mentioned earlier the authors have just started a small study called ECOS (Economic Competencies Study), which is currently in progress. The underlying measurement model, which we like to call the “Siegen model of economic competencies”, will be outlined in the following section.

4. Siegen Model of Economic Competencies

The Siegen model of economic competency is constructed based on the theoretical framework that was developed in section 2 of this paper. It incorporates all eight dimensions of the competence octagon.

Furthermore, research on expertise (e.g. Ericsson et al. 2006) in the culturally relevant techniques of reading, writing and calculating shows a sophisticated structure of different knowledge dimensions (Bransford et al. 2002 and an empirical paper on the economic numeracy Schuhmann et al. 2005). Similar results were obtained empirically in the OECD PISA studies. Achtenhagen and Winther (2009) speak with respect to the domain of vocational education of “economic literacy” and “economic numeracy”. The authors do strongly believe that the distinction of verbal and mathematical approaches also has a non-negligible impact on economic competency assessment because the area of economic thinking is typically orientated towards both “worlds”, the verbal and the mathematical one. For instance, already in archaic cultures all economic activity needed some kind of structured decision-making process involving mathematical calculating (“how many sheep do I have?”) and/or verbal acting (trading goods). If one accepts that verbal and mathematical abilities do somehow belong to the domain of economic competencies, the interesting question arises of how this could specifically be the case. Are verbal and mathematical competencies domain-specific? In the sense that they are originally attributable to the psychological construct of economic competency? Or are they only domain-related psychological constructs of their own that appear together with economic competency? To put it differently, one could ask if an economic competency could somehow exist without mathematical and verbal elements (see preliminary results for the domain of economic education in schools from Schloesser and Schuhen 2006).

To the best of the authors’ knowledge no existing study deals with the relation of mathematical, verbal and economic competency. Minor and unsystematic evidence could be given by the frequent approaches in the domain of economic education that try to develop class books for mathematics with only economics-related examples instead of the usual physics and sciences orientation.

In the study ECOS that we have conducted at the end of the year 2010, in a first approach we will differentiate between predominantly verbally and predominantly mathematically orientated economic contexts and related competencies at the highest level of the competency definition. To which extent this differentiation represents the “real” underlying psychological constructs in the students’ “heads” will hopefully become clearer from the pre-study data. Further evidence will then be derived through



testing in the areas of global intelligence (general fluid ability) and mathematical and verbal intelligence. These will be tested using the CFT-20 (Weiß 2006, 2007). The CFT-20 is the German version of Cattell's Culture Fair Intelligence Test-Scale 2 (1949, 1973).

In the Siegen model of economic competency we understand economic competency as the following:

Economic competency can be defined as the ability in verbally and mathematically orientated situations, roles and contexts to

1. recognise economic questions,
2. describe economic phenomena and arrive at economic conclusions,
3. apply economic knowledge in different situative actions,
4. occupy oneself with economic thoughts and ideas and deal with them in a way that is adequate to all current and future tasks of one's life as a constructive, dedicated and reflective citizen along with the related motivational, volitional and social dispositions and abilities, to make successful and responsible use of the obtained problem solutions in variable situations.

Parts (1.) and (2.) of this definition refer to the cognitive construct of knowledge-based competency in the sense of Winther and Achtenhagen (2008, 2009, 2010) such that an understanding of economic relations and issues is in focus. Parts (3.) and (4.) of the definition go back to students' action-based competencies, i. e. their actions in concrete economic situations and roles shall be modelled.

Typically any competence model needs a concrete operationalisation in a measurement model to be testable. In the ECOS project this operationalisation will be done – according to the competence octagon – by identifying eight relevant dimensions of measurement. Specifically, the dimensions are:

- A. content
- B. requirement
- C. aspects of actions
- D. problem solving
- E. situations
- F. roles
- G. task design
- H. motivation/volition

The content dimension (A.) of the Siegen model of economic competency is focused on a few core ideas that can represent the entire area of economic understanding. Such a concept of "big ideas" was developed in the OECD PISA studies and means – roughly speaking – that some content areas represent the whole content of the domain. To derive these big ideas from the domain of economic competency, we conducted a small content analysis of contemporary German school books on economics. The most frequently mentioned topics that we consider "big

ideas" were by far money, market and labour. These topics were also seen as relevant and content-valid in expert interviews with economic teachers and can – following these experts – stand as representative for the domain of economics. While the second dimension (B.) requires three different levels of task difficulty, the third dimension that we describe as aspects of actions (C.) has three different cognitive task types, which are "access information", "organise, structure, model" and "assess, evaluate" (following Adamina et al. 2008). In the fourth dimension (D., problem solving) we refer to Weinert's (2001) understanding of competence that leads to a certain kind of test questions in which new economic problems are solved with the help of prior economic knowledge, instead of only asking for prior knowledge (e.g. "What was the GDP last year?"). Fifth, our test questions are differentiated into the following four "situations" (dimension E.), which 8th graders face or will soon be facing in reality: personal situations, vocational or professional situations, societal situations, scientific situations. In these situations students assume different roles, (dimension F.) which are consumer, employee, employer and economic citizen. Furthermore (following Klieme 2006), test questions should have different formats (dimension G.), such as multiple choice, single choice, calculation and open answer format. Lastly, in a separate questionnaire, the dimension H of motivation and volition is measured.

The statistical analysis of the results will be carried out by using methods of the psychometric test-theory or Item-Response-Theory (originally Georg Rasch, 1960; Fischer and Molenaar, 1995; Davier and Carstensen, 2006; Rost, 2006) with the help of the programme Conquest 2.0 (Wu, Adams, Wilson, Haldane, 2007).

5. Summary

Following the idea of measuring economic competencies we have developed an eight-dimensional space for economic competency. In this space or matrix the different parameter values of each dimension for each test person can be assessed separately. This approach found a graphical representation in the competence octagon. In our model economic literacy is developed in a domain-specific way using "big ideas", assuming that there is both a mathematical and a verbal approach to economic competency. Therefore it is necessary to test within the competency model if the mathematical and the verbal economic competencies are domain-specific or domain-related. If and to which extent the role concept, the differentiation in mathematical and verbal parts and the other dimensions of our competency model will be relevant will hopefully be shown soon by our ECOS study data.



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