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ABSTRACT

This study sought to determine the effects of prior knowledge on the achievement of undergraduates in an economics course at the Open University of the Netherlands (OuN). A total the four law and seven economics students were given four instruments to test prior knowledge of economics, presented with a learning unit from the course "Economics and Money," and then post-tested on subject mastery. The results indicated that the second general measure of expertise, comprising the requisite test scores and the test scores for the subject-oriented expertise test, explained up to 42 percent of the variance in the posttest scores. Further analysis revealed that optimal requisite knowledge was an important component of student expertise. The study also found that the estimation of expertise level through self-assessment by the students was not very reliable. It is suggested that other dimensions, such as psychological and epistemological dimensions, can be put forward to analyze expertise. (Contains 20 references.) (MDM)

Quality and impact of Expertise in Economics: A Replication Study with Ou Students

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ABSTRACT

The research reported in this report is, considering the hypotheses, a replication of an earlier investigation with a different experimental population and in a different experimental setting. Where, in the earlier study, regular university students were involved, in the present study we focus on students studying in a distance education and open learning setting. One of the methodological difficulties with this research population is to reach a large and representative sample. As a consequence, the experimental group in the present study is limited in number, thus preventing to obtain statistically significant results in relation to all hypotheses tested.

Notwithstanding these methodological difficulties, the results are helpful to draw conclusions in relation to the quality and impact of expertise. As in the earlier study, attention was paid to the construction of a set of tests to grasp the complex nature of prior knowledge at the content level. The instruments used during the earlier study were improved in relation to their psychometric qualities.

Concerning the hypotheses about the quality of expertise, the results of this investigation revealed that students with different educational backgrounds and studying different diploma-types, possess a complex of different expertise components.

In relation to the impact of prior knowledge on the acquisition of subject-oriented knowledge, regression analysis reveals that expertise accounts for 37-42% of the variance in posttest scores. The optimization of the instruments used was helpful to differentiate to a better extent the impact of the three different expertise tests.

Since the results of the present study are consistent with the findings of the earlier study in relation to the quality and impact of expertise, more weight can be given to the arguments that can be put forward to support students, in the initial stage of their studies, to cope with the demands of specific domains to be studied.

1. INTRODUCTION.

Earlier research and overviews of recent theories and research concerning the effect of prior knowledge (expertise) on learning, indicate that prior knowledge is one of the most important educational variables (Dochy, 1988). We define prior knowledge or expertise as the domain-specific knowledge and skills, available before endeavouring a specific learning task. A domain is considered to be the total knowledge base related to an academic discipline, for example psychology, medical science or economics. In our case, this domain is 'economics' which can be sub-divided into different subject matters, e.g. accountancy, financing, etc.

In order to investigate prior knowledge phenomena and their potential impact on the learning process, we conducted a series of experiments with students enroled for the course 'Economics and Money'. This is a multi-functional course, which means that it is part of and supposed to fit for all students in different curricula within the university.

This study is a "replication" study, considering it's hypotheses. Among the different reasons for setting up this replication approach to the research questions about the quality and impact of expertise, the particularities of the Ou population is of primary importance.

Earlier experiences showed that it is extremely difficult to involve a large number of Open university students (heterogeneously, decentralization) in such a study. Because the Maastricht student population, for reasons like attainability and continuation, is much easier to investigate, former research has been carried out with Maastricht university students. From this investigation we concluded that contextual and personal variables are not valid indicators concerning a students' prior knowledge (Dochy, e.a., 1991a). This is in accordance with the findings of earlier research (Powell, Conway & Ross, 1990). Moreover, this already suggests that the Maastricht research results - although collected from a population with different contextual and personal characteristics - might be transferred to the Ou-research and education context. However, more research is needed to support the possibility and acceptability of this transfer. This can be called our "context-transfer approach". The main hypotheses of the present research have already been tested with the regular university student population (Dochy, et.al, 1991b). To look for additional support for the results obtained and to look for support for our context-transfer approach, a replication study has been set up.

The specificity of this approach is described in part 2 of the text when discussing the theoretical background. In our approach, special attention is paid to the construction of a set of expertise tests to measure a complex of expertise components. After summarizing the research procedure and the research results, implications of the present study for future investigations are presented.

2. THEORETICAL BACKGROUND.

Both from an experiential point of view (Miller Cleary, 1989) and from the researcher's point of view (Glaser, 1984) the importance of prior knowledge is stressed. Glaser (1984) states for instance that in education and thinking, "people continually try to understand and think about the new in terms of what they already know". Earlier research and our own research have tried to detect the impact and the quality of expertise. We review - in short - some basic research results in order to put the present research in context.

Although - in literature - the impact of prior knowledge is often stressed to this extent that all learning might even depend on it (Resnick, 1983), also other factors like student characteristics do influence the learning process and can interact with the impact of prior knowledge. But, it is yet not clear which personal or contextual variables play a significant role in this context (Ferguson-Hessler, 1989). Moreover, research indicates that, if different variables are taken into account, "prior knowledge" always has the strongest general effect and overrules other variables in descriptive and explanatory models (Ethington, 1990; Bruinsma and Geurts, 1988). This pre-dominance of expertise in learning brings Glaser (1987) to the conclusion that the assessment of prior knowledge should be stressed or studies should be conducted to assess the knowledge state of the learner. A common practice in this perspective is the explicitation of the rules that can account for systematic error patterns in task-performance. The explicitation of these rules can help to construct explanatory models of understanding. Typical examples of this approach are Siegler's rule assessment approach in science concepts (1981) and Brown and Burton's "buggy" system in arithmetic computation (1978).

In our own research, expertise was analyzed in relation to an introductory course in economics.
The results of a first project suggested that differences in expertise are to be found between economics students (ES) and law students (LS). These differences were derived from differences in pass rates and number of examination trials (Dochy & Bouwens, 1990).
A further investigation of 'the Heerlen Group' revealed that these differences are not significant in terms of differences in university test scores. Nevertheless, multiple classification analysis (MCA)[1] shows very consistent trends : economics students score systematically higher than law students. It could also be shown that no personal or contextual variables are useful as indicators of a student's prior knowledge (Dochy, Bouwens, Niestadt, Wagemans, 1991). In the latter study, 76 variables (i.e age, sex, prior education, motives, work experience, etc.), which could give a direct or indirect indication of a subject's expertise, were introduced.

The research results discussed above have in common that they stress the importance of future research, focusing on the detection of specific measures of expertise which can shed light on specific components of expertise. The present research is an attempt in this direction : we want to grasp a students' prior knowledge and its impact on learning, by concentrating the initial focus on the construction of a set of prior knowledge state tests. In past research, existing course-related tests were mostly used to assess prior knowledge (De Corte, 1990), without differentiating between types of expertise along certain dimensions (Dochy, 1990).

The current research invoked different tests, varying along the "content dimension". In later investigations, we will search the influence of educational, epistemological and psychometrical dimensions.
In order to define the variants along the content dimension, content experts (i.e. economists) were asked to ascertain types of content knowledge that influence learning results. Moreover, we also reviewed the types of tests used in literature.
Within the tests, used to grasp an individuals' mastery of the domain, we can distinguish a tripartite, i.e. subject-oriented knowledge state tests (SO-KST), mathematics tests (MA-KST) and optimal requisite knowledge state tests (OR-KST).

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[1] A multiple classification analysis (MCA) shows how the scores of the specific sub-groups are related to the mean (grand mean) of the total population. In a MCA-table the mean deviation of the sub-group scores to the grand mean is shown. If the analysis of variance takes into account the influence of a co-variable (analysis of co-variance), the adjusted deviation for independent variables is used in our MCA-tables.

Figure 1 gives an overview of these types of different tests in relation to the domain of economics.

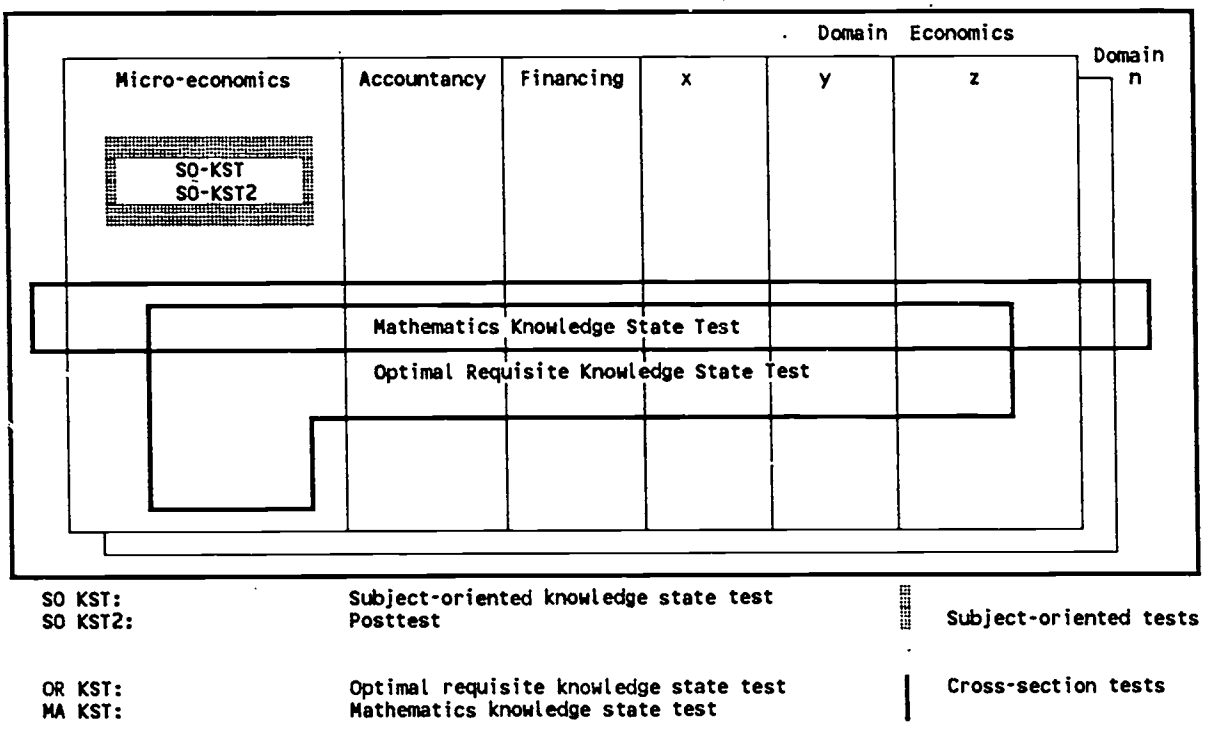

Figure 1 : Different knowledge state tests in relation to the domain.

This investigation focuses first of all on subject-oriented knowledge (SO) and a cross-section of SO knowledge, i.e. optimal requisite (OR) knowledge and mathematics (MA) knowledge. Optimal requisite knowledge is this part of prior knowledge that is, according to content experts, necessary to start the study of the learning task/course under optimal conditions. As shown in figure 1, the MA KST and the OR KST do contain items that do exceed above the subject-oriented knowledge of micro-economics. In this sense they are cross-domain tests. Our earlier research showed that these tests are promising in predicting student performance on a learning task. The predictive power was mainly related with mathematics and optimal requisite knowledge (Dochy, Valcke and Wagemans, 1991). Based on this and other earlier research (Dochy, 1988), we expect that higher scores on subject-oriented and cross-section expertise tests will result in higher scores on a posttest.

The Dochy, Valcke and Wagemans study (1991) also revealed that there are striking differences in mathematics expertise and optimal requisite knowledge between student types (economics students (ES) and law students (LS)).

An additional approach to grasp the prior knowledge level of the students, was to ask the students themselves to estimate their mastery level. In an experiment by Lodewijks (1981), it was shown that prior knowledge could account for 36 % of the explained variance in posttest scores. Prior knowledge was operationalized here as the subjective rating of the familiarity with the content of the learning task. However, when considering the Falchikov and Boud (1989) meta-analysis of 48 student self-assessment studies, the researchers came to more differentiated conclusions: most studies found positive effect sizes, indicating overrating on the part of the students, more experienced students in a particular field (or with more expertise) are more accurate estimators, and students taking introductory courses appear to self-assess particularly inaccurate.

3. RESEARCH DESIGN.

3.1 Hypotheses

Taking into account the theoretical background of the current investigation, the following three groups of hypotheses can be put forward[2] :

1. The quality of expertise in ES and LS :
   - The overall expertise of ES and LS does not differ.
   - ES and LS do possess a different composition of expertise components.
2. The impact of expertise and expertise levels on knowledge acquisition : expertise influences the posttest scores.
   - Specific expertise components influence the posttest scores.
   - Students with better expertise obtain higher scores for the posttest scores.
3. Student estimation of their expertise level does not reflect their real expertise level.

3.2 Research population

In September 1989 an experiment was set up in which students of the Maastricht university participated in order to investigate the role of expertise in studying a learning task (Dochy, Valcke and Wagemans, 1991). In the present study, students learning in a distance education setting, in particular students at the Open university were involved (januari 1991).

It is difficult to reach a large and representative sample from this research population. Our earlier research showed several reasons for this. First, one has to take account of the regular drop-out of nearly 60 % at distance teaching universities. Secondly, those students choose the open learning context deliberately because of the large degrees of freedom: free choice of study time, study place, study pace, etc. An experiment at a certain time, at a certain place, in which has to be studied at a certain pace is thus not the first choice of such students. Thirdly, also resulting from the open learning context is the conclusion that for simple questionnaires, 50 to 60 % of the respondents answer, but for true learning tasks in experimental settings only 10 % of the subjects persist. As a consequence, the experimental group in the present study is limited in number (n=15), thus preventing to obtain statistically significant results in relation to all hypotheses tested. In order to reach these students, we took a representative sample of students newly enroled for the course 'Economics and Money'. The students of this sample, all registered at the Ou study centre in Amsterdam, were asked if they were able to participate in the experiment.

From the final group of respondents who participated in the experiment, 7 students were identified as ES, 4 students as LS, and the rest studied a combination of disciplines or had not decided on a specific discipline yet.

3.3 Instruments

3.3.1 Description of the research instruments

In this investigation the construction of a set of four short tests was based on the following considerations:

- in order to detect the differential role of components of prior knowledge, the tests should reflect these components;
- the student load for completing the tests should be restricted;
- the research procedure should be restricted to the time limit of one day;
- within this time limit there should be enough time for students to complete the learning task.

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[2] Although a third category of students (other students=OS) were involved, we will mainly focus our hypotheses and analyses on ES and LS.

The following tests (1.1 versions) are used :

- A SO-KST1: This test includes 34 multiple-choice items (4 alternatives) and is related to learning units 14 and 15 of the "Economics and Money" course. Validity of the test was checked by content experts who evaluated if the items were representative for the subject-matter.
- An OR-KST: This test consists of 8 items (open-ended or multiple-choice), each of them representing a set of sub-items (17 in total). Construction of this test was based on the opinion of economics experts who identified and explicitated the optimal requisite knowledge for the execution of the learning task.
- A MA-KST: This test, cross cutting the domain, contains 28 items. The test is based on a self-evaluation test of the Antwerp university.
- A posttest (SO-KST2): This test, consisting of 34 items is a parallel test-version of SO-KST1.
- A questionnaire about background variables and experiential learning. This questionnaire was handed out at the end of the experiential session with the request to fill in at home and to return within a week to the Open university.

3.3.2 Psychometric qualities of the research instruments

To assess the reliability of the tests, the α-coefficient was calculated based on a first version of the tests (1.0), as used in a former experiment (Dochy, Valcke and Wagemans, 1991).

Table 1: Reliability of 1.0 tests.

	alpha
SO-KST	.40
OR-KST	.68
MA-KST	.82
SO-KST2	.23

Item-test correlation for all 1.0 versions of the tests revealed that there are no items with negative or low correlations to the total score. Nevertheless, reliability is to be considered as rather low, mainly due to the limited amount of items in the tests. It is generally accepted that a test needs 40 items to reach a reliability of .80. For the MA-KST holds that the original Antwerp test (Dyck, s.d.) had a reliability of .85.

In order to bring the reliability of all 1.0 versions of the tests up to .80 or more, we used the general Spearman-Brown prophecy formula. To estimate what the reliability of a test would be if it were made longer the prophecy equation is

$$r_{xx} = \frac{K \cdot r}{1 + (K - 1)\, r}$$

where
r_{xx} = predicted reliability of a test K times as long as test version 1.0
r = reliability of test version 1.0
K = ratio of number of items in test version 1.1 to number of items in test version 1.0

According to our calculation, all 1.1 versions are approximately three times longer than the 1.0 versions (see table 2, after correction), with the exception for the MA-KST which had already a sufficient reliability.

During test-construction special attention was paid to content validity. This was realized by involving content experts (SO-KST1 & 2, OR-KST) or by using valid item banks (MA-KST).

To assess the reliability of the 1.1 versions of the tests (after enlargement based on the Spearman - Brown) formula, the α-coefficient was calculated. Item-test correlation for all tests revealed negative or low correlations for some items. After omission of these items, the alpha coefficient was calculated for the corrected test versions (see table 2, after correction).

Table 2 : alpha-coefficients of the different test-versions 1.1

	Without correction	After correction
SO KST	.51	.63
OR KST	.94	.96
MA KST	.92	.93
POSTT.	.84	.85

3.4 Research procedure

The research procedure consists of 10 phases :

- Registration and introductory session.
  During this session, the main aim of the research project and the research procedure was outlined.
- The administration of the four expertise tests :
  SO-KST1 (± 50 min.)
  OR-KST (± 40 min.)
  MA-KST (± 45 min.)
- Lunch time (30 min.)
- A study period (± 90 min.) : during this study period the students studied the text of learning unit 14 & 15 of the course "Economics & Money". The study task was limited to the individual going through the course text. There was no control of individual approaches towards the study task. Text-support was equal to the regular support provided in Ou-courses.
- Administration of the posttest SO-KST2 (± 50 min.).

The administration of a set of expertise tests was a specific feature of this research as explained in the introductory parts of this text.
The overall procedure was timed according to a strict time schedule, while avoiding time stress or fatigue.

4. DISCUSSION OF THE RESEARCH RESULTS.

4.1 General results

Table 3 gives an overview of the mean and the standard deviation of the student-scores for the four different prior knowledge tests and the posttest :

Table 3 : mean scores for the prior knowledge tests and the posttest

	m	σ
SO KST	10.27	3.89
OR KST	9.00	10.53
MA KST	8.60	7.34
POSTT.	13.20	6.23
PKST1	27.87	19.45
PKST2	19.26	12.78

To calculate a general measure of expertise, the scores for the three prior knowledge tests have been added to each other (PKST1). Correlation analysis between the four tests reveals that the optimal requisite test and the mathematics-test do correlate to a very high extent (.891***)[3]. This is to be expected, since the optimal requisite test contains items, based on mathematics. Since both tests measure - to a certain extent - the same type of expertise, a second general measure of prior knowledge has been calculated, excluding the scores for the mathematics test (PKST2).
The mean and standard deviation of both general measures of expertise can also be found in table 3.

4.2 The quality of expertise in studying economics.

4.2.1 The overall expertise of students of different diploma type does not differ.

Analysis of variance of the overall expertise scores (PKST1 & PKST2) of students of different diploma type, reveals non-significant differences in expertise level of the three groups. Table 4 shows the mean scores of the three groups of students and the analysis of variance statistics. Diploma type ES refers to "Economy Students", LS to "Law Students" and OS to "Other diploma type Students"[4].

Table 4 : Differences in expertise between ES, LS and OS.

	m					MCA		
	ES	LS	OS	F	pF	ES	LS	OS
PKST1	40.17	16.00	24.25	2.74	.104	12.30	-11.87	-3.62
PKST2	27.00	10.60	18.50	2.85	.097	7.73	- 8.67	- .77

But the results of the multiple classification analysis (MCA), as shown in table 4, reveals consistent trends. The mean deviation of the mean of ES is always positive and always negative for LS and OS. These differences in expertise between ES, LS and OS are in agreement with our earlier findings (Dochy, Valcke & Wagemans, 1991b). The fact that the differences are not statistically significant might be due to the

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[3] *** $p < .001$

[4] This type of students comprises business studies, students following a very varied set of courses and students which final diploma type is - a this moment - not predefined.

small number of students involved in this study. Since, in the present study, a lot of attention has been paid to the optimization of the research instruments - to be more sensitive to measure differences in components of expertise - it is interesting to check whether the present composition of expertise components is different in economics, law and other students.

4.2.2 ES and LS possess a different composition of expertise components.

Based on the former analysis and the results of our earlier study, we expect that there are specific differences in the composition of expertise components in ES and LS. As explained earlier, due to the specific research population in distance learning, we entered a third category of other diploma type students (OS).

Table 5 : Differences in expertise components between LS, ES and OS

	m					MCA		
	ES	LS	OS	F	pF	ES	LS	OS
SO KST	11	9.4	10.25	.19	.826	.73	- .87	- .02
OR KST	16	1.2	8.25	3.79	.053	7.00	- 7.80	- .75
MA KST	13.17	5.4	5.75	2.30	.143	4.57	- 3.20	- 2.85

The results in table 5 reveal there are no statistically significant differences in the expertise components between the students of different diploma types, multiple classification analysis does confirm the trends found in the former part of this text. At each level, the ES obtain higher test-scores than the other students. Again we repeat that the non-significance of the trends detected might be due to the small number of students in the experimental group. The differences between the student types are remarkable (and nearly significant at the 5% level) for the optimal requisite expertise test (OR KST).
The latter finding could be of interest when looking at the potential impact of expertise on learning. Has, e.g. expertise as defined by the optimal requisite test, an impact on learning subject-oriented knowledge in relation to economics ?

4.3 The impact of expertise on knowledge acquisition.

4.3.1 Expertise influences the posttest scores.

In order to measure the impact of expertise on learning new economics knowledge, a subject-oriented posttest[5] was administered to all students after an experimental treatment. During this treatment, all students received a specific study task.

To detect the impact of expertise on the knowledge acquisition regression analysis has been used to define the extent to which the prior knowledge scores help to explain the variance in the results for the posttest.

Table 6 : Regression analysis of general expertise scores

	R2	% explained
PKST1	.368	37%
PKST2	.419	42%

The results in table 6 indicate that expertise - as measured by the PKST1 or the PKST2 - helps to explain 37% to 42% of the variance of the posttest results. This impact is statistically significant. Moreover, compared to the results obtained in our earlier study (Dochy, Valcke & Wagemans, 1991b), we obtain a much higher percentage of explained variance. The detected impact of expertise is comparable to the results

[5] This posttest was a parallel version of the SO KST. Both tests reflect the subject-content dealt with during the study task.

found in literature (Schmidt, 1987). This result also indicates that the optimization of the research instruments has an impact on their sensitivity to measure differences in expertise.
As a consequence, it might be interesting to look at the complex of expertise components to determine what type of expertise the high percentage of explained variance stands for.

4.3.2 Specific expertise components influence the acquisition of economics knowledge.

If we enter all the testscores in the regression equation, we get the following picture, indicating the % each separate expertise test helps to explain the variance in the posttest scores :

Table 7 : Regression analysis of expertise component scores

	R2	% explained
SO KST	.198	20%
OR KST	.353	35%
MA KST	.218	22%

Already at this level we can see that the optimal requisite test (OR KST) explains a very large proportion of the variance in the posttest scores. But a further analysis is needed to determine exactly what the specific contribution of each expertise component is. In order to do this, a stepwise regression analysis has been calculated[6]. The results show that only the optimal requisite expertise test is restrained and entered in the regression equation. The test explains 35% of the variance in the posttest results. The scores for the mathematics expertise test and the subject-oriented expertise test do not add any relevant (PIN = .05) and significant explanatory power.
Since the instruments, used in this research project, seem to be more sensitive to differences in expertise, a further analysis of the general expertise scores might be interesting. Entering the two general measures of expertise (PKST1 & PKST2) in the regression equation might give us more support for findings concerning the role of specific expertise components.
The results in table 7 confirm the pre-dominant impact of optimal requisite expertise in studying economics. But it is interesting to note that the second general measure of expertise, comprising the optimal requisite test scores and the test scores for the subject-oriented expertise test, helps us to explain up to 42% of the variance in the posttest scores. This rather high figure helps to get a fuller picture of the components of expertise in studying economics.

4.3.3 Students with better expertise obtain higher scores for the posttest scores.

To check this hypothesis, the results of two sub-groups of students have been used. The scores of 50% of the students with the highest scores (H) and the scores of 50% of the students with the lowest scores (L) for expertise in general (PKST1 & PKST2) and for each of the specific expertise tests have been used in the analysis[7]. We checked whether students with high or low scores for the specific expertise tests, do also obtain significantly different results for the posttest[8].

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[6] Taking into account the high intercorrelation between the optimal requisite test and the mathematics test, it is expected that not all expertise scores will be entered in the regression equation.

[7] The letter L and H in the table refer to the group with Low results and the group with High scores for each specific expertise test. Because of the limited number of students in the experimental population, we could not use the 25%-measure to split up low and high groups as in our earlier research project. The number of students in each sub-group might have been even more restricted.

[8] The mean scores of the high and low group for the specific expertise tests are significantly different ($p < .0005$).

Table 8 : The impact of low and high scores for expertise tests on the posttest scores

	m				MCA	
	L	H	F	pF	L	H
PKST1	10.25	16.57	4.907	.045	-2.95	3.37
PKST2	10.86	15.25	1.983	.183	-2.34	2.05
SO KST	11.57	15.63	.888	.363	-1.63	1.43
OR KST	10.25	16.57	4.907	.045	-2.95	3.37
MA KST	12.14	14.13	.360	.559	-1.06	.93

Taking into account the restricted number of students in the experimental group, we do not expect to obtain significant differences between the Low and High expertise groups of students. Nevertheless analysis of the trends might be interesting. The results in table 8 confirm our expectations. The differences are not significant but the trends are consistent : Low expertise students obtain lower results for the posttest than high expertise students.

4.4 Student estimation of their expertise level does not reflect their real expertise level.

As explained in the theoretical part of this text, earlier research revealed that students are generally unable to estimate their own expertise level. In this research project, students could prior to the administration of the expertise tests, indicate on a 4-point-scale their degree of estimated expertise (1=low 4=high). Table 9 gives the results of the analysis of variance (general expertise level x estimated expertise level).

Table 9 : The interrelation between estimated and real expertise

	Estimated exp. level						MCA			
	1	2	3	4	F	pF	1	2	3	4
PKST1	41.7	13.0	26.8	26.0	.19	.826	13.6	-15.15	- 1.35	- 2.15
PKST2	27.0	9.0	18.6	21.0	1.05	.416	7.8	-10.15	- .55	7.85

Table 9 shows that the estimated differences in expertise by self-assessment are not reflected in the levels of expertise as measured by the tests. Striking is the under-estimation of their real expertise level by the lowest self-assessment group. This group (self-assessment expertise level = 1) shows mean total scores on the tests which are higher than those for other level groups (see figure 2 and 3).

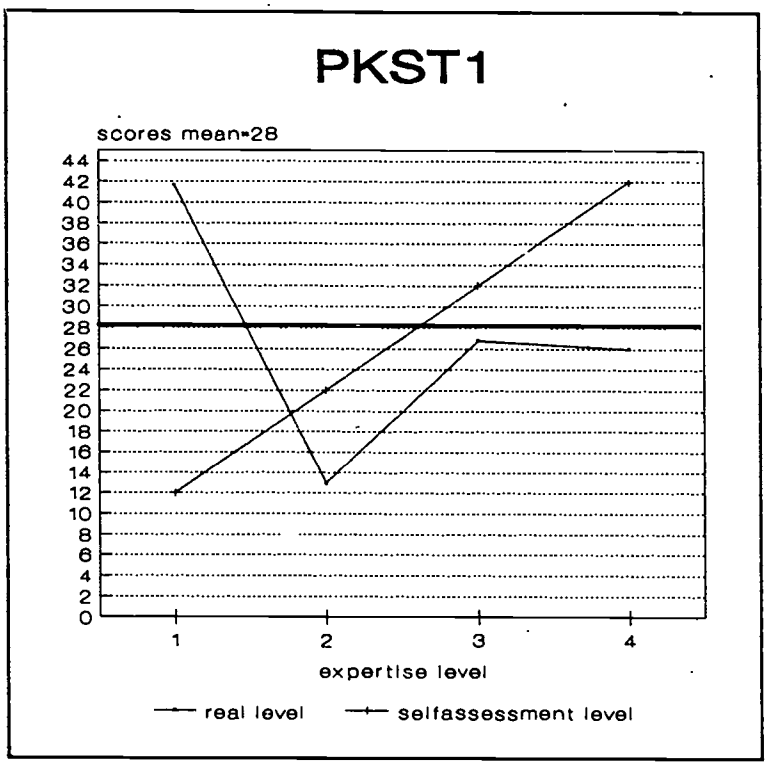

Figure 2: Differences between self-assessment levels and real expertise levels (PKST1).

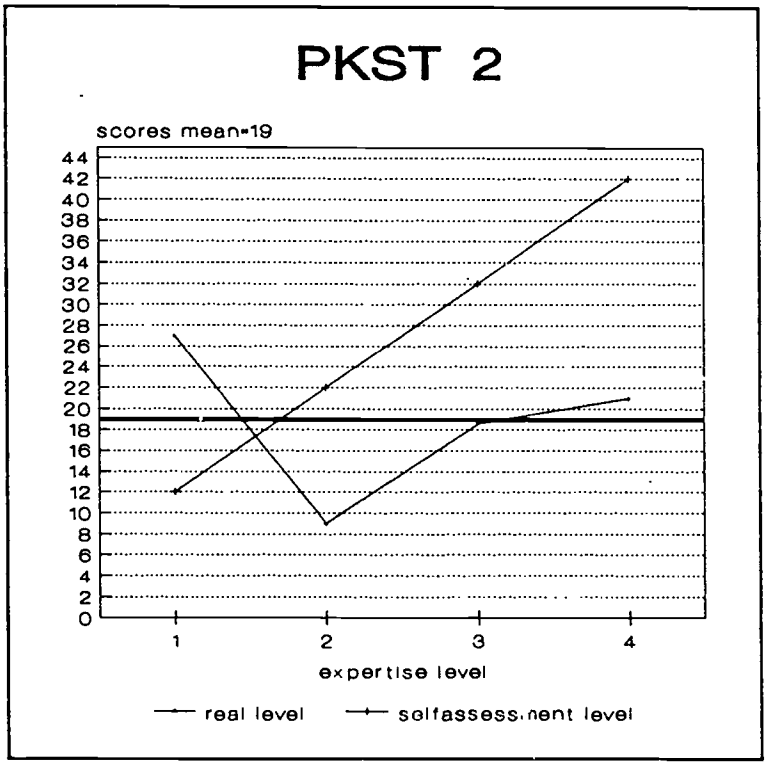

Figure 3: Differences between self-assessment levels and real expertise levels (PKST2).

5. CONCLUSIONS.

The results of this study concerning the quality and impact of expertise in economics has revealed some relevant results with implications for the content and organisation of education in the field of economics.

The first conclusion is that the variable "student type" (ES or LS) has been helpful to detect differences in expertise within a population of students. Moreover, these differences could be extrapolated in terms of specific components of expertise. Striking were the differences in optimal requisite knowledge and mathematics expertise between both sub-populations. This fact strongly contests the multi-functional nature of the course "Economics and Money" and implies structural, organisational of educational adaptations of this course towards these differences.

The second important conclusion of this research is that it could be stated that the level of expertise predicts - to a certain degree - future learning results of students. It should be noted that the second general measure of expertise (PKST2), comprising the optimal requisite test scores and the test scores for the subject-oriented expertise test, explains up to 42% of the variance in the posttest scores. Further analysis revealed optimal requisite knowledge is an important component of student expertise.
Further, it was shown that the estimation of expertise level through self-assessment by the students is not very reliable. The estimations do not reflect the levels of expertise as measured by the objective tests.
Concerning the context-transfer approach, the present study confirms the results of our former study (Dochy, Valcke & Wagemans, 1991b).

The results of this study can be helpful to indicate directions for further research, notwithstanding the research population is difficult to reach and the experimental group was relatively small. It looks for instance promising to analyze in more detail the complex of components in expertise. In this research project, expertise components were defined along a "content dimension". In the near future, other dimensions, such as psychological and epistemological dimensions, can be put forward to analyze expertise.

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