Educational re-design of courses to support large groups of university students by building upon the potential of ICT

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Abstract

This contribution focuses on the educational re-design of the introductory course 'Instructional Sciences' for large groups of university freshman studying psychology and educational sciences. The re-engineering approach focused, next to delivery issues, upon a re-design at content and at a didactical level. At content level, the course focused upon new areas in the knowledge domain of 'education', as compared to the former course. At didactical level a thorough rethinking resulted in the elaboration of an on-line task-driven package, offering students 'tasks' they could tackle by using on-line resources and by getting a number of support provisions: objectives, self-tests, advance organisers, etc. Next to this, a-synchronous communication facilities were offered to ask questions and to get feedback.

This implementation was carried out during the period February-April 1999. A research study was linked to this implementation that took as a central concern the question whether the redesign was sufficiently consistent with the overall teaching/learning model as reflected in other courses. Especially expectations as to ICT-use and appreciation of ICT-use were checked.

The results of the study indicate:

- the consistency of the approach as to ICT-use and appreciation levels of ICT-use and as a consequence a rapid adoption of the new study approach by students
- the weak adoption by students of the a-synchronous communication facilities (e-mail, newsgroups)
- the issue of growing access to computer facilities

Based upon the results, the course-design has been reconsidered. Especially at the level of support provisions, the approach has been changed. Guided and planned-in-time a-synchronous discussion groups are foreseen.

Defining the context for the study

The course 'Instructional Sciences' (Onderwijskunde) is a course in the first year programme Psychology, Educational Sciences and Logopaedics & Audiology. It is an introductory course with a study load of 180 hours. Given the large amount of students (about 818), the course is – traditionally – given during face-to-face sessions in first half year of an academic year.

Being appointed as a new lecturer for this course, the author of this contribution had to cope with a number of practical difficulties to organise and deliver the course to the students in the second part of the academic year 1998-99. A key problem was related to the fact that a completely new content for this course had to be elaborated. The author did not want to start from an existing book or a reader. How could students get in time the necessary learning materials for the weekly sessions? In solving this and other

problems, the author adopted an innovative approach to the design and delivery of the course thus developing a showcase for future innovative teaching/learning projects. The author built in this redesign upon his earlier experiences when working at the Dutch Open University in designing distance education courses.

A research study was linked to this re-design to gather data to document the experience an to direct future developments. This conference contribution describes this redesign and reports on the results of the research.

Redesigning the course 'Instructional sciences'

The following table compares the traditional design of the course 'instructional sciences' with the new design:

Table 1: Comparing the traditional and innovative course design

	Traditional design	New design
Type of educational objectives	• Insight	• Insight & application
Teaching activity	• Face-to-face lecturing	• Face-to-face lecturing • On-line provisions
Learning materials	• A book	• Web-based on-line course • At the end of the sessions a printed version was made available as an extra provision for students
Assessment	• Three intermediate summative assessment sessions	• Continuous self assessment • Formative final assessment session • Summative final assessment session
Support	• Opportunity to ask questions during face-to-face lectures	• Opportunity to ask questions during face-to-face lectures • FAQ on the course-website
Structuring principle of the course	• Academic themes	• Tasks based on themes problem fields

As explained in table 1, all key components of the didactical setting were taken into account in the actual redesign. But in adopting the re-design, care was nevertheless taken to stay – to a certain extent – in line with the existing teaching/learning culture students were used to. As will be discussed later on in this article, innovative approaches can go far beyond the current design of educational provisions at the micro-meso- and macro-level. As we have argued elsewhere (Valcke, 1999, in press), adopting innovative educational models at the level of a single course can be in conflict or be inconsistent with the educational approach at the meso- and macro-level. This explicit choice brings us to the key question that will be discussed in the research part of this study: to what extent has the re-design been adopted by students?

As to the actual re-design, we describe in short the different didactical components.
At the level of the **educational objectives**, a very high emphasis was put on objectives at application-level, next to the traditional emphasis on 'insight'. Students were not only expected to be able to replicate theories, approaches as given in the course, but were also expected to be able to apply all this knowledge on new cases, events, examples, etc. In the actual course design a multitude of journal articles, examples from practice were presented and used for this purpose.

Face-to-face teaching was still considered as essential in the new design of the course to structure the **teaching activities**. Lecturing is a key part of the teaching/learning culture and students expect to have weekly face-to-face contact with professors. Therefore, this approach was still incorporated into the new design. But, next to this kind of teaching activities, a web-based environment was elaborated that reflected an alternative teaching approach. In consulting this website (see figure 1), student could work independently, find the learning objectives, study the study materials/learning resources (read/download), find tasks in relation to the learning resources, solve self assessment tests, get feedback, find 'concept maps' that structure the knowledge base in relation to a task, , find examples, ...
(http://allserv.rug.ac.be/~mvalcke/Onderwijskunde/cursus.htm). Students were also informed about the fact that working with the website was a perfect alternative for attending the face-to-face lectures.
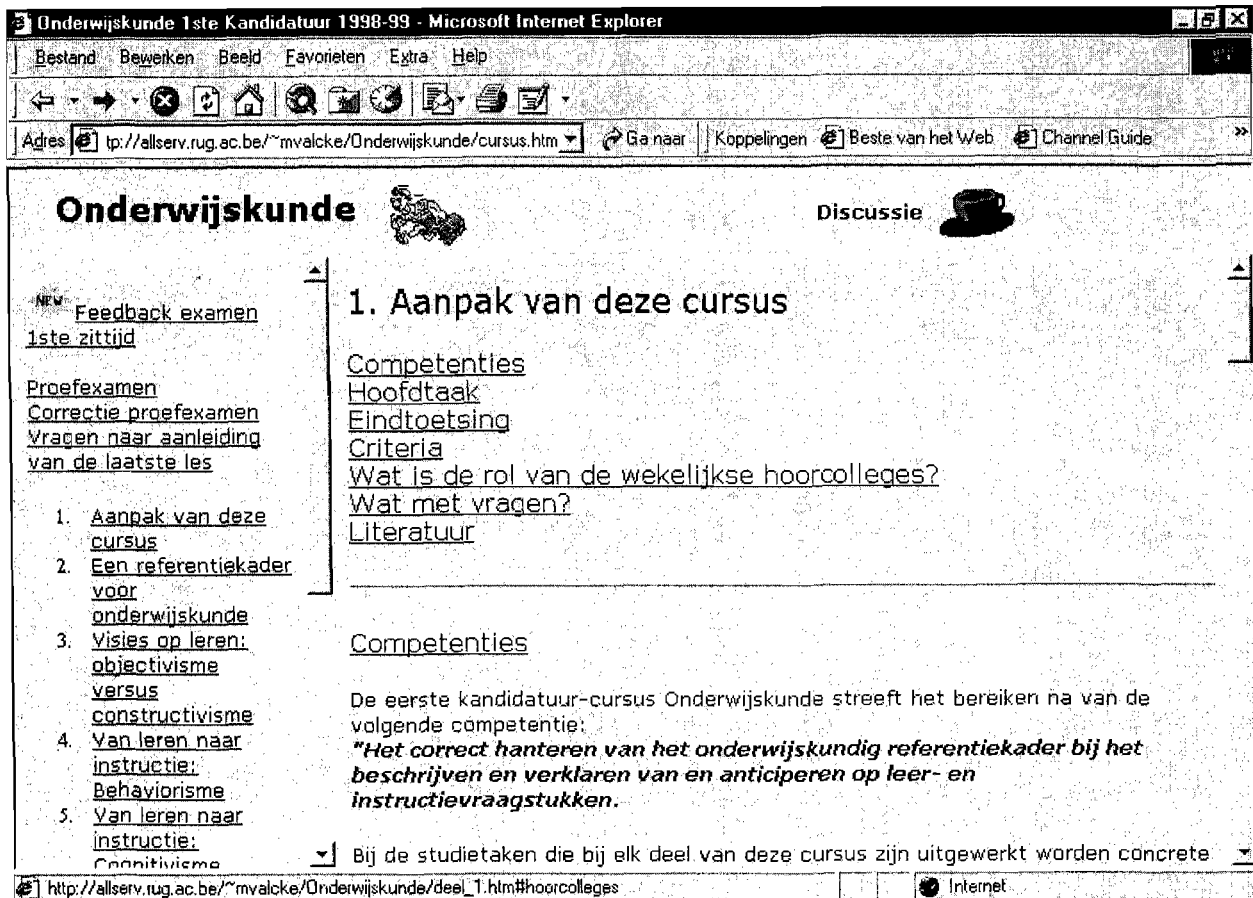

Figure 1: Start-up page of the on-line course

The **learning materials** were made available on a weekly on the course website. Students could read, print and/or download these materials prior to the face-to-face sessions. This was the only efficient way to distribute the learning materials to the students considering the very tight time schedule in developing the completely new content for the course. At the end of the academic year, a printed version of the learning resources was made available to the students. This versions different only marginally from he electronic version. The materials (tasks, self assessment tests, concept maps, resources, ...) were integrated, attention was paid to a lay-out that fits a printed delivery, a content table was added.

The **assessment** approach differed from the traditional design in a number of ways. The most important feature was the emphasis on continuous self-assessment. Each week, students could find, in relation to the central task of that week, a self assessment test on the web. No feedback to the tests was found on the website. Students were expected to work on these tests independently. They were also urged to work

together on these tests. The provision of these tests was expected to foster a more continuous and active learning approach towards the course.

To orient students furthermore on the final assessment for the course, a formative final assessment session was organised at the the week before the Easter holidays.. Students participated in this session on a voluntary base. Feedback was given after the Easter holidays.

Support provisions were enriched by putting answers to frequently asked questions on the website. The questions were asked during and/or at the end of the weekly face-to-face sessions.

A key issue in the educational re-design was the choice for a new **structuring principle for the course** 'instructional science'. The traditional course reflected the well-known 'thematic' approach to structuring courses, as reflected in academic books and articles. The new course tried to implement a task-based approach. This is in line with the strong emphasis on the 'application' educational objectives and the kind of test-items to be found in the self assessment tests. As a consequence, the learning materials were approached as resources to be used as resources to solve tasks based on actual problem fields, current educational discussions, newspaper articles, etc.

The high investment in this innovative design and delivery of the course 'instructional science' implied looking for a careful balance between pursuing innovative ideas and being in line with the current still dominant teaching/learning culture. We discuss this issue in the next paragraphs.

The key problem: the consistency between a redesign and the current existing educational culture

A t the moment, a large number of educational institutes pursue a major shift in their educational model, and this at the micro, meso- and macro-level. Institutes that move into this innovative directions have to be aware of their current dominant educational model and have to realise that moving towards a new models is not always easy, considering the traditional approaches. This is the main reason why we ask for a careful and planned innovation in this perspective.

Kirschner, Hermans & De Wolf (1995) distinguish in this context between substitution, optimisation and transformation. Adoption of web-based education remains in a large number of situations restricted to **'substitution'**. This means that certain - especially at information-level - approaches to education have been replaced but not changed by the use of the web. For instance, all information about the study programmes can now be found on the web, or all the course materials are published electronically on the web (electronic study books)

In a next stage, there is a slight modification in a number of variables and/or processes in the web-based approach as contrasted to the traditional approach. For instance, students can now find earlier tests on the web. They finally can view feedback on their own answers. This is the **'optimisation'** stage.

But the 'dream' of a high number of institutes is to 'innovate'. In this approach, a fundamental new conception of education has been adopted and implemented to realise a **'transformation'**. When we read about the potential of the educational use of the web, very revolutionary instructional approaches are presented when we contrast them with current approaches. We give a few examples:

- Bonk & Cummings (1998) e.g., speak about deep student engagement, public and private forms of feedback, facilitate and don't dictate, embed thinking skills and portfolio assessment, vary forms of mentoring and apprenticeship, etc.
- Campbell & Gibson (1997) present the idea of delivering and supporting workshops at a distance, using the web.
- Doherty (1998) stresses dynamic interaction, communication and all types of presentation.
- Gilbert & Moore (1998) stress social and instructional interactivity between students and between students and teachers/lecturers.
- Wiens & Gunter (1998) stress offering different modalities in presenting information in order to promote interactive discovery learning.
- The Dutch Open University runs since two year virtual companies on the web in which students work and study at a distance but in close collaboration with support staff and other students.
- ...

The examples show a variety of new promising directions, but the question we put forward in this conference contribution and our research study is: what is the congruency between the current educational model and the innovative model we are looking for? Is our institution ready for this new approach? Have our students sufficient experience with the new educational model advocated by the idea of e.g., web-based education? What about your colleagues? What about current provisions, support staff, assessment approaches, etc.? When we foresee a large use of information and communication technologies (ICT), do students have access? Have they sufficient experience with ICT? In other words: is immediately jumping to the transformation level the right decision?

These issues are especially vital when the redesign is realised in relation to a single course as compared to a redesign of a complete curriculum.

The former questions were also considered when designing and delivering the course 'Instructional Science'. Therefore, we linked a limited research study to the run of the new course design. We discuss this study in the next paragraphs. It has to be stated beforehand that the study did not focus on all variables involved in the redesign of the course. For this first study we limited ourselves to conditional variables related to ICT-provisions. Given the central position of these provisions in the redesign, congruency between our new approach and the current way of teaching/learning is a prior condition.

Research design

The central question we tried to answer with our study was: Do the students accept the innovative educational design of the course and are they able to cope with it? At an operational level we focused especially upon issues related to the use and integration of information and communication technologies (ICT). We therefore present the following more focused research questions and hypotheses:

a) The redesign of the course 'Instructional Science' builds upon the right expectations as to the use of computer and communication technologies of the students.
b) The redesign of the course 'Instructional Science' builds upon the right expectations as to what students appreciate in the use of ICT.
c) The redesign of the course 'Instructional Science' builds upon the right expectations as to the appreciation of the available ICT-provisions in the faculty.
d) The implementation of the redesign of the course 'Instructional Science' affects student responses to hypotheses a, b and c.

Research set-up
Due to limited resources and time-constraints, we opted for a research design based on the administration of a questionnaire at the start and the end of the teaching period.
Since attending the face-to-face lectures is not considered as obligatory and students have the –
questionable? – habit of not consistenly attending lectures, students participated on a voluntary base in the study. This brings about

Research instrument
A questionnaire was designed that tried to state the actual use and types of use of information and communication technologies (ICT) and student appreciation of ICT-use and types of uses; considering the hypotheses stated earlier.
To be able to analyse the responses to both questionnaires of each individual student, the student number was used to start paired comparison.
The items in the questionnaire consisted of 'statements'. Students responded by circling the yes or no-response for the dychotomous variables or an 'appreciation level' for those variables were a three-point scale or four-point Likert scale was presented. In relation to all items, students could always opt for the 'not applicable' option.
At the end of the questionnaire student got the opportunity to add some additional personal remarks.

Research population/sample
As indicated earlier the students, involved in the study follow courses in the following first year
programmes:
Psychology   594
Educational Sciences   179
Logopaedics & Audiology   45
Although the questionnaire was expected to filled out by the entire population, only those students that
attended the specific lecture filled in the questionnaire.

Procedure
Administration of questionnaire February 3rd 1999.
Administration of questionnaire 2 April 28th 1999, linked to the feedback session for the formative final
assessment.

Analysis of the results
χ^2 is used to test frequency distributions in relation to the different items in the questionnaires. Observed
frequencies are compared to specified expected frequencies for the different response categories.
In comparing the data of the two parallel questionnaires, non-parametric two-related samples tests were
used: the McNemar test for binary variables and the marginal homogeneity test (sign test; extension of
McNemar test) for multinomial responses.

Results

Student participation in the study
555 students returned questionnaire 1 (67.8%). Only 213 students returned questionnaire 2 (26%).
Part of the latter subgroup even differed from the group that returned the first questionnaire. Moreover,
paired comparison of the questionnaires was hindered due to a number of about 2 x 20 students that did
not fill in their personal student number. The low number of student participation during the second
administration of the questionnaire can be due to two reasons. First, the last lecture was organised after
the Easter holidays. At that moment already a large group of students whether have dropped out and
stopped their study or do no longer attend the lessons and already focus on the preparation for the final
examinations. Secondly, the fact that part of this lecture dealt with feedback upon the formative final
assessment, might have caused non-attendance of those students who did not invest time in the formative
final assessment.
Limited student participation for the second part of the study might question the extent to which the
results might be representative for the entire population. We will therefore , especially focus upon student
answers on the first questionnaire and discuss very carefully the comparison between the first and second
questionnaire.

Overview of the result: questionnaire 1

Table 2 gives an efficient overview of the answer profiles to the first questionnaire. The different
answering options for the different scales are typed in bold. The number of students responding to items
is different, due to the fact they could opt for the option 'not applicable'. We give between brackets how
the different items are related to the 4 research hypotheses in our study. The χ^2 value and p-value is given
to check whether the observed frequencies differ significantly from expected frequencies. The expected
frequencies are given between brackets for each item/cell.

Table 2: Overview of students answers on questionnaire 1

	Never	1 time a week	1-5 times a week	Every day	N for this item	χ^2-value p-value
1. I use regularly a computer a, d	5.8 (15)	46.0 (40)	39.5 (30)	8.7 (15)	554	68.056 0.000
2. I regularly surf on the WWW a, d	43.8 (15)	36.3 (40)	17.7 (30)	2.2 (15)	553	395.287 0.000
3. I use e-mail a, d	57.6 (15)	22.9 (40)	17.1 (30)	2.3 (15)	554	799.681 0.000
4. I use newsgroups a, d	95.7 (15)	2.7 (40)	1.1 (30)	.5 (15)	554	2827.605 0.000
5. I chat on the internet a, d	82.3 (15)	12.8 (40)	4.2 (30)	0.7 (15)	554	1974.362 0.000
	Never	1 course	2-6 courses	>5 courses	N for this item	
6. My use of computers is related to my study/courses a, d	14.1 (20)	15.4 (20)	64.0 (40)	6.6 (20)	547	143.411 0.000
	Yes	No	-	-	N for this item	
7. I have daily access to a computer a, d	62.2 (60)	37.8 (40)			553	1.080 0.299
8. It is useful that courses are supported with ICT b, d	72.1 (60)	27.9 (40)			433	26.221 0.000
9. Computers are too expensive c, d	64.9 (60)	35.1 (40)			427	4.222 0.040
10. I use the facilities in our faculty c, d	41.6 (60)	58.4 (40)			505	71.361 0.000
11. The facilities in the faculty are sufficient c, d	58.3 (60)	41.7 (40)			422	0.153 0.696
Appreciation of relevance of ICT-use	Not relevant	Medium relevance	Highly relevant		N for this item	
12. To have fast access to learning materials b, d	14.8 (20)	43.8 (40)	41.2 (40)		454	8.131 0.17
13. To get in touch with the professor b, d	42.1 (20)	46.8 (40)	11.1 (40)		378	175.274 0.000
14. To get in touch with other students b, d	47.6 (20)	36.5 (40)	15.9 (40)		389	205.203 0.000
15. To get feedback to my questions b, d	23.4 (20)	42.8 (40)	33.8 (40)		402	6.905 0.032
16. To look up extra information b, d	4.6 (20)	29.5 (40)	65.9 (40)		475	148.879 0.000
17. To process my own texts/summaries b, d	21.8 (20)	35.1 (40)	43.1 (40)		436	4.384 0.112

Comparing students responses in both questionnaires

The following table reflects only those questionnaire items for which the two-related samples test resulted in significant differences between the responses for first and second questionnaires. As stated earlier the number of student responses that can be included in the paired comparison is sometimes limited.

Table 3: Significant differences in the two-related samples test

	McNemar test	Marginal homogeneity test (sign test)	N for this item
I regularly surf on the WWW		Z −2.946 p 0.003	213
Computers are too expensive	χ^2 21,811 p 0,00		131
I use the facilities in our faculty to look up extra information		Z −7.586 p 0.000	102
I use the facilities in our faculty to process my own texts/summaries		Z −4.858 p 0.000	97

Discussion of the results

The discussion of the results is structured along the four basic hypotheses.

Hypothesis a: The redesign of the course 'Instructional Science' builds upon the right expectations as to the use of computer and communication technologies of the students.
Questionnaire items 1 to 7 can help us to test this hypothesis. All χ^2-values are significant.
- A larger group of students uses regularly computers than expected.
- Computer use is related to a higher number of courses than expected.
- Less students than expected use the world wide web, e-mail, newsgroups and chat.
The latter conclusion questions whether we can accept our hypothesis. Especially the limited use of (acquaintance with) the WWW raises doubts. To extend our analysis we check the student responses to the second questionnaire. The results of this analysis can be found in table 4

Table 4: Extra χ^2-results to check basic hypothesis a

Second questionnaire	Never	1 time a week	1-5 times a week	Every day	N for this item	χ^2-value p-value
1. I regularly surf on the WWW	29.6 (15)	47.4 (40)	22.1 (30)	0.9 (15)	213	65.650 0.000
2. I use e-mail	49.5	31.6	16.5	2.4	212	207.682 0.000

This second analysis, although based on a smaller number of observations, takes away some of our doubts as to the use of the WWW and student acquaintance with this ICT-provision. But still, there is the issue of limited e-mail use that is still far more less than expected (and needed?). This especially questions the potential to base support-facilities on ICT-provisions.
Therefore we state that we can only in part accept the first hypothesis.

Hypothesis b: The redesign of the course 'Instructional Science' builds upon the right expectations as to what students appreciate in the use of ICT.

Questionnaire items 8 and 12 to 17 are to be used to test this hypothesis. In view of our course redesign especially the appreciation of fast access, feedback possibilities, getting extra information and processing of one's own texts/summaries is considered of importance. Getting into touch with the professor and/or other students are of less relevance since they are not implemented in the actual redesign.
The results are clear:
- The potential in terms of fast access to learning materials, to get individual feedback and to find extra information is appreciated to a significantly higher extent than expected.
- The potential in terms of getting in touch with the professor and/or other students, is appreciated to a significantly lower extent than expected.
- ICT-use to support courses is appreciated to a significantly higher extent than expected.
- The appreciation to use ICT to process one's own texts/summaries is as expected.
These results are sufficient to accept hypothesis b.

Hypothesis c: The redesign of the course 'Instructional Science' builds upon the right expectations as to the appreciation of the available ICT-provisions in the faculty.

Questionnaire items 9, 10 and 11 are used to test this hypothesis.
- The opinion of students as to the financial implications of computer use are as expected. About 60% find them too expensive.
- Students appreciation of the available ICT-provisions are in line with our expectations: 60% sufficient – 40% not sufficient.
- Students use to a significantly lesser extent the ICT-provisions in our faculty than expected.
These results indicate that we can accept hypothesis c.

Hypothesis d: The implementation of the redesign of the course 'Instructional Science' affects student responses to hypotheses a, b and c.

When we consider the results in table 3 we see that only in relation to for items significant differences in student responses can be found:
- Significantly more students surf on the web.
- The option as to 'computers are expensive' has changed largely. About half of the students that initially state that computers are expensive, have changed their opinion. This might be in part due to the fact that students were – at the start of the sessions – not always making use of the ICT-provisions in the faculty.
- The appreciation of the potential of ICT-use changed significantly in relation to the issues looking up extra information and processing one's own texts/summaries

The responses to other items in relation to computer use and/or appreciation of computer use do not differ in a significant way when comparing both questionnaires.
This brings us to the conclusion that we cannot completely accept hypothesis d which means that the actual redesign of the course only affected to a limited extent student use of ICT and student appreciation of ICT-use.

Discussion related to general comments of students

Students also had the opportunity to give some general remarks at the end of the questionnaire. About 40 students have given such remarks. The majority of these remarks can be clustered along the following categories:

- I hate computers.
- It is wrong to expect students to use computers.
- It is better to have printed materials.
- It is better to have all the learning resources at the start of the course.
- Timing of student computer access did not always fit the moment that materials were available on-line (e.g., students wanted access to the materials during the weekend before the face-to-face session).
- It is confusing to have an on-line version and printed version of a course. Are they the same?

Conclusions and future directions

Two of the four hypotheses could be accepted. The two other hypotheses could only be partly accepted. Although this might indicate that we have to a certain extent built upon the right expectations as to computer use and appreciation of computer use, the study also raises a number of questions, e.g.:
- We e.g., limited the study to ICT-related issues. What about the very specific educational redesign features, such as the self assessment approach, the task-based structure of the course, ... ?
- Does the limited use of a-synchronous facilities affect a more significant elaboration of support provisions?
- Is the distribution of learning resources via the web still relevant if they are now available?
- Could the assessment-approach not have been more interactive and dynamic?
- ...

It has also to be repeated that – at a methodological level – the interpretation of the results has been hindered by the restricted numbers of student that filled in the second questionnaire. Especially the analysis of the results in view of the fourth hypothesis has been affected by this fact.

Considering the results of this study, our general experiences and informal comments of students and colleagues, the design/delivery of the course 'Instructional Sciences' will change during next academic year. Major changes our now being set-up in relation to the following issues:
- the learning resources will no longer be distributed via the web; they will be available as a printed book;
- in relation to each task, more attention will be paid to the self-assessment tests; feedback provisions will be available;
- to support students on a regular base and in a systematic way, structured discussion lists will be set-up; student will have to subscribe to lists they are assigned to; tutors will monitor the discussions that will focus on the solution of tasks in which the learning resources have to be applied
- extra support materials will be distributed; e.g. overhead slides;
- related sites with additional materials will be available.

Next to these design issues at the level of this specific course (micro-level), more thought and consideration will be given to a redesign of the overall curriculum. In view of the forthcoming programme reform in the Faculty of Psychology and Educational Sciences, discussions and redesign attempts will focus on other courses, sets of courses and eventually complete programmes.

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