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Didactic model for e-learning and regular courses

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Abstract: *In the past many didactic models have been developed for regular courses. But didactic models for e-learning courses and specific for MOOCs are still under development. Such a model should provide a basis for measurements against the high drop-out rate of MOOCs. Recently we introduced FETCH 2.0 as didactic model for e-learning using social media. In this paper we discuss a didactic model for regular courses and an adaption-extension to for e-learning courses. The model has been tested and the results of testing will be presented.*

Key words: *Didactic Models, Dropout Rates, Multimodal Assessment.*

INTRODUCTION

In the past many didactic models have been developed. Such a model should describe the teaching learning process and the conditions for optimal performance. A didactic model should provide insight in the phenomena of delaying students and dropouts. A diagnostic instrument is needed to detect delaying students as soon as possible and to provide assistance by student-counselling. In many models characteristics of students and Universities have been developed to predict the course of the interaction process of teaching learning of individual students in the future.

Such a diagnostic instrument is needed for the wellbeing of students. But in the Netherlands the financial support of the Ministry of Education depends on the number of students completing the study in time. Dutch Universities have no entrance exam. The first propaedeutic year should be used for selection of students. It proves that about 20 % of the students start a technical study without the required mathematical/technical abilities. They have to realise as soon as possible that a technical study is no option for them and leave this study as soon as possible. But another 20 % stops the study because the interaction student-educational environment fails. The hope is that via additional counselling these students are able to survive the dip and early diagnosis is important.

In this paper we present a didactic model underlying regular courses. Based on this model a questionnaire has been developed which provides a basis for a diagnostic instrument. The items in the questionnaire are questions about the interaction process student with the teaching-learning environment. Usually characteristics of students and the teaching learning environment are used to predict study success or study failure. We assume that the study process is a dynamic process and characteristics may change over time.

In case of regular courses students are requested to fill in questionnaires during one of the lectures. It proves that during e-learning courses and especially for MOOCs the response to questionnaires included in digital learning material is low. In an additional e-learning didactic model we studied the interaction process teaching learning on a micro-level. Students have to login, select learning material, make assignments, all these steps can be logged during e-learning and appropriate feedback can be provided. For the whole cohort of students data analytics tools can be used to assess the progress of students during the course.

The outline of the paper is as follows. In the next section we provide an overview of related work underlying our didactic models. The didactic model underlying regular courses is presented in section 3. In section 4 we present an adapted didactic model for e-learning courses. In section 3,4 we provide some results of experiments to validate our models. In the final section we state our conclusions, and future work.

RELATED WORK

From 1953-1957 there was a big research project at Delft University of Technology on delay in the study progress and dropout of students from their study [1]. The first goal of the research was to get insight in the causality of study delay and dropout. The second goal was to research if it was possible to predict study success or delay. The researchers found 6 factors playing a role in study success or failure: (s)wrong study choice, (c) insufficient capabilities, (w) bad study methods, (p) personal problems, (e) external components, (sa) social adaptation. The project at Delft was the start of many research projects on "study success or study failure. The procedure was to find characteristics of students and Universities to provide a basis for prediction of the study in the future. All students from the first three years got a psychological assessment. Well-known IQ-test, personality assessment, test for verbal and nonverbal abilities were used and typical test for technical abilities. From all students the results of exams were collected and the results of the exams at secondary school. All students were interviewed by student counsellors about personal characteristics, personal situation and personal problems. It proves that the results of exact courses as mathematics, physics and chemistry at secondary school were the best predictors of study success or study failure. The results of psychological assessment had no added value. A study at a Technical University requires exact abilities and the exams at secondary school are based on some years of study at that school.

In 1984 the study at Delft was reproduced at the Faculties of Mathematics, Physics and Informatics. But the results were similar [2]. Psychological assessment resulted in additional characteristics of students but these variables had no added value on the prediction of study success.

From 1968 Janssen [3] was involved in research on teaching and learning in higher education. In his whole research, the student with his study and exam experience and perception of teaching behaviour is the focus of attention. Janssen perceives studying as "deep level learning" and teaching as facilitating studying. Together with Goethem and Lacante [4] Janssen researched study experiences of students. They developed a questionnaire of more than 100 items and surveyed first years students at the University of Leuven. After analysing the responses of students using factor analysis they discovered three underlying components intrinsically motivation, self-confidence and activity. These components are similar to the Osgood dimensions evaluation, potency and activity [5]. In 1990 we performed similar research at Delft University of Technology.

In [6] Tinto introduced a theoretical longitudinal model showing how student and University characteristics have their impact on the interaction student-university in the course of the time. In fact he considers three systems: student, university and social system. According to Tinto a student will enter the university with some social background, personality and pre-education. Based on that he develops an attachment with the University and goal of education. This bonding will be expressed in motivation and expectation. Influenced by two systems, the academic and social and their interaction, this bonding changed and eventually results in dropout of the student.

A student as an open system as a composition of interacting parts has been described by many researchers. The composing parts are considered as information processing subsystems. They receive information, process information and broadcast information. To consider human beings as an information processing systems is a general accepted idea. Buis [7] describes the individual learning process of a student as a sequence of states similar to complex, goal directed open systems.

In [8] we introduced a didactical model for distant learning based on the use of social media. The focus of that model was on communication with and support by peers in a social network of friends. In the current model we focus on individual learning, on the interaction of students with the learning material.

DIDACTIC MODEL

Describing students as open systems implies an ecological attitude with respect to causality. Context and evolution have to be considered. Success of study is not only dependent of students characteristics as capabilities, knowledge, used study methods, but is the result of a complex interaction process. This will be the basic idea underlying our didactic model presented in this section.

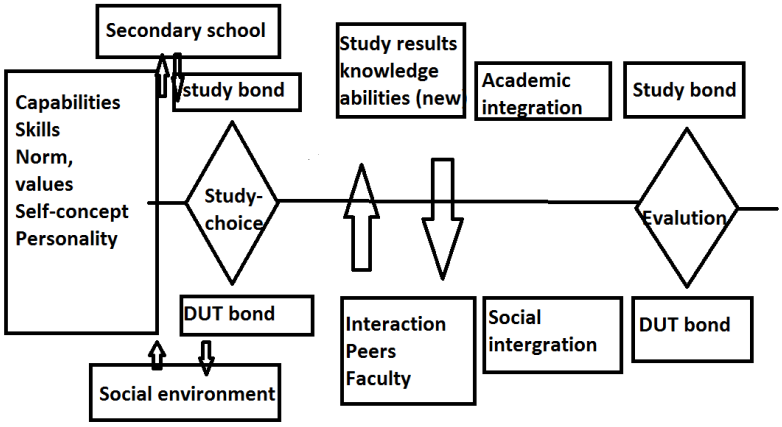

Figure 1: Didactic model based on the interaction student with teaching learning environment.

To validate the model we performed a survey study in 1983. All students Informatics (n=160) were requested to fill in a questionnaire of 190 items on a 3 point Likert scale. In these items students were questioned about their opinions, motivations, assessments, experiences with respect to the study, study environment and study conditions with a focus on the interactive aspect. The items were distributed over 10 topics: study choice (i1-i25), study motivation (i26-i36), study environment (i37-i58), teaching (i59-i65), counselling (i66-i70), study problems (i71-i85), study methods (i86-i97), preconditions (i98-i101), personal data (i102-i110), study skills (i111-i130), causalities of study delay (i131-i161), study progress (i162-i175), social network (i175-i190). It proves that 80% of the variables shows a significant difference between the groups of students passing, 0, 1, 2 , 3 or 4 exams successfully at the first exam session in October.

The questionnaire was designed as a diagnostic instrument to detect delaying students in an early stage of their study. The questionnaire was performed in the third month of study (November). We used the 190 variables to predict the numbers of exams passed successfully after after 10 months of study (June). We used multiple regression to predict the numbers of exams successfully. In Figure 2 we display the results. In total 14 variables were used to predict the number of exams passed successfully. We list some items with a high predictive value:

i83: ranking by students themselves as poor, average or one of the best students
i25: in case of a restart Delft University of Technology was chosen again
i45: adaptation in the first month of study caused some problems
i87: completion of practical assignments in time
i71: great problems with one or more courses
i58: ability to resist strong forces from the environment to take part in non-study activities
i79: students was able to follow the course successfully last weeks before the exam
i74: deficiencies in pre-knowledge
i89: used a wrong study planning
i97: used study method secondary school and university are quite different
i68: study at DUT is rather impersonal
i76: results of exams at secondary school represent skills and abilities

i80: got lost at lectures many times
i68: personals problems during first months of study

100								1	1	1	3
90								4	2	1	
80							6	1	1		1
70						3	1	4	1		1
60					1	1	6	1			
50			2	1		3	4	1			
40			1	1	2		1				
30		1	2	1	6	3					
20		3	1		3	1					
10	3	4	2	2							
0	2	2	4								
Percentage	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**

Figure 2: Relation between predicted study success (horizontal axis) and real study success (vertical axis).

DIDACTIC MODEL ON MICROLEVEL

We discussed a didactic model for regular courses and validated this model by survey research. In case of distant learning including MOOCs there is a focus on direct interaction student-learning material within a short time window of interaction. We stress the fact that the interaction is a dynamic process which can increase or decrease in intensity. In the next Figure 3 we display our didactic model on micro-level.

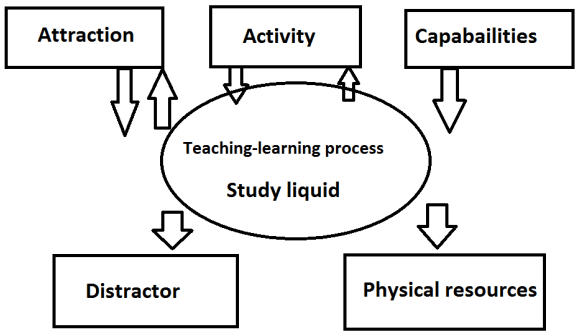

Figure 3: Didactic model describing the momentary interaction student learning material.

We discuss the components of our interaction model in more detail:

Attraction: An important component in the interaction student learning material is interest of students. As long as the learning material is interesting a student keeps on board. But as soon the learning material gets boring, student lose their interest and the dropout process has been started. In case of regular courses there is a lot of pressure of peers, Institute, teaching schemas to follow lectures the other day. New topics provide opportunities for a new start. Usually this is missing in case of MOOCs. By the huge amount of students individual tutoring is difficult to realize. A special didactic approach is needed. The span of attention or control is very short, only some minutes. A varied way of presentation of learning material is needed by showing movies, video lectures, simulations and interesting applied assignments for students. After positive experiences of the students with the learning material the attraction will be increased. For example after solving assignments, understanding the learning material, or after positive feedback of peers or tutor.

Capabilities: A student assumes at start he has sufficient capabilities to complete the course successfully. But when he interacts with the learning material and it proves that it is far beyond his capabilities, the dropout process has been started. In regular face to face courses a student is not allowed to leave the teaching hall. In case many students lose their interest an experienced teacher starts a summary, a clarifying example to get students back in the teaching-learning process. In regular courses there is support of peers during the breaks or after the lectures. In MOOCs social support of peers is wanted but usual less developed. There is a trend to develop MOOCs as self-paced courses for individual students. That makes these students vulnerable for negative interactions.

Activity: Attractive learning material and required capabilities are prerequisite of a positive interaction process of a student with his learning material. Next a student is assumed to play an active role in this process. Many students read the description of the offered courses, they even enrol in the courses but the next step is to start the study activity. Most MOOCs are not designed for passive students, a lot of activity is required varying from posing and answering questions, making assignments and involvement in project activities. After positive feedback from the interaction process of students with the learning material the activity can be increased

Distraction: Interest and sufficient capabilities are the positive drives of the interaction students with the learning material. But there are also two negative drives. Distraction is the first negative drive. In case of MOOCs students usually study in a stimulus rich environment. The computer used for taking the course offers a lot of alternatives for distraction especially in case the MOOC material gets boring or is beyond the capabilities of students.

Physiology: A second negative drive is the physiological sate of the students. If a student gets hungry, sleepy he can start a break. A lot of discipline is needed for a restart and to keep the length of the break under control. In case of regular courses there are social rules, institutional rules regulating breaks.

In the Figure 3 we displayed the teaching-learning process of MOOCs on a micro-level. The model has been validated by some exit interviews of students. Drop-off students usually receive a questionnaire to research the causality of a drop-off. But the response of such questionnaire is usually very low. So additional research is needed.

CONCLUSIONS AND FUTURE WORK

In this paper we introduced a didactic model for regular courses. This model was not focussed on the static characteristics of students and his learning environment but on the dynamic aspects of the interaction student with their teaching learning environment. On the macro and meso level this model can be used as a model of distant learning. But distant learning is characterised by individual freedom and less feedback and control of peers and teachers. As soon as a student enrolled a course for distant learning and start his first lessons he is driven by his motivation and wish to complete the course successfully. In the first interaction with the learning material it will prove if the learning material is stimulating and motivating. The interaction student learning material stimulates active participation of students and then it will prove if his knowledge and abilities are sufficient to start and complete this course successfully. If the learning material is not appealing for the student and if he is unable to perform the assignments, his interest for the course will gradually slope down and a process of dropout could be started. As noted before, during regular courses a student following a lecture is unable to leave the lecture room and is able to make a restart if the teacher gives a summary or for example presents an example. The learning experience will be discussed with peers during the breaks. In distant learning the interaction with peers and teachers cannot be realised in a face to face way but should be realised by social media or other ways of distant communication. The process of instant interaction student teaching learning environment has been described

by the second didactic model presented in this paper. The learning material should trigger a student to go on, increases his motivation and stimulates his eagerness for more knowledge and new skills. Otherwise the course will have high dropout rates. How to bind a student to the course and University is of great importance for distant learning. Our introduced model is a first step to get insight in the deep level learning process of a student. In [9,10,11] we discussed how emotional aspect contribute to the binding process of students.

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