

DIVERSITY OF STUDENTS AND THE CONSEQUENCES FOR E-LEARNING

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Students are not a homogenous group. They differ in cultural, motivation, cognition, learning styles and strategies as well as consciousness, self reflection and other aspects. The article reports some recent findings concerning the diversity of students that pose a problem for eLearning and discusses the question if adaptive systems may be a solution for the problem. It argues for open learning environments.

1 CULTURAL AND ETHNIC DIVERSITY

Uri Treisman (1992) reports his experiences with courses in mathematics in Berkeley that Black and Latin American students show worse results than Asian and White students. Many did not finish the course (<http://math.sfsu.edu/hsu/workshops/treisman.html>). Assistive courses were not accepted, but seemed to be discriminating black students. Interviews with Black and Chinese students opened the eyes for the extreme diversity of both groups: The Black students and the blue collar Whites and rural students typically worked alone, whereas the Chinese students “studied calculus for about 14 hours a week. They would put in 8 to 10 hours working alone. In the evenings, they would get together. They might make a meal together and then sit and eat or go over the homework assignment. They would check each others’ answers and each others’ English.”

Treisman introduced group work and fostered community life. He was surprised to observe the enthusiasm of the students and the intensity of their interaction in problem solving. Carefully selected math tasks were extremely helpful: “The results of the program were quite dramatic. Black and Latino participants, typically more than half of all such students enrolled in calculus, substantially outperformed not only their minority peers. But their White and Asian classmates as well.”

What is the essence of this story? It demonstrates that cultural and ethnic differences between groups of students have a relevant effect on learning. And the story tells us that support for minority groups may result in a failure if the minority is addressed as such, whereas a change in teaching methods taking into account the diversity among students may be successful.

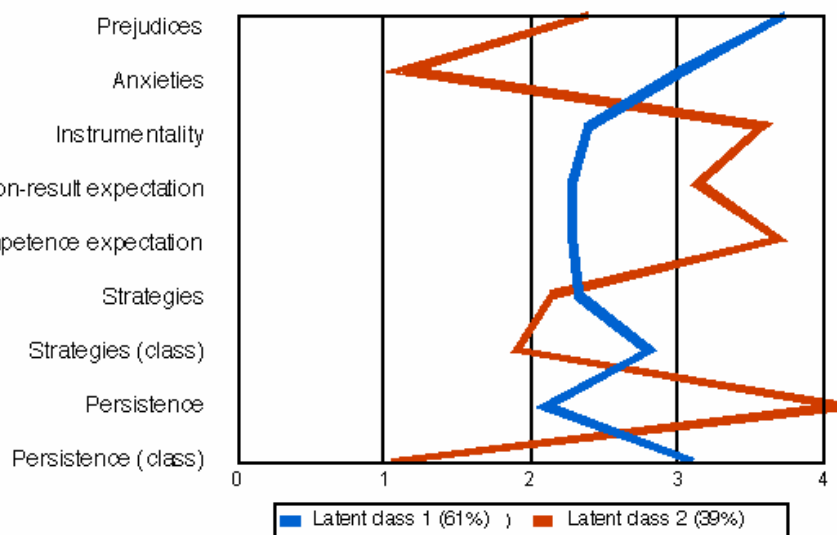
The economic relevance of diversity is illustrated by a study of Parker (1999) who found that “locus of control and source of financial assistance” predicted dropout from distance education courses up to 85 percent. What constitutes the diversity of students? There are a number of known dimensions of personality which are relevant factors in learning: Motivation, cognition and learning styles, learning strategies, learning preferences, consciousness and self reflection. The following is a first contribution to this research.

2 MOTIVATION AND ANXIETY

I have investigated students of psychology while learning statistics with tests, experiments, and with “loud thinking”. I found sources of learning difficulties and cognitive mistakes (Schulmeister 1983). A factor analysis, using items from Dreger & Aiken (1957) and Heemskerk 1975, yielded a strong disinclination to learn statistics consisting of two motivational types. One group had strong doubts concerning the role of statistics and empirical research, the other showed anxiety in dealing with formulae. Learning difficulties are motivational problems, one root may be of epistemological nature, the other may be a result of negative experiences with mathematics in school.

Studies by Zeidner (1991), Renkl 1994, and Abel 1999 have corroborated these findings. The construct „statistics anxiety“ proved valid with psychology students in Germany. While evaluating the learning software „Methodenlehre-Baukasten“ (building block for methods education; Vollmers, Schulmeister et al 2003) we again investigated the construct. The test was developed by Martens (2003) using scales by Prenzel, Kramer & Drechsel (2002) and Deci und Ryan (1993).

A pretest with more than 300 students confirmed our hypotheses. A latent class analysis generated two latent classes. Students of class 1 (61%) have a positive relation to statistics, less prejudices, expect positive results, and rely on their competence. Students of class 2 (39%) share a strong bias against statistics, do not expect to be successful, do not rely on their competence, and are inclined to give up early. Both groups do not differ much in their choice of learning strategies. But class 2 students prefer learning in groups to compensate their deficit. Gender is evenly distributed within the two classes. The gender difference is not significant.



META: Latent Class Analyse

Abb. 1: Latent Class Analysis of motivation in statistics classes (Martens 2003)

It is safe to assume that both groups of students need different teaching methods and learning strategies in order to be successful. Comparable motivational constructs (e.g. computer anxiety, cf. Chu & Spires 1991) may be found in other disciplines. Disregarding the diversity of students may result in failure.

3 COGNITION, LEARNING STYLES AND LEARNING STRATEGIES

The University of Central Florida (UCF) investigates its students in online education with a learning style inventory of W. A. Long (Twigg 2001):

Tab. 1: Learning styles of online students at University of Central Florida (Twigg 2001, S. 8)

Type	N	%
Aggressive Dependent (AD)	228	60
Aggressive Independent (AI)	87	23
Passive Independent (PI)	47	12
Passive Dependent (PD)	19	5

It is remarkable that there is a majority of aggressive dependent students in online courses, since another study of UCF found that all four types of students are equally distributed in non-virtual environments. May it be that online courses are attractive for this type of student? On the other hand, AD students and PD students expressed a wish for more non-virtual classes, while AI students and PI students did not. Anyway, I share the conclusion by Twigg: „We need to treat students as individuals rather than as homogenous group.“ (Twigg 2001, S. 5)

Learning styles research seems to become a hot topic in American universities. Towson University even founded a „Learning Styles Resource Center“ (<http://polaris.umuc.edu/~rouellet/learning/long.htm>) that administers a Learning Style Inventory to students of Towson and Maryland University.

While evaluating the „Methodenlehre-Baukasten“ we developed a learning style inventory on the basis of Kolb (1984) to find out if our students prefer a certain learning style that coincides or conflicts with our didactic concept. The inventory was validated with a sample of more than 400 students (Wolff 2003). The result showed an uneven distribution of the four learning types. It is now our aim to find out if one or more types of learners may profit from our concept of discovery learning in statistics.

Tab. 2.: Learning types according to Kolb (Wolff 2003)

Diverger	87	Converger	59
Assimilator	93	Accommodator	125

In another study investigating several courses in statistics we found a similar distribution of learning styles. Always assimilators and accommodators are the dominant learning styles. A differentiation according to gender is significant, but depending more or less only on one learning type (less males and more females of type diverger than expected). Otherwise gender is evenly distributed within the other three learning types.

Cook in a study of learning styles according to Kolb with 739 students found a high diversity of styles, but no significant interaction with gender. Mills (1993) found that learning styles as mediating variable decreases “between-gender” differences, whereas they increase “within-gender” differences. De Lange & Mavondo however found a significant interaction between learning styles, motivation and gender, but admonish to be careful, because it might be artefacts of the survey instruments used. Richardson & King (1998) maintain that styles are not gender specific. As a whole, variables that are relevant for learning, e.g. cognitive competence, learning style or motivation, seem to influence diversity more than gender.

4 COMPETENCE AND SATISFACTION

The Sloan Consortium on the basis of the National Postsecondary Student Aid Study, 1999-2000, with 60.000 distance education students (Sloan-C View ISSN 1541-2806 Volume 2 Issue 2 - April 2003), has recompiled the data and related them to the SAT score (Scholastic Aptitude Test; <http://www.collegeboard.com>) of the students, which was split into four classes. Satisfaction with distance education was highest among students with the lowest SAT score, while students with the highest SAT score showed the lowest degree of satisfaction and the highest degree of criticism. The degree of satisfaction was independent of teaching methods (video, Internet, etc.), age, type of institution as well as gender:

Tab. 3: Satisfaction with distance education and SAT score (Sloan-C 2003)

SAT Score	More satisfied (%)	Same (%)	Less satisfied (%)
1201-1400	8	48	44
1001-1200	12	53	35
801-1000	16	52	32
601-800	32	49	19

Is it possible that satisfaction with distance education implicitly denotes didactic parameters like learning preferences or learning styles? Satisfaction and acceptance are not independent variables, thus it is necessary to search for factors explaining satisfaction differentially or multivariate. One important error made in E-Learning today is the neglect of the diversity of students and the choice of a learning model that does not allow differentiation and learner centered learning: „All too frequently, even innovative institutions fall back on a one-fits-all approach [...] forgetting that students are different and have different needs“, reminds the former Educause vice president and director of the Center for Academic Transformation of the Rensselaer Polytechnic Institute, Carol A. Twigg (<http://www.center.rpi.edu>).

5 LEARNING PREFERENCES AND INSTITUTIONAL FACTORS

John C. Reis (1998), after experimenting with a number of modern teaching methods, summed up his experiences: „Students preferred active learning in classes (less lecture) and working assignments in teams.“ There are many studies like this one, but probably many as well that came to alternative conclusions. Thus Hobbs & Boucher (1997) found that students prefer traditional methods. It seems to be risky to rely on the result of interrogations trying to explore the learning preferences of students. The self-reflection of students sometimes does not match reality. Uri Treisman, wanting to ask students, how many hours they studied, had to drop this method, because he did not trust their answers: “The students weren't being dishonest, they just didn't have an accountant's view of how they organized their time.”

Sander and Stevenson (1998) questioned 395 freshmen in medicine, psychology and economy about their learning preferences and expectations. Lectures were rejected, although most students expected to be taught in lectures. Most students wished innovative teaching methods. Sander and Stevenson admitted that the learning preferences of students might be unrealistic.

The assumption that preferences of students – for lack of experiences with alternatives – are influenced by the culture encountered at their university is affirmed by a study of Waite, Jackson, Diwan, and Leonardi (2004). The reason for their experiment was the criticism of

the industrial advisory boards of their universities Colorado in Boulder and Stanford: “Our industrial advisory boards tell us that our students are well prepared technically, but they lack important group work skills.” Trainings did not improve the situation: “The students had an inherent bias against collaboration, and this bias was reinforced by the way in which assignments were posed and assessed.” Learning preferences of students are depending on their limited experience and are influenced by institutional conditions. That makes it difficult to find out what students really need. Waite et al proposed a modification of teaching methods, which did not seem easy to realize, because the lecturers had to change their role. Changes are only successful in a long-term experiment:

“The results of our longitudinal study show that, although these strategies may initially be strongly resisted by the students, they lead to better performance and increased student satisfaction. Over time, as students who have experienced them move through the curriculum, resistance decreases and the benefits begin to accrue earlier in a course due to carryover from previous courses.”

6 IS AN ADAPTIVE LEARNING DESIGN A SOLUTION FOR THE DIVERSITY PROBLEM?

The more we know about the diversity of students the more it becomes difficult to find a solution for this problem. I am sure that no teaching method is equally suited for all disciplines and all learners. But I am also sure that it is not possible to prepare variations of methods for different learners. This way seems economically not feasible. Astonishingly some developers of learning software seem to follow that path.

Espinoza & Hook developed a hypermedia system that adapts to the user. In this case adaptivity simply is the learning mechanism of a search engine, which may be pragmatically useful, but is in no means able to take the factors of diversity into account.

In NetCoach (<http://www.stemnet.nf.ca/~elmurphy/emurphy/adaptive.html>) adaptivity is generated by comparing lessons as knowledge base and the reactions of learners to test questions. The two criteria yield consequences for navigation and tutorial recommendations, not for alternative methods of teaching and learning. Intelligent tutorial systems (s. Schulmeister 1997) try to achieve this aim by developing a user model.

The WINDS Project (Web-based Intelligent Design and Tutoring System; Specht et al 2002) develops an Adaptive Learning Environment (ALE). ALE aims at individualized courseware “depending on their current state of knowledge, their preferences and learning styles.” It integrates a learning style inventory: “In this way, the system can adapt the sequence of learning objects according to the chose learning strategy.” What NetCoach achieves with simple multiple-choice questions, ALE tries to do with a user model and a learning style inventory.

“One primary obstacle facing e-Learning is its inherent ‘one-size-fits-all’ approach” (<http://www.indiana.edu/~scstest/jd/adaplearntech.html>), is the central statement of the Talon project of Indiana University. Talon’s ambitious aim is it to integrate the versatility of a real teacher into a virtual teaching system. Talon takes into account following variables of diversity: „visual learning, writing skills, critical thinking, time-revealed scenarios, case studies and empirical observation“. This collection of items seems to be rather strange and poses a number of critical questions: Is a sophisticated analysis of learner profiles really

possible? Does an adaptive system make sense or is it legitimate? Does the model really comprise all relevant variables, e.g. contextuality, culture of the discipline, which contribute to variability and learn ability? Is the development of learning objects for highly complex learning environments in multiple modality really feasible? I doubt that in the face of the multitude of dimensions and interactions between the variables it may be possible to develop an adaptive system that takes into account the individual differences of students. It seems to be absurd to develop a machine that automatically assigns different instructional methods to learning objects based on an individual analysis of learners.

Another project, VALA, will track “ability, cognitive style, learning style, and personality” and assign different methods as “treatments”. The external evaluator of this project criticizes that research has barely produced any useful criteria that allow to fit learner variables and instructional variables:

“The crux of the problem is ‘which differences- what treatments.’” She throws doubt on the assumption that “the research is sufficiently developed to identify the specific treatments that will be more efficacious for specific learners under all circumstances or even if this principle is consistently generalizable to web-based instruction. In fact, the use of web based instruction is a treatment modality itself in the larger context.” (<http://www.vala.arizona.edu/website/external.htm>)

There are several reasons not to accept adaptive systems as a solution for the diversity problem:

- The number of variables and their interactions is too high
- Fitting teaching methods to learning methods has no sound basis in research. There is no theory telling us which instructional methods make sense for which individual attitudes, there is even no empirical research
- The gap between theoretical assumptions and pragmatic decisions cannot be bridged by simple deduction, but are subject to norms and value judgments.

If adaptive systems are not the solution to diversity, what else may be the right way? The alternative to adaptive systems are open learning environments (Schulmeister 2004). OLEs are learning environments in which the learner has rich degrees of freedom to interact with learning objects. OLEs are highly interactive environments in which the learners adapt learning objects according to their individual needs and preferences. OLEs are systems that utilize discovery learning, case-based learning, or problem-based learning, cognitive tools or “mind tools”. In OLEs the learner has the chance to vary the learning method and to adapt to the environment or to adapt the learning objects to his strategies.

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