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Educational System based on Cognitive styles and/or Learning styles?

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Abstract

The concept of cognitive styles is frequently applied in the field of educational systems research (Chou, Chan & Lin, 2003). Roberts and Newton (2001) suggested that although the concept of cognitive styles is a useful starting point, it is unable to account for many finds in the literature, and that any model of strategy usage that is reduced itself to mechanisms governing strategy selection is incomplete. It is necessary to consider which strategies people have available and how they discover new ones. Therefore, the aim of the present study was to investigate the learning strategies of undergraduate students of Psychology and Computing Sciences courses in order to explore possible variables to implement in a Intelligent Tutorial System. Thus, to evaluate learning strategies, the Ross Test of Cognitive Process, which evaluates the student individual performance of thinking process and strategies, was used. The results suggests that each group have different learning strategies choices. According to this, it is discussed the use of learning strategies to implement educational systems.

Educational systems

Educational systems are a kind of system which act as tutor and it is known as Intelligent Tutor System (ITS). The ITS are systems which help in learning process and permit the devolpment of a cooperative enviroment between system and student. The objective of these systems is to improve learning process, promote cognitive flexibility and guide the students through learning process. This objetive is made through identification of students interests and needs. So, these systems work with the individual differences of students, including cognitive/learning styles (Carver et al, 1996; Papanikolaou et el, 2001; Triantafillou, 2003).

The Educational Systema is compound by three modules: Dominion Module (set of dominium content); Student Module (student features); Adaptative Module (according student's cognitive/learning style and information, the dominium content is adapted). The modules work integrated with different aspects of learning

process, adapting the content according student's knowledge, combining presentation mídias of the content, adapting learning strategies (tactics) and modifying examples and links.

There are two principal systems: Intelligent Tutor System (ITS) and Companion System. The main focus of ITS is manage with students individual necessities and give an adaptative feedback of the system to the student. The ITS must comprehend student's need and offer interactive strategies to the student. In general, these systems have four modules (Wenger, 1987): Dominion Module (Knowledge which represents learning objectives); Student Module (detects student's beliefs, actions and mistakes. It is used to give adaptative feedback to the student); Pedagogical Module (it is the pedagogical strategies used to guide student's interaction with the system); Interface (communication module with student). The other system, Companion System, uses educational agent in its structure and this agent has two plays: intelligent tutor and learning companion (Chou et al, 2003). A leaning companion acts like a student's companion during interaction and offer activities within the enviroment, it can colaborate or compete like a human student. The human student can observe campanion's actions while solving problems or explaining the solutions as a part of programmed actions of the companion. The purpouse of the enviroment is to use several campanion's agent in order to identify student's features such introversion, extroversion, among others. This agents are a kind of educational agents with human characteristics (showed by text, graphs, icons, voice, animation, and others) which facilitates social learning.

The pedagogical and didatic propousals of software products with ITS characteristics are extenses (Corredor, 1993), because it confirms the importance of student's individual features, recognizing that instruction could be individualize in order to facilitate the development of student's conceptual and methodological structures

according to his/her capacities and interests. Since the 80's there are several studies with substantial evidencies showing that the use of ITs improve student's performance who interact with these environments in relation to those who interact in traditional classroom (Cutmore, Hine, Maberly, Langford & Hawgood, 2000; Lee, Cheng, Rai, Depickere, 2004; Rau, Choog & Salvendy, 2004; Workman, 2004). However, there are still several critics in relation to the reliability of these results because there are different environments (virtual and real), leading to different variables. Moreover, different pedagogical and methodological concepts are used, so the comparison and the validity within these results are not reliable (Roberts & Newton, 2001).

Cognitive Style / Learning Style

The concept of cognitive style refers to a consistent and distinct way a person has to coding, organizing and performing with information, leading to a cognitive management of learning strategies (Riding & Cheema, 1991; Atkinson, 1998; Souto, Verdin, Wainer, Madeira, Vicari & Oliveria, 2002). Cognitive style implies in a cognitive control which gives organizational and representational interfaces of inner state and exterior world (Riding, 1997; 2000). Thus, cognitive style and learning style could be just different names to the same characteristic. However, Sandler-Smith (2001) point out that cognitive style is an independent characteristic from personality, as well as cognitive style is independent from learning style, which would involve comprehension, transformation, representation and organization. Moreover, the author suggests that both styles are complementary.

In educational system research the concept of cognitive style is widely used (Chou, Chan & Lin, 2003). Roberts and Newton (2001) suggested that although cognitive style is a very important starting point, there are in the literature several evidences showing that any model of strategies use which resume itself to a mechanism that governs strategy selection is incomplete. It is necessary to consider which strategies people have and how they discover new ones. In real world, a variety of strategies are used, even in the most ordinary task, and this is a testimony of human capacities of thinking and imagining. Roberts (1993, 2000) concluded that for any task which involves thinking, problem solving or judgment, in which individual differences in the use of strategies are practically inevitable, the research which assumes that people use same methods will inevitably fail. In contrast, efforts could be directed to comprehend individual differences about strategies uses. To this author, strategy would be any procedure that is not obligated or have a directed goal, been a set of cognitive processes which, in theory, could be modified, i.e., through discovery or instruction. Therefore, the processual constituents of certain cognitive activities could be immutable, i.e., visual perception, and the process used in other activities could be modified at any moment, and a set of modified cognitive processes could constitute a new strategy.

Aim of the study

The aim of the present study was to investigate the learning strategies of undergraduate students of Psychology and Computing Sciences courses in order to explore possible variables to implement in an Intelligent Tutorial System.

Method

Participants: 135 undergraduate students (79 from Computing Science and 56 from Psychology), with age between 18 to 40, was invited to participate in the study.

Instruments and Material: The Ross Test of Cognitive Process was used to measure cognitive strategies. The main objective of the test is to evaluate student's individual performance in thinking processes (Ross & Ross, 1976). The test was conceived to measure 3 general abilities, analyses, syntheses and evaluation, and in each of the 8 subtests (Analogy, Deductive Reasoning, Missing Sentences, Abstract Relations, Sequential Syntheses, Questioning Strategies, Relevant and Irrelevant Information, and Attribute Analyses) specific abilities are defined (table 1).

Table 1 – Abilities tested in Ross Test - Bloom (1976)

ROSS TEST		
Analyses	Syntheses	Evaluation
- Analogies (AN)	-Abstract Relations (AB)	-Deductive Reasoning (RD)
-Missing Sentences (PA)	-Sequential Syntheses (SE)	-Questioning Strategies (EQ)
-Relevant and Irrelevant Information (IN)	-Attribute Analyses (AT)	

Procedures: The test session took place in a classroom and those students who did not want to take part of the study could leave the room freely.

Results and Discussion

To a better analysis of the results, the sample was divided into 2 groups: Group 1 (Psychology students) and Group 2 (Computing Science students). Through the analysis of the test, there is a small difference about reasoning strategies used in both groups (Tables 2 and 3). Although, the variance within the students was very large. In group 1, subtests with bigger means were Deductive Reasoning (RD), Attribute Analyses (AT) and Missing Sentences (PA), respectively, 58,286; 57,143 e 56,929. On the other group, the subtests with bigger means were Relevant and Irrelevant Information (IN), Attribute Analyses (AT) and Deductive Reasoning (RD), respectively 74,114; 72,608 e 69,481.

Tabela 2: Teste Ross – group 1 (Psychology)

	AN	RD	PA	AB	SE	EQ	IN	AT
N	56	56	56	56	56	56	56	56
Min	0	1	0	0	16	1	0	0
Max	92	98	92	79	99	92	97	97
Mean	45.46	58.28	56.92	37.05	43.21	51.14	45.39	57.14
SD	30.65	29.76	35.08	30.23	27.78	26.72	30.55	26.22

Tabela 3: Teste Ross – group 2 (Computing Science)

	AN	RD	PA	AB	SE	EQ	IN	AT
N	79	79	79	79	79	79	79	79
Min	6	5	3	0	16	1	6	12
Max	96	98	98	79	99	92	99	97
Mean	67.17	69.48	67.53	57.41	61.08	61.02	74.11	72.60
SD	23.68	27.86	28.23	23.48	29.03	24.96	23.61	21.91

In the field of educational systems, cognitive style is used to built student module which shows the consistent and distint way a person has to coding, organizing and performing information, leading to a cogntive management of learning strategies. So cognitive style implies in a cognitive control of organization and representation, but not to a fixed group of learning strategies. Thus, in order to improve student's ability to acquare information it is necessary to consider which are the most frequent learning strategies he/she uses or his/her learning style. Moreover, if we consider that depending on the content to be acquired by the student, he/she has to show some cognitive flexibility to adapt old strategies or create new ones, this means that new strategies were created in order to provide information to be coded, represented and organized according to characteristic student's cogntive style. As a result, the concept of cognitive style implies in a personality characteristic while learning style implies in a group of tools used to access information, showing an adaptative component of student's learning process (Sandler-Smith, 2001).

In every Educational System the principal goal is to promote cognitive flexibility and guide the students through learning process. To achive these objectives the system must be capable to adapt itself to the learning needs and interests of the students. So, using learning styles concept it is possible to arrange a variety of variables that are independet of cognitive style and personality, but have correlations to these. This makes the systema more capable of adaptability, specialy to promoto cognitive flexibility. Moreover, this variable makes possible to identify student's preferences in relation to content structure, because cognitive style refers to a cognitive control between inner state and (representation) and external world. Thus, agregating learning style to the student module would implies to built a base of student's strategies frequently used and also prepare an adaptative module with tactic, knowledge, midias, links and examples considering these strategies as a teaching plan. According to Bloom (1976), all teaching plan should be

construct considering student's learning strategies. The author suggest that within teaching plan it should be consider the strategies that are less used by the student in order to develop a reasoning flexibility.

The present study indicates that there is a strong variation within students in relation to strategies use. However, the test gives some intersting variables to built an educational system based on prefered strategies, opening a possibility to have a system which could be capable not just to instruct students about chosen dominium of content, but also to make possible the development of metacognitive abilities.

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