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Technological Persuasive Pedagogy: A New Way to Persuade Students in the Computer-based Mathematics Learning

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Abstract
This study is an attempt to introduce a new technological pedagogy which is more effective in students attitudes toward mathematics. Content Analysis method as a qualitative research method was used in this research. Based on research method 16 principles were obtained prior persuasive models, theories and approaches. They are as usable principles to persuade students in the computer based mathematics classrooms. These principles can be employed by teachers and course ware designer in three different conditions; first, for students with negative attitude toward mathematics. Second, increase the positive attitude of the students to a higher level. Last but not least, for create a condition to prevent of changes in students' attitude from positive level to lower level.
Keywords: Persuasion, Pedagogy, Persuasive Technology, Attitude, Computer-based Learning

1. Introduction

In these decades, the appearance of technologies has caused enormous changes and innovations in man's life style, communications, education, and so on. These technological changes have provided the opportunities to enhance the learning processes by the way of appropriate utilization of learning theories. In fact, this is the era of persuasive technological pedagogy which supported by computer programs, internet advertising, web sites, virtual newspapers, CD ROMs, e-books, and so on.

Nowadays, perhaps one of the essential skills for teachers and trainers is persuasive technological pedagogy, which enable them to help learners for developing their skills and abilities (Bacon, 2011). Perloff (2010) believed persuasion is a process that attempts to change attitude in an atmosphere of free choice. Therefore, changing attitude through influencing techniques is a key into persuasion activities and persuasive technology. Generally, attitude is an individual evaluation regarding other individuals, objects or issues (French, 2008; Petty & Cacioppo, 1996).

The significant feature of Computer-based Learning (CBL) which makes it different from other media is interactivity. The computer is able to engage, communicate and adapt to the learner (Jacko & Stephanidis, 2003). Thus, if this technology is properly applied, it can appear as a beneficial factor and component to perform learning models and strategies in the educational systems and learning process.

2. Statement of the Problem

Often children set mathematics aside as a cause for concern in school, despite their limited exposure to it (Hoyles & Lagrange, 2009; Zeidner & Matthews, 2010). A negative attitude towards mathematics could considerably reduce a person's willingness to persist with a problem. Without the ability to persevere mathematical development is likely to be difficult. The conceptions, attitudes, and expectations in students regarding mathematics is considered as a significant factor underlying their school experience and achievement (Schoenfeld, 1985). Also, (Koçak, Bozan, & IsIk, 2009) pointed out that mathematics education, instead of learning just pure mathematics, should be aimed to educate people in a way to enable the learners to apply what they have learned, do mathematics, solve problems, connect information and enjoy the courses.

3. Persuasion

Researchers have introduced persuasion in various definitions. This means working on this issue is sensitive, delicate, and difficult. Although there are different definitions for persuasion (Andersen, 1971;(Bettinghaus & Cody, 1987; O'Keefe, 1990; Smith, 1982), perhaps Perloff definition is a succinct explanation; "a symbolic processes in which communicators try to convince other people to change their attitudes or behavior, regarding an issue through the transmission of a message in an atmosphere of free choices" (Perloff, 2010). Generally, the persuasion process represents a conscious attempt to influence others' attitude, behavior or both (Goode & Ben-Yehuda, 2010)

3.1 Prior persuasion models, theories, and approaches

Although the response shaping, reinforcing, and changing processes are elucidative when the persuasion process is described, theories may apply to more than one objective. They may be contained one, two or three different persuasion processes. The theories are not delineated based on the three above persuasive processes. For instance, a theory may be useful for persuading a learner both to keep an attitude (response reinforcing) and to change an attitude (response changing) or even convince learner for starting a new attitude. Researchers have different ideas about occurrence of persuasion. Some groups focused on messages conditions, others on behavior, on process and other ideas. But often is used these categories: Message Effects Models, Attitude–Behavior Approaches, Cognitive Processing Theories and models, Consistency Theories, Inoculation Theory, and Functional Approaches (Cameron, 2009). Also, Captology is used as new category that contains a situation for persuading others in the computers world (Fogg, 2003). Table 1 represents a brief structure of persuasion categories based on different models, theories, and approaches (Cameron, 2009).

4. Methodology

The research tool in qualitative methodology which is used to determine presence of certain concepts or words within texts or sets of texts is Content Analysis. Briefly, Content Analysis is defined as the systematic, objective, quantitative analysis of message characteristics. It includes the careful examination of human interactions (Neuendorf, 2002). Investigators analyze and quantified the presence; relationships of such words, meanings and concepts, then make inferences about the messages. These inferences are within texts, among writer(s) and audience, and even in culture and time (Nemati & Barko, 2004).

4.1 Collecting and Analyzing Data

For collecting data from persuasion theories, models and approaches, according to literature review, there are seven different categories about persuasion. Each of which contains one or more model, theory and approach (For more detail see Table 1), these categories were studied carefully before collecting the data. In fact, this process is done to obtain theory and rational, conceptualization and operationalization of this study. In this way, the researcher attempted to find and extract principles of persuasion models, theories and approaches by using Content Analysis. These extracted principles and concepts are listed in Table 2.

After extracting models' principles, coding step was conducted. Coding is a process of transforming raw data into a standardization form (Neuendorf, 2002).As mentioned, after determining rational of research, coding needs the logic of conceptualization and operationalization (Babbie, 2010). In this part, principles and concepts were combined for preparing the next steps. These combinations are represented in Table 3. Thus, based on these combinations, sixteen 16 titles, each of which originated from one or more principles and concepts, were prepared. This is not be ignored that these combinations are conducted for preparing a teaching and learning process for computer based mathematics learning in schools.

In the next step, for pilot reliability of coding, three researchers (PhD students in educational fields) reviewed the extracted codes. They agreed on the coding, after a discussion on extracted principles. Then, in an independent coding test, reliability of each code was ascertained. At each step, the codebook or coding form were discussed and revised if needed.

To conduct coding step, a codebook based on combined persuasive principles was prepared. This codebook contained 16 different codes originated for 38 principles. In fact, these 16 codes were obtained to integrate previous principles. Table 3 lists the results of the coding process. It should be noted, based on main research goal, these code are prepared for using in computer based learning processes (see Table 4).

Next step is the final reliability for coding. In fact, no specific norm to reliability for Content Analysis methodology was obtained. Krippendorff (2004) believes, although every Content Analyst faces this question, there is no set answer. To shed light this matter, it can be said that:

- Rely only on variables with reliabilities above $\alpha = .800$
- Consider variables with reliabilities between $\alpha = .667$ and $\alpha = .800$ only for drawing tentative conclusions. (Krippendorff, 2004)

According to these view, William Scott formula was employed for measuring reliability of this coding process. Based on this formula, for recoding, 20 percent of models, theories and approaches with operational definitions were given to three researchers (Scott, 1955). As a result, reliability of coding process was $\alpha = .896$ that is an acceptable norm of reliability based on Krippendorff definition. After to conduct this step, results were reported as follow (See Table 6)

The last step in Content Analysis method is tabulation and reporting. Before that and due to little differences between experts in the reliability of coding process, a meeting was organized. In fact, this meeting held to finalize coding between the researcher and collogues who conducted the coding. Accordingly, coding table (see Table 6) was approved by all participants in meeting. Therefore, coding process was completed with 16 codes.

5. Conclusion

In doing this study, the history of previous investigations about persuasion and persuasive models were reviewed. After reviewing the persuasive definitions, models, theories, and approaches a list of persuasion principles was extracted based on Content Analysis Method. Although these principles are introduced as elements which can be used to design a course ware to persuade learners, the importance of creativity and innovation in designing process may not be neglected. Therefore, spread of this issue is very much in performance steps. In light of different abilities of course ware designers are very different; the proposed technological pedagogy way, may act as a guideline for course ware designer and teachers. Moreover, teachers' abilities for combining these principles with teaching method are very important. On the other hand, these principles and elements can play a general role for the student with various levels of attitude toward mathematics. First, the students who have negative attitude toward mathematics; for leading their attitude to positive level. Second, for increasing the students' positive attitude to higher levels. Last but not least, for making a condition that prevents changes in students' attitude from positive level to lower levels.

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Table 1. Persuasive Theories, Models, and Approaches

Theoretical Category	Theories Discussed
Models with focus on massage	Message learning approach: 'Yale Model of Persuasion'
Approaches with focus on attitude-Behavior	Theory of Reasoned Action/Theory of Planned Behavior Triandis Model of Interpersonal Behavior
Models with focus on Process	Elaboration Likelihood Model Heuristic-Systematic Model Social Judgment Theory
Theories with focus on Consistency conditions	Balance Theory Cognitive Dissonance Theory Probabilogical Models
Theory with focus on Resistance to change	Inoculation Theory
Approach with focus on Functions	Functional Approaches
Computer Based Approach	Captology Theory

Table 2. Principles and Concepts of Persuasion Models, Theories and Approaches

Categories of Models, Theories and approaches	principles and concepts of persuasion
Message Effects Models	Existence of a clear message, presenting message in a new process, assent of message by recipient
Attitude Behavior Approaches	Attention to recipients' attitude and believes, to create new motivations, present new concepts and knowledge, attention to social norms
Cognitive Processing Theories and Models	Increase of the knowledge, creativity and innovation in the presentation, possibility to change in the conditions, using past knowledge, fixing defects and solving problems, to create testing ability
Consistency Theories	Attitudes towards subject, attitudes towards presenter, possibility to change in forming elements, present new knowledge, presenting importance of subject, Presenting logical deduction, concluding based on reasons
Inoculation Theory	Presenting logical reasons for new issues, presenting in the appropriate conditions
Functional Approaches	Presenting usefulness reasons, giving reward, removing punishment
Computer Based Approaches	Reducing complexity, attention to tunneling, providing new information relevant to individuals, possibility of personalization, Presenting in the appropriate conditions, possibility of self-evaluation, giving reward, possibility of simulation situations, physical cues, psychological cues, language cues, social dynamics cues, social role cues

Table 3. Grouping Extracted Principles

No.	Combined Principles and Concepts	Frequency
1	Existence of a clear message, assent of message by recipient, Presenting logical deduction, concluding based on reasons, presenting usefulness reasons, Reducing complexity	6
2	Presenting message in a new process, increase the knowledge, presenting logical reasons for new issues, present new concepts and knowledge, present new knowledge, providing new information relevant to individuals	6
3	Attention to psychological cues, presenting in the appropriate conditions, presenting in the special conditions, to create new motivations	4
4	Giving reward, removing punishment, giving reward	3
5	Attention to social norms, attitudes towards presenter, social role cues	3
6	Attention to recipients' attitude and believes, attitudes towards subject	2
7	To apply language cues, social dynamics cues	2
8	Possibility to change in forming elements,changes in physical cues,	2
9	Possibility to change in the conditions, possibility of personalization,	2
10	possibility of self-evaluation, to create testing ability	2
11	Fixing defects and problems	1
12	Possibility of simulation of conditions	1
13	Presenting importance of subject	1
14	Using past knowledge	1
15	Attention to tunneling process	1
16	Creativity and innovation in the presentation	1
	Total Frequency	38

Table 4.Codebook of Persuasion in Learning Process

Code No.	Codes' Description
1	To transmission of messages, by employing rational steps and processes are effective to persuade learners.
2	The contents which are presented to increase the learners' knowledge are effective for persuading them.
3	Attending to learners' emotion, empathy and compassion can be effective on persuade them in the learning process.
4	Giving reward and to remove unpleasant contents during learning process to learner can be effective in persuading learners.
5	Ability to produce the social roles based on social norms can be effective to persuade learners.
6	Attending to learners' attitudes and beliefs can be effective in persuading them to learn.
7	Providing an interactive condition in the learning process by languages cues, conversations, etc. are effect to persuade learners.
8	The physical cues that are shown on display can be effective to persuade the learners (i.e. faces, colors, movements).
9	Ability to personalize the display and course ware based on personal interests can be effective in persuading learners.
10	Providing opportunities for self-assessment by learner during the learning process can be effective in persuading learners.
11	Presenting new contents based on learner needs and problems can be effective in persuading learners.
12	Enabling the learners for simulation the real conditions by computer can be effective to persuade learners.
13	Explaining the necessity of presented content can be effective in persuading learners.
14	Consistency of new knowledge and messages with previous knowledge can be effective in persuading learners.
15	To provide the conditions that to guide learners into the learning tunnel can be effective to persuade learners.
16	Providing opportunities in the learning process to enable the learners to access personal creativities and innovations can be effective in persuading learners.

Table 5.Coding Reliability

Researchers	Percentage of Similarity
Researcher 1	% 90
Researcher 2	% 85
Researcher 3	% 94
Total Reliability	α= .896

Table 6.Tabulation Codes

No.	Codes
1	The physical cues that are shown on display can be effective to persuade the learners (i.e. faces, colors, movements).
2	Attending to learners' emotion, empathy and compassion can be effective on persuade them in the learning process.
3	Ability to personalize the display and course were based on personal interests that can be effective in persuading learners.
4	Providing opportunities in the learning process to enable the learners to access personal creativities and innovations can be effective in persuading learners.
5	Ability to produce the social roles based on social norms can be effective to persuade learners.
6	To provide the conditions to guide learners into the learning tunnel can be effective to persuade learners.
7	To transmission of messages, by employing rational steps and processes are effective to persuade learners.
8	The contents which are presented to increase the learners' knowledge are effective for persuading them.
9	Explaining the necessity of presented content can be effective in persuading learners.
10	Attending to learners' attitudes and beliefs can be effective in persuading them to learn.
11	Consistency of new knowledge and messages with previous knowledge can be effective in persuading learners.
12	Providing an interactive condition in the learning process by languages cues, conversations, etc. are effect to persuade learners.
13	Presenting new contents based on learner needs and problems can be effective in persuading learners.
14	Providing conditions to learners for working in simulated conditions by computer can be effective to persuade learners.
15	Giving reward and to remove unpleasant contents during learning process to learner based on their performance can be effective in persuading learners.
16	Providing opportunities for self-assessment by learner during the learning process can be effective in persuading learners.