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The purpose of this study was to investigate the role of e-learning, as a pedagogical tool, for changing initial conceptions when learning about physics by using the learning management System of the Moodle platform. Our study provides an empirical exploration of the pedagogical use of Moodle Learning Management System (LMS) in order to investigate a) the change of students' conception of fundamental issues in electricity and b) their attitudes towards the use of this LMS system. Analysis of questionnaire data shows a slight improvement in students' performance and this difference is associated with participants' conceptual understanding. Students had strong attitudes towards blended learning but this was not reflected upon their intention to further use the LMS, as expressed in responses to the TAM's questionnaire.

Keywords: science education, blended learning, e-learning, Moodle, TAM, LMS

INTRODUCTION

ICT and Science Teaching

Research studies have focused largely on the examination of students' ideas/perceptions of concepts and phenomena within the field of natural sciences (Shipstone, 1985; Lederman, 1992; Duit, 1995; Solomonidou & Kakana, 2000; Psillos & Niedderer, 2002). Students build new ideas in the context of their existing conceptual framework. Extensive research conducted during the last 30 years has shown that students come to science classes with a wide range of informal ideas and conceptions that often differ considerably from accepted scientific views (Driver & Easley 1978; Shipstone 1984; McDermott & Shaffer 1992; Limon & Mason 2002).

Students acquire these intuitive conceptions from their everyday experiences before any formal instruction ever takes place. Although these intuitive conceptions are often poorly articulated, internally inconsistent and highly context-dependent, they offer tremendous explanatory power to the students (Lee & Law 2001; Planinic et al., 2006). As a consequence, intuitive conceptions can be very resistant to change and easily interfere with students' abilities to learn correct scientific principles. In the domain of electricity, there is a large body of research evidence that shows that students at all school levels have severe difficulties in

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State of the literature

- Students come to science classes with a wide range of informal ideas and conceptions that often differ considerably from accepted scientific views.
- Moodle has been used as a LMS platform for sharing useful information, documentation, and knowledge management in research projects.
- Moodle can serve as a pedagogical tool for students
- The Technology Acceptance Model (TAM) is a commonly used model which investigates the users' adoption behavior, in computer systems, by estimating their level of acceptance.

Contribution of this paper to the literature

- This paper provides a critical literature review about students' perceptions on electric circuits.
- This paper provides a significant contribution in literature, regarding on-line learning's use in secondary science education, for concepts related to electric circuits.
- It highlights the positive attitude that is observed towards the model of blended learning and the use of Moodle.
- This study attempts to understand the factors that influence the adoption of Moodle e-learning system based on users' own experience.

and hold common misconceptions about electric circuits even after formal instruction (Cohen et al., 1983; Osborne, 1983; Shipstone, 1984; McDermott & Shaffer, 1992; Shepardson & Moje, 1999; Jaakkola & Nurmi, 2008). Since intuitive conceptions are grounded on personal experience, educational environments should expose students to re-experiencing phenomena and concepts.Moreover, the setting should enhance students' recognition of the conflict between prior knowledge and new concepts as well as support them in the demanding conceptual change process.

One promising method of promoting conceptual change in science learning is inquiry-based (or discovery-based) learning (Hofstein & Lunetta, 2004; de Jong, 2006). Therefore, learning of complex science issues such as electricity often requires not only acquisition of new knowledge, but also changes in students' deeply entrenched intuitive conceptions.This kind of learning is referred to as conceptual change (Limon & Mason 2002; Jaakkola & Nurmi, 2008).

Contemporary instructional approaches expect students to be producers of knowledge and to develop a more active role in the educational process (Psycharis, 2011). Information and Communication Technologies (ICT) enable multiple representations of concepts, foster experimental study and enable the creation of models and problem solving applications (Duit, 1995; Psillos & Niedderer; 2002; Psycharis, 2011). According to Lijnse (2006) focus on modeling is interrelated with the following ideas. The first one is related to the recent constructivist attention to conceptions that students bring to the classroom. The second one regards the present emphasis on the role of philosophy, which highlights the importance of considering the nature of scientific models in science education. Hestenes (1999) argues that traditional physics courses lay heavy emphasis on problem solving and this results to the undesirable consequence of directing student attention to problems and their solutions as units of scientific knowledge. However, modeling theory suggests that these are the wrong units whereas models represent the correct ones.

Problem solving is important, but it should be subservient to modelling. Hestenes (1999) states that most physics and generally science/engineering problems are solved through the construction or selection of a model that provides the answer to the problem following model-based inference. In a profound sense the model provides the solution to the problem. Thus, an emphasis on models and modeling simplifies the problem and organizes a physics course into understandable units.

ICT tools aim to actively involve students in the research process and offer teachers the opportunity to work under conditions that could not be traced in a traditional learning environment. Despite general findings concerning expectations from ICT in education (Dertouzos, 1995; Smeets, 2005; Tselios, Avouris & Komis, 2008; Kalogiannakis, 2010), even if a relative improvement on performance can be observed, conceptual transformation is not largely benefited. Unfotunately, the implementation of ICT in the teaching and learning process has failed to meet initial expectations. Offering distance education and using ICT for teaching natural sciences is neither a simple nor an easy task. Quality guidelines for e-learning courses are needed (Kidney, Cummings & Boehm, 2007). Implementation of e-Learning could eventually lead to a total automation of administrating the teaching and learning processes by means of software known as Learning Management Systems (LMS). The Learning Management System (LMS) is a software platform designed to manage a coherent educational electronic system. In particular, through LMS electronic classes management and educational material delivery become possible. Also, the LMS offers: institutional support, course development, teaching and learning processes, course structure, student support, faculty support as well as evaluation and assessment. The development of distance learning systems along with technological advancements enables the creation of a new dynamic

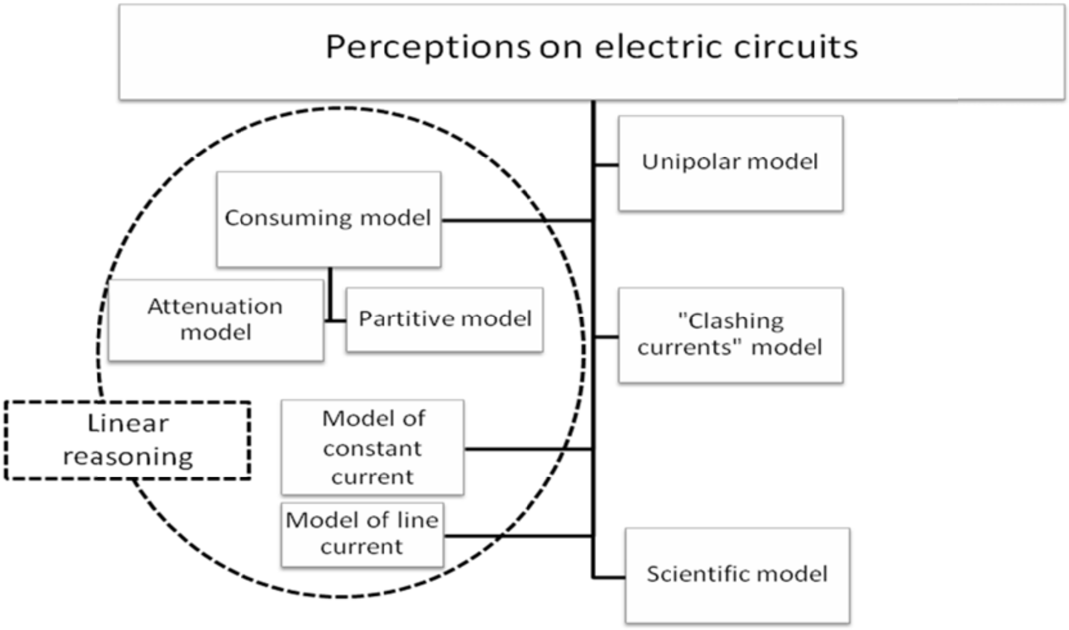

Figure 1. Mental models on electric circuits

technology in e-learning. Users' registration can thus be automated, access to classes can be controlled and learners' actions can be monitored from the moment they enter the platform to the moment the exit the system.

The real value of e-learning should not only be based on its ability to train just anyone, anytime, anywhere, but also on the opportunity it offers to train the learners to conceptualize scientific issues and principles at the right time. This pedagogical methodology has to be in alignment with the constructivist model of learning (Martin-Blas & Serrano-Fernandez, 2009).

Blended Learning

Through face-to-face lectures and tutorials, students can interact with teachers and their peers in an environment where facial expression, tone of voice and gestures all contribute to enriched meaning in enhancing communication (Tolmie & Boyle, 2000). However conventional classroom teaching is often teacher-directed and students can make only limited contributions in class time, particularly if the class is large. However, the web environment allows students to demonstrate their learning experiences as they achieve both intended and unintended learning outcomes.

'Blended learning' was redefined when the World Wide Web (WWW) was found to be useful to the educational community. Currently, it is referred to as mixing the face-to-face and the virtual learning environments (Osguthorpe & Graham, 2003; Garrison & Kanuka, 2004; Alonso, López, Manrique & Vines, 2005; Hughes, 2007).

The concept of blended learning is based on the idea that learning is not just a one-time event but a continuous process. This term has evolved to encompass a much richer set of learning strategies or "dimensions" (Singh, 2003). Blended learning combines multiple delivery media that are designed to complement each other and promote learning and application-learned behavior (Singh, 2003; Alonso, López, Manrique & Vines, 2005; Hughes, 2007).

Students' Perceptions on Electric Circuits

Today the majority of children grow up in a technological environment, which includes a variety of electrical appliances (Solomonidou & Kakana, 2000). The word electricity is familiar to children from preschool age and children have developed certain initial ideas about the concept of electric current which can be taught with the use of ICT (Kalogiannakis & Lantzaki, 2012).

Recorded students' perceptions on simple electric circuits are coded in five models (Osborne,. 1983; Shipstone, 1984, 1985; Osborn & Freyberg, 1985) (Figure 1), namely:

(a) unipolar,
(b) "clashing currents",
(c) attenuation,
(d) partitive (cases c and d are consuming models) and
(e) scientific.

According to research studies, as age and didactics proceed gradually, there is a transfer from the unipolar to the scientific model (Figure 2). Osborn & Freyberg (1985) found that 50% of 12-year-old students in elementary school adopt consuming electricity models.The same percentage grows to 60% for 14-year-old students and falls below 40% for 17-year-olds. The scientific model was followed by less than 10% of 12-year-old students, less 40% of students of 15 years and just 60% of 17-year-olds. 50% of 15-year-olds have adopted a consuming electricity model. Nevertheless, even after graduating from secondary education, students in their majority support the consuming model or electricity maintenance (Rocard et al., 2007).

A common perception underpins these models. More specifically, 'electricity' starts from the battery and following a linear flow, meets the cables, the resistors, the lamps and other parts of the circuit as it passes through, thus resulting in another mental model, especially when more complex circuits are involved (Rocard et al., 2007). The difficulties students face cannot be dealt with traditional teaching and learning processes, which are based on quantitative approach to electric phenomena and thus students learn mainly to solve mathematical equations.

In the framework of their education, students should develop model developing skills and conceptual understanding using appropriate model building software. ICT use for model development requires the application of Computational Science principles according to the following paradigm: problem ↔ theory ↔ model ↔ simulation method ↔ effectuation (using programming languages or software) ↔ evaluation

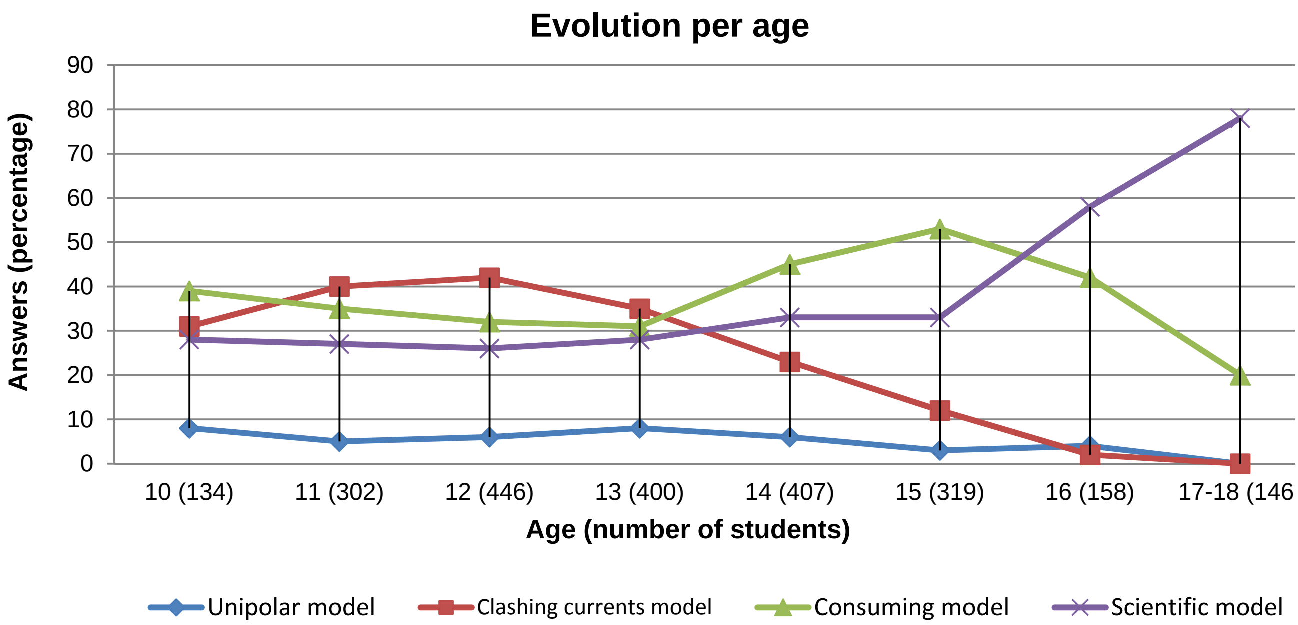

Figure 2. The evolution in model adoption for electric circuits per students' age

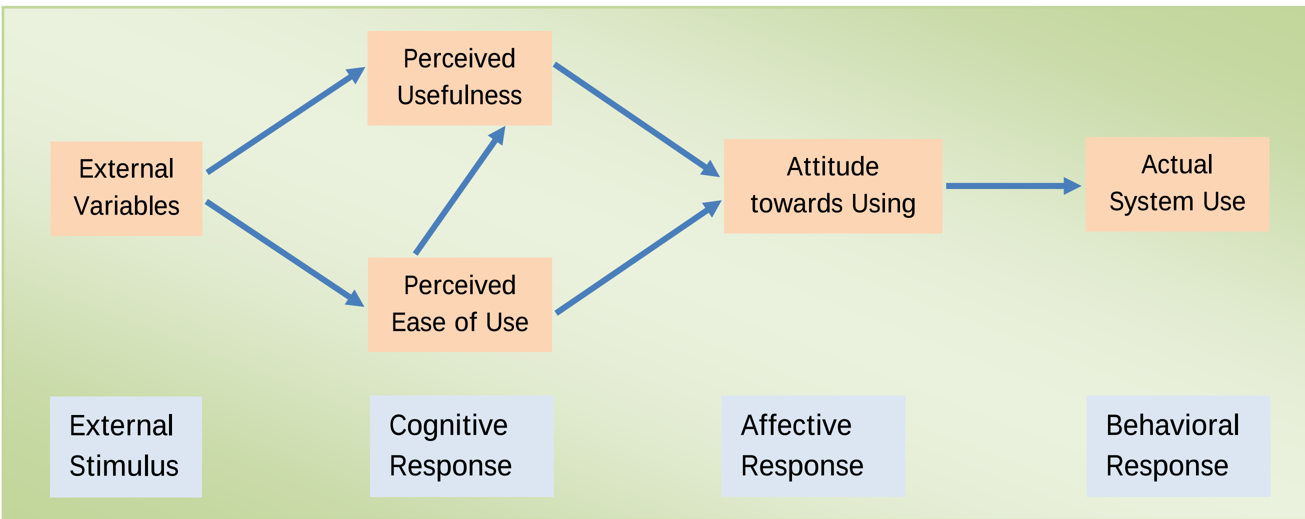

Figure 3. The three phases in TAM: Cognitive, Affective, Behavioral adopted from Davis (1986)

(comparison to actual data) (Psycharis, 2009). The objective in the above scheme is to transform the phenomena from the abstract level to a scientific model, which will then be tested with regard to its evaluation and validity (Psycharis, 2009). Certain constraints in applying the above are: time restrictions in school educational programs, school infrastructure, practical difficulties in computer and internet access concerning natural phenomena simulation when children are in school and the established teacher-centered model. Space and time restrictions as well as issues relating to the difficulty of applying an alternative pedagogical framework within the natural school space, may be overcome by means of distance learning, through a particular learning management system. Our research examines among other questions the extent to which such an interactive platform can be used to eliminate such restrictions.

Learning Management System (LMS)

E-learning systems have several names which basically mean the same: Virtual Learning Environment (VLE), Learning Management System (LMS), Course Management System (CMS), Learning Support System (LSS) and Learning Platform (LP). LMS is a relatively recently coined term and goes beyond basic content delivery. Dougiamas and Taylor (2003) bring forward the importance of the social constructivist framework in developing LMS. While some LMSs still lack underlying pedagogical principles, there are others, for example MOODLE (Modular Object Oriented Development Learning Environment), the development of which primarily relies on a strong pedagogical foundation creating a new trend to the education system (Katsamani, Retalis & Boloudakis, 2012). Today, most LMS have inbuilt mechanisms to track and record a certain amount of information about online activities.

The major roles for such an LMS include record-keeping for student's learning, planning for student's learning, instruction for student's learning, and assessment for (and of) student's learning. The secondary roles include communication, general student data, school personnel information and LMS administration (Watson & Watson, 2007). The dynamic nature of online forums, discussion boards and other means of communication either synchronous or asynchronous integrated in LMS portray the conversational and collaboration tools. These would enable students to work together cooperatively in order to achieve their common learning objectives. The focus here should be put on the pedagogical aspect of designing LMS.

Moodle has been used as a LMS platform for sharing useful information, documentation, and knowledge management in research projects, yielding important benefits to the researchers (Uribe-Tirado, Melgar-Estrada & Bornacelly-Castro, 2007; Blas & Serrano, 2009; Katsamani, Retalis & Boloudakis, 2012). On an individual basis, the teacher can develop awareness of the range of activities undertaken by individual students, i.e. number of visits, time spent doing each task, scores, etc. This information can be retrieved numerically or graphically.

The TAM instrument

There are theoretical models that attempt to explain the relationship between user attitudes, perceptions, beliefs, and eventual system use. These include the Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), and the Technology Acceptance Model (TAM). Among these, TAM, proposed by Davis (1986) seems to be the most widely used by researchers (Figure 3). It is a model which explains the adoption behavior of computer systems by the users and calculates the level of acceptance.

We used TAM for evaluating the Moodle platform in the framework of a course in natural sciences in secondary education. The TAM is an analytical simplification of how functionality and interface characteristics relate to adoption decisions. According to TAM, one's actual use of a technology system is influenced directly or indirectly by the user's behavioral intentions, attitude, perceived usefulness of the system, and perceived level of difficulty in system operation (Davis, 1993).

In TAM, technology acceptance and use is determined by behavioral intention (BI). BI in turn, is affected by Attitude Towards Use (ATT), as well as the direct and indirect effects of Perceived Ease of Use (PE) and Perceived Usefulness (PU). Both PE and PU jointly affect ATT, whilst PE has a direct impact on PU (Davis, 1986; Davis, 1993). TAM also proposes that external factors influence intention and actual use through mediated effects on perceived usefulness and perceived ease of use. Although TAM is considered as a widely recognized model in the field of information systems, little systematic research has been conducted in the LMS context for teaching natural sciences.

Selim (2003) argues that there is a need to investigate TAM with web-based learning. In his study, e-learning refers to pure, web-based, asynchronous learning. For Saadé, Nebebe & Tan (2007) university students' participation and involvement were important for successful e-learning systems. Therefore students' acceptance behavior should be assessed. They suggested that TAM is a solid theoretical model whose validity can extend to the e-learning context (Saadé, Nebebe & Tan, 2007).

METHODOLOGY

The aim of the study can be divided into two major sub-domains, as described below:

(a) The domain of Natural Sciences Teaching and learning:

(a1) Applying strategies to correct students' erroneous perceptions in electric circuits, by introducing the appropriate educational activities which should lead to conceptual transformation.

(a2) Evaluating the efficiency of educational tools with regard to learning objectives.

(b) The effectiveness of LMS's use in education:

(b1) Creating, developing and applying an interactive learning environment at school level through the use of the distance learning platform Moodle.

(b2) Exploring the response model of the LMS, its use and intention of using it.

Sample

The sample of our study was 25 students, 12 boys and 13 girls of the grade eight (K8) studying the course "General Physics", in a General Lyceum in Greece during the Academic Year 2009-10. Participants' grades varied between 14 and 19.9, reflecting moderate to high levels of achievement- taking into account that the assessment scale employed in upper secondary education ranges from 01 to 20. The criterion for the school selection was the fact that it is a typical, district school. Students' social backgrounds are diverse. The majority of them come from agricultural and working families (employees in the public/private sector), representing a large part of the economically active population in Greece.

Students' willingness to participate could have been affected by the treatment of marking as an external reward. Thus we decided that 40% of the final grade assigned to participants would reflect the outcomes of their engagement with the computer environment discussed whereas 60% of the final grade would mirror class performance.

Instruments

In the first phase, we worked on organizational issues related to the Moodle implementation and upload at the Web Server of the School. We also discussed issues related to distance learning, the Learning Management systems, the use of Moodle for teaching and learning, as well as students' use of the web page which would be dedicated to the use of Moodle. Moreover, participants were informed about the research process and ethical issues were also considered.
In the second phase, students completed a questionnaire about the conceptions relevant to the electrical circuit's models. Students' answers were registered by the log file system of Moodle. Students participated individually at this stage. Next, students were involved cooperatively in the activities provided by the Moodle. They were provided with problems to solve and they had to predict the outcome. For example simulations provided by the system intended to extrapolate student's views and create an environment of cognitive conflict, in order to guide the students to conceptualize the issues under consideration. At this stage students formed groups while a group coordinator would provide the final answer to the particular group. Log files of Moodle registered the responses of each group.
The Forum of Moodle was used in order to provide a permanent space for students to discuss course related concepts, and a glossary was provided to students as well as a list of definitions. Simulations were uploaded by the authors of the article mainly using Java applets. All the simulations presented to students used the model as a nit of teaching according to Hestenes (1999).All groups had to solve three identical problems directly connected to the fundamental ideas of electric circuits. These problems were developed by the authors of the article. The problems with which students engaged were adjusted to their responses to the initial questionnaire.

Finally, students responded to a questionnaire equivalent to the one described above, in order to investigate their new conceptions, if any. The questionnaire included yes-no items. Another questionnaire was given to students in order to explore the interactivity inside the group. That methodological tool aimed at investigating the change in students' views due to the interactivity in the group and consisted of questions, like "after the discussion within the group, did you change your prediction?". The Questionnaire was marked using a Likert scale (1-5).

To measure the learning performance and the change in conceptions, we used statistical methods. The normality Kolmogorov-Smirnov test and the t-test evaluation on dependent samples (performance before and after teaching) were used to compare the mean values of students responses. In addition, the criterion "Wilcoxon signed rank" was used to measure the prior and post learning performance, in cases there is a variation in the normality test. The final questionnaire was also checked in terms of validity and reliability. In order to guarantee the conceptual construct validity of the questionnaire, the factual structure was examined, using the principal components analysis method. Validation and reliability of students' attitudes towards the use of Moodle were checked using certain methods of the Statistical Software SPSS, version 17. The reliability coefficient Cronbach's Alpha was found to be .552 with 17 items.

RESULTS

"Transformation" of Perceptions

Results indicate that there is a significant change in student's conceptions only for the unipolar model as analyzed by specific questions relative to that model (see Figure 4, Questionnaire number three). The mean values of students' responses for the other questions are close to the research findings in the literature. There are certain conceptions which tend to persist, even after the intervention using the LMS. The improvement in students' performance, as shown in the completed questionnaires, is not statistically significant in the other two questionnaires, related to the other models (Questionnaire 1 refers to the consuming model and Questionnaire 2 refers to the consuming model constant current model (Table 1, Figure 4).

Data reveal that six students made a wrong choice in the first questionnaire. However, they provided a correct response in the final instrument. As far as the second questionnaire-containing questions related to the constant current model-we observe that ten students selected at the initial stage the wrong answer, but at the final questionnaire they chose the correct answer. For the questionnaire three, which includes questions related to the unipolar model, we observe that twelve students selected at the initial stage the wrong answer, but at the final questionnaire they chose the correct answer. Significant changes are observed only at questionnaire three, where twelve students selected the correct model while eleven students kept their initial conceptualization. Results relevant to Moodle use and change in conceptions resulting from its employment are encouraging but not of statistical significance. The findings of our research are in alignment with those of other investigations for the use of Moodle for the same domain (Martin-Blas & Serrano-Fernandez, 2009).

Attitudes towards the LMS

The theoretical grounding in this research is the Technology Acceptance Model (TAM). TAM specifies the causal relationships between perceived usefulness, perceived ease of use and actual usage behavior. Students completed a questionnaire in order to investigate their attitudes towards the use of Moodle according to the TAM's Model (Davies, 1986). In order to have a more concise view of student's attitudes we added the collaboration and teaching attitudes from the Constructivist On-Line Learning Environment Survey (COLLES) methodological tool which was designed to evaluate the quality of online learning environments from a social constructivist perspective (Taylor & Maor, 2000). The final questionnaire regarding the investigation of the attitudes was examined in terms of validity and reliability. In order to establish the conceptual construct validity of the questionnaire, the factual structure was used by the principal components analysis method (Tables 2, 3, 4, and Figure 5).

Factor analysis was implemented to find the most important factors that contribute to students' attitudes. Using the specific methodology of SPSS we ended up with 5 factors, as they are presented at Table 3.

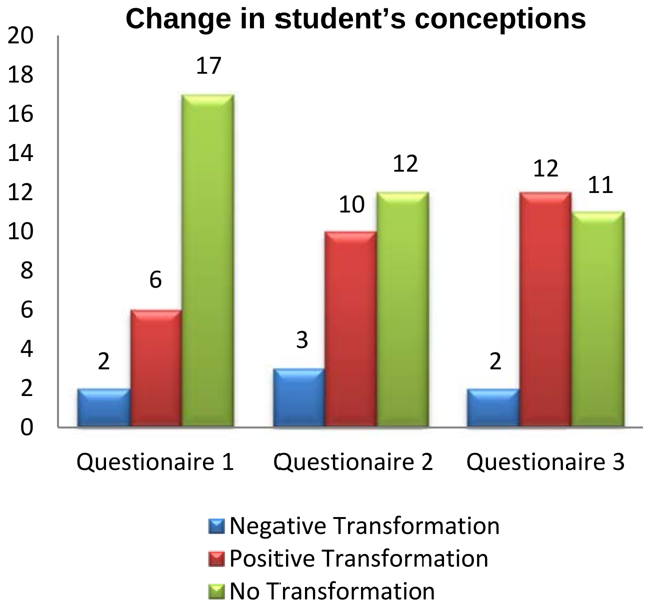

Figure 4. Change in student's conceptions

Table 1. Questionnaire results

		N
Questionaire 1 (post-pre)	Negative Ranks	2
	Positive Ranks	6
	Ties	17
	Total	25
Questionaire 2 (post-pre)	Negative Ranks	3
	Positive Ranks	10
	Ties	12
	Total	25
Questionaire 3 (post-pre)	Negative Ranks	2
	Positive Ranks	12
	Ties	11
	Total	25

Table 2. Sample Efficiency (KMO and Bartlett's tests)

Keiser – Meyer – Olkin Measure of Sampling Adequacy		.571
Bartlett's test of sphericity	Approx. chi square	262.168
	df	136
	Sig.	.000

Table 3. Varimax rotation

Factor Loadings for Measures of Constructs	PU	PE	EA	CTA	AS
Perceived Usefulness PU (cognitive response) Factor 1	.800 .933 .902 .735				
Perceived ease PE (cognitive response) Factor 4		.953 .818 .860			
Environment Attitudes EA (Affective response) Factor 5			.530 .878 .688		
Collaboration and teaching attitudes CTA (Affective response) Factor 3				.788 .928 .919	
Actual System Use AS (Behavioral response) Factor 2					.805 .834 .355 .859

Table 4. Matrix of factual correlations p<0.01

Component correlation Matrix	1(PU)	2(AS)	3(CTA)	4((PE)	5(EA)
1(PU)	1.000				
2(AS)	.062	1.000			
3(CTA)	**-.269**	-.082	1.000		
4(PE)	**.217**	**-.240**	-.189	1.000	
5(EA)	**.328**	-.0.24	-.125	.005	1.000

Note: *We can notice that the only correlation that we should take into account is that betwwen(PU- Perceived Usefulness) and (EA- Environment Attitudes)(correaltion=0.328).*

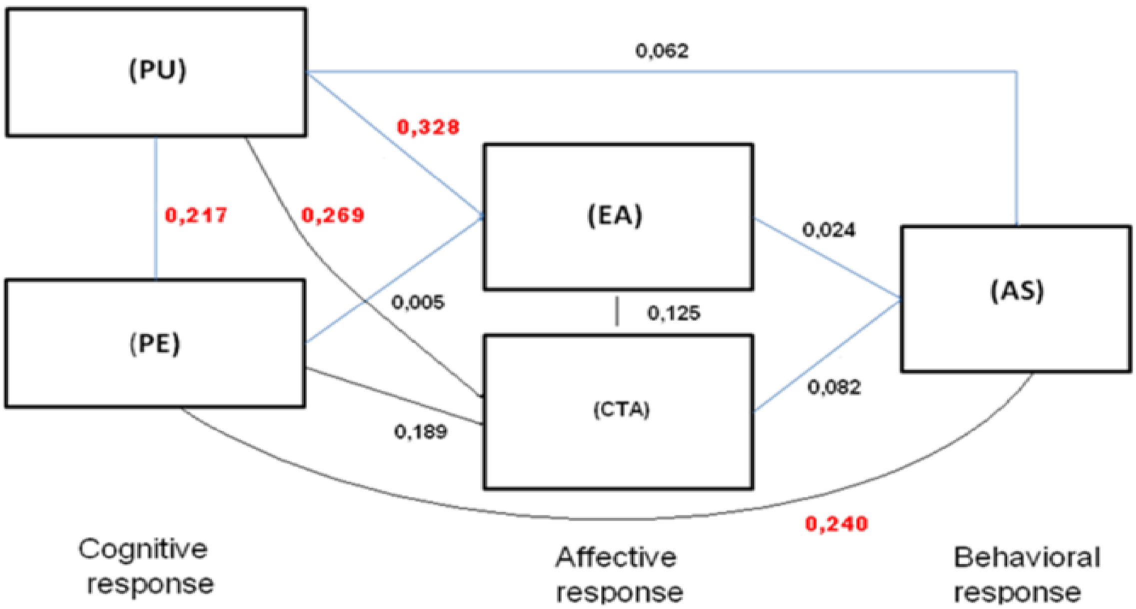

Figure 5. Factual correlation of response questionnaire for TAM

As far as our intention to use Moodle is concerned, results indicate that there is no significant correlation between the different factors (Table 4).

CONCLUSIONS AND IMPLICATIONS

Learning Management Systems are not always popular with the students, for a number of reasons. Students report that they experience difficulties in technical issues (Weller, Pegler & Mason, 2005), lack of familiarity with the system (McGill & Hobbs, 2008), and discussion overload (Kear & Heap, 2007). However, in general, students express positive attitudes towards their intention to use Moodle for teaching and learning Natural Sciences.

Students can also perceive its usability in terms of the opportunities it can offer. However, the relation between positive attitudes towards the system, its use and intention of using it , the perception of its usability and ease of use is affected on a large scale by other factors, like the need for free time, the general views on school reality and learning in school, the mentality and practices of most teacher(lack of experience, workload etc) and lack of team-working experience. The above mentioned features and their interrelationship with the use of Moodle as a teaching and learning tool should be further investigated.

Our approach was based not on "general" questionnaires that explore the use of Moodle, but on the TAM's Model. Initially students had a positive attitude to collaboration. However, their enthusiasm was not maintained during the next stages of the research. Only 1/3 of students' responses to the questionnaire on collaborative issues (e.g. "did you feel that collaborating with others is of added value for your learning performance") revealed a positive perception of collaboration and this is an issue that needs to be furhter investigated. Students expressed the view that the forum provided by Moodle could be advantageous in case they gained experience so as to use it for scientific problems and could be of added value when the teacher has uploaded model of simulations relevant to the physics phenomena under consideration. Students expressed the view that the model as a fundamental teaching unit helped them to have a better conception about the physical quantities and they would prefer to attend lectures that include the inquiry method and the modelling of physical processes, but they are not too experienced to do that even if they work collaboratively.

The findings of this research could be useful for the assessment of e-learning services in secondary education for teaching natural sciences which would pave the way for future improvement. Our findings should be interpreted within the limitations of a small-scale exploration study and more systematic research is needed.

Future studies should also investigate the role of adding other variables as 'user experiences' and 'user characteristics' to those originally employed in the model. Apart from careful planning and aim identification, it is vital that certain factors should be taken into account, including educational staff, material and procedures. Research in progress includes the correlation of students learning styles and epistemic beliefs in relation to the effectiveness of the use of the Moodle platform.

Manochehr (2006) conducted a study, comparing "the effects of e-learning versus those of traditional instructor-based learning, on student learning, based on students learning styles". The results revealed that the learning style in traditional learning was irrelevant but in e-learning it was quite important. The study showed that learners with an assimilating or converging learning style achieved better learning results in e-learning. We are in process to conduct a large scale research with Greek and British students to explore the effectiveness of the Moodle platform, integrating adaptive characteristics according to students' learning styles with experimental and control groups. Our research will take into account the ersearch findings of Coffield, Moseley, Hall & Ecclestone (2004). Acxcording to this research "the research field of learning styles needs independent, critical, longitudinal and large-scale studies with experimental and control groups to test the claims for pedagogy made by the test developers".

Graf (2007) also studied how well VLEs can adapt to learning styles and which of the existing non-commercial VLEs are the best to be extended into adaptive VLE. He stated that from the thirty six VLEs nine can be used as adaptive VLE's, namely: Atutor, Dokeos, dotLRN, ILIAS, LON-CAPA, Moodle, Open-USS, Sagai and Spaghetti learning. Communication tools, learning objects, management of the user data, usability, adaptation, technical aspects, administration and course management were the issues that were used as variables in each of the nine VLEs.

The results showed that Moodle can be seen as the best VLE concerning adaptation issues. Extensibility is supported very well and also adaptability and personalization aspects are included in Moodle (Kanninen, 2008). Using Moodle the learning environment encourages students to be connected knowers(Connected knowers learn cooperatively and like to build on the ideas of others whereas separate knowers take more critical and argumentative way to learning).

Our intention is also to further examine the types of cooperation that can be implemented using Moodle, and specifically the dimensions of positive independence, individual accountability, equal participation and simultaneous interaction (Dougiamas & Taylor, 2003; Abdullah & Shariff, 2008). Our intention is to apply the same methodology for Mathematics, since the use of VLEs is dependent on the particular course (Kanninen, 2008).

Instead of completing questionnaire students could use the discussion forum or provide direct feedback to the teacher, adopting a mote active role in the research process. However, both the forum and feeddback are sparingly employed probably due to the the fact that they constitute new elements in the learning environemtn or because there is no greater need for giving quick feedback. Giving the feedback only at the end of course can be frustrating to the students because their answers have an effect only to next time the course is carried out. Therefore it is important to gather feedback also in the middle of the course. The students are eager to answer the questionnaires if they benefit from it during the course (Kanninen, 2008).

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