

Design and Implementation of Differentiated Instruction Digital Scenarios in LAMS

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Abstract

This article researches the design, implementation and assessment of the application of differentiated instruction scenarios in secondary education. In particular, a case study is presented concerning the Information Technology Applications subject who is taught in grade A of General Upper Secondary School. The article examines the extent to which the implementation of the technologically assisted differentiated instruction can be supported by the new Learning Management System service of the Greek School Network, which is based on the free and open-source LAMS (Learning Activity Management System) software. The results which were obtained after conducting research in five General Upper Secondary Schools of the regional unit of Pieria in the school year 2014-2015, showed that differentiated instruction with the use of LAMS increases students' interest and results in the improvement of their performance. Moreover, the LAMS service of the Greek School Network proved to be able to support, to a satisfactory degree, the implementation of innovative practices in teaching, such as the differentiated instruction. Nevertheless, schools which have old equipment and slow internet connection speed should upgrade their infrastructure and their internet connection speed. Therefore, it is also possible to implement such innovative practices on a larger scale in Greek and foreign schools.

Keywords: Differentiated Instruction, LAMS, Digital Lesson, Sequences of Learning Activities

JEL classifications: O32 Management of Technological Innovation and R&D

Introduction

Today, there is a great need to differentiate instruction in multicultural schools, so that it meets all students' needs. In order for instruction to become more effective, it has to cover, to the greatest possible extent, the different needs and interests of individual student sub-groups, instead of addressing the average student.

Tomlinson (2003) believes that the only way in which education will manage to keep up with the development and the progress of our

society, is to find those ways in which to differentiate instruction, so that it meets the diversity of the student population.

The term "Differentiated Instruction" refers to a systematic approach in the design of teaching for students who have different learning needs (Panteliadou & Antoniou, 2008). The differentiation of instruction is the academic process during which the teachers follow different teaching methods and pace of instruction for different students.

Even though research (Gayfer, 1991; McAdamis, 2001; Johnsen, 2003) shows that differentiated instruction is more effective, it hasn't been frequently implemented until today because it requires more preparation time and its implementation in class is also more time-consuming. The progress of educational technology has provided us with systems which facilitate the implementation of differentiated instruction. One of the most mature and popular tools which apply the principles of the learning design (Britain, 2007; Siriou & Karatrantou, 2011) and support the creation, management and monitoring of e-courses, is the Learning Activity Management System (LAMS) (<http://lamsfoundation.org>). The LAMS has a vast range of tools which can be used in a series of pedagogical approaches; teachers can create a workflow template for students with different levels of knowledge and expertise (Pashalis & Papadakis, 2009; Dalziel, 2007; Papadakis, 2010; Fakoliakis & Papadakis, 2011; Kazatzis, Stamatis, Pratsoli & Asimakopoulou, 2015).

LAMS is appropriate for the design and development of differentiated instruction scenarios in digital form, because it has tools which allow the provision of alternative learning material and activities in various forms and conditions. For example, students, depending on their response in a previous assessment (Figure 1), can follow other paths with different educational activities and learning opportunities.

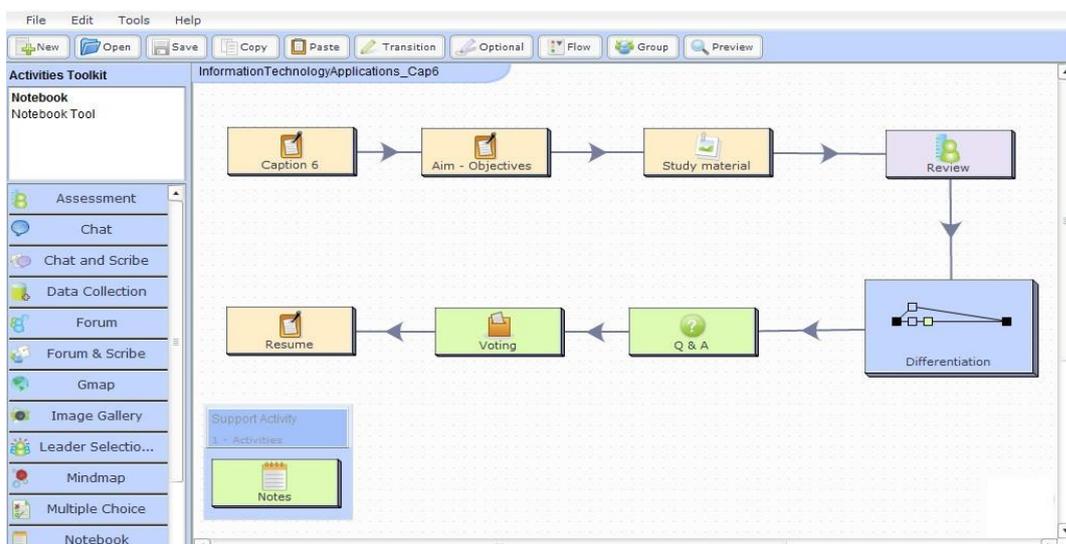


Figure 1: Differentiated Instruction Design in the LAMS Environment

Furthermore, LAMS provides the opportunity to monitor the learning process via the Monitoring Environment. The Monitor can be always

aware of the number of students who have begun a sequence of learning activities; the Monitor is also able to know which activity stage each student has reached, so that (s)he can facilitate students accordingly, provide feedback, improve and complete the activities and their content, as well as export students' work files in order to grade their tasks (Figure 2).

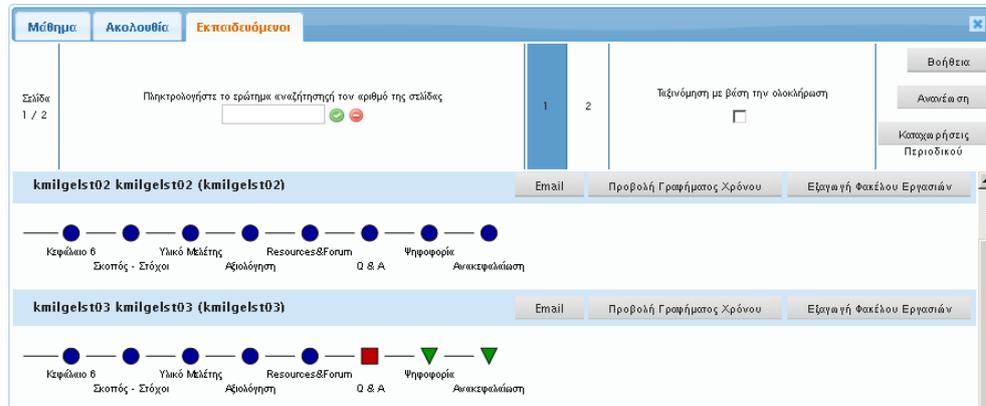


Figure 2: The LAMS Monitoring Environment

The research which has been designed is important because it examines the extent to which differentiated instruction can be assisted by the use of technology and can be used in Greek schools. In order to examine this issue, we organised differentiated instruction lessons in the Information Technology Applications subject which is taught in grade A of General Upper Secondary School, by using the Learning Activity Management System (LAMS) online platform for the creation, management and monitoring of digital lessons, via the corresponding service which has been provided, at a pilot stage, by the Greek School Network.

Research Methodology

Aim, Objectives and Questions of the Research

The main aim of the present research has been to design, implement and assess learning designs for technologically assisted differentiated instruction, in the framework of the Information Technology Applications subject which is taught in secondary education, in grade A of the General Upper Secondary School.

The main objectives of the research are the following:

- The use of learning designs for the technological support of differentiated instruction in the Information Technology Applications subject.
- The implementation of sequences of learning activities for the purposes of differentiated instruction, in the Information Technology Applications subject.
- The control of the available infrastructure, i.e. the LAMS service in the Greek School Network, and of its ability to support differentiated instruction in the Information Technology Applications subject.

The present research attempts to assess the effectiveness of the technologically assisted differentiated instruction in the Information Technology Applications subject.

The following main questions are addressed in the research:

- 1 Is students' performance improved by the implementation of technologically assisted differentiated instruction?
- 2 To what extent does the use of a Learning Management System help to provide differentiated instruction in the Information Technology Applications subject in grade A of General Upper Secondary School?
- 3 To what extent does the Learning Activity Management System (LAMS), which is installed in the Greek School Network, suffice for the design and practical implementation of differentiated instruction in Greek schools today?

Research Method and Sample

A combination of qualitative and quantitative methods has been used in the present research. The data collection has been based on electronic questionnaires which were completed by students and teachers, as well as on semi-structured interviews which were conducted with teachers. Thus, with the use of the triangulation technique, the collected data complement and verify each other. The term "triangulation" refers to the use of at least two methods, usually qualitative and quantitative, for the study of the same research problem (Morse, 1991).

In the first stage of the experiment of the present research, we used LAMS to design and develop two sequences of learning activities for the Information Technology Applications subject which is taught in grade A of General Upper Secondary School.

The 1st sequence (<http://goo.gl/Xuf0gj>, available in the LAMS Central Community) concerned the 6th Chapter, which is entitled "Application Development Environments", of the school book. This chapter was chosen because students were familiar with its content, as they had been already taught a similar topic in Lower Secondary School. We used students' previous knowledge and differentiated the content of the chapter by implementing the differentiated instruction method. Students' knowledge was assessed and, with the use of the LAMS branching tool, students were led to different activities depending on the outcome of this assessment. The branching tool helps us to implement differentiated instruction, as it assigns alternative tasks and provides options which correspond to students' learning profiles. The activity of questions with feedback was also used.

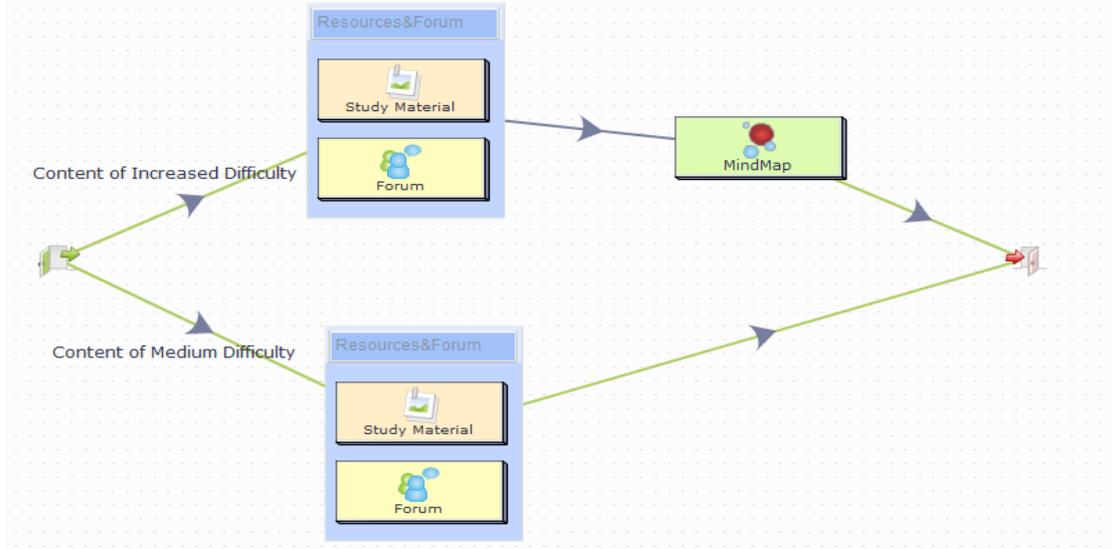


Figure 3: The LAMS Authoring Environment and Branching Tool

The 2nd sequence (<http://goo.gl/TxBEIM>, available in the LAMS Central Community) concerned the 1st section of the 7th Chapter, which is entitled "Application Programming in Programming Environments", of the school book. We chose this section because it enabled us to implement the differentiated instruction method by differentiating the environment and the process. Students had at their disposal the necessary files as well as step-by-step instructions in order to create an application with AppInventor. They also had the opportunity to continue this exercise at home. The Share Resources, Submit Files, Discussion and Multiple-Choice Questions with feedback activities were used, for which the corresponding tools are provided by LAMS.

Στην ενότητα **Build-in** και στην κατηγορία **Control** βρίσκουμε τα εργαλεία του AppInventor για την **δομή επιλογής if**.

Απλή δομή επιλογής Αν (συνθήκη=αληθινή) τότε Ομάδα εντολών **Τέλος_αν**.

Λογική Συνθήκη

Εντολές που θα εκτελεσθούν αν η συνθήκη είναι αληθής

Σύνθετη δομή επιλογής Αν (συνθήκη=αληθινή) τότε Ομάδα εντολών **A** **αλλιώς** Ομάδα εντολών **B** **Τέλος_αν**.

Λογική Συνθήκη

Εντολές που θα εκτελεσθούν αν η συνθήκη είναι αληθής

Εντολές που θα εκτελεσθούν αν η συνθήκη είναι ψευδής

Figure 4: The 2nd Sequence of Learning Activities

In the second stage of the experiment, these lessons were taught in the classes of five (5) out of the total of fourteen (14) General Upper Secondary Schools of the Directorate of Secondary Education of the prefecture of Pieria, which constituted the research sample. The

sequences of learning activities were saved in the infrastructure, i.e. in the Learning Activities service in the LAMS server of the Greek School Network, in order to be used by teachers and students.

These sequences are available, under Creative Commons licenses (Attribution - Noncommercial - ShareAlike), in the LAMS central repository.

In the third stage of the research, we evaluated the differentiated instruction, which was technologically assisted with the use of LAMS of the Greek School Network infrastructure, in the Information Technology Applications subject, by using quantitative and qualitative evaluation methods (questionnaires and structured interviews). The evaluation was made by analysing the opinions, the beliefs and the attitude of the students and teachers of the schools which were selected in order to teach the model lesson by using the learning activities of the Greek School Network LAMS.

The research sample consisted of the students of Grade A of five (5) General Upper Secondary Schools, out of the total of fourteen (14) General Upper Secondary Schools of the Directorate of Secondary Education of the prefecture of Pieria. The sample also consisted of the Information Technology teachers who taught the Information Technology Applications subject in these schools during the school year 2014-2015. The total student population of Grade A is 1064 students, and 458 of them chose to attend the Information Technology Applications subject. 127 students attend the particular subject in the classes of the five schools which were selected. 104 students attended the 1st model lesson and 99 students attended the 2nd model lesson. 96 of these students completed the questionnaire. This student number forms the research sample and corresponds to approximately 21% of the total number of all schools' students who chose to attend the Information Technology Applications subject in Grade A of General Upper Secondary School. Five (5) teachers participated in the research; these teachers attended a 3-hour training which aimed to inform them on the differentiated instruction with the use of advanced technologies and to train them in order to use and monitor a learning process with the Learning Activity Management System (LAMS) of the Greek School Network.

Means and Methods

After the in-class implementation of the learning activities, the teachers and students of these classes were asked to complete a questionnaire which aimed at assessing their opinions, beliefs and attitudes. Regarding the qualitative research method, personal semi-structured interviews were held with the Information Technology teachers who taught the particular subject.

The research questions formed the basis for the creation of the questionnaires which were completed by teachers and students after the end of the 2nd lesson. In this way, students' opinions, beliefs and attitudes were recorded as regards the use of technologically assisted differentiated instruction with the use of LAMS. The questionnaires were provided electronically, with the use of the free platform drive.google.com (Google Forms).

We also used the technique of semi-structured interviews, which were conducted with the Information Technology teachers of the selected

classes. The interviews were held with the use of Skype and were recorded with the use of the MP3 Skype Recorder tool.

Results

The research results showed that students want teaching to be enhanced by the use of a Learning Management System; 3 out of 4 students responded positively to this question. However, when students were asked if they want to continue being taught with the use of LAMS, 60% of them responded positively and 40% of them responded negatively to this question. The percentage of students who want to use LAMS is smaller than the percentage of students who want to use any Learning Management System in general, because of the problems which occurred during the lessons regarding the equipment of the Information Technology laboratories. The students' response to the fact that LAMS enables them to repeat a lesson at a later date is also very interesting. The vast majority of students, in a percentage of 75%, consider this to be a positive feature. 70% of students answered positively when they were asked if the use of LAMS in the lessons helped them comprehend and study a section more effectively. Finally, the majority of students (80%) stated that LAMS is easy to use.

Would you like the teaching of a school subject to be enhanced by the use of a Learning Management System in the classroom?

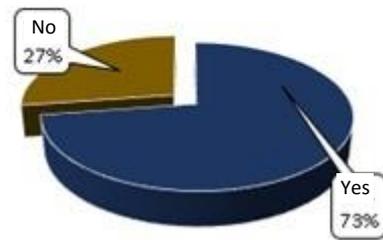


Figure 5: Students' answers

Students gave positive feedback about the LAMS Learning Activity Management System and the problems which occurred during the lessons. 73%, i.e. 7 out of 10 students, stated that they faced few or zero problems. However, it seems that students responded negatively when they were asked if the computers of the laboratory functioned satisfactorily. 50% of the students stated that the function of the computers was a bit or not at all satisfactory.

Regarding teachers, they responded positively when they were asked about the extent to which students' performance was improved with the use of differentiated instruction and technologically assisted learning.

To what extent do you believe that students' performance is improved with the use of technologically assisted learning?

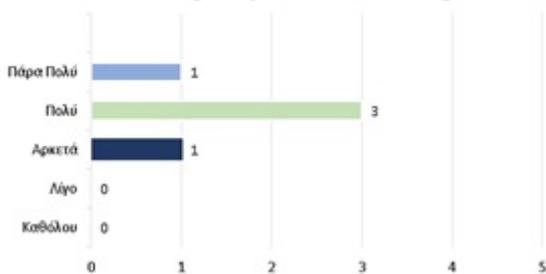


Figure 6: Teachers' answers

Teachers also expressed their positive opinion regarding the improvement of students' performance, during the interviews. They stated that the use of technology helps to attract the interest of more students and to direct them to pay more attention to the learning content, which results in the improvement of their performance. Even though teachers believe that LAMS is easy to use, all of them stated that some practice is required in order to learn how to use the platform. Moreover, all teachers responded

positively to the question about the reliability of the platform, regarding its function and the content which can be integrated in it.

Another important outcome is the extent to which it is considered difficult or quite difficult to implement an educational scenario with the use of LAMS, as an educational method in secondary education. Teachers stated that the available infrastructure, i.e. the limited number of computers, the old equipment and the slow internet connection speed are the most significant factors due to which it is difficult to practically implement the use of LAMS in the classroom. For these reasons, teachers proposed to update the laboratory computers, to increase the internet connection speed and to reduce the number of students who use the computers in the Information Technology laboratories.

In the semi-structured interviews, teachers stated that the use of the technology can help to overcome the obstacles that are encountered during the implementation of differentiated instruction, since teachers are able to assign tasks of varying complexity to students and to enrich and adapt teaching to students' learning style, knowledge, interests and readiness.

Finally, some teachers stated that it is difficult to implement technologically assisted differentiated instruction with the use of the available infrastructure of most schools in secondary education.

As regards the limitations of the research, we should mention that in order to prove the adequate use of the platform in Greek schools, research has to be conducted on a larger scale and the research sample should consist of a greater number of participants. The present research effort was made in the framework of a pilot research in order to collect the initial data, aiming at their improvement.

Conclusions

The research has yielded positive results as regards the effectiveness of Learning Management Systems; these results encourage the use of a Learning Management System in the classroom, thus enabling the implementation of differentiated instruction in practice.

The students' possibility to reuse the digital lesson at home, either in order to participate in it or for revision purposes, is particularly important. It is considered that students' performance is positively influenced by these features which are provided by a Learning Management System. Teachers also believe that students' performance is improved by the use of technologically assisted differentiated instruction, as they have realised that students are more interested and participate to a greater degree in lessons in which a Learning Management System is used.

Students liked teaching with the use of LAMS; they showed enthusiasm for the way in which the lesson was taught, they had a positive attitude and their interest was significantly increased. Many students wish to continue having lessons with the use of LAMS and believe that the LAMS environment is user-friendly and easy to use.

As regards the infrastructure, students stated that computers did not function adequately because of the schools' slow internet connection speed, in contrast to their domestic internet connection. Teachers

also state that both computers and the internet connection speed are inadequate and that they need to be upgraded. These problems significantly hinder the implementation of differentiated instruction with the use of technology.

The general conclusion of this research is the students and teachers' satisfaction with the technologically assisted differentiated instruction which was realised by use of LAMS. For further research, it is suggested to apply the differentiated instruction on a larger scale, following the students and teachers' familiarisation with the LAMS Learning Activity Management System through the use of the existing sequences, and following the improvement of the infrastructure of the Greek School Network and schools.

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