A Mobile Learning Combinative Application for Comparing Educational Techniques

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Abstract—**This article focuses on the e-learning fora of with the purpose of comparing educational techniques widely used in the fields (such as Snowballing and Brainstorming) in a combined environment both via mobile and computer devices, in the framework of a training course in advanced technologies integration skills computer instructors. For the purpose of this study, modeling in formal language was used to classify the messages in the Moodle forum, as well as a respective system to automate this procedure.**

Keywords- e-learning; mobile learning; education ;educational techniques; modelling; advanced technologies integration skills

I. INTRODUCTION

Over recent years, the rapid development of mobile devices has made possible the support of educational applications in e-learning to the extent that the term m-learning (mobile learning) has now been established as a relatively autonomous field with distinct features as to the means used compared to e-learning in general. The main feature of e-learning is that there is physical distance between the trainee and the instructor. Therefore, communication is important for the success of an e-learning course. Extremely useful tools used by e-learning are the fora that provide the opportunity for asynchronous communication not only between the instructor and the trainees, but also between trainees themselves. During the past twenty years, a multitude of systems that offer the critical service of asynchronous fora for e-learning have been developed, such as: Manhattan Virtual Classroom (MVC), Moodle, Claronline, Online Learning and Training (OLAT), Cisco Networking Academy Management System (CNAMS), Pioneer (Microelectronics Educational Development - University of Paisley), AulaNet, etc. Furthermore, over the recent years, the development of mobile devices has made possible the support of educational applications (MSN Messenger, Gmail, etc.) to the extent that the term m-learning (mobile learning) is now a significant field of e-learning with distinct features as to the means used.

Moreover, field researchers have been interested in a basic issue during these past twenty years: how they can have, at each given moment, an overall picture of the situation in a number of discussion threads in a e-learning forum, not just at a quantitative level of participation, but at the quality level of what is discussed and whether the desirable learning climate is achieved through the discussion in the fora. This paper presents a study that compares educational techniques (Snowballing and Brainstorming), in the asynchronous forum Moodle through the use of a combined environment, both via computer and mobile devices in a training course in in advanced technologies integration skills computer instructors. It is worthy to note here that, for this study, the previous practical and research experience was utilized within the framework of Hellenic Open University (HOU) and concerns, among other things, previous projects related to the attitude of HOU students [1][2], as well as fora modeling as a methodology for the interpretation of messages [3].

The structure of this article is the following: Section II, where a brief literature review is presented. In section III, the study methodology is presented. In section IV, the data analysis is presented. In section V, the respective discussion takes place and the results are presented, which are combined with the conclusions of relative studies and finally section VII, where the major conclusions and the future goals are presented.

II. LITERATURE REVIEW

There are a number of studies about the use of mobile devices in e-learning. Indicatively, Nonyongo, Mabusela, & Monene [4] studied the reliability and effectiveness of communication through messages, as a complementary form of communication for the students of the distance education University of South Africa (UNISA), as an opportunity in communicating and providing support for their students who in their majority live in rural areas and informal settlements with limited infrastructure, while Nakahara et al. [5] study the encouragement provided to collaborative learning environments through mobile technology. Gerosa et al. [6] focused on the improvement of coordination support in educational forums using mobile devices through patterns in discussion groups, while Wang et al. [7] researched the impact of mobile learning on students' learning behaviours and performance. Rekkedal & Dye [8] present an in depth presentation of the pedagogical dimension of mobile distance learning, while Kukulska-Hulme [9] studied mobile usability in educational environments and discovered that it is dependent on human factors. These indicative studies show the ever growing importance of mobile learning and demarcate a distinct role in the broader framework of e-learning. Gikas & Grant [10] focus on exploring teaching and learning when mobile

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computing devices, such as mobile phones and smartphones, have been applied to higher education. Lai et al. [11] investigates the **d**ifferences between mobile learning environmental preferences of high school teachers and students. Bannan, Cook, & Pachler [12] examine how the intersection of mobile learning and design research, prompts the reconceptualization of research and design individually as well as their integration appropriate for current, complex learning environments.

In the field of fora in e-leraning, a subject researchers have been focusing on in the past years (as well as coordinators and tutors) is how we can have, at any given moment, an overall picture of the situation in a number of threads about what is being discussed and whether the creation of the desirable learning climate is achieved through discussion in the fora [13]–[16]. Dringus & Elis [17] seek to intersect the information an instructor may wish to extract from the forum, with viewable and useful information that the system could produce from the instructor's query. Romero, Ventura & Garcia [18] describes the full process for mining e-learning data, as well as, how to apply the main data mining techniques used, such as statistics, visualization, classification, clustering and association rule mining of Moodle data. Furthermore, Romero & Ventura [19] describes the different groups of user, types of educational environments, and the data they provide, as well as, the most typical/common tasks in the educational environment, that have been resolved through data-mining techniques.

There are numerous studies on educational techniques used in e-learning fora some of which concern educational techniques such as Snowballing and Brainstorming. Indicatively, concerning Brainstorming technique Pinsonnealt et al. [20] adopt the term Electronic Brainstorming (EBS) addressing that "it has been proposed as a superior approach to both nominal Brainstorming (working alone) and face-to-face Brainstorming (verbal)". There are studies that try to particularise in subcategories the Brainstorming technique, namely Camacho & Paulus [21], refer to solitary Brainstorming, while Helquist et al. [22] to "very large groups" of Brainstorming, and studies which examine the creativity [23] or the productivity [24] in a web-based context of asynchronous electronic Brainstorming groups. Offner et al. [25] explored the unblocking Brainstorming. Finally, Dugosh et al. [26] examine the potential of cognitive stimulation in Brainstorming technique.

With regard to the Snowballing technique Thomas & Carswell [27] use it in their effort to assess the role of collaborative learning in a distributed education environment within the framework of a relative research of the Open University of London, highlighting that it offers essential support for students studying at a distance. Kember & Gow [28] also evaluate it when studying the action research as a form of staff development in higher education, in attempting to improve their own teaching through cycles of planning, acting, observing and reflecting.

In summary, it is concluded that despite the fact that there is a multitude of studies on the mobile dimension of e-learning, and other studies referring to educational techniques, such as Snowballing and Brainstorming that are widely used in e-learning fora, a void is detected however in the comparison of educational techniques through processes that use a combined environment with a computer and mobile devices.

III. METHODOLOGICAL FRAMEWORK

A. Sample

This research was conducted from October 2016 to February 2017, in 8 training computer instructors' centers of Greece. The sample consisted of 144 instructors-trainees', at the areas of Attica (3 Centers), Central Greece, Thessaly, Western Greece, Peloponnesus and Crete within the framework of a training course in advanced technologies integration skills computer instructors. All trainees were of the same level of knowledge. Evaluated were the discussion threads on forum (in all 2498 messages).

B. Method

The trainees were grouped in 8 groups of 18 people; there was an effort to form all groups absolutely uniform as far as the members' education profile was concerned (age, sex, experience, etc.) Supporting material with the concepts to be presented, as well as a manual with the commands of the 5 modules of the course (IHMC Cmap tools, Edison for the creation of electrical circuits, Java Virtual Machine, Scratch and Java applets for Ph.E.T.) were available via Internet before the beginning of the course. Training was based upon the Moodle forum, with the use of a combined environment via internet and mobile devices. Furthermore, after the end of each of the 5 modules of the course, a self-evaluation test was completed by the trainees. The aforementioned educational procedure is mainly applied by HOU in Greece.

At this point, it should be noted that the standard instructions for designing applications for Mobile devices were followed, as described in the mobile best web practice document of the World Wide Web Consortium (W3C).

C. Activities

The lesson plans distributed to the trained to be developed, should comprise: a) title for the hourly module b) the goals of the course (as for knowledge, skills, attitudes), c) sub-units, (parts into which teaching shall be divided) and time used for each one, d) educational techniques and teaching aids to be used for each sub-unit and e) justification of the above choices. The lesson plans concerned the creation of 5 exercises of each object IHMC Cmap tools, Edison for the creation of electrical circuits, Java Virtual Machine, Scratch and Java applets for Ph.E.T).

D. Procedure

During the asynchronous discussion on the forum it was decided to use the educational techniques of Snowballing and Brainstorming. More specifically the Snowballing technique was used in four groups while the Brainstorming was used in the other four.

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In the case of the Snowballing technique, it was chosen so that views were exchanged in order to advance and expand the trainees' consideration as far as the advanced technologies integration skills is concerned. In particular, the procedure which took place exclusively through the Moodle forum and was repeated in each course of the program was the following: a) The trainees had the opportunity to comment on the issues of the concepts' teaching approach in advanced technologies integration skills they faced b) Then each trained person compared their comments to another (by creating threads of 3 people) c) The same procedure was repeated in groups of six and d) At the end of the procedure all the trainees of the group participated (18) presenting all the views in a plenary session and they tried to compose their views and to reach conclusions, as they did in Brainstorming technique. At this point it is advisable to present the modeling used.

As for the Brainstorming, the procedure intended to the exposure of numerous sides of the issue of advanced technologies integration skills, the knowledge enrichment of the trained and finally the consolidation or change of their opinions. In particular, the procedure which took place exclusively through the Moodle forum and was repeated in each course of the program was the following: a) They all participated in the same thread and each one was stimulated to express her/his own ideas in a spontaneous way even if their ideas seemed unrealistic at a first level without being necessary (at this phase) to explain them and without criticizing any of them b) The tutor codified all ideas and presented them in a uniform manner c) Each trainee was asked to explain or even modify (if they wanted) their initial placement d) At the end of the procedure, it was stimulated to compose the opinions and to reach conclusions as for the compilation of lesson plans.

E. Modelling

Based on observations at the HOU fora, the following became evident: a) There are two categories of communication actors: Tutors and Students. For brevity, tutors will be symbolised with a *T* and students with an *S* b) As regards message types, these are distinguished into questions and answers. Hereinafter, symbolised with *q* and *a* respectively c) As to their content, messages are distinguished into those relating to (the respective symbols are given in brackets): i) study of educational material (*M*), ii) questions/answers for exercises – assignments (*X),* iii) presentation of sample assignments by tutors (*P*), iv) instructions (*I*), v) assignment comments, corrections (*C*), vi) student comments on assignments (*D*), vii) sending – receiving assignments (*J*), viii) sending - receiving grade marks (*G*), ix) notification of advisory meeting (*V*) and x) pointless message (*L*).

Finally, the order in which the above symbols will be written is: a) message carrier b) message type and c) the content of the category to which the message belongs. A message concerning a student's question for an assignment is represented as: *SqX* (where *S* for student, *q* for question and *X* for the fact that this message is about an assignment). An indicative example is presented that contains a series of messages represented by the sequence *SqVMTaVMSqMXSaXM,* which represent a discussion thread as follows: in the beginning is a message whose sender is student *S* who is asking a question *q* referring to forthcoming advisory meeting *V* and also concerning the study of educational material *M*. This message is replied to by tutor *T* who is answering *a* referring to forthcoming advisory meeting *V* and also about the study of educational material *M*. This message is replied to by student *S* who is asking a question *q* concerning the study of educational material *M* and also about the forthcoming assignment *X*. This message is replied to by another student *S* who is answering *a* about the forthcoming assignment *X* and also about the study of educational material *M*. As it is obvious this modeling uses a formal language. Additionally, it should be noted that for this Language syntax check algorithm was used, as well as a respective system to automate this procedure by inserting threads from discussion fora and exporting the respective strings.

According to this approach, a system of automatic classification [29]-[33] was used, which comprised the following steps: Data filtering, Storage of roots files and Strings' production. In data filtering process, an algorithm was used, that would input a file containing one or more discussion threads in their original form and output a file of documents containing the following information (User name, date, message content). In the second stage (Storage of roots files) an algorithm of roots export of words was used, that produces the result with one parsing and removes the endings based on the Quick Fitting (QF) principle. In Strings' production stage, was used a process that inputs: a) the records file containing useful information (User name, date, message content); b) the file containing pairs of word/phrase roots or symbols and terminal symbols relating to the type of message; and c) the file containing the pairs of words/phrases and terminal symbols referring to the content category of the message. This system was tested experimentally using a combination of algorithms, such as: AdaBoost, Naive Bayes, 1-Nearest, and WINNOW. Subsequently, was followed a calibration process of repeated readjustment, and the results was deemed satisfactory (98.92% correct message interpretation in present case).

IV. DATA ANALYSIS

In groups 1, 2, 3 and 4, where the Snowballing technique was used, we received 1119 messages; 81 from the instructors and 1038 from trainees while, as far as content categories are concerned we had 1685 appearances in all. In groups 5, 6, 7 and 8, where the Brainstorming technique was utilized, we received 1379 messages; 115 were from the instructors and 1264 from the trainees. Given that, according to the above modeling, more than one category of content may be included in each message (e.g. the same message may be a question on the study of educational material as well as a project too), 2788 such questions were confirmed. The above information is presented in Table I.

TABLE I. APPEARANCES NUMBER (AN) PER MESSAGE CONTENT CATEGORY (CC)

Content Category	Groups 1, 2, 3 and 4 (Snowballing)	Groups 5, 6 , 7 and 8 (Brainstorming)
M	288	652
X	356	781
P	44	47
I	41	59
C	201	272
D	256	380
J	357	360
G	37	36
V	33	32
L	72	169
Total	**1685**	**2788**

It is obvious "Figure 1" that there is a respective uniformity per message content category but with a different intension.

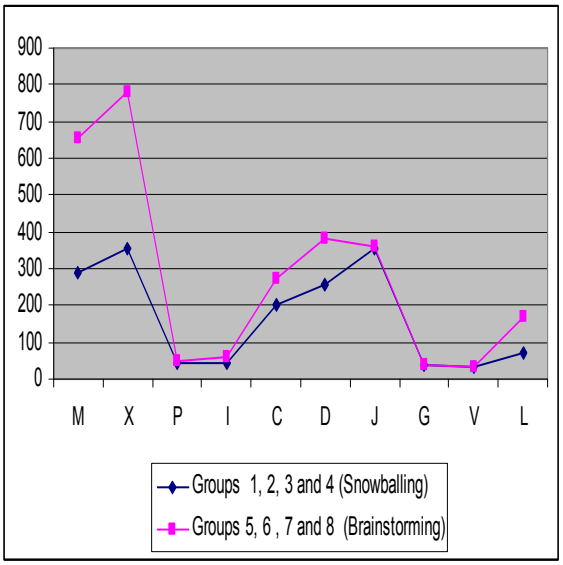

Figure 1. Graphic representation of Snowballing and Brainstorming techniques.

If we take into account only interventions of trainees, then we have 879 appearances for Snowballing groups. This arises from the deduction the tutor's interventions and the said "service type" of interventions, i.e. the categories presentation of sample assignments by tutors (P), assignment comments, corrections (C), sending – receiving assignments (J), sending - receiving grade marks (G), notification of advisory meeting (V) which function as separate variables according to the initial plan, as well as the tutor's interventions appearing on the remaining content categories. The respective numbers of appearances for Brainstorming groups are 1889. The above information is presented in Table II.

TABLE II. APPEARANCES NUMBER (AN) PER MESSAGE CONTENT CATEGORY (CC) WITHOUT THE TUTOR'S INTERVENTIONS

Content Category	Groups 1, 2, 3 and 4 (Snowballing)	Groups 5, 6 , 7 and 8 (Brainstorming)
M	241	605
X	311	735
D	255	380
L	72	169
Total	**879**	**1889**

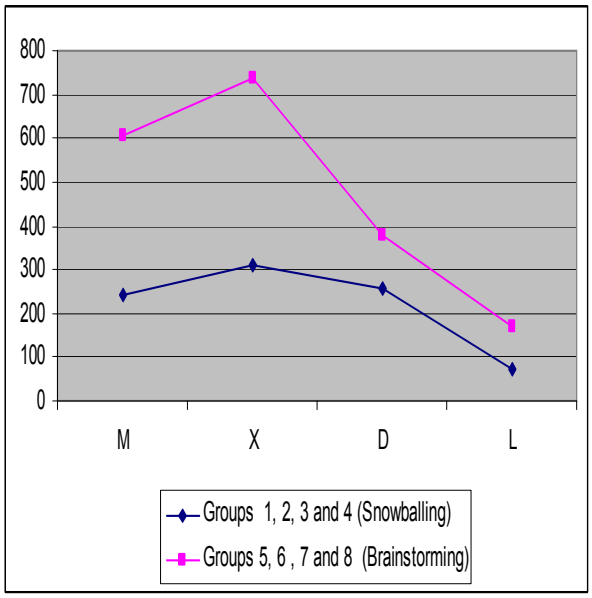

Figure 2. Graphic representation of the distributions of Snowballing and Brainstorming techniques containing only the trainees interventions.

It is obvious "Figure 2" that the difference in participation increases when the tutor's intervention reduces.

V. DISCUSSION

According to the data analysis, in groups where Brainstorming was used, higher participation at forum is noted, compared to Snowballing in both as for messages (1379 against 1119) and range of content categories (2788 against 1685). Furthermore, if from this number the content categories P, J, G, V are deducted, as well as the tutor's interventions, which in our case constitute separate

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variables, then the discrepancy (respectively) increases even more (1889 against 879). Moreover, even if we deduct the needless messages (L), then the discrepancy of participation (in educationally substantial categories) is 1720 against 807.

In the case of the Brainstorming in relation to the Snowballing, enforcement of the creativity and the participants' experiences is noted; this finding arises from practical experience and messages' texts analysis as well as from the fact that we have 605 against 241 and 735 against 311 for the categories: study of educational material (M) and questions/answers for exercises assignments (X) respectively. In addition, improvement of critical thinking is noted (category: student comments on assignments (D): 380 against 255).

On the other hand, in Brainstorming technique the phenomenon of more needless messages arises, i.e., off topic interventions (169 against 72). Despite the fact that it can be quantitatively proven, meanwhile the observation and study of messages' contents offers (in a quite small extent) a show of imagination by a smaller percentage of participants in Brainstorming technique, in contradiction to Snowballing technique. This may be explained given the fact the Snowballing technique is more "disciplined".

As it can also be seen in Tables I and II, a slightly uniform distribution to both techniques is noted, as far as where the attention is during the forum discussions, both throughout all the messages and also to those remaining if we deduct the messages functioning as separate variables. It becomes thus obvious that (*X)* category: questions/answers for exercises – assignments comes first (781 and 735 against 356 and 311), followed by the (*M*) category: study of educational material (652 and 605 against 288 and 241).

Even though, as mentioned above, there is a void regarding the comparison of the educational techniques of Snowballing and Brainstorming through processes that use a combined environment with computer and mobile devices for e-learning, yet there are relevant studies referring to these techniques individually. When studying the results of this study, we had in mind that the educational practices are regarded as social practices to be changed through collaborative action [28]. On the high percentage of participation in Brainstorming, despite seeming presumable, at first it is not always so, given that "a poorly crafted Brainstorming input creates a cognitive load that consumes attention resources and may stifle the Brainstorming process" [22], while according to Michinov and Primois [23] participation is encouraged "only when participants have access to a shared table facilitating the comparison among group members". As for the ascertainment of educational participation of Brainstorming in this study, it is at first, in contrast to a respective study [20] where it is highlighted that "the prevailing popularity of group Brainstorming (verbal or electronic) in organizations may be explained by the perceived productivity" and that "these perceptions, which are at odds with reality, create the illusion of productivity"; but Camacho & Paulus [21], who, despite ascertaining the same, however explain that "part of the productivity loss observed in interactive Brainstorming groups may be due to the inhibited performance of individuals who are uncomfortable with group interaction"; Michinov and Primois [23] are of similar opinion. This conclusion is also reached by a respective study [26] where it is noted that "the attentional set of the participant and the content of the exposure manipulation (number of ideas, presence of irrelevant information) affected its effectiveness". To the above, we must add that similar results regarding the increased participation of Brainstorming compared to Snowballing appear in a relevant study on training of programming didactics for informatics high schools teachers [34].

VI. CONCLUSION & FUTURE GOALS

The development of a plethora of systems that provide the service of asynchronous e-learning fora the development of mobile devices and their use in education creates a new landscape the recent years in education, which needs to be studied from many aspects. This paper focuses on the comparison of educational techniques that are widely used in the e-learning fora (such as Brainstorming and Snowballing) through a combined environment via computer and mobile devices, in the framework of a training course in the advanced technologies integration skills of computer instructors. As is deduced, both from data analysis, as well as from the study of the text messages in the Moodle forum, the groups where Brainstorming technique was utilized show higher participation at the forum than those utilizing the Snowballing technique. Additionally, a better enforcement of the participants' critical thinking is noted. On the other hand, in Snowballing technique it is noted that quite less time is spent and there are no off topic interventions in relation to Brainstorming.

Among other things, future goals are the comparison of the remaining educational techniques that are used in e-learning as well as the study of dimensions that affect the effectiveness of asynchronous fora, such as the size of the group of participants through relevant environments.

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