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Educational techniques comparative study by using combined environment via computer and mobile devices in asynchronous discussion forum

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Abstract—**Over recent years, the rapid development of mobile devices has made possible the support of educational applications in distance education 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.**

This paper focuses on the fora of asynchronous distance education with the purpose of comparing educational techniques widely used in the fields (such as brainstorming and snowballing) in a combined environment both via computer and mobile devices, in the framework of a training program in IT basic skills for primary education teachers.

For the purpose of this study, modeling in formal language was used to classify the messages in the Moodle forum (V.1.6), as well as a respective system to automate this procedure. As it is deduced from the data analysis and the study of the text messages in the Moodle forum (V.1.6), the groups using brainstorming technique show higher participation at the forum than those using the snowballing technique. Furthermore, brainstorming technique is more advantageous than Snowballing technique concerning the educational effectiveness.

Keywords-*asynchronous discussion fora; mobile learning; adult education;educational techniques; modelling*

I. INTRODUCTION

The main feature of distance education is that there is physical distance between the student and the tutor. Therefore, communication is important for the success of a distance education program. Extremely useful tools used by distance education are the fora that provide the opportunity for asynchronous communication not only between the tutor and the students, but also between students themselves. During the past fifteen years, a multitude of systems that offer the critical service of asynchronous fora for distance education have been developed, such as: Moodle, Claronline, Atutor, ILIAS, OLAT, CNAMS(Cisco), MVC(Manhattan Virtual Classroom), Pioneer (MEDC-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 these past years: how can they have, at each given moment, an overall picture of the situation in a number of discussion threads in a Distance education 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 (brainstorming and snowballing), in the asynchronous forum moodle (v.1.6) through the use of a combined environment, both via computer and mobile devices in a training program in IT basic skills for primary education teachers. 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; section III where the study methodology is presented; section IV, with the data analysis; section V, where 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 distance education. 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 distance education.

In the field of fora in distance education, 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 [10-13].

Furthermore, there are numerous studies on educational techniques used in distance education fora some of which concern educational techniques such as brainstorming and snowballing. Indicatively, concerning brainstorming technique Pinsonnealt et al. [14] 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)", while Stenmark [15] adopted the term "IT-Supported Organisational brainstorming". There are studies that try to particularise in subcategories the brainstorming technique, namely Camacho & Paulus [16], refer to solitary brainstorming, while Helquist et al. [17] to "very large groups" of brainstorming, and studies which examine the creativity [18] or the productivity [19] in a web-based context of asynchronous electronic brainstorming groups. Hymes & Olson [20] and Offner et al. [21] explored the unblocking brainstorming and Gallupe et al. [22] attributed the superiority of electronic brainstorming to a number of factors, including the technology's ability to reduce production blocking. Finally, Dugosh et al. [23] examine the potential of cognitive stimulation in brainstorming technique.

With regard to the snowballing technique Thomas & Carswell (2000) 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, while Scarpellini & Bowen [24] use it when evaluating the role of the evaluation process in sustaining and developing quality distance education programs in collegiate aviation. Kember & Gow [25] 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 distance education, and other studies referring to educational techniques, such as and snowballing that are widely used in distance education 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 during March to September 2008 in 6 Training Centres of Piraeus, Greece. The sample consisted of 108 primary education teachers' and 1620 students of theirs, at the area of Prefecture of Piraeus within the framework of a training program in IT basic skills for primary education teachers. All trained people were of the same level of knowledge. Evaluated were the discussion thread on forum (in all 1873 messages), the results of the trained teachers in 4 modules of the program (432 marks), as well as the students' results in 4 chosen activities after the experimental teaching of 5 hours.

B. *Method*

Trained teachers were grouped in 6 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 4 modules of the program (word, excel, access and powerpoint) were available via internet before the beginning of the program. In addition, by the program's beginning, 4 subjects for the creation of lesson plans were distributed from tutors to the trained teachers, which had to be developed and applied by each one in their classroom within 5 hours. One hour was used for the resolution of questions in each classroom. Moreover, it was agreed with the 108 teachers that after this procedure chosen activities would be given to the students of the respective schools as a test (in all 1620 students, approximately 15 per class). The participating schools are city neighborhoods of Piraeus Prefecture and are of the same socio-cultural level.

Training was based upon the Moodle forum, with the use of combined environment via internet and mobile devices (Fig. 1), while five (5) 3-hour advisory meetings also took place in each group. Furthermore, after the end of each of the 4 modules of the program, a self-evaluation test was completed by the trained teachers. 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).

Figure 1. Moodle forum, with the use of combined environment via internet and mobile devices.

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 4 exercises of each object (word, excel, access and powerpoint).

D. *Procedure*

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

In the case of brainstorming the procedure intended to the exposure of numerous sides of the issue of didactics of IT basic skills to the students of 6th grade of primary School, 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 their 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, the educational techniques to be used by each one in their school, the supporting material to be distributed to the students etc.

The snowballing technique was chosen so that views were exchanged in order to advance and expand the teachers' consideration as far as the didactics of IT basic skills to students of the 6th grade of primary School 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 trained people had the opportunity to comment on the issues of the concepts' teaching approach in IT basic skills they faced b) Then each trained person compared their comments to another (by creating threads of 2 people) c) The same procedure was repeated in groups of four 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.

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 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.

IV. Data Analysis

In groups 1, 2 and 3, where the brainstorming technique was utilized we received 1034 messages; 86 were from the tutor and 948 from the trained people. Given that, according to the above modeling, more than one categories 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), 2091 such questions were confirmed. Contain, in groups 4, 5 and 6 where the snowballing technique was used, we received 839 messages; 61 from the tutor and 778 from the trained people while, as far as content categories are concerned we had 1264 appearances in all. The above information is presented in Table I.

TABLE I. Appearances number (AN) per message content category (CC)

CC	groups 1, 2 and 3 (brainstorming)	AN	%	groups 4, 5 and 6 (snowballing)	AN	%
M		489	23.4		216	17.1
X		586	28.0		267	21.1
P		35	1.7		33	2.6
I		44	2.1		31	2.5
C		204	9.8		151	11.9
D		285	13.6		191	15.1
J		270	12.9		268	21.2
G		27	1.3		28	2.2
V		24	1.1		25	2.0
L		127	6.1		54	4.3
Total		**2091**	**100**		**1264**	**100**

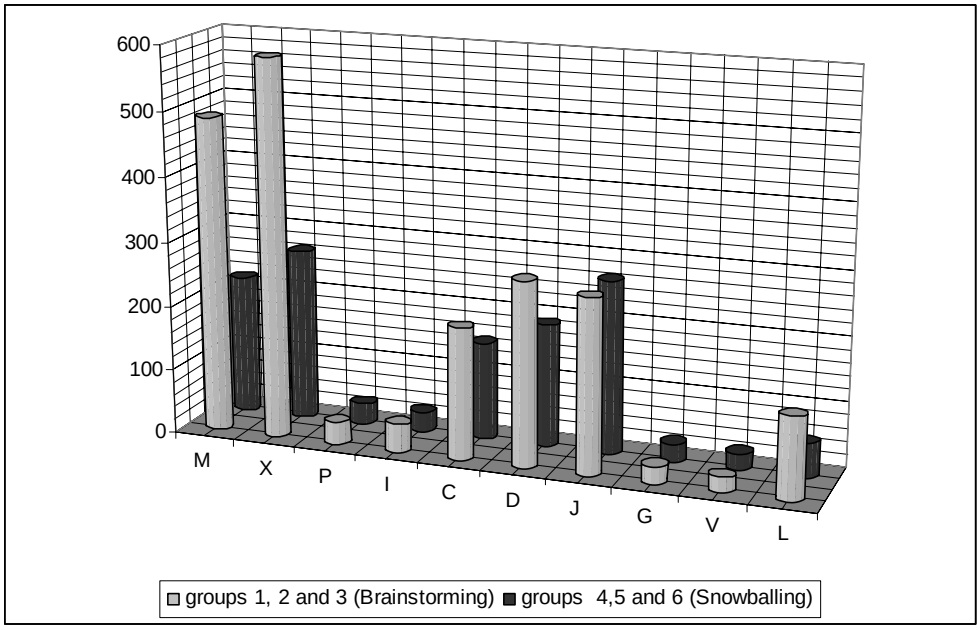

Figure 2. Graphic representation of brainstorming and snowballing techniques.

It is obvious (in Fig. 2) that there is a respective uniformity per message content category but with a different intension.

If we take into account only interventions of trained people, then we have 1417 appearances for brainstorming 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 snowballing groups are 659. The above information is presented in Table II.

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

CC	groups 1, 2 and 3 (brainstorming)	AN	%	groups 4,5 and 6 (snowballing)	AN	%
M		454	32.0		181	27.5
X		551	38.9		233	35.4
D		285	20.1		191	29.0
L		127	9.0		54	8.2
Total		**1417**	**100**		**659**	**100**

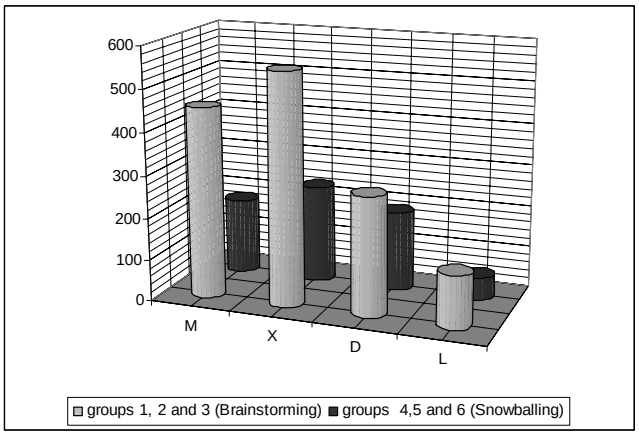

Figure 3. Graphic representation of the distributions of brainstorming and snowballing techniques containing only the trained people interventions.

It is obvious (in Fig. 3) that the difference in participation increases when the tutor's intervention reduces.

As far as the trained people's performance is concerned in each test of self-evaluation at the end of each module is concerned, the collective data for groups 1, 2 and 3 (brainstorming) and 4, 5 and 6 (snowballing) are presented respectively on Table III. For the estimation of the central tendency of the results, the three Pythagorean means and the average of interquartile range were taken into account. The three classical Pythagorean means are the arithmetic mean, the geometric mean, and the harmonic mean. As for the average of interquartile range (I.R.) taken into account were the means i.e. (50%) without counting the highest and the lowest quarters of values (25% and 25% respectively). The means' choice (not only the average) was done so as not to "be affected" by exceptionally high or low values. Table IV presents the statistics measures of central tendency concerning the trained teachers' and their students' performance at the tests (of the chosen activities) after the 5-hour teaching.

TABLE III. MARKS DISTRIBUTION OF THE TRAINED TEACHERS PER MODULE (EXCELLENT =100

groups 1, 2 and 3 (brainstorming)	Marks				
	Course	61-70	71-80	81-90	91-100
	1	8	19	17	10
	2	0	12	25	17
	3	0	8	29	17
	4	0	0	30	24
groups 4,5 and 6 (snowballing)	**Marks**				
	Course	**61-70**	**71-80**	**81-90**	**91-100**
	1	20	19	14	1
	2	3	17	27	7
	3	5	17	29	3
	4	0	8	26	20

TABLE IV. STATISTICS MEASURES OF CENTRAL TENDENCY CONCERNING THE TRAINED TEACHERS' AND THEIR STUDENTS' PERFORMANCE (EXCELLENT=10) AT THE CHOSEN ACTIVITIES

	teachers				their students			
	Geom.	***Harm.***	***Aver.***	***I.R.Av.***	***Geom.***	***Harm.***	***Aver.***	***I.R.Av.***
group1	86.07	85.71	86.40	87.83	7.59	7.58	7.59	7.65
group2	86,82	86,53	87.10	88.06	7.63	7.63	7.64	7.67
group 3	85.00	84.68	85.32	86.08	7.52	7.46	7.58	7.58
brain-storming groups	**85.96**	**85.64**	**86.27**	**87.32**	**7.58**	**7.56**	**7.60**	**7.63**
group 4	80.59	80.02	81.15	81.14	7.23	7.22	7.23	7.23
group 5	81.10	80.58	81.61	82.53	7.30	7.30	7.30	7.24
group 6	80.60	80.15	81.03	81.03	7.24	7.19	7.26	7.22
snowbal-ling groups	**80.76**	**80.25**	**81.26**	**81,57**	**7.26**	**7.24**	**7.26**	**7.23**

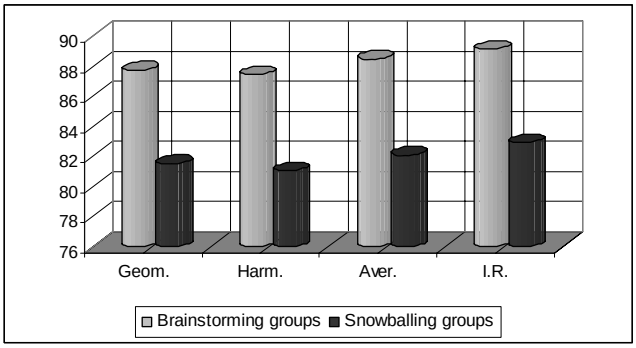

Figure 4. Graphic representation of the trained teachers' performance.

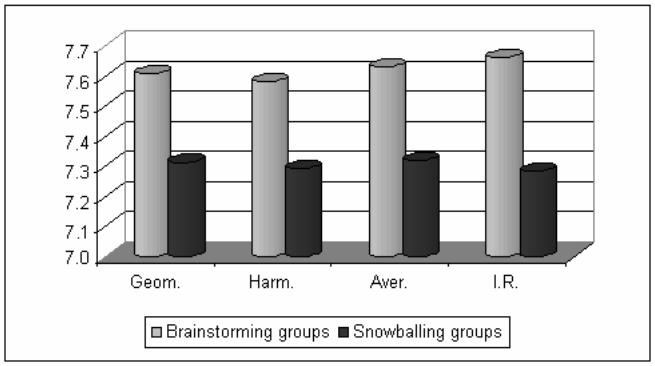

Figure 5. Graphic representation of the students' performance in the chosen activities.

In this study, the advantage of the brainstorming technique is obvious (Fig..4 and Fig..5).

V. DISCUSSION

As it is deduced from the data analysis, in groups where brainstorming was used, higher participation at forum is noted, compared to snowballing in both as for messages (1034 against 839) and range of content categories (2091 against 1264). 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 variables, then the discrepancy (respectively) increases even more (1417 against 659). Moreover, even if we deduct the needless messages (L), then the discrepancy of participation (in educationally substantial categories) is 1290 against 605.

In the case of brainstorming in relation to 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 454 against 181 and 551 against 233 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): 285 against 191).

On the other hand, in brainstorming technique the phenomenon of more needless messages arises, i.e. off topic interventions (127 against 54). 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 (586 and 551 against 267 and 233) , followed by the (*M*) category: study of educational material (489 and 454 against 216 and 181).

As far as the effectiveness of the two techniques is concerned, the advantage of brainstorming against snowballing is obvious, both on the primary level concerning performance in self-evaluation tests of the trained people (average 86.27 against 81.26) and on the secondary level concerning the students' performance at the procedures chosen to be the test (7.58 against 7.26) after the application of lesson plans, which were applied by the same teachers. This given is reinforced by the appearance of similar results among the groups (86.40, 87.10 and 85.32 in brainstorming groups against 81.15, 81.61, 81.03 of snowballing) and also (7.59, 7.64 and 7.58 against 7.23, 7.30 and 7.26 average student performance, respectively). The above assumptions are certified not only in relation to arithmetic means and geometrical, harmonic and arithmetic means of the interquartile range but also at trained teachers performance (in self-evaluation tests) as well as the respective students of theirs in the chosen activities.

Even though, as mentioned above, there is a void regarding the comparison of the educational techniques of brainstorming and snowballing through processes that use a combined environment with computer and mobile devices for distance education, 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 [25]. As for the high rate 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" [17], while according to Michinov and Primois [18] 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 [14] 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 [16], 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 [18] are of similar opinion. This conclusion is also reached by a respective study [23] 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". The conclusions of this study may be thus explained (as far as brainstorming effectiveness is concerned) and agree with a relative study [22] that concludes that "electronic brainstorming groups were found to be significantly more productive" and likewise Hymes & Olson [20], who support their opinion about unblocking

brainstorming through the use of a simple group editor, as well as Stenmark [15]. There is similar consideration about snowballing by Thomas & Carswell [26], who for instance remarks that "it is helpful if each sub-group to be given a different, but related task" which in other cases, e.g. [24] cannot occur due to the nature of the educational object.

To the above, we must add that similar results regarding the increased participation and effectiveness of brainstorming compared to snowballing appear in a relevant study on training of programming didactics for informatics high schools teachers [27].

VI. CONCLUSION & FUTURE GOALS

The development of a plethora of systems that provide the service of asynchronous fora for distance education and 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 to the comparison of educational techniques that are widely used in the fora of asynchronous distance education (such as brainstorming and snowballing) through a combined environment via computer and mobile devices, in the framework of a training program in IT basic skills for primary education teachers. As is deduced both from data analysis as well as from the study of the text messages in the Moodle forum (V.1.6) 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. Finally, as it is deduced from data analysis, brainstorming is more advantageous than snowballing as to its effectiveness. Both on the primary level of trained teachers and on the secondary level (results of their students).

Among other things, future goals are the comparison of the remaining educational techniques that are used in distance education 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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