Suitable asynchronous distance education fora size for working groups in informatics teachers training

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Abstract— A substantial communication tool used in distance education is the asynchronous discussion fora. One of the most popular educational techniques used by fora of distance education is the educational technique of working groups which is the eminent technique that may be applied in all stages of a learning circle. This study uses a specific modelling made for Hellenic Open University's fora, refers to a distance education program for computer teachers and studies the most appropriate group size when working groups technique is implemented through an asynchronous discussion forum, both as for participation and also as for the educational effectiveness.

Keywords- asynchronous discussion fora; distance education; adult education; working groups size; modelling

I. INTRODUCTION

In distance education the student often feels isolated [1,2] consequently the communication between the student and the teacher as well with the other students is an important parameter for the success of a distance education program. A substantial tool supporting the communication is the asynchronous discussion electronic forum, or e-forum, hereinafter called forum (plural fora). Fora encourage true collaboration creating a good social climate and sense of community [3]. This study focuses on working groups (WG) using fora for their communication and specially discusses the subject of ideal WG size within a distance education process referring to uniform WG. This study refers to a distance education program for computer teachers and studies the most appropriate group size as for participation but also the educational effectiveness of five-member and seven-member WG when WG technique is implemented through a distance education forum using the open source framework Moodle (version 1.8.3). This study uses a specific modelling development and initially applied with success for Hellenic Open University's (HOU) fora [4].

II. THEORETICAL FRAMEWORK

WG in asynchronous distance education environments constitute the subject matter of numerous studies. Others use the term "online group projects" and support that a substantial goal is to encourage collaborative dialogue for new knowledge construction [5], while others use the term "student groups" supporting that "the asynchronous media can provide student groups with more options to think" in relation to modern education [6]. Others [7] study the determination criteria of a group examining even each single person as a group, defining that the group size varies between 1 and n, n being the total number of students; while others study this matter from the effective pedagogies point of view [8]. As for the appropriate size of a group in a distance education forum there are studies supporting that "the preferred group size is between three and five students" [9] or from 2 to 4 [10], other supporting that "the optimal group ranges from four to six members" [11] and others proposing a wider range supporting that the ranging 5-10 is manageable and effective [12].

This study examines the size of 5 and 7 people, taking into account the respective literature. As for the group size of 2 people, it is obvious that it befits more to the snowballing technique and not that much to WG in the ordinary meaning of the term. Furthermore, according to the overwhelming majority of respective studies on the group size of 3 people, there is danger the exchange of views to be soon finished, while on

the other hand in groups of 9 and more people a complete exchange of views takes place due to multiple interventions. In addition, in 4-people group there is the danger of endless dispute of two members against two others; given the fact that the same reason exists for all the groups of even number of members, it was decided to study the five-members and seven-members WG, according also to Woods' finding that [13] "a dominant practice is to randomly assign students to small groups of five to seven members".

III. Methodological Framework

A. Sample

This study was conducted during June to November 2008 in two Training Support Centres of Piraeus. The sample was constituted by 48 High School Computer Teachers and 942 students of theirs, at the area of Prefecture of Piraeus within the framework of a training program on Didactics of Informatics. There were evaluated the discussion threads on forum (in all 910 messages), the results of the trained professors in the 4 courses of the program (192 marks), as well as their students' results in a chosen activity after the experimental teaching of 3 hours after the end of the training.

B. Method

The program comprised the following courses: a) teaching and learning b) organizing and planning the Lesson c) educational methods and techniques d) presentation of the creation of flowchart software. All trained people were of the same level of knowledge and they were separated in 8 groups, 4 with five-members and 4 with seven-members. Supporting material with the concepts to be presented, as well as a manual with the commands of the program for the creation of flowcharts were available via internet before the program's beginning; in addition, by the program's beginning, there were distributed from tutors to the trained teachers 2 subjects for the creation of lesson plans, which should be developed and applied by each one in their classroom within a duration of 3 hours. One hour was used for questions' resolution in each classroom. Moreover, it was agreed with the trained teachers that after the training these lesson plans would be applied and a chosen activity would be given to the students of the respective schools as a test. In all, we had 942 students (approximately 20 per class). The participating schools are city neighbourhoods of Piraeus Prefecture and are of the same socio-cultural level.

The training was based upon asynchronous environment of distance education, utilizing Moodle, while there also took place five (5) 3-hour advisory meetings in each group. After the end of each course, a self-evaluation test was completed by the trained teachers. Similar educational procedure is mainly applied by HOU in Greece.

C. Activities

As aforementioned, the trained teachers had to prepare 2 lesson plans comprising: a) title for the hourly course b) the goals of the course (as for knowledge, skills, attitudes), c) parts into which teaching shall be divided and time spent on each one, d) educational techniques and teaching aids to be used for each course and e) justification of the above choices. The lesson plans concerned activities for the creation of flowcharts with the use of the specific program (visual flowchart), which executes a flowchart by automatically creating also the commands in Language LANGUAGE used for the course "Applications' development in a programming environment" of 3rd class of High School. The chosen activity which was agreed to be given by the trained teachers as a test to their students concerned the teaching of the algorithm of bubble sort (fig.1) in two versions: The one mentioned in this specific course's book (execution of all repetitions) as well as the so-called "smart" or "quick" bubble where the (conditional) repetition stops when the table is sorted.

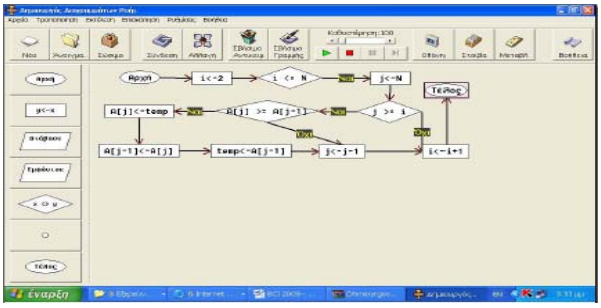

Fig. 1. Visual flowchart. Commands' menu is in Greek.

D. Procedure

During the asynchronous discussion fora through Moodle forum, it was decided to use the WG educational technique as follows: Both in five-members and seven-members groups the goal was the Computer teachers to discuss issues concerning the

teaching of the bubble sort algorithm, as for instance the students' cognitive difficulties in the construction of sufficient representations for the bubble algorithm and at the exchange of ideas for the special teaching and educational sides of this issue.

In each group the following procedure took place and was repeated in each course: a) the relative instructions were given b) 20 days time horizon for the function in WG level was given c) at this end of this period it was asked the presentation of each group's project through the forum in a plenary session (of 20 people for five-members WG and 28 for seven-members WG). At this point, it is worthy to mention that all groups without discrimination were asking for an extension from 3 to 5 days for the function at WG level for each course d) after the presentation of each group's project in a plenary session, it followed the stage of composition and reach of conclusions through the utilisation of each group's project in each group (20 and 28 people).

Given that it was about adults' educational groups, it shall be noticed that during the aforementioned procedure it was utilized the previous practical and research experience within the framework of the HOU concerning, among others, previous projects related to HOU students' attitude [14,15,16], as well as to the forums' modelling as a methodology of messages' interpretation [4] in distance education, which is in brief presented below.

E. Modelling

Based on observations at 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 *E* 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.

An indicative example is presented that contains a series of messages represented by the sequence *EqVMTaVMEqXEaX*, which, according to the above, represent a discussion thread as follows: in the beginning is a message whose sender is student *E* 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 *E* who is asking a question *q* concerning the forthcoming assignment *X*. This message is replied to by other student *E* who is answering *a* about the forthcoming assignment *X*. As it is obvious, this specific modelling uses typical Language. It is worthy to note hereat that for this Language it was developed a syntax check algorithm, as well as a respective tool to automatize this procedure by inserting threads from discussion Fora and exporting the respective strings.

IV. DATA ANALYSIS

In the 4 seven-member groups we received 424 messages; 46 were from the tutor and 368 were from the trained people. Given that according to the above modelling in each message more than one categories of content may be included (e.g. in the same message may be a question on study of educational material and on a project), there were confirmed 940 such appearances.

Respectively from the 4 five-member groups we received 486 messages from each; 41 from the tutor and 445 from the trained people, while, as far as content categories are concerned we had in all 902 appearances. The above are presented in Table 1.

TABLE 1. APPEARANCES NUMBER IN SEVEN-MEMBERS & FIVE-MEMBERS WG.

Content Category	Appearances number in (seven-members WG=28)	Appearances number/ Person 28+1(tutor)	Appearances number (five-members WG=28)	Appearances number/ Person 20+1(tutor)
M	232	8.00	223	10.62
X	278	9.59	269	12.81
P	18	0.62	16	0.76
I	22	0.76	14	0.67
C	91	3.14	78	3.71
D	132	4.55	148	7.05
J	112	3.86	97	4.62
G	14	0.48	19	0.90
V	16	0.55	15	0.71
L	25	0.86	23	1.10
Total	940	32.41	902	42.95

If we take into consideration only the trained people's interventions, then we have 602 appearances

for seven-member groups. This comes if we deduct 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 other content categories. The respective number of appearances for five-member groups is 631. The above are presented in Table 2.

TABLE 2. APPEARANCES NUMBER IN FIVE-MEMBERS AND SEVEN-MEMBERS WG AFTER THE DEDUCTION OF CASES FUNCTIONING AS SEPARATE VARIABLES.

Content Category	Appearances number (seven-members WG = 28)	Appearances number/ Trained	Appearances number (five-members WG=20)	Appearances number/ Trained
M	197	7.04	207	10.35
X	246	8.79	253	12.65
D	132	4.71	148	7.4
L	27	0.96	23	1.15
Total	602	21.50	631	31.55

As far as the trained people's performance in each test of self-evaluation at the end of each course is concerned, the collective data for seven-member and five-member groups are presented respectively in Table 3. For the estimation of the central tendency of the results, the arithmetic mean and the average of interquartile range were taken into account. As for the average of interquartile range, there were taken into account the means i.e. (50%) without counting the highest and the lowest quarters of values (25% and 25% respectively). This choice was done so as the results not to be "affected" by exceptionally high or low values. In Table 4 there are presented the arithmetic means, as well as the average interquartile range for each group and in all 4 self-evaluation test of the trained people. There are also presented the students' performances at the test.

TABLE 3. MARKS OF THE TRAINED TEACHERS PER COURSE (EXCELLENT =100).

	seven-members WG				five-members WG			
Course	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
61-70	8	0	0	1	4	1	1	0
71-80	7	11	14	12	4	4	2	2
81-90	7	12	10	11	7	7	8	9
91-100	6	5	4	4	5	8	9	9

V. DISCUSSION

As deduced from the data analysis, in five-members groups, higher participation at forum is noted, compared to seven-members groups both as for messages (486 against 424) and as for range of content categories, if we take into account that the 4 five-members groups have 20 people, while the seven-members have 28; then we had 42.95 appearances per person in five-members groups against 32.41 in seven-members. 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 variable, then the discrepancy (respectively) increases even more (31.55 against 21.50). Moreover, even if we deduct the pointless messages (L), then the discrepancy of participation (in educationally substantial categories) is 30.40 against 20.54. As it also obvious in figures 2 and 3, a slightly uniform distribution to both cases is noted, as far as where the attention during the forum discussions is concerned, both throughout all the messages and also to the remaining if we deduct the messages functioning as separate variables. It becomes thus obvious (tables 1 and 2) that (*X)* category: questions/answers for exercises – assignments comes first (269 and 253 against 278 and 246) and it follows the (*M*) category: study of educational material (223 and 207 against 232 and 197).

TABLE 4. AVERAGE AND AVERAGE OF INTERQUARTILE RANGE OF THE TRAINED TEACHERS' AND THEIR STUDENTS' PERFORMANCE (EXCELLENT=20) IN THE CHOSEN ACTIVITY.

	teachers		their students	
	average	***average of interquartile range***	***average***	***average of interquartile range***
WG1	86.72	87.79	15.02	15.14
WG2	87.48	88.36	15.24	15.31
WG3	86.94	88.02	15.12	15.19
WG4	87.26	88.15	15.14	15.28
five-members WG	87.10	88.08	15.13	1523
WG5	84.61	85.38	14.15	14.14
WG6	85.17	86.18	14.49	14.36
WG7	85.28	86.38	14.52	14.47
WG8	84.51	85.18	14.11	14.03
seven-members WG	84.89	85.78	14.32	14.25

As far as the effectiveness of the two cases is concerned, it is obvious the advantage of five-members groups against seven-members, both in primary level

concerning performance in self-evaluation tests of the trained people (average 87.10 against 84.89) and in secondary level concerning the students' performance at the procedure chosen to be the test (15.13 against 14.32) after the application of lesson plans, which were applied by the same teachers. This fact is reinforced by the appearance of similar results among the groups (86.72, 87.48, 86.94 and 87.26 for the 4 five-members groups against 84.61, 85.17, 85.28 and 84.51 in the case of seven-members groups) and also (15.02, 15.24, 15.12 and 15.14 against 14.15, 14.49, 14.52 and 14.11 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 activity (table 4).

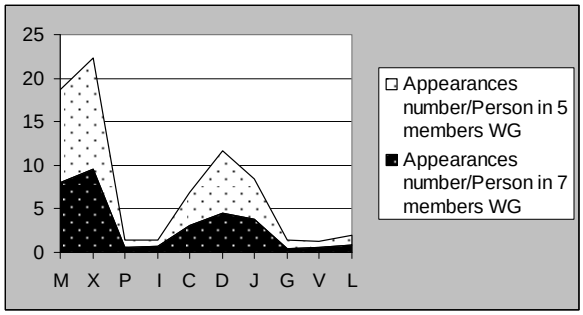

Fig. 2. Graphic representation of the distributions of five-members and seven-members WG. It is obvious the respective uniformity per message content category but in a different intension.

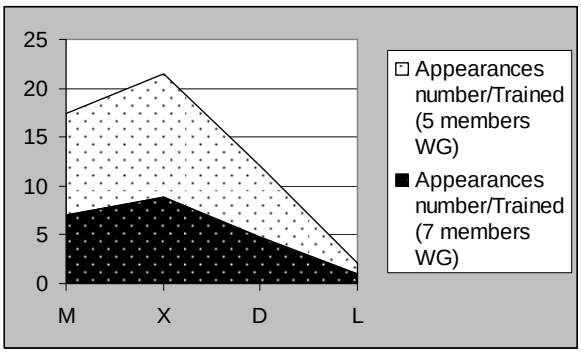

Fig. 3. Graphic representation of the distributions of five-members and seven-members WG containing only the trained people interventions.

VI. CONCLUSIONS AND FUTURE GOALS

According to the above, some clear conclusions can be reached. Firstly, in five-member groups the participation is much higher than in seven-member groups, both in total number of messages and in subsidiary content categories. Additionally, it is noted a clear advantage of five-member groups in relation to seven-member groups as for the educational effectiveness in primary level, concerning the trained teacher's results, as well as in secondary level, concerning their students' results in the chosen activity. This assumption is in conformity with the relative researches [17,18] where it is noted that the WG of 5 students were created, in our experience for an ideal size for online course discussions and partly according to Grooms [9] who argues in favour of groups of up to five-members, as well as according to Johnson and Johnson, [11] who consider ideal size to be between 4 and 6, and also according to the respective research concerning sizes 4 to 11 people [19], which concludes, among others, that "that participants from the course that used large groups (seven-members each group) scored lower on the experiences with collaborative learning than the participants from the other courses". The above results should of course be seen in the light of "optimal group size depends, in part, on the nature and function of the group" [13].

Among others, as future research actions, long-term comparative studies of five-member and seven-member groups are predicted in relation to HOU topics with studies focusing on different cognitive sub-fields of informatics. Additionally, it will be more emphasized the central question, what reinforces the participation at Fora and how this contributes to the educational process effectiveness by investigating side questions, such as how much it affects the person who starts the thread (teacher or student), how it starts, the period when the thread starts, how important is the time of response in threads, the groups' size etc. in combination with these two sizes.

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