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The influence of group size on nonmandatory asynchronous instructional discussion groups

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Abstract

In this study, the authors examined the effect of group size on students' behavior in asynchronous, nonmandatory instructional discussion groups. The focus in this study is on four main questions: (a) Does group size affect the proportion of learner–learner and instructor–learner interactions? (b) Does group size influence the number of messages instructors post? (c) Does group size have an effect on the number of contributions that students post? (d) Does group size affect instructor lag time as well as the interval between successive postings? It was found that group size affects all these aspects of asynchronous discussion: The proportion of learner–learner interaction increased as group size increased, while the proportion of instructor messages decreased. Most students participated to a minimal degree and only a small minority of students posted more than 10% of a discussion group's messages. Last, as group size increased, the interval between successive instructors' postings decreased; lag time, however, was not influenced by group size. Results are discussed in terms of the restructured theory of transactional distance by Gorsky and Caspi, 2003, and several explanations relating group size and students' behavior in asynchronous discussion group are suggested.

Keywords: Group size; Interaction; Discussion groups; Distance education

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1. Introduction

1.1. Web-based instructional environments

Over the last decade, distance education systems have been evolving rapidly from correspondence-based courses to Web-based instructional environments (WBIE). Recently, Sikora and Carroll (2002) reported that among students in the United States who participated in distance education programs, about two-thirds did so via the Internet. Universities that traditionally deliver courses face-to-face are also implementing WBIE to some extent. The integration of WBIE into traditional course design ranges from very limited (i.e., downloading learning material) to very extensive (i.e., full replacement of in-class meetings). Instruction via the Internet enables course designers to update course content on a semester basis, thereby accommodating up-to-date papers, research findings, and other changes in curriculum. More importantly, WBIE enables access to remote databases using multimedia technologies and allows students to interact, asynchronously or synchronously, in diverse ways (i.e., voice–text).

The authors of this article conducted a study of the impact of group size on patterns of interactions in optional, nonmandatory, and asynchronous instructional discussion groups. These kinds of discussion groups are gaining prominence since many universities and colleges are routinely implementing such services through course websites. Specifically, the following issues were investigated: The amount and kinds of interpersonal interaction (instructor–learner; learner–learner), the proportion of instructor messages, the level of learners' participation (i.e., How many massages do they post? Does a small minority of participants account for most of the messages regardless of group size?), and temporal dimensions such as time intervals between messages (lag time) and between successive postings made by instructor. To begin, a review is presented of the concepts of interaction and dialogue as defined in transactional distance theory (Moore, 1993) and later in its reconstructed version (Gorsky & Caspi, 2003).

1.2. Interaction and dialogue in transactional distance theory

Transactional distance theory assumes the centrality of dialogue as a means of facilitating learning. Interaction may be live or mediated through technology; it may be synchronous or asynchronous. The increasing use of technology, its transparency and user-friendliness encourages the use of asynchronous discussion groups and on-line, synchronous chat rooms. Instructors may or may not choose to participate in these forums. These technologies enable students to share ideas, gain insights, and seek support.

Moore (1989) wrote that the term interaction has been misused and "carries so many meanings as to be almost useless, unless specific submeanings can be defined and generally agreed upon." More recently, researchers (e.g., Reeves, 1999; Rose, 1999; Yacci, 2000) have noted that the term is often defined loosely and inconsistently. For current purposes,

the authors opt for a structural definition of interactivity (interaction) proposed by Yacci (2000). He defines four major attributes of the concept:

1. Interactivity is a message loop;
2. Instructional interactivity occurs from the learner's point of view and does not occur until a message loop from and back to the student has been completed;
3. Instructional interactivity has two distinct classes of outputs: content learning and affective benefits; and
4. Messages in an interaction must be mutually coherent.

As opposed to Yacci (2000), the authors assume that instructional interactivity also occurs from the instructor's point of view, that is, if an instructor posts a message that leads to a coherent response, this too, is instructional interactivity.

Dialogue, as defined by Moore (1993, p. 24), is more than mere interaction:

> The term "dialogue" is used to describe an interaction or series of interactions having positive qualities that other interactions might not have. A dialogue is purposeful, constructive and valued by each party. Each party in a dialogue is a respectful and active listener; each is a contributor, and builds on the contributions of the other party or parties... The direction of a dialogue in an educational relationship is towards the improved understanding of the student.

The restructured model of transactional distance (Gorsky & Caspi, 2003) includes four kinds of dialogue relevant to distance education. Moore (1989) defined the first three while Fulford and Zhang (1993) identified the fourth.

Instructor–learner: An interaction that provides the learner with information, feedback, and motivation.

Learner–learner: An interaction that provides learners with information, feedback, motivation, and a social environment.

Learner–subject matter: An internal interaction in which the learner assimilates and accommodates the subject matter.

Vicarious interaction: A vicarious learner can learn through other students' interactions with the instructor and other students.

The scope of this investigation includes only instructor–learner and learner–learner interactions. The goal of this study is to investigate the impact of group size on interaction in asynchronous discussion groups. A literature review follows.

1.3. The effect of group size on interaction in distance education courses

Compared to the effect of class size on learning outcomes in the classrooms, remarkably few research studies have addressed the effect of group size on interaction or learning outcomes in distance education courses. However, these few studies found that on-line group size does have a significant and meaningful impact on interpersonal interaction (instructor–learner, learner–

learner). Chen and Willits (1998) found that the larger the learning group, the greater the transactional distance between instructor and learners (as perceived by the learners). Vrasidas and McIsaac (1999) explored participation of students in a small asynchronous discussion group. They found that four students were not enough to generate productive asynchronous discussion. They speculated that if more students were enrolled in the course, more asynchronous interactions would have occurred.

Two other studies dealt with group size in distance education, but the focus was not directly on interaction. Biner, Welsh, Barone, Summers, and Dean (1997) explored students' satisfaction in groups that ranged in size from 1 to 33 and found that learners in small groups were more satisfied with the courses and more apt to exceed their previous academic performance than in large groups. Sugrue, Rietz, and Hansen (1999) compared course satisfaction and students' performance in small (30 participants) and large (63 participants) groups. In this study, learners were taught synchronously via two-way video broadcast, while the instructor alternated between the large and the small groups every other week. Sugrue et al. found that students achieved higher exam scores in the small group relative to the large one, as well as significantly lower students' satisfaction in the large group.

Twigg (2001) surveyed several distance education programs and found that class size was limited to about 9–25 students in programs where high interactivity was deemed important. Field recommendations limited this range from 12 to 20. For instance, in the Distance Education Online Symposium Listserve (DEOS-L), (http://lists.psu.edu/archives/deos-l.html) the common recommendation is to limit enrollment to 20 participants.

Fahy, Crawford, and Ally (2001) maintained that as group size increases, the number of potential learner–learner and instructor–learner interactions grows proportionally. Gorsky and Caspi (2003) proposed another relation between group size and proportion of potential (and actual) learner–learner and instructor–learner interactions. The restructured transactional distance model contends that as group size increases, the potential for learner–learner interaction increases, whereas the potential for instructor–learner interaction decreases. Thus, group size seems to be a major structural determinant regarding levels of interactions in distance education.

Another structural dimension of instructor–learner interaction studied was the temporal. Two aspects of this dimension were identified: (1) the lag time (i.e., speed of reply) between learner-posted messages and instructor reply and (2) the time interval between successive instructors' postings. A review of literature showed that these variables have not been studied. However, these temporal dimensions may affect the amount of participation in asynchronous discussion groups. Knowing that the instructor is present, learners may participate more frequently in the discussion group. In nonmandatory groups, frequent instructor presence may alter learner behavior. Group size may affect instructor's presence in a very simple way: In large groups, instructors are called upon to answer more often; therefore, they are present in the group more frequently.

As a historical note, these seemingly straightforward findings may be significant. A half-century of research into the relation between class size and learning outcomes in traditional classrooms has yielded inconclusive findings; therefore, it is ostensibly surprising to find that group size does indeed influence outcomes in distance education settings. There is, however,

a reasonable basis to suppose that this may be the case. Lazear (2001) pointed out factors that interact simultaneously with the variable class size in traditional classrooms: behavior and disciplinary issues (class size effects are larger for less well-behaved learners), age and attention spans (optimal class size varies directly with the attention span of learners), and group segregation by ability (for good learners, class size may rise with no detrimental effects on outcomes). Disciplinary issues, attention spans, and homogeneous grouping are less relevant for university level distance learners. Therefore, it seems that group size may indeed be a relevant and significant factor, as the above-cited findings indicate.

1.4. Interaction and participation in nonmandatory asynchronous discussion groups

Adding information collected in public, not necessarily in instructional, discussion groups, completes this review. Similar to the present research, participation in these groups is nonmandatory. In research of public discussion groups, Hiltz and Turoff (1978) noted that conferences with less than 8–12 active participants would, after a short while, fail to produce enough new material to justify their continued use of the system. Thus, they set a lower boundary for an optimal number of participants.

In public discussion groups, Jones (2000) found that a small minority of participants posted a large proportion of messages and increasing the number of participants did not increase user contributions. This finding has not provoked studies so far. Nonmandatory instructional discussion groups may provide a relevant starting point to test the generality of this finding.

Moreover, Jones (2000) claimed that the upper boundary for the number of optimal participants is determined by cognitive factors, in particular "information overload." When the group is too large, participants are confronted with too many data items. To cope with information overload, participants may choose to end participation, ignore parts of the discussion or participants (for instance by filtering), or to split the discussion group into subgroups. Thus, Jones' analysis suggests that, on the one hand, group size is not an important factor because the number of active participants does not influence contribution, and in any group size, a small minority posts most of the messages. On the other hand, behavior of participants is influenced by group size, especially when it becomes too large.

1.5. Research questions

The study raises four questions:

1. Does group size influence the proportion of learner–learner and instructor–learner interactions?
2. Does group size influence the proportion of instructor messages posted to the group?
3. Does group size influence the distribution of the number of messages per student? In other words, does a small minority of participants indeed account for most of the messages regardless of group size?
4. Does group size affect instructor posting rate: instructor–learner lag time and instructor posting interval?

2. Background

The Open University of Israel is a distance education university designed to offer academic studies to students throughout Israel. Established in 1974, the university offers a home study system based on textbooks, tutors, and study centers throughout the land. This year's enrollment is more than 38,000 students.

The classic text–tutor system was enriched in 1999 with the introduction of WBIE, wherein each course has its own website. Course sites are intended to simplify organizational procedures and to enrich students' learning experiences. Use of the website is optional, nonmandatory, so that equality among students is preserved (this year, only about 42% of the students have home access to Internet). The WBIE does not replace textbooks or face-to-face tutor-led class sessions that are the pedagogical foundations of the Open University.

From its inception, researchers at the Open University have studied the WBIE. Tal (2000) studied WBIE in its first year and found that only 28% of Open University students entered discussion groups at least once. Of these percentage, only one quarter (about 7% of the total student body) actively participated in discussions (i.e., posted at least one message). The remainder took an observational role. The authors reiterate that use of WBIE is optional, that is, students receive no academic credit for their participation. This year, from 2002 to 2003, about 15% of the total student body posted at least one message.

In this study, *instructor* is the term used for the person who communicated with students via asynchronous discussion groups. Instructors may be senior academic staff members who are responsible for all pedagogical and administrative aspects of the course or junior tutors, subordinate to senior staff, who appear in the face-to-face class sessions throughout Israel.

3. Method

3.1. Sample

The sample included 47 out of about 200 courses that offered nonmandatory, asynchronous discussion groups during the spring semester of 2002. Courses were randomly sampled from each of the four university faculties: humanities, social sciences, natural sciences, and exact sciences. Table 1 presents the sample population of the study.

Table 1
Number of courses by faculty

Discipline	Number of courses
Social sciences	17
Natural sciences	7
Exact sciences	15
Humanities	8

3.2. Procedure

The basic unit studied in this research was a "message." Each message was categorized according to the following criteria: (1) authorship (instructor or student) and (2) date and time of posting. A second unit investigated was a *thread*, defined as an initial message and all replies to it. Threads were then categorized according to instructor involvement. A thread containing at least one instructor message was categorized as an instructor–learner interaction; whereas, threads without instructor comments were categorized as a learner–learner interaction. The proportion of instructor messages was calculated separately for each course. Instructor lag time was calculated from learner's initial message to the first instructor posting within the same thread. For each course, instructor lag time was averaged separately. A time interval was calculated between any two successive instructor postings. This time interval was averaged separately for each course.

4. Results

A total of 7706 messages were analyzed. Instructors initiated 235 messages; learners initiated 2996 messages. Of instructor-initiated messages, 75% remained unanswered. Of learner-initiated messages, 19% remained unanswered. All initiated messages that received one or more responses (that is, interaction loops) were divided as follows: 1768 instructor–learner interactions (the term *instructor–learner interaction* relates to interactions initiated either by instructors or learners) and 694 learner–learner interactions. It is noteworthy that in 5 of the 47 courses, no *interaction* of any type was recorded because all initiated messages remained unanswered.

Active participation in groups ranged from 1 to 156 participants. Three group sizes were defined based on the number of active participants without regard to the actual number of enrolled learners. Table 2 presents the number of courses by group size.

4.1. Proportion of learner–learner and instructor–learner interactions

Fig. 1 presents the proportion of learner–learner and instructor–learner interactions. The observed pattern is clear: Instructor–learner interaction overwhelmingly dominated all groups. Analysis of variance (ANOVA) conducted on the number of interactions with interaction type (learner–learner vs. instructor–learner) and group size as between-group factors, confirmed

Table 2
Distribution of courses by group size

	Small	Medium	Large
Number of active participants in discussion groups	0–10	11–50	>51
Number of courses (%)	23 (48.9)	14 (29.8)	10 (21.3)
Average number of enrolled learner	82.35	201.36	751
Average number of active participants (% of enrollment)	3.09 (12.6)	26.86 (17.9)	90 (18.7)

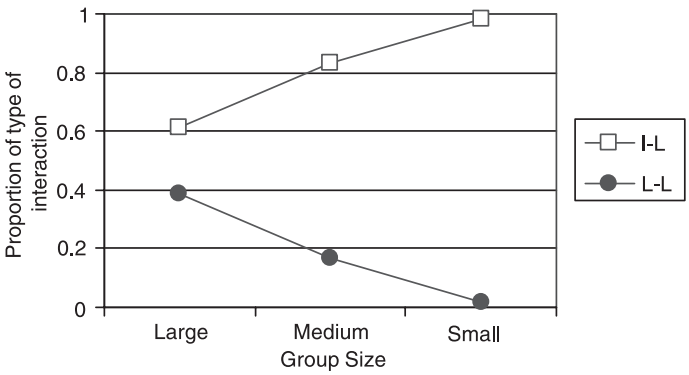

Fig. 1. Average proportion of instructor–learner (I–L) interaction and learner–learner (L–L) interaction.

this observation. Interaction type and group size were found significant [$F(1,78) = 17.46$, $P < .001$; $F(2,78) = 37.74$, $P < .001$, respectively] as well as a marginally significant interaction between them [$F(2,78) = 3.03$, $P = .055$].

To complete this picture, instructor–learner and learner–learner interactions were analyzed. In instructor–learner interactions, on the average, two to three participants interacted within each thread. Table 3 presents the average number of participants who interacted per thread according to group size. A significant difference between group size was found [$F(2,38) = 6.37$, $P < .001$]. This effect stemmed from significantly fewer participants in the small group relative to the large group ($P < .01$). For learner–learner interactions in 17 groups no such interactions occurred. For those groups in which learner–learner interactions did occur, group size significantly influenced participation in interactions [$F(2,22) = 5.19$, $P < .05$]. Again, in small groups, there were fewer participants per interaction relative to large groups ($P < .05$).

4.2. Proportion of instructor messages posted to the group

The number of active participants correlated negatively with the proportion of instructor messages ($r = -.57$, $P < .001$). Fig. 2 presents the average percentage of messages posted by the instructor in the three group sizes. ANOVA was performed on the percentage of instructor posted messages and revealed a significant group size effect [$F(2,39) = 19.72$, $P < .001$].

Table 3
Average number of participants in interactions

Type of interaction	Group size		
	Small	Medium	Large
I–L	2.11	2.25	2.39
L–L	1.67	2.19	2.44

I–L = instructor–learner; L–L = learner–learner.

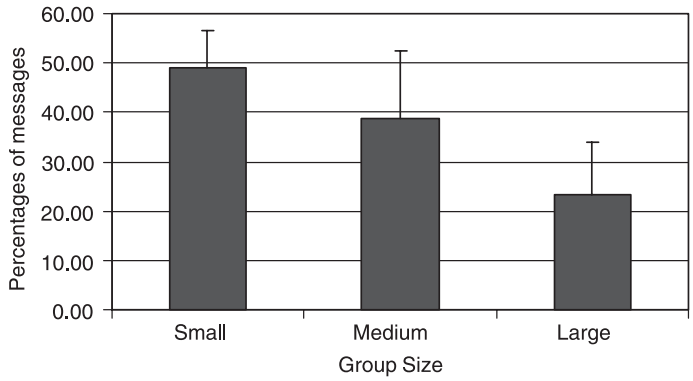

Fig. 2. Average percentages of messages posted by instructors.

Scheffe's post hoc test showed that proportionally, in small groups, instructors posted significantly more than their peers in medium and large groups. A significant difference was also found between medium and large groups (both P's $< .05$).

4.3. Number of messages per student

The claim that a minority of participants posts a majority of messages was tested. As Jones (2000) found, most students posted a small amount of messages. Fig. 3 presents distributions of the average percentage of students per group size who posted once, twice, and up to 10 times. A negligible number of students posted more than 10 times (Fig. 3 does not present these data items that, however, were accounted for in the statistical analysis). Clearly, most of the learners posted very few messages. The curve approaches its asymptote at around four, which means that most of the learners (about 80%) posted once, twice or, at most, three times during the entire course. As Fig. 3 shows, there is no difference between group sizes, that is, an increase in the number of active participants does not result in an increase in the number of contributions per participant.

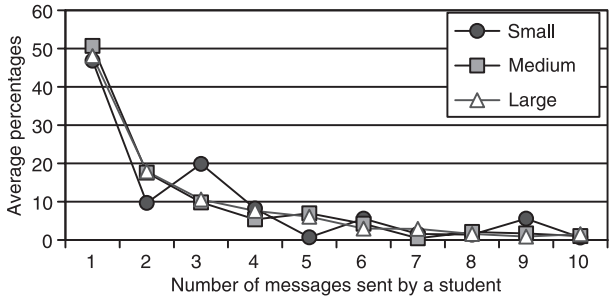

Fig. 3. Distribution of average number of messages per student in three group sizes.

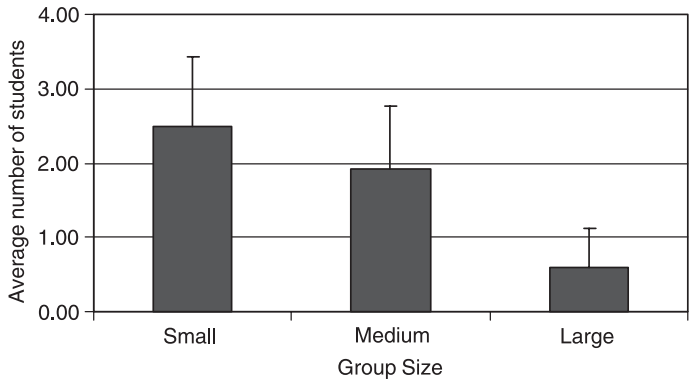

Fig. 4. Average number of students that sent more than 10% of the messages.

In addition, the number of learners who posted a "significant" amount of messages was counted. The criterion selected for significant was having posted more than 10% of the learners' messages per discussion group. An extremely small minority of learners (5.8% out of the total number of active participants) met this criterion. Nonetheless, group size affected this number (Fig. 4), as was confirmed by ANOVA [$F(2,39) = 17.602$, $P < .001$]. In large groups, such students were significantly fewer relative to medium and small groups ($P < .001$), which did not differ significantly.

4.4. Temporal dimensions

The impact of group size on two temporal dimensions was examined. The dimensions were (1) lag time between students' posted messages and instructor response and (2) the time interval between instructors' successive postings. The latter takes into account all postings, initiated messages as well as responses, in the discussion group.

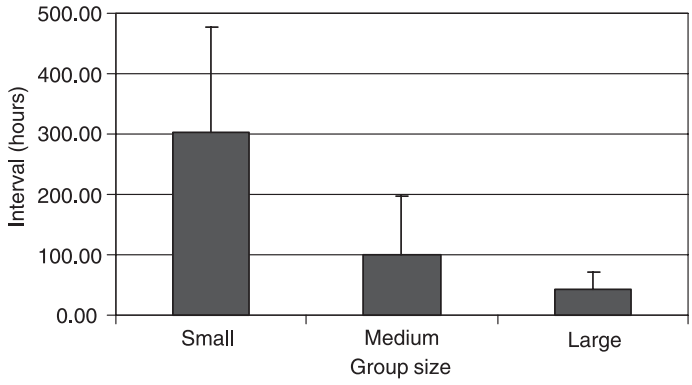

Fig. 5. Average interval in hours between successive postings of instructors.

First, no effect of group size on lag time was observed [$F(2,39) < 1$]. In general, instructors' lag time was 32 hours (about one day and a half). However, variance between courses was very large (S.D. 24 hours), implying individual patterns of instructor behavior.

Second, the time interval between instructors' successive postings was affected by group size [$F(2,39) = 16.22$, $P < .001$]. Fig. 5 shows that instructors posted less frequently in small groups than in medium and large groups ($P < .001$), which did not differ significantly.

5. Discussion

In this study, several questions concerning the influence of group size on interactions in a nonmandatory, WBIE were asked. Before discussing the implications of each specific research question, it should be noted that the environment studied was utilized actively by a minority of the learners enrolled in the courses (15%). Of these 15%, it was found that about 80% posted one to three messages during the entire semester. That is, only 3% of the university students enrolled in these courses posted four or more messages over the entire course. One partial explanation for this behavior is that participation is nonmandatory. A second is that learners are explicitly identified when logging on by their usernames and that this lack of anonymity may discourage participation. Kelsey (2000) found that social anxiety discourages learners from participating in synchronous discussions. This same concern may limit participation in asynchronous groups. Third, the system may indeed have been utilized effectively by unrecorded and undocumented vicarious learning.

In addition, instructors initiate very few interactions (7% of the total). Furthermore, of instructor-initiated messages, 75% remained unanswered. Three tentative explanations are proposed: First, even if instructors perceive WBIE as an effective tool, they may choose not to use it since a large proportion of university students have no access to Internet providers. Therefore, any use of this medium would be discriminatory in nature. Second, assuming instructors perceived WBIE to be an effective tool, and in fact posted messages with intent to initiate discussion, a lack of learner response would lead to an extinction of such initiatives. Third, instructors may not perceive WBIE to be an effective instructional or learning tool. Having made this assumption, instructors may have posted messages that were of a primarily informative nature regarding assignments, tests, etc. Therefore, most of the messages were unanswered. Instructor perception of the WBIE as ineffective may have emerged from the fact that, at the time of the study, the instructor had no information regarding the number of learners who logged on to the system and were inactive. Such passive users may have experienced vicarious learning without the knowledge of the instructor.

Regarding the research questions, it was found that as group size increased, the proportion of learner–instructor interaction decreased while the proportion of learner–learner interaction increased. These findings support the restructured model of transactional distance proposed by Gorsky and Caspi (2003). A tentative explanation of this finding is that small groups enable instructors to devote more time and attention to each learner. In large groups, the potential for learner–learner interaction is greater than in small groups simply because the

number of participants means a larger number of opportunities to find a compatible discussion partner. In this study, interaction was defined structurally, not by its content. To more fully understand WBIE discussion groups, content analysis is required. Such an analysis would reveal differences, if any, between contributions made by instructor and learner, that is, who talks about pedagogical/intellectual issues (Anderson, Rourke, Garrison, & Archer, 2001) and who talks about organizational, technical, or social issues.

In addition, the vast majority of instructor–learner interactions was limited to one learner only, that is, multiparticipant discussions did not emerge. One may conclude that learners who received no credit for participation did not perceive the WBIE as relevant. An alternative explanation is that since the instructor responded to student-initiated messages quickly (within 36 hours), the instructor's definitive response discouraged further participation. Again, to more fully resolve this issue, content analysis and a study of the impact of a delayed lag are called for.

Furthermore, the proportion of instructor messages (including interactive messages as well as those not responded to) in the group decreased as group size increased. Two tentative explanations for this finding are suggested. Either the instructor chose not to intervene when learner–learner interactions were deemed satisfactory or the instructor was simply overloaded by students' inquiries and chose not to answer every message. In the absence of an instructor response, learners may have contributed their own ideas.

Moreover, it was found that, regardless of group size, a minority of participants contributed the majority of messages. Learners generally made one to three contributions per course to the ongoing discussion. In small groups, two to three learners (constituting about 25% of such groups) contributed more than 10% of the messages. In medium and large groups, one to two learners (about 4% for medium and 0.5% for large groups) contributed more than 10% of the messages. To generate more than 10% of the messages in large groups with an average of about 300 messages would be more difficult than in small groups that averaged about 20. To send more than 30 messages of any kind per semester, a learner must post at least two messages a week. Such students are few and special, given that contribution was not credited. It will be interesting to examine their qualitative contributions, if any, and to find out if these learners share common characteristics.

Finally, as group size decreased, the interval between successive instructor postings increased. Few participants, lacking motivation to respond to noncredited instructor postings, may explain this. This, in turn, cannot generate or sustain a "critical mass" of interaction. Therefore, instructor postings decrease and the time intervals between them increase. In medium and large-sized groups, although the percentage of active participants is low, their actual number is large. Therefore, activity at the site is generated and is sufficient to sustain interaction that, in turn, leads to more frequent postings made by the instructor.

In large groups, although the instructor posts more messages more frequently, the proportion of instructor–learner interactions decreases vis-à-vis learner–learner interactions; that is, in larger groups, a larger number of learners interact among themselves. From a pedagogical point of view, if one believes that learner–learner interactions facilitate learning, this might be an excellent way to do so. Such methodology might be formalized didactically.

6. Conclusions and implications

The authors conclude that only a limited number of learners actively participate in nonmandatory discussion groups. This is in accord with similar findings from synchronous discussion groups (Kelsey, 2000) as well as asynchronous, public discussion groups (Jones, 2000).

Two implications emerge from the study. First, to increase learner participation in asynchronous, nonmandatory discussion groups, a larger group size is called for. This creates a greater potential for interaction, especially between and among learners. Second, for instructional designers, since only a very small percentage of learners fully utilized the system's potential for interaction, it may be worthwhile to characterize the personality traits of these learners and to orient the environment toward their needs.

The authors reiterate that these findings are limited to a nonmandatory WBIE. An interesting research direction might test whether these patterns of interaction and participation as a function of group size hold also in mandatory discussion groups.

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