Student Groups as Tutors in Information Systems Education
Students' Perspectives on Collaboration and Outcomes

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Abstract: The study explores the potential of the research-teaching nexus in a peer-tutoring setting. During the Fall semester of 2016, students in an Information Systems course worked collaboratively on domain topics, assigned to them by the teacher and created educational material for their fellow students. Students' tutoring role was concluding with a class presentation and a discussion session in each course lecture. The study focuses on students' perspectives in the collaborating groups and the audience and analyzes how learning strategies in self-regulation, peer learning, and help seeking affect students' experiences during group work. Analysis of student activity revealed four distinct patterns of collaboration. Findings suggest that students that rely more on group members for help were less satisfied by the communication among them. However, students were in general satisfied with their collaboration, being able to adapt the activity to their needs. Similarly, the teacher and the audience (students attending the student-tutoring sessions) evaluated positively students' performance as teachers.

1 INTRODUCTION

Integrating research and teaching is viewed by many scholars as a desired goal to be achieved in higher education settings. Once these are linked together, they can promote learning (Brew, 2003) and an increasing number of studies conclude that students benefit in their learning process, when they actively participate in research activities and are instructed by active researchers (Healey, 2005; Jenkins et al., 2003).

Healey (2005) proposed a generally accepted model on the different ways that research activities and the students' role can be integrated in a course (Figure 1). According to this model, students can act as audience or as participants and the emphasis of the curricula can be driven either to the research content or to the research processes or problems. When acting as audience, students learn through publications of their teachers combined with the teachers' personal research experience. When acting as participants, students are actively engaged in research design, outcomes and publications or they are asked to conduct their own research regarding a topic. Furthermore, they can act as tutors for their peers by presenting and discussing with them the findings of their research. The types of research activities may depend on the subject areas (Griffiths, 2004). Yet, the sum of activities in which students are engaged during a course does not necessarily fall into one unique category.

No matter the role students have when engaged in research activities, it is imperative that they have to accomplish tasks, which require the comprehension and processing of scientific articles. Students often face difficulties in accomplishing such tasks. Inadequate knowledge about the scientific domain and failure to apply appropriate reading strategies are considered the main reasons for performing inefficiently in such tasks (Kolić-Vrhovec et al., 2011; McNamara et al., 2007).

Instead of working individually, collaborative learning can further facilitate students' processing of academic literature (Eryilmaz et al., 2016; van der Pol et al., 2006). In the context of a successful collaboration, students are engaged in explaining (Webb et al., 2009), questioning (King, 1998), or arguing (Noroozi et al., 2012) and through these activities, they can acquire both domain-specific knowledge and cross-domain skills such as collaboration, argumentation or peer-assessment skills (Vogel et al., 2016).

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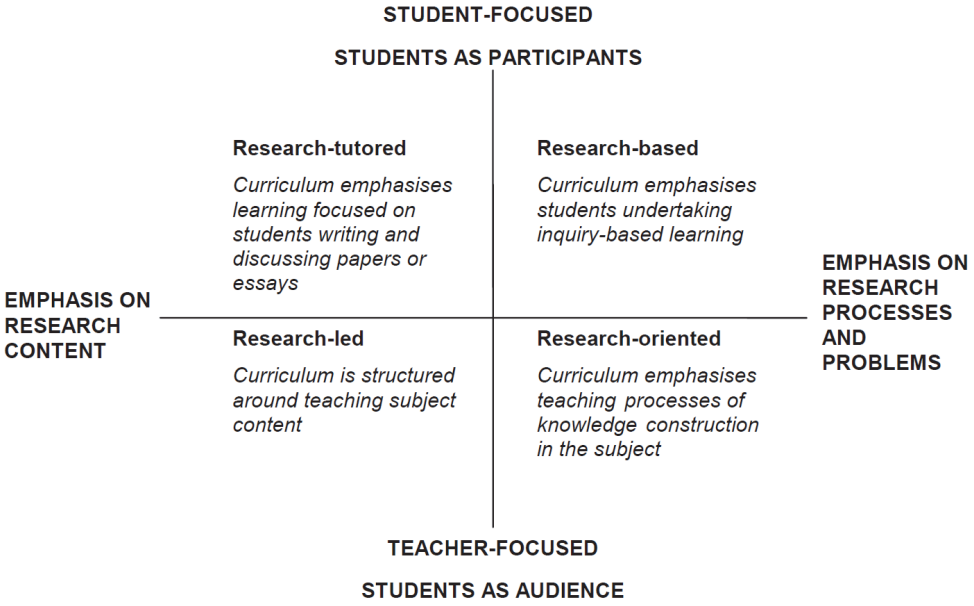

Figure 1: Curriculum design and the research-teaching nexus (Healey, 2005).

In such group settings, students' characteristics can affect the outcome of collaborative learning (Noroozi et al., 2012). An important student characteristic is the effective use of learning strategies (Solimeno et al., 2008). Among them, self-regulated learning (SRL), peer learning (PL) (Pifarre and Cobos, 2010) and help seeking (HS) (Kyza et al., 2013) are considered to influence the success of collaborative learning. While self-regulated learning has been extensively studied regarding individual learning, less focus has been given for its contribution in collaborative learning (Dettori and Persico, 2008; Panadero et al., 2015).

Based on the above, the aim of this study is to investigate the way students evaluate the process of their collaboration when engaged in research-tutored activities in small groups in the domain of Information Systems (IS). More specifically, we examine whether the use of different individual learning strategies influences the assessment of the way a group collaborated and the participation during the group work. To explore these relationships, we observed groups of first semester graduate students working together in order to critically engage with scientific papers, represent the knowledge acquired from these papers in different ways (e.g., identifying and extracting highlights of the paper, summarizing the text etc.) and prepare a presentation and discussion session in front of their peers.

2 METHOD

2.1 Participants and Domain

The course "Information System Development and Implementation in a Business Context – ISDI" is a 10 ECTS course, offered in the first semester of the "Master Degree Programme in Economics and Business Administration" in the Department of Management and runs over 11 weeks with a total of 120 teaching hours. The course is taught in English and it aims at giving students an understanding of the diverse challenges, risks and complexities of developing and/or implementing IS in organizational environments. After the course is finished, the students are expected to be able to describe, analyze, evaluate, reflect upon, and apply models of information systems development in a business context.

The course is heavily influenced by real-life context, making the research-teaching nexus an integral part of the learning design. In the course, students are experiencing the connection between research and learning in several ways (Table 1), playing both the roles of a peer-tutor (students as tutors, ST) and the audience (students as audience, SA). The current study focuses on the research-tutored collaborative activity, in which students have to work together on a teacher-assigned topic. Their task is to analyze scientific literature and produce a

Table 1: Activities the students are engaged in during the course.

Research Quadrant	Student Activity
Research-led	Students learn about research findings through their teachers' own research activities.
Research-tutored	Students work in groups of three or four. They are given a publication on a specific topic and are asked to prepare five different types of deliverables, including a presentation followed by a discussion session in front of their peers and their teacher.
Reseach-oriented	Students have to critically reflect and discuss the research design and methods of seminal IS papers.
Research-based	Students have to hand-in a group report a month before the final exam. The exam itself is conducted orally in a form similar to a thesis defence and is individual for each student. Each group of students can decide the actual topic and research design by themselves.

set of five deliverables that can be used as learning material by their fellow students. Their role as peer-tutors ends with the presentation of their assigned topic in the class. In addition, the student audience needs to provide feedback on the structure, usefulness, and overall quality of the material produced by the student-tutors. Students' research-oriented (discussion of research methodology), research-based (final report) and research-led (teacher's own research) activities complete the course canvas. However, analysis on student activity in these other quadrants span outside the limits of this study and will not be discussed, since the course is still ongoing.

A total of 65 freshmen students formed 18 groups of three or four members and participated in the activity, which was a mandatory, non-graded, part of the course. Seven of those groups consisted of three students and 11 groups consisted of four students. Regarding students' background, 34 of them were majoring on "Information Management", 28 on "Business Intelligence", while the rest were studying "Logistics and SCM" and "Technology Governance" programs. Finally, 13 students were international/exchange students.

2.2 Research Instruments

The study employed three instruments: the Motivated Strategies for Learning (MSLQ) instrument (Pintrich et al., 1993), the student-tutors' questionnaire, and the audience/teacher questionnaire.

MSLQ was used to measure students' strategies related to self-regulated learning (SRL), peer learning (PL), and help seeking (HS). MSLQ is a comprehensive measurement instrument that can be used in its entirety or in parts. The instrument is divided into two sections and includes a total of 81 questions grouped in 15 scales. The three scales used in this study (i.e., SRL, PL, HS) were selected because they are the ones that influence more the collaborative activity. The version of the MSLQ used in this study included 19 closed-type questions (SRL: 12; PL: 3; HS: 4), each one using a 7-point Likert scale.

The student-tutors (ST) questionnaire, developed by the authors for the purpose of this study, was filled in individually by the students and used to record students' attitudes and opinions on the collaborative activity. More specifically, the questionnaire focused on how each student experienced collaboration in his/her group, in relation to aspects such as the volume and format of communication, role assignment, and own contribution. Both the volume and format of communication were assessed by a set of four closed-type questions, each one using a custom 5-point Likert scale. Role assignment was assessed against a scale ranging from "One of us was responsible for producing the final version" to "We worked together on the same parts producing together the final version". Students' contribution to the creation of each artifact ranged from "Discussant" to "Leader" in a 5-point scale. Furthermore, this instrument also included a dichotomous item on students' general preference towards collaborative/individual activities and a set of four open-ended questions in which students could further elaborate on peer support, reaching consensus, sharing understanding, and communication satisfaction.

Finally, both the students audience (SA) and the teacher completed the same questionnaire to evaluate the peer tutoring session in terms of structure of the presentation, quality of material used, effectiveness of presentation, and student-tutors' ability to respond to audience questions and provide clarifications on the presented topic. This instrument included six 5-point Likert scale questions and was used after each peer tutoring

session by the SA (i.e., students attending the class) and the teacher.

2.3 Procedure

In the beginning of the course, students were asked to respond to the adjusted MSLQ instrument. Students were also asked to provide their names in all instruments, to allow the researchers to follow their activity throughout the study. Students were aware of the research aspect of the course assignment, knowing also that their identities and responses would not be shared with their fellow students.

Next, students formed groups of three to four members and were assigned a course topic by the teacher. Each group received a seminal scientific paper on a course-related topic and had to produce five deliverables:

- An annotated version of the paper, with comments and emphasized parts;
- A list of five highlights, providing a concise view of the paper;
- A list of five questions, along with their answers, that would cover the major issues discussed on the paper;
- A short summary of 200-300 words;
- A comprehensive presentation of the topic for the peer tutoring session that could use slides or any other material. The total duration of the presentation should not exceed 40 minutes, including a discussion session with the class audience and the teacher.

After each peer tutoring session, these deliverables were made available to all students as part of the course material. To assist the work of the group acting as a peer-tutor and to create a homogenous set of learning material, the teacher provided detailed instructions and generic examples of how these deliverables should look like. In addition, each group received access to a separate Google Drive folder containing the necessary assignment material, along with empty templates for the five deliverables. The three main reasons for using Google Drive tools were that (a) students were familiar with these, (b) the tools allowed for real-time co-authoring, and (c) these tools provide a revision history log, offering the possibility of examining students' co-authoring strategies during the semester. Nevertheless, it should be noted that working online was not mandatory for the students (e.g., students could upload their deliverables after producing them offline or with other tools). Each group had two weeks to prepare its peer-tutoring session and present the topic in the class.

To support meaningful collaboration, students were given general guidelines. However, since we were interested in understanding emerging collaboration patterns and their relationship to different learning strategies, we purposefully allowed for a high degree of self-regulation within the groups. More explicit collaboration scripts may have provided better scaffolding for some students, but at the same time potentially influence the impact of personal strategies on collaborative activities. In particular, the students were advised to:

- Communicate as much as necessary and have all group members on the same page;
- Contribute to all group deliverables, even if it is on different levels;
- Reach a shared understanding, demonstrated by the ability to explain, analyze, argue, and answer questions on all deliverables;

After each peer-tutoring session, student tutors (STs) filled in the student-tutor questionnaire. At the same time, the teacher and the remaining students in the audience (SA) evaluated the presentation, by using the SA/teacher instrument.

The assessment of the rest of the deliverables (i.e., annotated version, highlights, summary, questions & answers) is planned to be conducted at the end of the semester after the students have studied this material for their exams.

2.4 Data Analysis

For all statistical analyses, a level of significance at .05 was chosen. In order to explore whether students' learning strategies influenced students' assessment of group communication and collaboration as well as of student participation, the sample was half-split in low and high level MSLQ subscales (SRL, PL, HS), using the respective median as the cut-off point.

Independent-samples t-tests were conducted to compare the volume of communication, the collaboration among group members and the participation in the deliverables' creation with High and Low groups of SRL, PL and HS. To investigate whether there is an association between the preference in individual or collaborative working and the MSLQ subscales, a series of Chi-square tests for independence was conducted.

Paired-samples t-tests were conducted to examine the difference in students' knowledge before and after the presentations.

Finally, a qualitative analysis of students' responses in the instruments was carried out to identify the collaboration patterns in the group work and examine whether these patterns were influenced by the self-regulated learning, peer learning, and help seeking learning strategies.

3 RESULTS

3.1 Students as Tutors (ST)

The Cronbach's alpha coefficient for the self-regulated learning, peer learning and help seeking subscales of MSLQ were 0.82, 0.73, and 0.71, respectively, indicating satisfactory reliability. In general, the students scored (scale 1-7) rather high in the SRL (M = 4.36, SD = 0.93, min = 2.50, max = 6.50) and HS (M = 4.27, SD = 1.21, min = 1.50, max = 6.50) subscales, while they were split in PL (M = 3.96, SD = 1.35, min = 1.33, max = 6.67), with 22 students having a negative disposition towards peer learning.

Table 2 presents student responses in the questions regarding the volume and format of communication. In addition, response analysis showed a strong students' preference in organizing meetings with all the group members in a synchronous manner either face-to-face or online, i.e., chatting, mainly in Facebook. This finding from the students' answers was further supported by examining the revision history of their co-authoring activities in Google Docs. The low number of different versions in students' deliverables suggests that the majority of groups completed the larger part of the assignment offline and used the Google Docs templates for minor edits or for submitting the final draft of their deliverables.

Figures 2 and 3 present student responses in the questions concerning the way their groups worked during the collaborative activity and their level of responsibility during the process. It can be seen that students collaborated less during the production of the annotated version of the paper, while the presentation was the deliverable in which most of the collaboration happened.

In order to examine whether all members of each group perceived the same volume of communication and collaboration during the group work, the coefficient of variation (CV) for the questions Q1 and Q4 was computed and used as an indicator. A group was classified as perceiving the same volume of communication and collaboration, when $CV < 0.3$ and having different perception when $CV \geq 0.3$. No differences were found regarding the perceived volume of communication between the members of all groups. As far as the perceived volume of collaboration is concerned, differences were found in 10 groups. The differences in all of these groups were attributed to the way members perceived their collaboration in the creation of the annotated version of the paper. Only in three of these groups there were also differences observed in the list of highlights, list of questions and short summary. No differences were found regarding the perceived volume of collaboration for the presentation.

The analysis of the students' answers in the open-ended questions revealed that their main problem during the collaboration was to arrange meetings with all members of the group. Apart from that, the vast majority of the groups (15 out of 18) stated that they were satisfied with their communication and collaboration in accomplishing the group task. Their members participated equally and they were engaged in transactive discussions while they were trying to give or receive support about their tasks or trying to reach common understanding of the paper. In three groups the problem identified in the collaboration was the 'free riding' behavior by one of the members in each group, which caused frustration and complaints by the rest of the members. These groups are the same as the aforementioned groups in which the differences in perceived collaboration among their members were observed.

Table 2: Student responses in the student-tutor questionnaire, regarding the volume and format of communication.

Question	M	*SD*
Q1. How much communication happened in your group? *(1: A little; 5: A lot)*	4.28	*(0.71)*
Q2. How much of this communication was one-to-one (one member communicating directly with another member)? *(1: A little; 5: A lot)*	2.63	*(1.39)*
Q3. How much of this communication was one-to-many (one member communicating directly with two or more members)? *(1: A little; 5: A lot)*	4.00	*(1.21)*

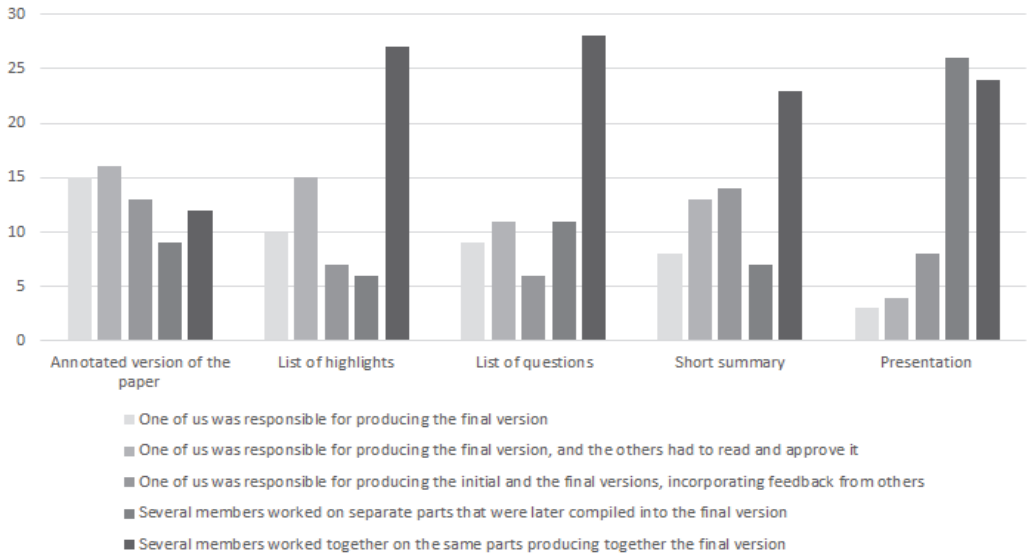

Figure 2: Student responses (N=65) in the student-tutor (ST) questionnaire regarding the way their groups worked (Q4. "For each of the learning artifacts, select the phrase that describes best the way your group worked.").

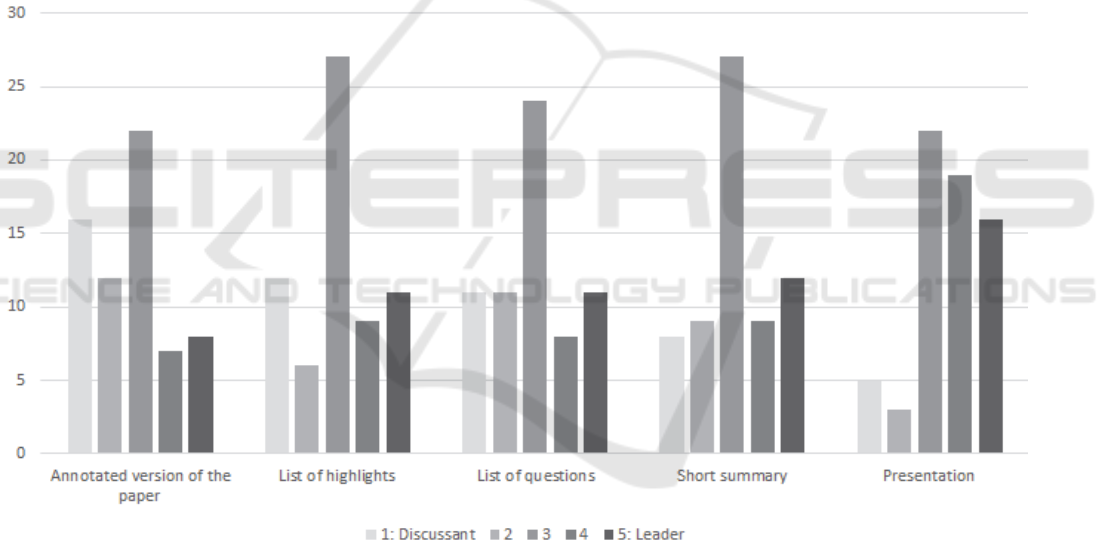

Figure 3: Student responses (N=65) in the student-tutor (ST) questionnaire regarding their level of responsibility (Q5. "For each of the learning artifacts, select a value that describes best your level of responsibility.").

Table 3: Patterns of collaboration among groups (N=18).

Pattern	Student participation	Homogeneous Groups	Heterogeneous Groups
Collaboration	Equal participation - group members worked together on the same parts producing together the final version	2	1
Mainly collaboration	Equal participation in most of the deliverables – in some deliverables one was responsible for the final product incorporating feedback from the other members	3	2
Mainly cooperation	Students split the work in most of the deliverables - one was responsible for the final product and the others had to provide feedback	3	5
Cooperation	Students split the work in all the deliverables – one was responsible for the final product and the others had only to approve it	2	0

T-test result analysis revealed that students with extreme values in the HS subscale had a significant difference on their perception of the volume of collaboration that occurred in their groups (HS_{High}: M = 3.18, SD = 0.93; HS_{Low}: M = 3.86, SD = 0.98; $t[63] = 2.57$, $p = 0.01$). Students who characterized themselves as 'help seekers' perceived the way their group worked as less collaborative. Chi-squared tests for independence indicated a significant association between preference in group working (question Q6 in the ST questionnaire) and the students' score in the PL subscale ($\chi^2(1, 65) = 6.78$, $p = 0.01$), as expected. Conversely, no significant association between Q6 and the use of SRL and HS strategies was found.

As far as the collaboration patterns that emerged in the groups are concerned, comparative analysis of group member responses in Q4 and Q5 and their statements in the open-ended items of the student-tutor questionnaire revealed four distinct patterns (Table 3). Three groups worked collaboratively, with all members participating equally in all of them, by working either together for all the different parts of the deliverable or in separate parts which they had to compile later in the final version after reaching consensus. Another five groups worked mainly collaboratively for the majority of the deliverables while in some other deliverables, one member had the leader role and was responsible for the final product incorporating feedback from the others. The rest of the groups applied patterns that resemble different aspects of cooperation by splitting the workload and working individually (see Dillenbourg (1999) for a detailed discussion on the nature of collaboration).

To examine whether the observed collaboration patterns were influenced by the learning strategies of the students, each group was first characterized as homogeneous/heterogeneous. The coefficient of variation (CV) for the three MSLQ subscales was used as an indicator of homogeneity for the group. A group was classified as homogeneous, when $CV < 0.3$ for all three MSLQ subscales, and, as heterogeneous when $CV \geq 0.3$ at least in one of the three subscales. According to this process, ten groups were characterized as homogeneous and eight as heterogeneous. Specifically, no differences was observed in the self-regulation subscale between the members of any of the groups, while one group was characterized as heterogeneous because of differences in HS and seven additional groups for differences in PL (two of them also varied on the HS subscale). However, analysis did not reveal any visible link between group homogeneity and collaboration patterns, since the groups appeared equally distributed into the four observed patterns (Table 3).

3.2 Students as Audience (SA)

Table 4 shows the mean and standard variation of the evaluation of the 18 student presentations by the teacher and the audience (students attending the class on the day of the presentation). The population of the audience varied during the semester (approximately 50 on average each week) and the aggregated values refer to the overall structure and quality of all the ST presentations through the course timeline.

Table 4: Evaluation of student-tutor presentations (N=18) by the audience and the teacher.

	Audience		Teacher	
Questions	M	*SD*	M	*SD*
Q1. What is your opinon about the organization/structure of the presentation? *(1: Several issues on structure and/or time; 5: Timely and well-organized)*	3,69	*(0,61)*	4,00	*(1,00)*
Q2. What do you think about the presentation material (slides)? *(1: Too packed, boring, or confusing; 5: Clear, easy to follow, and aesthetically nice)*	3,69	*(0,65)*	3,68	*(0,97)*
Q3. What is your opinion about the effectiveness of the presentation? Were the topics explained clearly? *(1: The paper was poorly outlined; 5: The main topics were clear and easy to understand)*	3,54	*(0,64)*	3,45	*(1,16)*
Q4. What is your opinion about the group's responses to audience questions? *(1: Confusing or incomplete answers; 5: Clear and correct answers)*	3,46	*(0,66)*	2,77	*(1,17)*
Q5. How knowledgeable were you on the topic, before the presentation? *(1: Not at all; 5: Very much)*	2,07	*(0,57)*	-	-
Q6. How knowledeable do you feel on the topic, after the presentation? *(1: Not at all; 5: Very much)*	3,47	*(0,56)*	-	-

As it can be seen from Table 4, both the audience and the teacher evaluated positively the structure, the quality, and the effectiveness of the student-produced presentations. This evaluation by both of them suggests that the group work resulted in cohesive and aesthetically pleasing presentations whose main topics were clear and understandable. The discussion sessions, which followed the presentations, received the lowest scores by both the audience and the teacher, despite the discrepancy in the respective scores. This indicates that the students-tutors may have not been well-prepared to provide appropriate answers to their peers. Yet, paired-sample t-test showed that the audience knowledge increased significantly during the student-tutor presentations for all presenting groups ($p<0.05$). Furthermore, there was agreement among students and the teacher in the ranking of the respective presentations in all the assessed factors, suggesting that students in the audience could accurately differentiate the quality of the different presentations.

The analysis of the students' comments in the open-ended questions regarding the activity showed their positive attitude towards the deliverables. It also showed that they considered them useful and helpful as preparation material for the final exam.

4 DISCUSSION AND CONCLUSIONS

Results analysis shows that students were successfully engaged in collaborative research-tutored activities in the domain of Information Systems. Analysis also shows that students did not fully exploit the available digital tools that could facilitate their collaboration. As such, they faced difficulties in time management and mainly, in arranging meetings with all the members of the group. However, they were satisfied with their collaboration. They managed to communicate adequately and almost every student in a group contributed to all group deliverables, although to a different extent. Finally, they reached a shared understanding, as demonstrated by their ability to present the topics in a clear and understandable way and answer questions on all the group deliverables.

Four collaboration patterns were identified. The majority of the groups preferred to set a student as a leader for the creation of each deliverable and the role of the other members was either to just approve the prepared deliverable or provide constructive feedback and help in producing the final deliverable. The presentation was the deliverable in which students collaborated the most, probably because they had to be also prepared to answer their peer's questions in the discussion session followed the presentation.

The aforementioned patterns were not influenced by the variance of group members regarding their self-regulated learning, peer learning and help seeking strategies. The preference for face-to-face or online synchronous meetings, in order to communicate and collaborate along with the difficulty of finding common meeting hours, might have led to the patterns identified.

Students with higher scores on the help seeking scale were concerned of the way their group collaborated. One explanation for this could be that these students had higher communication demands and were relying more on help coming from their fellow students in their groups.

Self-regulated and peer learning strategies did not seem to influence the students' self-assessment of group collaboration nor their role during the activity. Regarding self-regulated learning strategy, the study sample consisted of graduate students who all had relatively high scores and thus, showed few differences among them. As for peer learning strategy, the fact that the students had not been given a detailed collaboration script may have led them to adapt the activity, creating a flexible space that allowed even students with extremely low scores on the peer learning scale to participate in a self-satisfying manner.

Students also played the role of the audience and evaluated their peers in the presentation and discussion sessions. The evaluation of the presentations by both the students as audience and the teacher showed that the groups managed to create high quality presentations of the topics under study. In addition, all the students were significantly more knowledgeable of the topic under study after the presentation and discussion session with their peers.

In conclusion, this study provides preliminary evidence that engaging students into collaborative activities that utilize the research-teaching nexus offers the students the opportunity to apply and develop their skills in processing, presenting, and discussing academic work, assuming also the responsibilities of a tutor. It should be noted that the long-term evaluation of the examined approach of the research-teaching nexus will have to be corroborated through future studies in different

contexts. Nevertheless, the current study provides a useful reference for further discussion.

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