Towards socially shared regulation within CSCL scripts: mirroring group participation in PyramidApp

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Abstract. Computer-Supported Collaborative Learning (CSCL) has been shown to enhance learning by promoting peer interactions. With the support of collaborative learning flow patterns (CLFP), the collaboration process within the so-called CSCL macro-scripts can be further structured and constrained. However, social dynamics within tasks, even within scripts, have the potential to hinder the collaborative element as students might not participate sufficiently in conversations. To determine if participation in discussions between students was balanced within a CSCL script we analysed data from an implementation of the Pyramid CLFP. The data showed that student participation varied across different groups, with some groups and students not initiating conversation between them. Socially shared regulation is a social form of regulation where students regulate their learning as a group rather than as individuals through the means of discussion, negotiation, and perspective taking. As research has shown that for collaborative learning to be successful students need to engage in fruitful discussions and support each other to regulate their learning, we propose the implementation of a social awareness feature mirroring group participation through learning analytics in a CLFP tool (PyramidApp) to promote socially shared regulated learning.

Keywords: Socially shared regulated learning, CSCL, Pyramid CLFP, Social awareness, Learning analytics

1 Introduction

This study focuses on motivating the need and presenting a design of an application of learning analytics to enhance social interactions in Computer Supported Collaborative Learning (CSCL). In particular, it proposes the design of a social awareness feature mirroring group participation to support student regulation in the context of scripted Pyramid-based collaborative learning flows.

1.1 CSCL and Collaborative Learning Flow Patterns (CLFPs)

Collaborative learning is an effective educational approach that has been shown to enhance students' learning by allowing them to externalize their knowledge, monitor their peers' learning and negotiate their opinions and ideas. However, when learners are asked to collaborate without any instructions the results are not as effective as with scaffolded collaboration [1]. In CSCL, there is significant research supporting the effectiveness of collaboration scripts that structure the flow of collaborative learning actions with the help of technology. CSCL scripts scaffold learners towards collaboration by promoting specific activities in a sequence and implicitly or explicitly distributing roles amongst the learners which effectively guide and improve collaboration processes and subsequent individual learning [2]. Collaborative learning flow patterns (CLFP) provide specific structures to CSCL scripts [3]. One such CLFP is the one of Pyramid where students are faced with a problem and through different levels discuss and improve their initial answer [4].

Alternative or complementary approaches seeking effective collaborative learning are related to supporting student's regulation. Research has shown that collaborative learning can be hindered by social dynamics as this type of learning situation poses socio-emotional challenges and requires regulation of learning [5, 6]. During face-to-face collaborative learning students are more likely to be aware of each other's socio-emotional interactions as they can be conscious of each other's task perceptions or goals. Collaborative learning supported by socially shared regulated learning (SSRL) has shown to further assist collaboration by encouraging group members to support each other to regulate their learning and by promoting self-regulation [7].

1.2 Co-regulation and socially shared regulation in collaborative learning

During individual learning, students internally regulate their thoughts and behaviours to help them reach a goal. The theory of regulated learning addresses this process and concerns how learners develop and effectively use learning skills [8]. An important contribution of this theory is the method of self-regulated learning. Self-regulated learning (SRL) refers to an iterative process where learners through self-generated thoughts, feelings and behaviours take control of their learning by planning, monitoring, and evaluating their learning to attain a goal [9]. Regulated learning can also be applied in collaborative learning settings through the social modes of co-regulation and socially shared regulated learning (SSRL).

Co-regulated learning describes a relationship between individuals where one person is more knowledgeable or more skilled. Co-regulated learning is a dynamic metacognitive process where individuals self-regulate their learning and share regulation of their cognitions, emotions, behaviours, and motivations towards the aim of an academic goal [10]. SSRL occurs when groups perform interdependently on a set task and negotiate perceptions, goals, and strategies as a group rather than as individuals [7,11]. Such a process assumes that a positive socio-emotional interaction will be maintained by promoting listening and perspective taking in individuals [12]. Group awareness and group mirroring features in CSCL solutions can support regulation in collaborative learning.

1.3 Group awareness and group mirrors in CSCL

Group awareness was defined by Dourish and Bellotti (1992) [13] as the "understanding of the activities of others, which provides a context for your own activity". Tools that take into account the group awareness, can provide the participants valuable information. Particularly, CSCL-related group awareness tools offer such kind of additional value, as they often focus on variables that are not directly available in face-to-face settings, such as assessing and providing information about how a learning group evaluates the group members' contributions [14]. However in group awareness tools the information has to be salient enough to capture the learners‘attention. But at the same time, awareness information needs to be easy to understand and interpret.

There are three types of group awareness: Behavioural awareness refers to the information about other members' activities in the group, such as what they are doing and what they will do later. Cognitive awareness refers to cognitive information, including knowledge, beliefs or goals of the members in the group. Social awareness refers to being aware of what other members of the group are doing or gathering continuous information about them and acting accordingly [15].

One example of social awareness in CSCL is the Reflect table proposed by Bachour et al (2008) [16]. The table provides a display on their surface showing participants their interaction level (contributions to a conversation) with the others. However, the visualization on the table did not suggest changes in participant behaviour. It simply showed the participants the state of their conversation as a group mirror, and it was up to the participants to decide if a change was needed.

Section 2 describes the need of supporting student regulation in the case of CSCL scripts structured according to the Pyramid CLFP. Then, section 3 presents a design of a social awareness feature aiming at facilitating socially shared regulation in Pyramid App, an application enabling the design and enactment of Pyramid scripts [4].

2 Need for socially shared regulation in Pyramid collaborative learning flows

PyramidApp is a web-based tool that facilitates the deployment of Pyramid pattern based CSCL activities where students can collaborate during several stages. Initially students are required to provide an individual answer to a given task. Then they are allocated into small groups where they can see the answers that were provided by their group members and rate them. In the next stage, the "answer improving" stage, students can discuss between them the given task and provide an improved answer. At the end of the small group level, students enter a second individual rating stage. Finally, the smaller groups are merged to formulate larger groups where they can further engage in discussions and vote for the best answers to reach a consensus at the end of the activity.

Log data from the PyramidApp tool was analysed to determine the discussion participation of students during Pyramid activities. In the following we first present students' overall participation in the discussion in three Pyramid activities. Then in order to better understand the discussion participation differences of each student in each Pyramid activity we provide a detailed analysis.

2.1 Overall Discussion Participation

The first column in Table 1 shows the activity ID. We considered three Pyramid activities conducted by a teacher online in a postgraduate course named "Learning Technologies". During activity A, B, C teacher proposed open-ended knowledge sharing tasks for students. The third column represents the Pyramid group level, the fourth column provides an identifier for different groups and the fifth column shows the total number of students in each group. In the final column students' chat participation is given which was calculated based on the percentage of students who wrote chat messages out of total students in a given group.

Table 1. Chat Participation of Students.

Activity ID	Topic / type of task	Group Level	Group ID	Group size	Chat Participation %
A	Brainstorming ideas (for a particular type of computer system design) based on previous experiences	Small	GA0	5	60%
			GA1	5	80%
			GA2	4	80%
		Large	GA3	14	57.14%
B	Compare two types of educational technologies	Small	GB0	5	60%
			GB1	6	0%
			GB2	4	100%
		Large	GB3	15	66.67%
C	Reflection with critical analysis based on a reading	Small	GC0	3	100%
			GC1	5	66.67%
			GC2	6	80%
		Large	GC3	14	14.29%

As presented in Table 1, it can be seen that students' discussion participation varied across different groups. Only GB2 and GC0 groups had 100% participation in the discussion meaning every student in the group participated in the discussion at least once. In the other groups however, the discussion participation varied across participants. It is noticeable that in GB1 and GC3 students had the least discussion participation.

2.2 Detailed Discussion Participation

The graphs under Fig. 1 present along the X-axis the number of chat messages posted by each student during the first and second rating levels of the Pyramid activities and the Y-axis represents students. As it can be seen in Fig.1(a) four students (S1-1 , S1-3, S1-6 and S1-7) only contributed to the first rating level and student S1-13 only participated in the second rating level. Noticeably S1-12 and S1-14 did not participate in discussion at any Pyramid level. In Activity B (see Fig. 1(b)) there is unequal participation in the discussion. For instance, it can be seen that seven students (S2-1, S2-2, S2-3, S2-4, S2-5, S2-6 and S2-7) mainly contributed and dominated the discussion while others have less participation or no participation at all in the discussion. In Activity C (see Fig.

1(c)) many students contributed to the discussion in the first rating level, whereas only two of them contributed to the discussion in the second rating level.

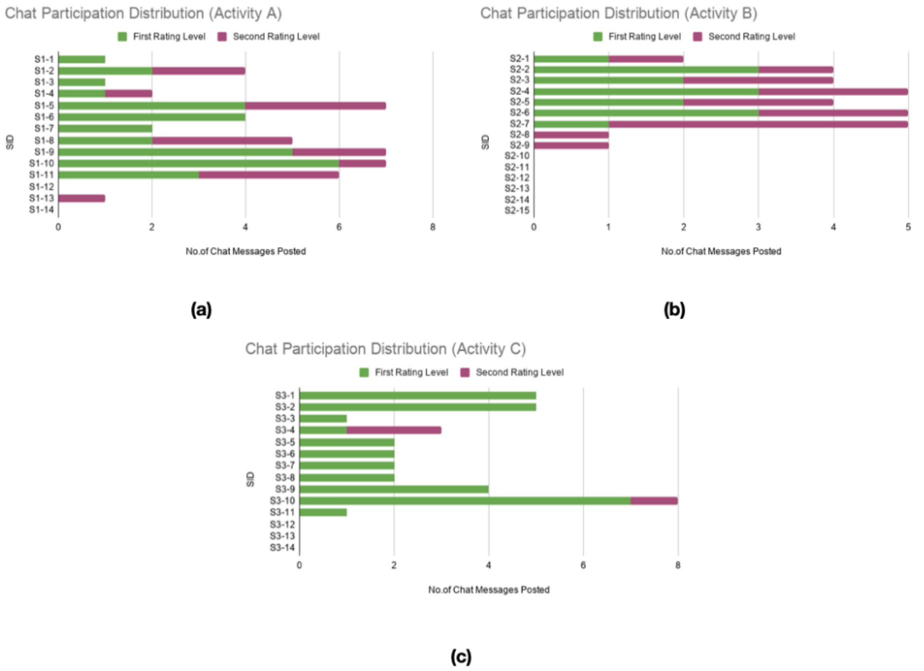

Fig. 1. Chat participation distribution of students in (a) activity A, (b) activity B and (c) activity C.

3 Design of a social awareness feature for socially shared regulation in PyramidApp

The analysis of the PyramidApp log data has shown that student's participation varied across different groups, reaching both extremes of 100% and 0%. As empirical evidence indicates that SSRL has the potential of increasing group performance in collaborative learning [17], we hypothesise that the implementation of a feature to support SSRL within PyramidApp has the potential of enhancing discussion dynamics in the PyramidApp. We therefore propose a social awareness feature to be implemented to allow participants to become aware of their social contribution and support SSRL. Similarly, to the approach of Reflect [16], which achieves social regulation by displaying the levels of participation on the surface of an interactive table, we propose a design mirroring participation in the PyramidApp level of "answer improvement". In particular, we use the metaphor of a participation bar that is visible to all the participants (Fig 1). The design has taken into consideration the space limitations and amount of information within the GUI. The expectation is that this feature supports socially shared regulation by improving participants' awareness of their own contributions in relation to other group members’ contributions.

To calculate user participation, an algorithm counts the characters sent, edited, or deleted from the chat and the answer improvement text-editor. Then to compute the user’s participation the following algorithm has been proposed:

(User participation / (All participants average participation * 2)) * 100

This algorithm implies the following cases: at the beginning, all user’s participation will be 50% as the average will be 0, a user’s progress will be under 50% if their participation is under the average, and the user's progress will be at 100% if their participation is equal or greater than twice the average. See the notes of figure 2 for a detailed use case using the algorithm.

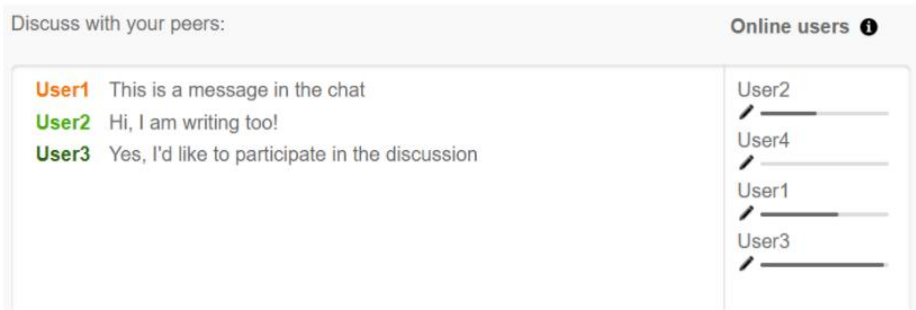

Fig. 2. The proposed social awareness feature can be seen under each user. Use case: User1 introduced 29 characters, User2 introduced 21 characters, User3 introduced 46 characters and User4 introduced 0 characters. The average of the characters is 24. The participation bar for each user has been calculated based on the above algorithm. User1 participation → (29 / (24 x 2)) x 100 = 60% , User2 participation → (21 / (24 x 2)) x 100 = 43%, User3 participation → (46 / (24 x 2)) x 100 = 95% and User4 participation → (0 / (24 x 2)) x 100 = 0%.

4 Conclusions and future work

This study aimed to investigate students' participation in Pyramid pattern based scripted CSCL situations and explore regulated learning theories to help enhance participation in collaborative activities. Log data from PyramidApp were analysed to determine the distribution of students’ discussion participation within three classroom based CSCL situations. Results of the analysis showed that participation levels varied across different groups with a number of students not participating at all. The sample size that was used to analyze the data was small, however, as CSCL can be hindered by social dynamics and socio-emotional factors, we found it important to further investigate mechanisms that can reduce this effect. Thus, this paper further proposed the implementation of a social awareness feature within a pyramid CLFP to promote socially shared regulation by allowing group members to monitor each other's contributions. However, its effectiveness has not yet been evaluated in practice and its future implementation could have some limitations. For instance, the design of the social awareness feature could potentially hinder its effectiveness as students might not become aware of its purpose. Additionally, the amount of information that appears on the page could possibly lead to an overload of their cognitive load, not allowing them to concentrate on the given task. Follow up research needs to be conducted to evaluate the design of the feature and its effectiveness in collaborative tasks. In contrast, students becoming aware of the tool's functionality may cause the conversation to become a competition of who will send the most messages and derail the discussion from being productive. The current design of the platform prevents such behaviors from happening through a teacher monitoring system where teachers can intervene in the conversation. However, the feature's limitation could be addressed in future work by implementing an algorithm to analyze the quality of contributions rather than word volume. Follow-up research will be conducted to determine if the implementation of the proposed feature enhances discussion participation within a pyramid CLFP. Further future work may also address how the feature affects dominant speakers' participation level and propose amendments to the design to help prevent dominant speakers from controlling and overpowering the conversation. The proposed design in this paper does not explicitly address this. Such a design needs to be carefully thought to not adversely affect the participation levels of dominant speakers.

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