Triggers of Teacher-Perceived Stressful Moments When Orchestrating Collaborative Learning with Technology

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Abstract

Teachers' well-being may be negatively impacted by the widespread adoption of educational technologies. The stress linked with teachers' use of digital technologies is an emerging area of research. To promote teachers' well-being through the design of CSCL tools, it is crucial to gain a deeper understanding of the stressful moments experienced by teachers when orchestrating collaborative learning activities facilitated by technology. Following a mixed method approach, this paper sheds light on the triggers of teachers' perceived stressful moments when using a CSCL tool in F2F and online classes. In the scenarios studied, teachers report feeling less stressful moments during online sessions. However, more stress-related triggers and orchestrated actions happened during F2F sessions. It was found that technological difficulties, students' behavior, and time constraints all contributed to the highlighted stressful moments. In addition, the dashboard interventions were found more related to stressful moments than other actions such as teacher-class interaction. This work provides an initial understanding of what makes teachers stressed when orchestrating CSCL activities from their perceptions. Collecting objective data about stress and orchestration load is needed to assert the findings of this work.

Keywords

Computer-supported collaborative learning, stressful moments, Orchestration, Dashboards, Teacher support tools

1. Introduction

In the field of Computer-Supported Collaborative Learning (CSCL), the notion of teacher orchestration has been used by several scholars to describe the way in which a teacher manages or regulates different classroom activities, learning processes, and numerous of teaching actions in real-time [1, 2, 3]. The term orchestration is used to refer to "cognitive, pedagogical, and practical dimensions of a distributed CSCL environment" [3]. Teacher orchestration in this context refers to three aspects of a distributed CSCL environment: cognitive (e.g., managing individual, small-group, and class-wide interactions); pedagogical (e.g., real-time adaptation of intended activities to classroom demands); and technology (e.g., management of the transactions between software components) [3]. The use of learning analytics (LA) tools such as dashboards may support teachers in monitoring and fostering the types of interactions between students that are favorable for learning [4, 5, 6]. However, introducing teacher-supporting tools as additional technology (e.g., dashboards) may affect the overall teacher's orchestration load resulting from facilitating and controlling collaborative learning.

Teaching itself, without considering the involvement of any technology, is already described by various researchers as a "stressful occupation" [7]. Adding technology to the equation of

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teaching, stress has been long associated with the use of technology in the workplace as well [8, 9]. Stress in the workplace refers to an individual's reaction when confronted with a threatening scenario at work, which can be caused by a variety of circumstances that are aggravated by the use of new technologies [10. Further research [11] on technology-induced stress defines six factors that can be a potential cause for technostress in the workplace: 1) the changes that may arise with the implementation of technology in the workplace, 2) a factor of pressure for an enhanced performance, 3) excessive information overload, 4) technology-induced anxiety due to the evolving nature of the former, 5) training of technical skills on a constant basis and 6) reduced social support due to the limitations of the virtual working space.

Studies on educational technologies focus mainly on improving student learning, while research on how teachers have been impacted by the emergence of technology in education is limited [10]. The use of technology in learning and teaching processes may have negative impacts on teachers' well-being, since it could lead to shifts in their teaching methods or pressure to gain technological skills, resulting in physical, social, and psychological issues [12]. A growing subject of study is the stress associated with the teachers' use of digital technologies. Such stress can emerge due to a number of factors e.g., lack of training in the use of technology, teachers' aversion to using technology in everyday teaching and learning situations, design issues related to teacher supporting tools [10, 13].

In this paper, we explore the triggers of teacher-perceived stressful moments when using a web-based CSCL tool that enables teachers to implement Pyramid pattern-based learning activities [6]. In addition, the orchestration actions that can be related to the identified triggers are explored. Thus, the research questions that are tackled in this paper are:

- What are the triggers of teacher perceived stressful moments when orchestrating collaborative learning with technology?
- What orchestration actions can be related with teacher perceived stressful moments when orchestrating collaborative learning with technology?

2. Background

Individuals' feelings and thoughts regarding the level of stress a human is experiencing presently or over time are referred to as perceived stress [14]. It focuses on feelings about unpredictability and loss of control, with these frustrations causing changes in one's life as well as one's confidence in their capability to deal with challenging situations [15]. The term Technostress has been increasingly used due to a lack of adaptation to technological environments [14]. Technostress refers to a condition caused by an individual's inability to adapt or react to circumstances of new technology use, which varies according to age, prior techno experiences, workload, and work-place environment, and ultimately affects people's performance [8].

In the field of education, several studies on technostress have covered students' use of technology in learning processes [16, 17], and the area that is more related to this paper, teacher technostress [18, 19, 20]. Initial research on teacher technostress attributed it to the introduction of technology into the classroom as well as a lack of adaptation to the technological environment [7]. More recent research has emphasized such a relation and extended to identify influences of technostress on teachers' psychological well-being [21] and on their job satisfaction and technology-mediated performance in collaborative learning environments [22, 19].

Due to the dynamic nature of the collaborative classroom, teachers are generally under pressure to orchestrate the activity and have, for example, to continuously decide which group receives their attention at any given moment [23]. The orchestration load and stress resulting from facilitating CSCL activities remains understudied. In this study, the term orchestration is used to refer to the run-time coordination of CSCL activities, following the definition used by some authors (e.g., [5, 24]). Broader definitions can be found in the literature (e.g., [25]). CSCL orchestration load can be broken down into two categories: a) the physical and logistical load (such as walking around the classroom and interacting with students); and b) the cognitive load of assessing what is happening in the classroom, weighing different actions, and deciding about

how to better help the ongoing CSCL process [26]. After observing teachers' orchestration actions in classroom situations, in our previous work have deconstructed orchestration load into three different facets namely: situation evaluation, goal formation and action taking [24]. Previous studies have also provided evidence that orchestration load can be estimated by triangulating multimodal data (observations, log data, physiological data) with teachers' subjective perceptions collected using questionnaires [26, 6].

3. Methods

3.1. Study design

The web-based tool used in this study, Pyramid App, provides an activity authoring space and a teacher-facing dashboard for the teachers and an activity enactment space for students [27]. The teacher-facing dashboard provides a real-time overview of collaboration in addition to different controls, e.g., activity pause-resume, increasing time, and an alerting mechanism that informs critical moments of collaboration to the teachers to support their orchestration actions [24]. Students can use their mobile phones, tablets, or laptops to join the activity. The activity flow is as follows: First students are required to provide an individual answer to a given task. Then they join in small groups and later in larger groups to discuss and improve individual answers and to reach a consensus at the end of the activity.

This study was designed to collect post-activity data from teachers about how they rate their stress level when orchestrating a CSCL activity, and whether they experienced particularly stressful moments, explaining the triggers of those if any exists. Thus, teachers were asked to complete a short questionnaire after orchestrating a technology-facilitated CSCL activity. Data was collected from five university instructors (three males and two females) in the field of Information and Communication Technologies (ICT) and used the tool for orchestrating collaborative learning activities between Fall 2021 and Fall 2022. Three of the participants have had three years of experience in using the tool, while two had been using the tool for one to two years.

3.2. Procedures

Data was collected from the teachers during 36 collaborative learning sessions in the subject of introduction to ICT. Due to the lasting consequences of Covid, ten of these sessions occurred during online classes. A four-item mixed-method questionnaire was designed to capture teachers' perceptions of the activity and the stressful moments. The first item asks the participants to rate their perception of the stress they experienced throughout the entire class from 1 to 10. Then they were asked to answer a Yes/No question whether there were any particularly stressful moments during the activity. In the case of a Yes answer, they were asked to describe that stressful moment in detail identifying its trigger and rate the level of the identified stressful moment from 1 to 10.

3.3. Data analysis

For the quantitative data, means and standard deviations of the participants' rating of their overall and moment-related perceived stress during the activity in F2F and online sessions were calculated. Then the qualitative responses provided by 60% of the participants about particular stressful moments were analyzed through qualitative content analysis [28]. This analysis was conducted to identify the triggers of perceived stressful moments and the orchestration actions that could occur concurrently with the perceived stressful moment.

Qualitative content analysis is an approach for the subjective interpretation of textual data using the systematic categorization process of coding and identifying themes or patterns [28]. For the triggers, the text was first analyzed to identify patterns and suggest main categories of

the triggers, then breaking each category to more specific triggers. For the orchestration actions, we adapted the codes in Table 1, which were found consistent with the CSCL activities being orchestrated in this study [24]. If any other orchestration actions were mentioned in the responses, they will be coded and included as well.

4. Results

As indicated in Table 2, teachers' average perceived stress in F2F sessions (M=5.96; SD=1.97) is higher than the stress perceived in online sessions (M=3.3; SD=1.73). Regarding the question asking whether the participants experienced particular stressful moments or not, the participants in 60% of the sessions (20 out of 36 sessions) answered Yes and provided detailed answers that were considered for later analysis. 14 of these sessions were F2F and six were online.

Table 1
Codes defined to describe teacher orchestration actions when using the tool [24]

Orchestration action	Example
Teacher-individual interaction	The teacher replies to questions raised by individual students.
Teacher-class interaction	Interactions between teachers and the whole class (for example, the teacher requesting information from the class, debriefing the final responses, providing instructions to the students on how to use the tool, and completing the given activity).
Announcements to class	The teacher gives announcements to the students (i.e., time remaining for the activity and phase transitions of the script).
Check responses tab	This code contains the two actions (i.e., the teacher is checking individual student devices (e.g., mobile or desktop screens) as well as the task projection).
Check participation tab	This code describes actions of the teacher in the dashboard (i.e., checking information related to satisfactory and unsatisfactory voting participation of groups, opening a group box, and scrolling through the chat messages posted by the students and the new option formulated).
Dashboard interventions	This code describes actions of the teacher in the dashboard (i.e., checking information related to satisfactory and unsatisfactory voting participation of groups, opening a group box, and scrolling through the chat messages posted by the students and the new option formulated).

Table 2
Mean and standard deviation of the overall perception of the stress out of 10

Evaluate your perception of the stress you experienced throughout the entire class from 1 to 10 (not necessarily related to the cognitive load)		
	Mean	SD
F2F sessions (n=26)	5.96	1.97
Online sessions (n=10)	3.30	1.73
All sessions (n=36)	5.22	2.25

Following the qualitative content analysis approach, the content of the participants' textual responses was grouped into concepts and themes. In the first cycle of analysis, three main themes were identified as triggers of teacher-perceived stressful moments during orchestrating CSCL activities namely Technological difficulties, Actions by students and Time-related issues. An in-depth analysis was conducted to break down the aforementioned themes into more specific triggers, resulting in eight triggers. The Technological difficulties category included four triggers which are Dashboard Problems, Access Problems, Lack of prior knowledge about the tool, and Setting. Actions by students category included three triggers namely Noises from the students, Chat Messages and Answers. The last category is Time-related issues which have one trigger Shortage of time. A total of 30 stressful moments were identified, 16 of which were technological difficulties, eight of which were actions by students and six of which were time-related issues (Figure 1).

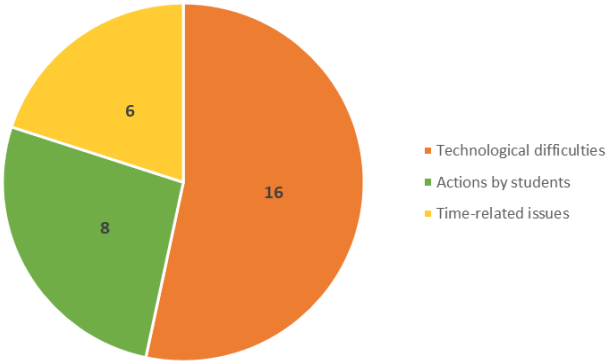

Figure 1: Categories of triggers of teacher-perceived stressful moments

Table 3 provides details about the trigger category of the teacher-perceived stressful moments, the number of the stressful moments, per category, per trigger and per learning setting, in addition to examples of the teachers' responses and the orchestration actions related to the identified stressful moment. The participants identified 30 stressful moments overall. First, 16 stressful moments (53%) were caused by techno-logical difficulties, eight moments of which were brought up by access problems, while four moments were triggered by problems with the dashboard. Other three technological stressful moments were triggered by issues related to setting up the environment and one by the lack of prior knowledge about the tool. Second, Actions by students caused eight stressful moments (27%). Two of them were triggered by the noise students made during the activity, three by their chat messages, and four resulted from their answers. Third, Time-related issues caused six stressful moments (20%) due to time shortage in some of the activity phases (Figure 2).

Among 21 stressful moments that happened within 14 F2F sessions, 12 moments were triggered by technological difficulties, seven by students' actions and two by shortage of time. On the other hand, among nine stressful moments that happened within six online sessions, four were triggered by technological difficulties, one by students' actions and four by shortage of time.

Regarding the orchestration actions that coincided with stressful moments, four codes of actions were identified from the analysis of the teachers' responses (see Table 3). Three of these orchestration actions are mentioned in the previous code scheme explained in Table 1, which are Check responses tab, Check participation tab, Dashboard interventions and Teacher-class interaction. In addition, we came up with a new code which is Activity Configuration. This code describes teachers' actions that are related to publishing the activity to the students.

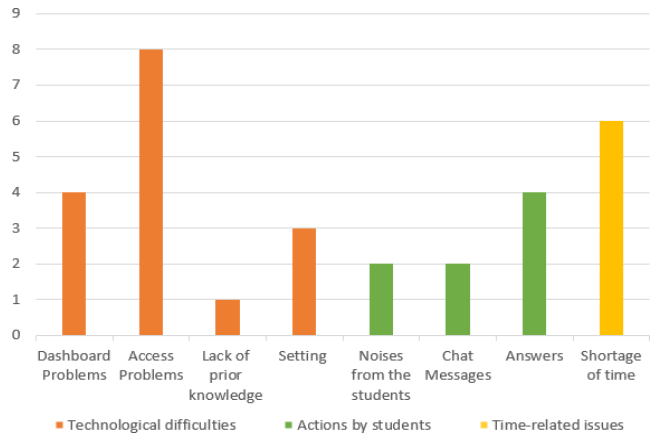

Fig. 2. Triggers of teacher-perceived stressful moments

Table 3
Details about the triggers of the participants' perceived stressful moments

Trigger category	No. stressful moments	Triggers	No. moments per triggers and settings		Samples of participants' responses	Related orchestration actions
			F2F (n=14 sessions)	Online (n=6 sessions)		
Technological difficulties	16	Dashboard Problems	4 (19%)	0 (0%)	- *"I pressed twice "Next phase" skipped the phase of improvement"* - *"I had issues making the "next step" control work"*	Dashboard Intervention
		Access Problems	5 (23%)	3 (33.3%)	- *"I informed wrongly the students about the activity URL"* - *"Students did not login correctly"*	Activity Configuration
		Lack of prior knowledge about the tool	1 (4.76%)	0 (0%)	- *"At the beginning it was not all clear to me"*	—
		Setting	2 (9.52%)	1 (11.11%)	- *"The laptop was running out of batteries and I needed to plug it"* - *"I needed to restart m browser"*	—
Actions By students	8	Noises from the students	2 (9.52%)	0 (0%)	- *"When students ended any phase they started to talk, and the class started to be clearly noisy.* - *"Those moments/noise were alerting me that I needed to take an action: i.e. asking all of them to finish, and pressing "next phase" in the dashboard even if there were time left"*	Dashboard Intervention & Teacher-class interaction

		Chat Messages	2 (9.52%)	0 (0%)	*- "Some students wrote inappropriate and vulgar phrases in the chat, and the chat was not used for the purpose it should be" -" People were using the chat in an unserious and even rude way"*	Check participation tab
		Answers	3 (14.28%)	1 (11.11%)	*- "when some students still do not provide their answer when the time is finishing" - "When students told me that they could not continue editing their improved answer"*	Check responses tab
Time-related issues	6	Shortage of time	2 (9.5%)	4 (44.4%)	*- "In the submission phase I notice students were needing extra time just about when the time was finishing" - "The class time was running out, I needed to reduce time in the activity"*	Dashboard Intervention
Total	30		21	9		

5. Discussion

Understanding the teachers' stressful moments that contribute to the orchestration load in CSCL settings is important not only to design and develop CSCL tools but also to improve teachers' well-being. Following a mixed-method approach in this paper, we shed light on teachers' perceived stress in F2F and online settings. Overall, when considering the learning context, teachers reported their perceived stress is higher in F2F settings when compared to online settings. In order to understand why this is the case we conducted a detailed analysis by deconstructing each trigger (e.g., technology, aspects related to students and time). For instance, when considering the technological difficulties in both learning settings, our detailed analysis showed that in the F2F setting teachers faced a high number of technical problems arising from both CSCL tool and other extrinsic factors. For instance, regarding the CSCL tool, teachers' highlights faced a high number of dashboard problems which were reported as zero in the online setting. This is interesting because the same dashboard was used in both settings. We interpret that in the F2F setting teachers not only pay attention to interpreting information in the dashboard, rather they visit students' groups, talk to students etc. which deviates their attention from what is presented in the dashboard. Dividing teachers' attention across physical and digital space could have caused more stress for the teachers in the F2F setting.

When considering the trigger "actions by students", noise in the F2F setting was reported high when compared to online settings for obvious reasons. Off-task messages and answers were prominent in the F2F settings which added to the stress of the teacher as well. This hints that the nature/dynamics of the classroom could trigger off-task behavior among students during collaboration when compared to online settings which eventually contribute to increased teachers' workload that could result in stress. In addition, this finding indicates that the CSCL tool may require variations in the design of its features depending on the type of setting it supports.

Finally, the "time related issues" were common in both F2F and Online settings. This is a known issue in teaching in general and especially present in collaborative learning, including scenarios in which collaboration is structured across a number of phases. In Pyramid scripts, determining the optimal number of phases required to build knowledge while reaching a consensus and the adequate allocation of timing for the phases involves real-time decision

making on the side of the teachers' considering both social and epistemic aspects of the learning situation that adds to their workload.

6. Conclusions and future work

The use of technology in the field of education adds a burden of stress to what has already been known as stressful processes, i.e., teaching and learning. This paper concerns the level to which teachers perceive their stress level when orchestrating CSCL activities and explores the triggers and orchestration actions by which they experience particular stressful moments. The overall teacher-perceived stress was found to be lower in online sessions, while more triggers and orchestration actions related to stress were identified in F2F sessions. This finding remains questionable and requires further investigation, as it could be due to the uneven sample sizes of each condition rather than the conditions themselves.

The triggers of teacher-perceived stressful moments were divided into three categories: technological difficulties, actions by students and time-related issues. About half of the discovered stressful moments were triggered by technological difficulties, while the dashboard intervention was the most related orchestration action to these moments.

The future direction of this work involves collecting data about teachers' stress and orchestration load beyond their subjective perceptions. Objective data is needed to further understand how orchestrating collaborative learning with technology can impact teachers' stress. For example, more data about orchestration actions is being collected from different sources such as video and dashboard recordings during CSCL sessions. In addition, physiological data (e.g., electrodermal activity) is being collected from the same sessions to objectively estimate teachers' stress-related indicators.

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