Collaborative Learning Designs using PyramidApp

Computer Supported Collaborative Learning in Classroom Sessions

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1. ABSTRACT

Designing effective collaborative learning activities for classroom is challenging. The PyramidApp is a tool that facilitates the implementation of the Pyramid pattern, shaping a collaboration structure that promotes the participation of all students and fruitful social interactions. This paper shows how this educational strategy can be applied to different types of tasks and subject matters, shedding light about how computer-supported collaborative learning can be incorporated in the classroom.

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2. KEYWORDS: 4-6

Computer-Supported Collaborative Learning, Scripts, Pyramid Pattern, Educational Technology

3. DESENVOLUPAMENT:

1. Introduction

Computer-Supported Collaborative Learning (CSCL) has emerged as a dynamic and an interdisciplinary field of research which aims in studying how people can learn together with the help of computers (Stahl, Koschmann, & Suthers, 2006). In CSCL, collaborative learning scripts explicate the flow of pedagogical scenarios using different techniques such as role and group allocation (Dillenbourg, 2002). Deployment of scripted collaborative learning activities in classroom learning situations and engaging learners in argumentative knowledge construction processes were seen to enhance the domain-specific knowledge acquisition, motivation and collaboration skills of the activity participants (Radkowitsch et al., 2020).

Collaborative Learning Flow Patterns (CLFP) capture the essence of well-known collaboration scripts and facilitate to pre-structure collaboration, supporting collaborative learning practitioners to design learning tasks which will result in establishing productive social and cognitive interactions among learners (Hernandez-Leo et al., 2005). CLFPs can also be described as templates that capture expert teaching practices in achieving educational objectives during CSCL situations (Hernández-Leo et al., 2006). These readily available templates can be used by novice teachers to structure collaboration hence the use of CLFPs is efficient as they eliminate the need of designing their own activities from scratch (Hernández-Leo et al., 2006). Some of the well-known examples of CLFPs include Pyramid, Jigsaw, Think-Pair-Share (TPS) and Thinking Aloud Pair Problem Solving (TAPPS) (Hernández-Leo et al., 2006). The structure of collaboration within these CLFPs are shaped by the pedagogical rationale and constraints defined within the CLFP itself (Manathunga and Hernández-Leo, 2018).

Pyramid pattern is an example of one such CLFP, that could be applied in collaborative learning scenarios in which a number of participants face the resolution of the same complex problem usually which does not have a unique solution (Hernández-Leo et al., 2006). The Pyramid pattern constitute a number of phases that occurs one after the other, structuring collaboration following a Pyramid structure (Hernández-Leo et al., 2006). The pattern integrates activities that are occurring at multiple social planes, i.e. individual, group and class-wide levels as described below. First at the initial stage of the

CLFP, students require to provide individual solutions to a given problem. In the next levels, students are grouped into small groups to evaluate solutions proposed by the individual students. Small groups are then merged formulating larger groups in an iterative manner as the flow advances, facilitating groups to reach a common consensus (at the class level) for the problem under investigation. This CLFP provides opportunities for all learners to express their solutions, discuss their solutions with peers and to learn and reflect on others ideas. Each individual has to contribute and sustain participation from the beginning till the end of the consensus building process following several phases of the pyramid structure to attain fruitful collaboration. Such facilitated interactions nurture individual participation, accountability and balanced positive interactions (opinions of all members count) in a collaborative knowledge-oriented negotiation process (Manathunga & Hernández-Leo, 2018). A specific software implementation of the Pyramid CLFP scripts is PyramidApp (Manathunga & Hernández-Leo, 2018). The tool provides an automatic mechanism to enact the aforementioned Pyramid pattern via different activity phases.

The Activity-Centred Analysis and Design (ACAD) framework (Carvalho & Goodyear, 2014) has been proposed and used to analyze the design of arrangements that lead to successful learning activities and outcomes. The framework defines three elements that can be designed by educators: the epistemic tasks, the setting (space, place, tools, ...), and the social organization (dyads, teams, division of labor, …). Therefore, according to the ACAD framework (Carvalho & Goodyear, 2014), PyramidApp offers a setting (the tool online space) and a social organization (pyramid structure) (see Graphic. 1). The question is then to what extent the use of the tool is marginal, only valid to limited educational scenarios, or to what extent it can be applied to a wide range of subject matters and types of learning tasks. To answer this question, this paper presents and analyzes a number of designs implemented using the PyramidApp. We hope these examples also shed light for those who seek to deploy similar CSCL activities in their own learning situations.

2. PyramidApp

PyramidApp is a web-based system which through an authoring tool enables educators to deploy Pyramid CLFP-based activities in both classroom and distance learning situations (Manathunga & Hernández-Leo, 2018). The tool provides an activity design space for teachers and an enactment space for students. The activity design space of the tool is built into the Integrated Learning Design Environment (ILDE) (Hernández-Leo et al., 2018). When designing a Pyramid activity teachers require to input the question to be answered by the students and configure the following parameters: (i) size of the class, (ii) size of small groups, (iii) number of levels in the pyramid, (iv) number of students per pyramid, (v) duration for answer submission, (vi) duration for collaboration at the group levels, (viii) configurations related to countdown timers. Upon finishing the activity design teachers can generate a public URL to the activity that can be shared later with the students for activity enactment (see Graphic. 2).

Through the PyramidApp enactment tool, students can submit individual answers to the given task and discuss initial options in small groups. They agree upon a common option that will be propagated to the next level(s) where much larger groups are formulated and reach a consensus on one or few options at the global level. The tool comprises an option submission space, a voting feature to aid in reaching consensus along with an integrated discussion space (see Graphic. 3).

3. Learning designs applying Pyramid App in the classroom

3.1. Participants

Teachers (N=11) were recruited to deploy CSCL activities using opportunity sampling, i.e. the tool was offered for use to naturally accessible groups in essentially the Engineering School but also the Communication and Human Biology faculties and a Design School associated with the university. After knowing the mechanisms of Pyramid CLFP and the PyramidApp, teachers were free to design tasks appropriate for their respective classes.

3.2. Methods

Graphic. 5 outlines learning designs used by the teachers in eight different subject areas. The learning objectives specified for CSCL activities (Graphic. 5 column 3) were analysed based on the cognitive skills proposed in Bloom's taxonomy (Bloom, 1956), which describes skills and abilities teachers expect as outcomes of their students. The taxonomy consists of six levels namely knowledge, comprehension, application, analysis, synthesis and evaluation.

Knowledge is referred to as one of the most common educational objectives that describe the amount and kind of knowledge a student possesses as a result of completing an education unit (Bloom, 1956). Knowledge emphasizes the "remembering, either by recognition or recall, of ideas, material, or phenomena" (Bloom, 1956, p. 62). Comprehension explains a learner's ability to make use of material or ideas which has already been communicated (Bloom, 1956). Comprehension can be more demanding than remembering information and will facilitate learners to grasp the meaning and intent of the material (Bloom, 1956). This will guide learners to application, in which learners may apply knowledge in appropriate situations to which a solution is not specified. The next level analysis refers to the breaking of the material into its constituent parts (Bloom, 1956). During synthesis, learners may put together or reconfigure elements and parts to constitute a pattern or structure which has not been there before (Bloom, 1956). Finally, during evaluation, students make quantitative or qualitative judgments which involves a combination of the previously stated behaviors (Bloom, 1956). A summary of how the educational objectives proposed for CSCL activities map with specific cognitive skill levels proposed in the Taxonomy are shown in graphic. 4. As shown in graphic. 4, three activities map with knowledge. Three activities map with comprehension. One activity map to Application. Two activities map with Analysis. Three activities map to synthesis and one activity maps with evaluation.

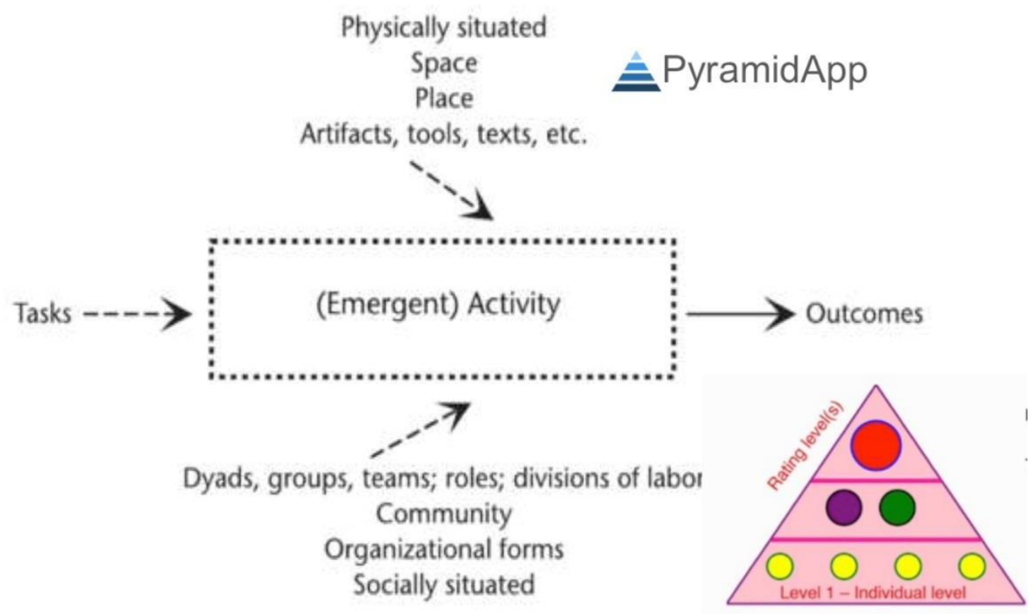
4. Summary

In summary, this study presents how eleven teachers have used the PyramidApp tool to implement pyramid pattern-based collaborative learning activities in their classrooms. Graphic. 5 outlines the details of the activities carried out by the teachers. The activities proposed by the teachers were analysed in accordance with the cognitive skills proposed in Bloom's taxonomy to set examples and to reflect the wide range of possibilities that the proposed pyramid mechanism provides.

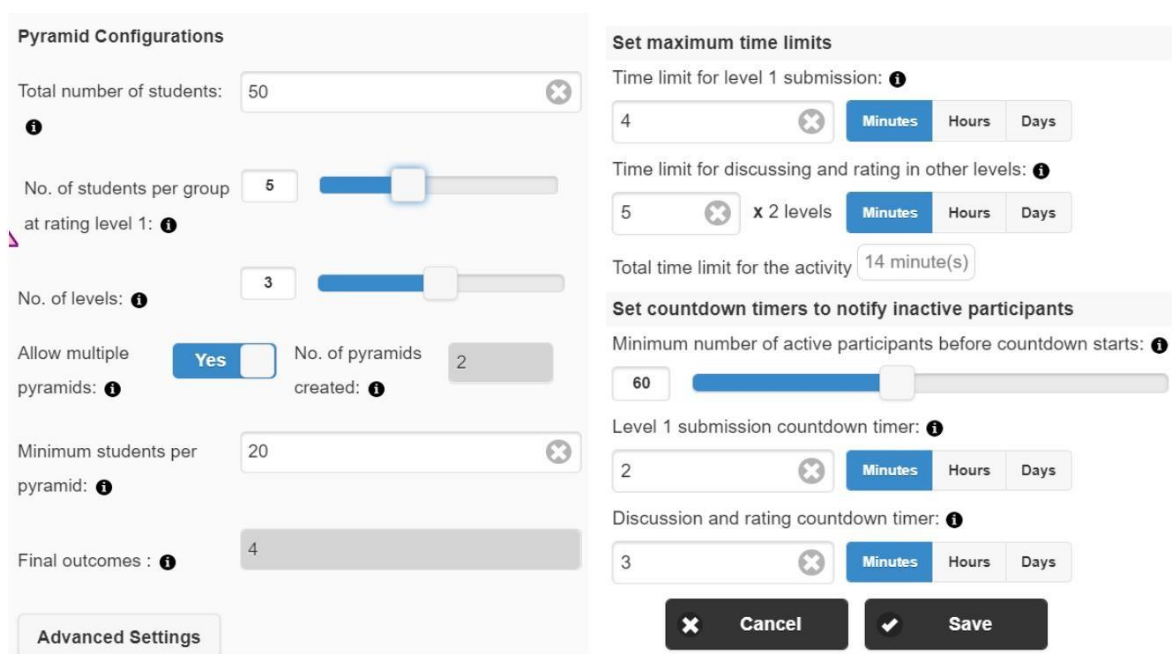
5. Conclusions

This study presents in detail scripted collaborative learning sessions conducted by eleven teachers in eight different courses. The objectives of the proposed CSCL activities have been analysed using cognitive skills specified in Bloom’s Taxonomy which focuses on the development of students' intellectual aspects of learning. The results of the analysis revealed that the CSCL activities proposed in different courses can be aligned into different cognitive skills. Even within the same course, teachers were seen to deploy CSCL activities that aimed to address the different cognitive skills of students. The aforementioned activities have been enacted in both small and large group contexts. Results suggest that the Pyramid pattern-based CSCL activities can be designed and deployed to achieve different cognitive skills of students, in diverse types of epistemic tasks, across different course domains while scaling up the activities to the requirements of different classroom sessions.

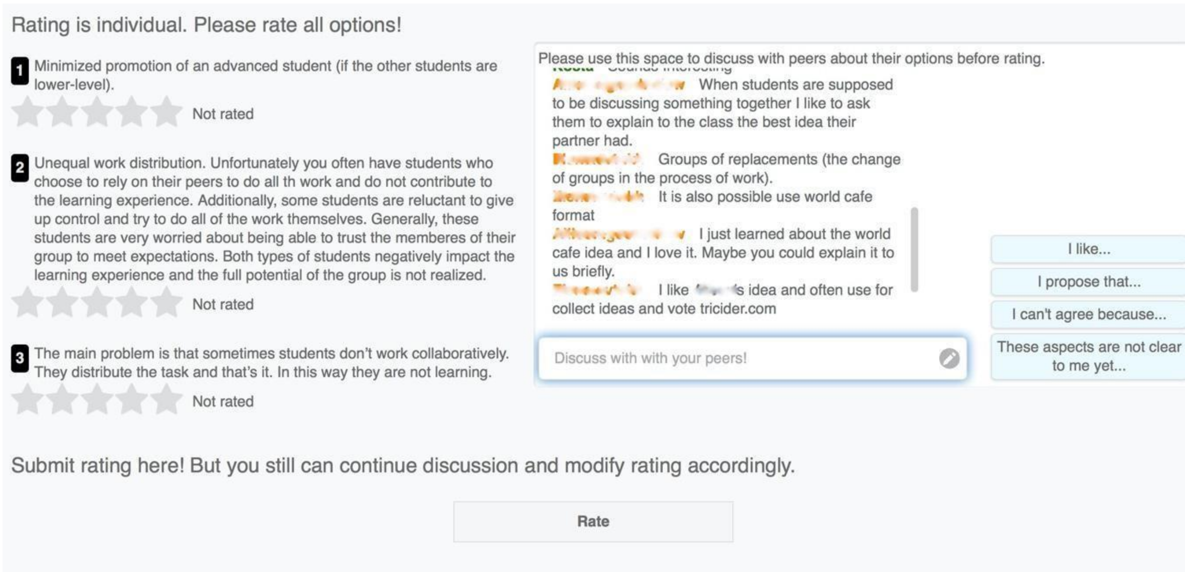
5.1. GRAPHIC OR TABLE 1



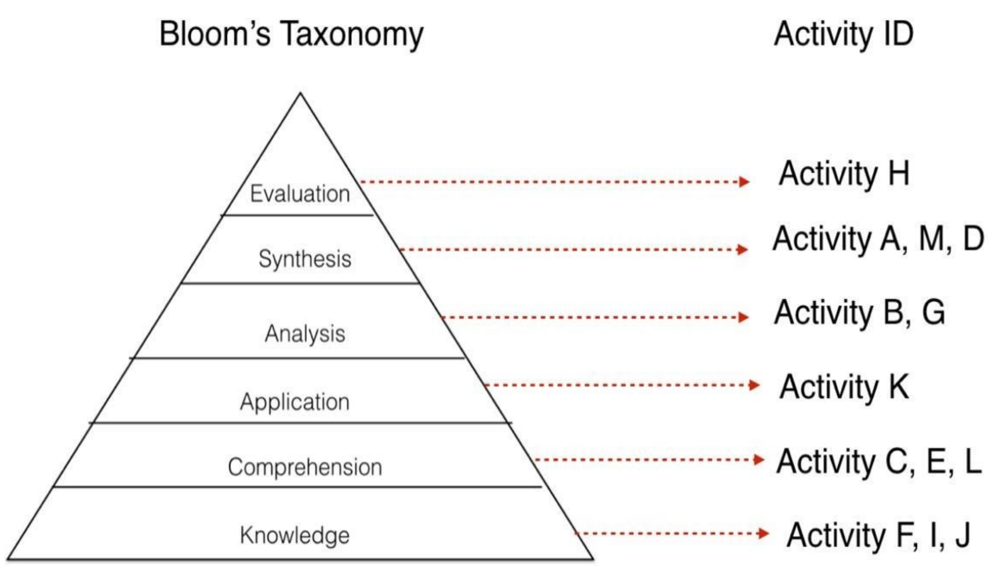
5.2. GRAPHIC OR TABLE 2



5.3. GRAPHIC OR TABLE 3



5.4. GRAPHIC OR TABLE 4



5.5. GRAPHIC OR TABLE 5

Name of the Course	Activity ID	Educational objective of the task	Task Description	Number of Students participated
Introduction to ICT Engineering studies (Undergraduate program)	A	Reflecting about the potential of data to infer relevant characteristics for analytical models leading to practical applications.	Considering the following proposed header for a service similar to whatsapp, define a user profile oriented towards financial risk with the most relevant characteristics that are possible to obtain from those events. Choose the 4 characteristics you believe are more important and argue why those are related to financial risk.	12
	B	To help students reflect and discuss key concepts in the lesson.	Students are asked to analyse different cases dealing with ethics and how computing professionals should make decisions regarding professional and social conduct. Students have to read the corresponding cases carefully and identify which ethical principles have been committed or violated in the particular case.	24-30
	C	To help students practice generating questions; to nudge students to pay attention to peer presentations; and to facilitate student understanding of peer presentations.	Students are asked to generate a question about a presentation that has just finished. Students are then asked to review the questions of their peers and select the ones they most want to hear the answers to. The selected questions are then asked to the presenters.	16-19
	D	To help students understand key concepts in the lesson; to have students practice retrieval learning.	Students are asked to pause for 1 minute and think about how to explain a concept (e.g. distributed practice) to a peer. They are then asked to write down their explanation; review and rate the explanations of peers considering keywords (e.g. active forgetting, spacing effect); and then rewrite their explanation of the concept.	54
	E	To motivate students to ask questions and think more about the presentations and topics that are presented. Also, the idea was to initiate a discussion based on the questions selected, choose questions that were not selected and explain the benefits of asking questions, going through them and discussing.	Each student should submit one question regarding the topic that was previously presented.	16
	F	To open minds with open questions before introducing a topic to generate some initial debate on the topic of increasing the interest on the session content.	Students had to answer an open question about a topic at the beginning of the sessions. Answers were then voted by students to come to the ones with more consensus in the group. After this, the selected top answers were discussed and commented in class as introduction to the session topic	33-50
Distributed Applications (Undergraduate program)	G	To practice the analysis of non-functional requirements for distributed applications. To clarify concepts.	Read the description of a scenario that requires the development of a distributed application. Explain which are non-requirements especially relevant for the given case.	18-25
Network Protocols (Undergraduate program)	H	To practice the recognition of the mechanisms of transport layer networking protocols in real network traffic. Learning from failure: identifying common failures in students' problem-solving when addressing these types of tasks	Recognize and explain which TCP protocol mechanisms for flow and congestion control can be seen operating in the following network traffic capture file.	25-60
Research Methods (Postgraduate program)	I	To recall guidelines on how to write a paper.	List the key aspects that need to be considered when writing an Introduction section for a research paper.	19-28
Academic uses and specific terminology in English - Prototyping with Arduino (Undergraduate program)	J	To recall arduino components	Task A: Students were shown an image with an electric schematic of Arduino board, sensors and actuators and a programming code (with errors) for using the components. Students were then asked to write down a solution for solving all the errors. During Pyramid phases students discuss about the proposed solutions to agree in the most complete solution. Task B: Students were shown an image including 12 different arduino components. Then, students are asked to write down the names of all the components they are able to recognize. During Pyramid phases students discuss about the proposed solutions to agree in the most complete solution	12-27
Fundamentals of Television Production (Undergraduate program)	K	To understand the basis of TV and new audiovisual formats productions and developing television programmes at a small scale.	Task A: Recognising the different *mise en scène* models when working with a television multi-camera system. Task B: Debating different technical solutions for a TV production after the close reading of an article and the screening of several examples. Task C: Suggesting alternative for new television formats in the current audiovisual scenario.	21-67
Introduction to University (Undergraduate program)	L	To co-construct a definition about Responsible Research and Innovation (RRI)	After a short lecture on RRI, students are asked to write their own definition of what they consider to be responsible in the field of biomedical research. They then share their individual definitions through pyramid activity, discuss and vote the definitions of their classmates. At the end, the most voted definitions are commented with the whole class.	2 groups of 60 students
Foundations of science teaching and learning (Postgraduate program)	M	To synthesize the key ideas of a classroom	After the classroom, students had to write individually the take-home message of the session. Through the pyramid activity, they were selecting the key ideas that better represented the content of the classroom. Then, the teacher facilitated a reflection about what they have learned and she used this for introducing the next class.	2 groups of 30 students

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