

Learning and Motivation Impact of Collaborative Questioning Sessions in Construction and Building Engineering Educational Environments

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Abstract

This manuscript offers an in-depth examination of an innovative active learning methodology introduced within the Master's Degree program in Advanced Construction Engineering at the Universitat Politècnica de Catalunya. This pedagogical initiative centered around structured competitive engagements among student teams, where each group devised and presented multiple-choice questions to their peers. The primary objectives of this study are to delineate the implementation process comprehensively, appraise the efficacy of this approach, and scrutinize its influence on student learning and motivation. The evaluation encompassed experiences and surveys. The findings yield valuable insights into the potential of Collaborative Questioning Battles to cultivate highly competitive dynamics, thereby augmenting comprehension, retention of concepts, and overall engagement, thus fostering a conducive learning environment.

Keywords: *Active Learning; Collaborative Questioning Sessions; Questioning Battles; Construction Engineering Programs.*

1. Introduction

Traditional pedagogical approaches often rely on passive learning, where students act as recipients of information rather than active contributors to their own understanding. These traditional teaching methods may not sufficiently address today's educational issues, such as motivation, as they often prioritize passive learning over active engagement (Schwerdt & Wuppermann, 2011 and Nurutdinova et al., 2016). In this context, the multifaceted benefits of active learning (Freeman et al., 2014) present an intriguing opportunity to address these prevalent challenges, fostering deeper comprehension, critical thinking, and engagement among students. In this regard, this manuscript delves into the implementation and assessment of

Collaborative Questioning Battles Sessions within the context of a subject of the Master's Degree in Advanced Construction Engineering program at the Universitat Politècnica de Catalunya, where basic structural design and seismic resistance of buildings are taught. The battles involved teams presenting face-to-face multiple-choice questions to their peers, encouraging a dynamic and engaging learning environment. Rooted in the principles of Constructivism (Dewey, 1986; Bonwell & Eison, 1991; Anthony, 1996 and Cooperstein & Kocevar-Weidinger, 2004), Game-Based, Experimental, and Collaborative Learning (Van Staalduinen & De Freitas, 2011; Plass et al., 2015; Qian & Clark, 2016; Bakan & Bakan, 2018; Petrunich-Rutherford et al., 2019 and Zainuddin et al., 2020), this activity seeks to create a dynamic learning environment that transcends the confines of conventional teaching methods.

The aim of this manuscript is to contribute to the ongoing discourse on effective pedagogical strategies by presenting a detailed account of this Team-Based Questioning Battles active learning experience, its execution, and its impact on students. By drawing upon our practical involvement and survey results, we furnish evidence-based perspectives on the efficacy of this approach. Moreover, the potential to enhance learning outcomes and motivation in the field of construction and building engineering is highlighted.

2. Materials and methods

To investigate the effectiveness and usefulness of a Collaborative Questioning Battles (so called Collaborative Questioning Sessions) implemented, this paper employs a mixed-methods approach, combining the experience of the author together with a detailed survey and interviews; thus, bringing a deep understanding of practical nuances.

2.1. Collaborative Questioning Sessions description

To foster active learning in a Master's Degree program at the Universitat Politècnica de Catalunya, an innovative pedagogical approach was implemented involving competitive battles in a collaborative questions session. Teams of 3-4 students created challenging multiple-choice questions to reinforce understanding of fundamental course concepts. Battles were conducted face-to-face with each team presenting their questions to opponents within a time constraint of 20 minutes. Rounds were repeated with teams facing different rivals to ensure fair competition. Scores were tallied to determine the winner. This format encouraged thorough subject review, active collaboration, and communication skills development. Post-battle, correct answers were discussed with the entire class to facilitate knowledge-sharing. This approach provided a dynamic learning experience, enhancing both technical understanding and teamwork skills among students.

2.2. Survey Design

2.2.1 Participants

The survey aimed to collect quantitative data from students enrolled in Building Engineering, a compulsory course in the Master's Degree in Advanced Construction Engineering program at Universitat Politècnica de Catalunya. 55 students participated. The study captured a diverse student body, with class sizes ranging from 25 to 30, promoting interactive learning. Participants hailed from varied academic backgrounds, including architecture, civil engineering, and building engineering. Culturally, the majority were Spanish speakers, representing Spain, Chile, Mexico, Peru, Uruguay, Brazil, Colombia, and Ecuador. Moreover, Chinese and French students' participation in the course enriched its cultural perspective, providing valuable insights into the impact of diverse backgrounds on the activity.

2.2.2 Questions

The study was carried out after the Building Engineering course, aiming to gauge participants' views on the impact of Questioning Battles on their learning experience and overall effectiveness. This timing was chosen to assess students' attitudes towards this approach compared to traditional teaching methods used previously in the course. The survey, meticulously crafted, comprised four sections: (1) Previous Engagement with Active Learning or Team-Based Questioning Battles; (2) Effects on Learning and Motivation; (3) Study Patterns and Performance; and (4) Preferences and Enjoyment. Participants responded to a total of twelve questions, with this manuscript focusing solely on presenting findings related to the impact on learning and motivation.

- Q_A- On a scale of very low to very high, how would you describe the level of competitiveness and difficulty of questions during the team-based battles?
- Q_B- On a scale of very low to very high, how would you rate the impact of the activity on enhancing your understanding and retention of the subject concepts?
- Q_C- On a scale of very low to very high, how would you rate the impact of the activity on improved team building skills?
- Q_D- On a scale of very low to very high, how would you rate the impact of the activity on improved communication skills?
- Q_E- On a scale of very low to very high, how would you rate the impact of questioning battles on your overall motivation to learn?

3. Results and discussion

A certain level of competitiveness is essential in educational activities of this nature to cultivate an environment that encourages student engagement, facilitates effective learning, and ultimately improves overall educational outcomes. Insights gleaned from the results of inquiries

into the competitiveness and question difficulty levels during battles (QA) offer valuable perspectives on student perceptions.

The data reveals that a significant majority of respondents, comprising 69.1%, categorized the competitiveness level as "High" (49.1%) or "Very High" (20.0%), indicating a considerable degree of challenge and competitiveness. This indicates that a substantial number of participants found the questions both stimulating and demanding, thereby achieving a competitive atmosphere during the battles. Following closely, 30.9% of participants described the competitiveness level as "Medium", indicating a perceived moderate level of challenge. This suggests a range of experiences among students, with a notable portion finding the questions moderately challenging. Importantly, no respondents indicated that the competitiveness level was "Low" or "Very Low". This absence suggests that the activity effectively creates a dynamic and stimulating learning environment where the level of challenge aligns with the diverse preferences and capabilities of the participants.

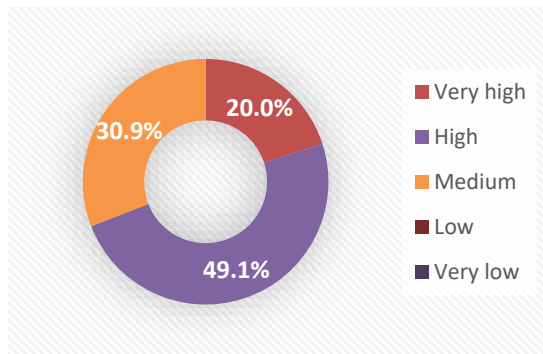


Figure 1. Students' perception of the level of competitiveness and difficulty of questions (QA)

The question related to the assessment of the activity impact on enhancing understanding and retention of subject concepts (QB) reveals a highly positive response from the participants (see Fig. 2). A substantial majority (72.7%) rated the impact as "Very high", highlighting a significant and effective influence on their comprehension and retention of the subject matter. Furthermore, 27.3% rated the impact as "High", reinforcing the overall positive trend. Remarkably, no respondents selected "Medium", "Low" or "Very low", indicating a unanimous consensus among participants that the activity had a substantial positive effect on their understanding and retention of the subject concepts. This clearly favorable response suggests that the activity successfully achieved the intended educational goals and was perceived as highly beneficial by the majority of participants.

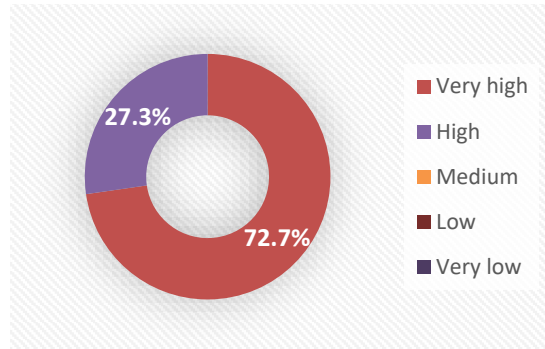


Figure 2. Student's perception of how the activity help them in the understanding and retention of subject concepts (QB)

The examination aimed at gauging the effect of the activity on enhancing team-building skills (QC) demonstrates a promising trend, as depicted in Figure 3. A considerable proportion of participants, comprising 91.0% of respondents, appraised the impact as either "Very high" (45.5%) or "High" (45.5%), signaling a significant positive influence on team-building skills. Conversely, a minor percentage of students (9.1%) evaluated the impact as "Medium". Moreover, the absence of responses in the "Low" and "Very low" categories underscores that the majority of participants encountered a substantial improvement in their team-building skills. The prevalent high and very high ratings for the impact of the activity on QC underscore its effectiveness in fostering collaborative abilities and dynamics within the teams.

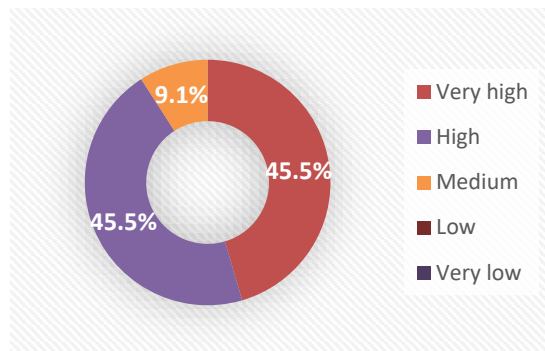


Figure 3. Students' perception of how the activity improved their team-building skills (QC)

The results of the question regarding the impact of the activity on improved communication skills (QD) reveal a generally positive perception among the participants. However, these results also highlight that the activity has not been perceived as overwhelmingly positive compared to the team-building aspect (QC). A majority of respondents perceived the efficacy of the activity in enhancing communication skills as either "Very high" (54.5%) or "High" (25.5%). While a

smaller proportion rated the impact as "Medium" (18.2%) and "Low" (1.8%); none rated it as "Very low." (see Fig. 4)

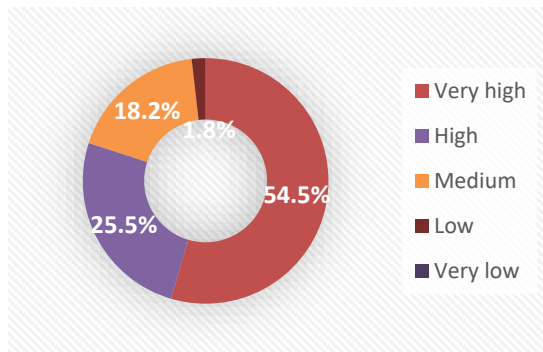


Figure 4. Students' perception of how the activity improved their communication skills (QD)

The results of the question that evaluated the impact of team-based questioning battles on overall motivation to learn (QE) revealed a notably positive trend (Fig. 5). A significant majority of respondents (69.1%) rated the impact as "Very high" and 29.1% assessed the impact as "High", emphasizing a strong positive influence on their motivation. Only a small percentage (1.8%) rated the impact as "Medium" indicating that the majority of respondents perceived a significant boost in motivation.

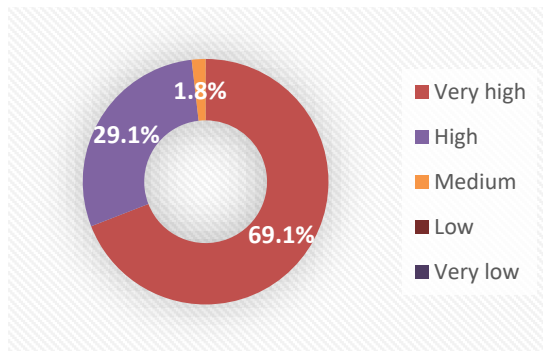


Figure 5. Students' perception of how the activity improved their overall motivation to learn (QE)

In summary, the analysis of the learning and motivation impact section presents a thorough and positive evaluation of team-based questioning battles as an educational tool. Students generated a competitive environment by formulating high-quality and challenging questions, such circumstance, together with the activity dynamics, contributed to heightened motivation to learn. This underscores the effectiveness of the activity in establishing a stimulating and engaging learning atmosphere. Furthermore, the activity was positively perceived as a tool for enhancing communication skills, but specially in improving teamwork.

Taking into account this feedback, it's crucial to highlight that while the proposed method is engaging and offers educational value, the activity is rather time-intensive. With consideration to class size, completing all rounds may consume up to three hours for a moderate-sized group. Repeating it frequently throughout the course could impede the timely progression of curriculum delivery and might diminish its novelty, potentially making the activity less stimulating or predictable. Drawing from our own experiences, we suggest integrating this activity either as a concluding session for the course or within a designated block of time.

4. Conclusion

This research offers valuable insights into the influence of Team-Based Questioning Battles on diverse aspects of learning and motivation. Unlike conventional educational approaches, the Battled method consistently garners recognition from participants for its positive impact on engagement, comprehension, information retention, team-building abilities, and overall enthusiasm for learning. Participants uniformly view the activity as highly competitive, fostering a dynamic atmosphere conducive to active learning and facilitating a comprehensive educational experience.

An important suggestion emerging from this study entails incorporating select battle questions into final assessments, presenting a potential pathway for the activity to contribute to formal evaluations and academic recognition. To maximize its benefits while ensuring the timely coverage of curriculum content, the study proposes a strategic integration approach, such as incorporating it as a concluding session for the course or within specific thematic blocks.

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