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RESEARCH PAPER

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A systems approach to enabling student-led critical discussion

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Abstract

This research explored the application of Systems methods and tools to enable student-led critical discussion in both face-to-face and online learning environments. We found that student teams using Systems tools to help address a problem (whether working face-to-face or online in virtual teams) reported an increased level of controversy and disagreement in their discussions compared with teams that worked without using Systems tools. Interestingly, the teams applying Systems tools also expressed more confidence and satisfaction with the problem-solving process and resulting decision. We discuss these findings and set out some suggestions for applying Systems thinking to encourage team working and student-led critical discussion in both online and face-to-face learning environments.

KEYWORDS

critical discussion, face-to-face, Systems thinking, virtual teams

1 | INTRODUCTION

Enabling students to think critically and engage in difficult conversations where different viewpoints must be acknowledged is considered to be one of the defining characteristics of a university education (Collini, 2017). What skills comprise critical thinking has been the subject of much research but can be summarized as including the ability to '... search, comprehend, and evaluate relevant statements logically and rationally during problem solving' (Shaw et al., 2020); the ability to engage reflectively with problems (Halpern, 1999); and the ability to respect and appreciate different viewpoints and worldviews (Vickers, 1965). Finding ways to enable critical discussion and articulate differing opinions can seem even more difficult in an online learning environment (O'Neill et al., 2016). This research explored if the application of Systems methods and tools could facilitate student-led critical discussion in both face-to-face (F2F) and online learning environments and also support respectful conversations in student discussion.

The research was conducted as a field study with 36 student-participants, who were enrolled at a higher educational (HE) establishment in the United States. The students were randomly assigned to a team of three, and each team was then assigned to one of four different experiences. One set of student teams worked synchronously, through the virtual environment (VST) and a second set of student teams worked F2F in a physical classroom (F2FST), with the discussion in these two groups of teams being facilitated using Systems thinking tools that had previously been taught to the students. A

third set of student teams worked synchronously in a virtual environment (V1), where the students were all in different physical locations, and this set of teams did not use Systems Tools. Finally, a fourth set of student teams acted as a control group, working on the problem in a standard classroom environment, F2F (F2F1) where each team was co-located in a physical classroom, and without using Systems Tools.

Our research showed that both sets of teams who used Systems tools (F2FST and VST) reported an increased level of controversy and disagreement during their exercise as compared with the other teams and expressed more confidence and satisfaction with the experience and resulting group recommendation compared with the other groups. We argue that controversy and disagreement in teams, if constructively managed, can result in better discussions and outcomes (see also Johnson & Johnson, 2012; O'Neill et al., 2020; Tjosvold, 2008). Our research suggests that the application of Systems tools to support and structure student-led discussion can contribute to helping students voice disagreements and reach a decision that team members believed was valid.

The paper is organized as follows: In the next section, we discuss the Systems tools we applied in this research and set out our research questions. In Section 3, we describe our research method and the task that was set the student participants, and in Section 4, we present our findings. In Section 5, we discuss the outcome from this research that the student teams applying Systems tools expressed more confidence and satisfaction with the problem solving process and resulting decision and make some recommendations for future research.

2 | APPLYING SYSTEMS TOOLS TO ENABLE CRITICAL DISCUSSION

In educational settings, one of the most significant challenges is how to create the conditions for students to come to understand and appreciate different perspectives about an issue. Vickers (1965) emphasized the importance of understanding how relationships between participants manifest themselves, as this impacts upon the readiness of people to do the work to understand different viewpoints and opinions of others. Being able to listen and come to understand a different perspective (even if it is a view with which ones disagrees) is an essential critical skill. In our research, we have explored how Systems tools could help create an environment for critical discussion in both physical and online classrooms.

Bonk and Dennen (2007) identified three different pedagogical strategies that can promote critical thinking in virtual classrooms: first, online case analysis, where the discussion occurs after students have read the case and then they comment and discuss issues via an online forum; these usually take place asynchronously, though discussion can be moderated by the tutor; second, collaborative learning activities, where students work as a group on a problem in the virtual environment; and third, 'structured controversies' (Bonk & Dennen, 2007), where students are required to support and justify their reasoning with well-structured argumentation and support from the academic literature.

Disagreement is a natural byproduct of working in teams in any setting, physical F2F or online, as team members can have diverging points of view on an issue of concern (de Wit et al., 2012). Some of the literature suggest that disagreement leads to overall negative outcomes in teams (de Dreu & Weingart, 2003; de Wit et al., 2013; Thomas & Bostrom, 2010) although more recent work suggests 'groups might reap the most benefit when members present divergent perspectives, [even if ...] those perspectives can create conflict' (O'Neill et al., 2020).

Whether working synchronously or asynchronously, online teams have been found to have different characteristics to teams that work F2F. For example, Sarker and Valacich (2010) commented that the lack of nonverbal cues within a virtual setting can lead to a reduced social presence and so reduced engagement by participants. Schweitzer and Duxbury (2010) found participants working in virtual teams reported a perceived loss in the quality of performance and member satisfaction, possibly due to a reduced level of knowledge sharing. Research has also suggested there is reduced trust between virtual team members (Kanawattanachai & Yoo, 2007) and difficulties with providing good leadership when members are not collocated (Wakefield et al., 2008); additionally, Chiravuri et al. (2011) suggested virtual teams found it difficult to build shared mental models.

For this research, we compared how using Systems tools supported student teams working in an online environment to student teams using Systems tools working F2F, physically co-located in a classroom (see Section 3.3). We compared these outcomes with results from student teams in an online environment and with student teams working F2F, who did not apply Systems tools to structure their discussion but who were left to discuss the problem issue as a group with no intervention (see Section 3.4). We explored whether Systems methods and tools could help students to structure their discussion and problem solving, improve the exchange of knowledge between members, and also increase the diversity of views discussed during a critical thinking exercise. As part of this work, we also investigated how well teams were able to come to joint agreement on a decision.

The Systems tools applied in this exercise were the CATWOE mnemonic (Customer; Actor; Weltanschauung; Owner and Environment) (Checkland, 1981), Systems Maps (Stowell & Cooray, 2017; Stowell & West, 1994) and the PEArL mnemonic (Participants; Engagement; Authority; relationships and Learning, the 'r' for relationships is kept small as a reminder that this is the most important element of the mnemonic (Champion & Stowell, 2001, 2003; Champion & Wilson, 2010). These tools were selected as first, these tools support collaborative problem structuring and decision-making from two different perspectives. Systems maps help to support an understanding of the perceived issues around an issue of concern (see Figure 1, for an example created by a student team during this research). CATWOE (Checkland, 1981) (see Table 1) helps participants analyse the main elements of a system of concern, and the PEArL mnemonic (Champion & Stowell, 2003) (see Table 2) offers insight into how a situation is being managed, who has authority to take a decision and the relationships between stakeholders. Second, these Systems tools could be taught to students quickly in the time available.

We asked three research questions:

Research Question 1: Information exchange. Does the application of these Systems methods impact on the level of information exchange during critical discussion in face-to-face and virtual teams, as compared with teams who did not use Systems methods?

Research Question 2: Controversy and disagreement. Does the application of these Systems methods support disagreement to be managed more constructively in face-to-face and virtual teams, as compared with teams who did not use Systems methods?

Research Question 3: Confidence in decisions. Does the application of these Systems methods impact on the level of confidence and satisfaction in the team decision in both face-to-face and virtual teams, as compared with teams who did not use Systems methods?

TABLE 1 The CATWOE mnemonic

Elements of CATWOE	Explanation
Customer	Who will benefit from the change being considered? Who will benefit from things staying the same?
Actor	Who will be involved in bringing about a change?
Transformation	What change is being considered?
Worldview/Weltanschauung	What is the underpinning value set expressed in the change being considered?
Owner	Who will own the change? Who can stop the change?
Environment	What is needed for the change to succeed? What are the constraints?

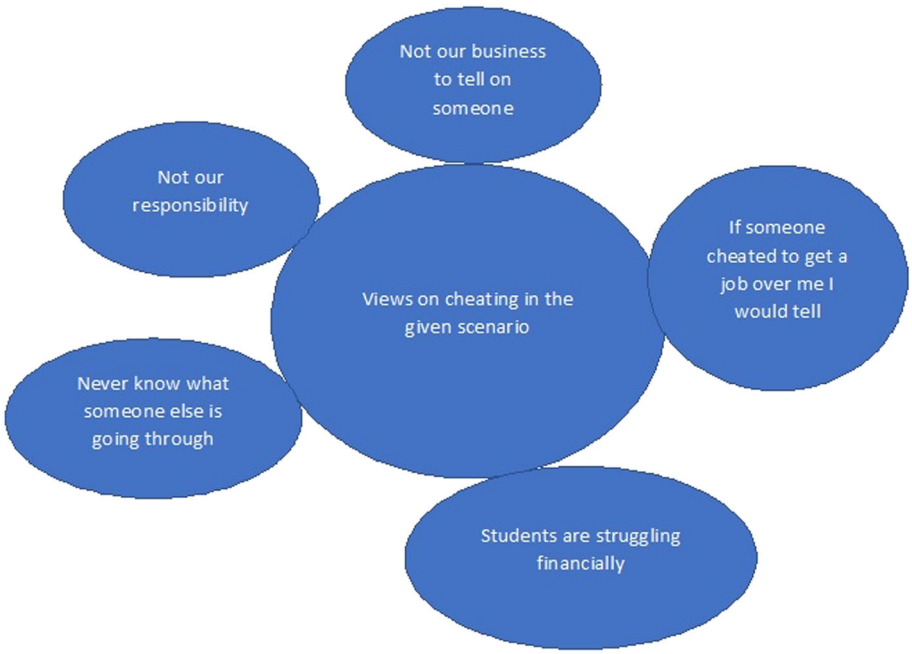

FIGURE 1 A selection of issues raised by the student teams who applied Systems tools [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 2 The elements of the PEArL mnemonic

Elements of the PEArL mnemonic	Explanation
Participants	Who is involved in the situation? (that is: the discussion around academic cheating). Why are they involved? Who is excluded?
Engagement	How are these participants involved? What methods of engagement are being used? How much time are they devoting to the issue and why?
Authority	What forms of authority are being expressed in this situation? (formal, social, cultural, financial)? Who can stop the process of discussion around cheating at the college and how?
Relationships	What are the relationships between different stakeholders, and how are these relationships being expressed? How might these relationships and connections change in future?
Learning	What is being learnt as a result of this inquiry process? (Theoretical? Practical? Empathetic?).

3 | RESEARCH METHOD

3.1 | A field study approach

The research was conducted as a field study (Klein & Myers, 1999) with 36 active student-participants, who were enrolled at an HE establishment in the United States. Students were divided into teams of three. Students were then assigned to one of four different experiences. One set of student teams worked F2F (F2F1) in a physical classroom, and one set worked synchronously in a virtual environment (V1), where the students were all in different physical locations. Both F2F1 and V1 addressed the problem task with no other intervention. A third set of students also worked synchronously (though physically separate) through the virtual environment (VST) and a fourth set worked F2F in a physical classroom (F2FST), with the discussion in these two groups being facilitated using Systems thinking tools that had previously been taught to the students. These tools were intended to enable problem structuring, group discussion and decision-making.

3.2 | The task

Each team was presented with a written description of a controversy around cheating during exams and the potential implications of it. The scenario included common information that was made available to all participants. In addition to the common information, each participant in a team was given one piece of unique information that was not made available to the other participants. So, each participant in a team had one piece of unique information that the other participants were not privy to. A few days before the study, students were emailed copies of the scenario, which included the common information, and one piece of unique information per participant. The teams each had two end goals for the exercise. First, they had to discuss the issues around the scenario and decide on *one* course of action to recommend as a team to address the problem described in the scenario. Second, at the end of the exercise, each student had to fill out an individual survey reflecting on the experience.

3.3 | The experiences of the teams using Systems methods (VST and F2FST)

The meetings for all the student teams (online and F2F) using Systems tools were conducted in the same manner. Prior to the meeting, each participant was asked to consider the problem and create their own Systems map of the issues. The first task in the team meeting was to review each other's maps and create a Systems map that summarized the group perspective on what the main issues were around the cheating scenario. A college tutor was present in each discussion. The tutor did not contribute to the discussion and was present as an observer. Figure 1 depicts an illustrative Systems map showing a selection of the issues raised about the scenario from teams who used Systems tools:

During the discussion, there were some heated debates around the preferred courses of action. For instance, many students said that the correct action would be to *not* report the offending student. They stated their reluctance to report a fellow student due to multiple reasons including being uncomfortable reporting a fellow student, the inability to know what others are going through, that students were not properly educated on the consequences of cheating and so on. Students discussed that COVID had resulted in many competing pressures and that many athletes are compelled to work to support their tuition/families, perform well in sports and maintain a high grade point average (GPA). One student also mentioned an increase in suicide rates among college students, even among athletes. She cited the situation at a local university where there were numerous suicides within a 12-month period. The main issue that caused conflict was about whether to report a student when the

exam is 50% of the final grade, and only those within the top 2% have guaranteed paid internships. Many teams found it harder to agree on one group recommendation/course of action when this fact was considered.

When participants did not agree on elements in the map and conflict arose, two additional Systems methods were used to support debate. The CATWOE mnemonic (see Table 1) was introduced and applied to structure debate around any courses of action being suggested (including no action being taken).

PEArL was then used to help participants explore the issues around who was involved in the discussions and decision-making processes around the problem situation. See a summary of PEArL elements in Table 2.

The PEArL and CATWOE questions helped participants to consider many different aspects of each proposal including those who would participate in implementing the proposed course of action, those who would be affected by it, those with the formal and informal authority to control it, the outcomes expected by the proposed action and the worldview within which the action makes sense. By using both PEArL and CATWOE to explore the controversial aspects of the problem and potential action, each proposal was considered and interrogated in some depth. VST and F2FST teams took approximately 30 min to come to a decision. Students in these teams commented that these mnemonics particularly helped them to analyse the areas where there was disagreement amongst the team.

3.4 | The experience for the sets of teams not using Systems methods (F2F1 and VT1)

A few days before the study, participants in both F2F1 and VT1 teams were emailed copies of the scenario, which included common information, as well as information unique to each participant. On the day of the study, participants in F2F1 teams were physically co-located in a classroom, and the participants in VT1 teams completed the exercise in a virtual live format with each student located in separate rooms at the university, using the virtual conferencing software Zoom. Teams were asked to discuss the problem and agree on one course of action to recommend as a group. Neither F2F1 or VT1 teams were given any further direction on how to reach a group decision and were free to use any method of choice to reach an agreement. Most F2F1teams and VT1 teams completed the task within 10–15 min. While the team members freely discussed the issue, none of the F2F teams used the physical whiteboard or post it notes that were available in the classroom. Similarly, none of the VT1 participants used the Zoom whiteboard feature.

The difference observed by the tutor in each of these sets of experiences was that the student teams who did not use the Systems tools got the exercise over and done with quickly, without an in-depth information exchange or much debate, or reflection, hence the shorter time to completion.

4 | FINDINGS

4.1 | Information exchange

In Research Question 1, we asked if the use of Systems methods impacted on the level of information exchange in both F2F and virtual teams? After the group meeting, each individual student was asked to fill in a survey, asking each student, if specific pieces of unique information had been shared by the participants in their session. We used each student's response to count the unique pieces of information that had been shared in their particular sessions and analysed the results.

A two-factor analysis of variance (ANOVA) was conducted to determine any statistically significant differences between the responses of students in the different groups. The independent variables were modality (F2F or virtual) and use of Systems tools (that is, the group did or did not use Systems tools), with the dependent variable being the level of unique information exchange. The two-way ANOVA did not yield a main effect for the use of Systems tools or for modality. As such, the results did not show that the use of Systems thinking tools led to higher information exchange. We used an alpha level of 0.05.

4.2 | Managing disagreement and controversy

In Research Question 2, we asked if the application of Systems thinking can facilitate controversy and disagreement to be managed constructively during critical discussion and problem solving in F2F and virtual teams? In the questionnaire, students were asked to consider the level of disagreements or controversy within their team in the individual survey and rate the level of disagreement.

Again, a two-factor ANOVA was conducted to determine any statistically significant differences between the responses of students in the different groups. The independent variables were modality (F2F or virtual) and use of Systems (used or did not use Systems tools), with the level of conflict being the dependent variable. This analysis yielded a main effect for the use of Systems tools, $F = 42.66$, $P < 0.05$, such that the level of disagreement

was significantly higher when Systems tools were used than when Systems tools were not used. The main effect for modality was not significant, $F = 0.29$, $P > 0.05$, such that the level of disagreement was not significantly different between F2F teams and virtual teams. The interaction effect was non-significant, $F = 0.29$, $P > 0.05$.

These results show that the use of Systems tools generates higher conflict in teams when compared to teams that do not use such tools.

4.3 | Developing confidence in decisions

Students were asked to consider the level of confidence and satisfaction in the final group decision and rate that level of confidence. A two-factor ANOVA was conducted to determine any statistically significant differences between the responses of students in the different groups. The independent variables were modality (F2F or virtual) and use of Systems (used or did not use Systems tools), with the level of confidence being the dependent variable. The two-way ANOVA yielded a main effect for the use of Systems tools, $F = 16.16$, $P < 0.05$, such that the level of confidence was significantly higher when Systems tools were used than when Systems tools were not used. We used an alpha level of 0.05 for all statistical tests. The main effect of modality was not significant, $F = 1.45$, $P > 0.05$ such that there was not a significant difference in the level of confidence within F2F teams and virtual teams. The interaction effect was non-significant, $F = 0.16$, $P > 0.05$.

These were the most interesting of our findings. Our results established that students in the teams that applied Systems methods (F2FST and VST) reported significantly higher levels of confidence in the eventual team recommendation than did the teams who did not apply Systems methods (F2F1 and V1). Systems methods and tools seem to have provided participants an opportunity to self-reflect on the problem and the perspectives of others and to find ways of asking for clarifications and discuss areas of disagreement.

5 | DISCUSSION AND CONCLUSION

Disagreement and controversy in teams are predominantly discussed in the literature in a negative light. Many organizations devote resources to training their employees on how to avoid disagreement. But the results of our study show that disagreement does not have to lead to a negative outcome. Disagreement can lead to some energetic debate that can broaden individual perspectives, help to identify common themes and promote innovative outcomes. In our study, the teams that applied Systems methods (F2FST and VST) did have high levels of disagreement and reported significantly higher levels of confidence in the eventual team recommendation than the other teams. Our results demonstrate that when team members are trained in the use of Systems methods, conflict can be managed constructively leading to more confidence and satisfaction in outcomes.

The application of Systems methods enabled the teams that used them to follow a structured path that involved self-reflection on personal views, comparison of well-defined alternative views, discussion of alternative opinions and identification of common themes. All of these activities seem to have led to an increased satisfaction and confidence in the team recommendation. This was the case with both F2FST and VST even though there was significant reported disagreement in these teams.

The teams who followed a Systems-led inquiry could be seen to follow several distinct inquiry phases:

1. Self-reflection phase—The process of participants drawing the Systems maps for themselves first helped them to take a step back and reflect on what they truly thought about the problem and the worldview that prompted them to see the issue in a particular way.
2. Conflict generation phase—The Systems maps proved to be agendas for discussion and prompted many questions. Often, the answers to the questions prompted follow-up questions and further debate amongst the teams using Systems tools.
3. Conflict examination phase—When disagreements occurred, the tutor prompted the group to examine that particular issue using the other Systems tools such (PEArL and CATWOE). Participants stated that this stage enabled them to consider aspects of the problem that they had not thought about before or of which they were previously unaware.
4. De-escalation phase—The groups applying Systems maps found that they were able to create a Systems map that the group could all agree with in the context of action to take (or not take) within the situation.

One of the characteristics of our study is that the teams who applied Systems methods (F2FST and VST) were able to structure any controversy and disagreement and use these tools to de-escalate any disagreements.

The main contribution of this research is the finding that teams who applied Systems methods (F2FST and VST) showed more confidence and satisfaction in the eventual group decision than the groups who did not

apply Systems methods (F2F1 and V1). The Systems methods supported the students to think critically and engage in difficult conversations and to compromise, if necessary, when arriving at a final recommendation. The process followed by the teams who applied Systems methods (F2FST and VST) also adheres to the definitions for critical thinking we presented at the start of the paper: the ability to evaluate statements logically; the ability to be reflective; and the ability to show respect and accommodate different viewpoints. In enabling students in the F2FST and VST teams to lead their own critical discussion and reach a recommendation agreed by the group, the application of Systems methods resulted in more satisfaction and confidence in the recommendation made.

In the aftermath of the COVID 19 pandemic, there will be a move towards more blended learning and mixing of online and F2F teaching. Our research contributes to understanding where Systems methods can help student-led critical discussion in both F2F and online environments and highlights that achieving high-quality outcomes is rarely straightforward. This field study constitutes the first stage in an ongoing exploration of how Systems methods support debate. To better understand the contribution of Systems methods to critical discussion, the next stage of this research will conduct a similar field study comparing Systems methods to other 'non-Systems' tools such as potentially the 'Delphi Method' (Dalkey & Helmar, 1963). This will allow us to directly compare how an inquiry unfolds when using Systems tools compared with other methods.

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