The Team Balancing Act - Enhancing Knowledge-building Activity in On-Line Learning Communities

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Abstract: Online learning in the university sector is a given. Constructivist views of learning (often team based) and the notion of knowledge-building, mediated through the use of ICTs seemingly address many of the imperatives to equip individuals for emergent knowledge-age work practice. While teamwork has many perceived advantages, teams also inexplicably fail despite the apparent quality of the participants. Teams are successful when members address what is a relatively narrow range of actions. However, even within this limited range of actions individuals demonstrate definite preferences towards certain activities and roles. This paper reports on the findings from a study that investigated if knowledge-building activity can be enhanced in tertiary education CSCL environments through the use of groups balanced by Team Role Preference (Margerison & McCann, 1995, 1998). The study found that higher quality knowledge-building activity was more likely to occur in balanced groups than in random groups. The analysis of data revealed that a diversity of ideas was more likely to emerge from within balanced groups than from within random groups particularly when the random groups were heavily skewed towards one team role preference. This provided a compelling reason for explaining why balanced groups may lead to better knowledge-building activity.

Introduction

In thinking how information technology should be utilised in education, much consideration is currently being given to "what it should mean to be an educated person in the 21st century" (Bereiter, in press). That is, in what ways do individuals need to learn if they are to become full participants in knowledge-age work practices (Lave, 1997), where the activities of collaboratively creating and managing knowledge are seemingly in demand. Information technology, it would appear, needs to be employed more as a 'tool to think with' (Bereiter, in press, Resnick, 2002) and as affording a space for collaborative exploration rather than merely as a window to a range of pre-packaged information, a metaphor of use where computer technology and online communications is more closely analogous to finger painting than to television (Resnick). Technology should allow for the active and creative 'messing' with ideas rather than the mere receiving of them. Computer Supported Collaborative Learning (CSCL) is one approach that has sought to embrace information technology as an affording space for collaborative and creative 'messing' with ideas where the major focus is on the building of conceptual artefacts rather than on the completion of tasks and/or the passive reception of pre-packaged ideas (Scardamalia & Bereiter, 1999).

However, while CSCL is conceptually a useful framework for online learning, achieving ongoing engagement and peer interaction in CSCL environments has proved to be a recurrent, perplexing problem (Luff & Jirotka, 1998; Sorensen, 1999; Stahl, 2002). It has been suggested that the technology is not inherently bad, rather there has been a failure to recognise that ongoing engagement and interaction in online environments needs to be designed for – it will not happen just because we wish it so (Liaw & Huang, 2000; Northrup, 2001; Zielinski, 2000).

One important aspect that needs to be considered during the design of online CSCL environments is the scaffolding of learning. Scaffolding of learning has been identified as a necessary condition for learning in a number of different learning contexts including CSCL environments (Brown & Campione, 1994; Cheesman & Heilesen, 1999; and Sorensen, 1999). Within the field of CSCL, much of the focus has been on the research and development of technology scaffolds. Technology scaffolds are incorporated within the CSCL software systems to structure and facilitate online collaborative discourse and construction of knowledge. The cognitive scaffolds provided within Knowledge Forum® are typical examples of technology scaffolds.

Bielecyck and Collins (1999), however, argue that technology scaffolds by themselves may not be sufficient to ensure that the engagement and interaction necessary for knowledge-building discourse to occur within CSCL environments; they contend that social interactions also need to be scaffolded within CSCL environments. Further to this the authors believe that within any social scaffold there is a need for 'creative controversy' (Johnson & Johnson 1993, 1995) along the lines of Piaget's notion of cognitive dissonance. This point has been echoed by Scardamalia (2002). She identified twelve technological *and socio-cognitive* determinates of knowledge-building. Of particular relevance for this study is her principle of idea diversity. According to Scardamalia, socio-cognitive dynamics are crucial component of knowledge building activity. As she says,

> Idea diversity is essential to the development of knowledge advancement, just as bio-diversity is essential to the success of an eco-ecosystem. To understand an idea is to understand the ideas that surround it, including those that stand in contrast to it. Idea diversity creates a rich environment for ideas to evolve in to new and more refined forms. (p. 9)

The authors believe that one of the ways in which social interactions within a CSCL community can be scaffolded to include 'creative controversy' is to ensure that the community consists of members balanced in terms of 'team-role preference'. Here team-role preference is defined as the tendency of an individual to behave, contribute and interrelate with others at work in certain distinctive ways (Belbin, 1993). The authors also hypothesise that people with overlapping team role preferences will contribute in similar ways and thus not provide the creative controversy or the diversity of ideas that Scardamalia (2002) indicated were essential conditions for knowledge-building activity. If we have a diversity of team roles then we hypothesised that this can lead to a diversity of ideas which creates a rich environment for the evolution of new and more refined forms of knowledge. This assertion is supported by findings from research conducted into team development within work settings which indicate that the effectiveness of teams can be improved if emphasis is placed on ensuring a balance within teams in terms of each individual's 'team-role preference'(Belbin, 1993; Coleman, 2001; and Margerison & McCann, 1995). While the types of behaviour in which people can potentially engage are infinite, Belbin has proposed that the range of useful behaviours that make an effective contribution to team performance is limited. Consistent with this, Margerison and McCann (1995) – the developers of Team Management Systems (TMS) - have found that the 'types of work' teams must undertake if they to be successful is essentially as follows:

1. **Advising**: Gathering and reporting information
2. **Innovating**: Creating and experimenting with ideas
3. **Promoting**: Exploring and presenting opportunities
4. **Developing**: Assessing and testing the applicability of new approaches
5. **Organising**: Establishing and implementing ways of making things work
6. **Producing**: Concluding and delivering outputs
7. **Inspecting**: Controlling and auditing the working of systems
8. **Maintaining**: Upholding and safeguarding standards and processes
9. **Linking:** Coordinating and integrating the work of others

Within this range of tasks, individuals actually prefer to limit the behaviours that they will utilise. That is, they have a tendency to PRACTISE what they PREFER and become more PROFICIENT in their preferred area and way of working (Margerison & McCann, 1997).

While a number of approaches are available to determine an individual's preferences across various scales, not all these approaches focus directly on how an individual prefers to contribute in a team context. Margerison and McCann's focus is particularly useful given that it expressly determines an individual's preferences as related to work within a team context. To establish team role preferences, each individual completes the Team Management Profile Questionnaire. This is "a sixty item normative, forced-choice instrument which measures work preferences along the four key factors of *relationships*, *information*, *decisions* and *organisation*. The scores on these constructs are then mapped on to the Team Management Wheel resulting in a major role preference and two related roles" (Margerison & McCann 1995, p. 26). As can be seen, the Team Management Wheel (below) mirrors the 'types of work' listed earlier in the discussion.

In mapping an individual's team role preference to the Team Management Wheel, commonly the two related roles are adjacent to the major role, for example, Thruster-Organizer with the related roles of Assessor-Developer and Concluder-Producer. 'Split wheel' results are possible. A two-way split example would be that of a major role of Reporter-Adviser and related roles of Creator-Innovator and Concluder-Producer. An example of a three-way split would be a major role of Explorer-Promoter and related roles of Concluder-Producer and Upholder-Maintainer.

Figure 1: Margerison-McCann Team Management Wheel
(Source: Margerison, C. J., D. J. McCann, Davies, R. V. (1998, p. 27)

The assumption is that in forming any team there is a need to have a balance of role preferences if the team is to be successful. However, in forming a team it is also important to note that a team does not necessarily need to be comprised of eight or nine people. While individuals certainly have a major role preference, they will also comfortably contribute via their related role areas. Thus teams need not be of a certain size but are successful when between them, members are comfortable in working across all work preferences (Margerison & McCann 1995). Of the roles indicated above, 'Linker' is not considered to be a work preference. Rather it is a skill that any member of the team can develop and it describes the ability to coordinate and integrate the work of the team (Margerison, McCann et al., 1998). Rushmer, (1998) suggested that the identification of the linking role (as opposed to a specific leader) reflects the TMS view of leadership being performed by different members of the team at different times rather than by one person. This conceptualisation of 'shared leadership' in no way downplays the significance of the role. Rather Margerison and McCann (1995) caution that if a team is to be successful, it must not only be well balanced in respect to role preferences - it also must be well linked. They further emphasise that even "well balanced teams can fail if linking is not carried out to a high standard" (p. 75).

The Study

The goals of this study were to investigate if engagement and knowledge-building activity can be enhanced in a CSCL environment through the use of groups 'balanced' by Team Role Preference (Margerison, 1995, 1998), and if so, the nature and ways that engagement and knowledge-building activity are enhanced.

The participants in this study were a cohort of 30 pre-service business education teachers enrolled in a BEd (Secondary) business curriculum subject at a major metropolitan university in Queensland, Australia. Twenty-one of the participants were on-campus students; the other nine participants were external students. We acknowledge that any results cannot be generalized to more representative student or adult populations. In this study, the participants were required to collaboratively develop online a 'Guiding Principles Model' that could be used to inform the development of business curriculum units and lesson plans. Through developing the Guiding Principles Model, it was envisaged that the participants would be required to develop, reflect upon and share understandings about promoting optimal learning experiences for students they will teach.

The study proceeded in four phases:

1. Preparation
2. Orientation
3. Computer Supported Collaborative Learning activity
4. Evaluation.

Preparation

The major purpose of this phase was to generate data to inform the process of allocating participants into their knowledge-building communities (or teams).

First, three data sources were used to derive an aggregated score to rank the participants in terms of their subject-matter knowledge (SMK) and pedagogical content knowledge (PCK) about business education: 1) scores derived from the analyses of concept maps created by each participant about four focus business and accounting schemas: *business environment, strategy, structure* and *accounting* (subject-matter knowledge), 2) scores derived from the analyses of concept maps created by each participant about four focus business and accounting teaching and learning schemas: *learning styles, teaching approaches, learning activities,* and *learning environments* (pedagogical content knowledge), and 3) Grade Point Average scores of the participants prior to their enrolment in the curriculum subject (subject-matter and pedagogical content knowledge). Using a method adapted from Chinnappan, Lawson and Nason (1999), each subject-matter and pedagogical content knowledge concept map generated by the participants was awarded by a panel of two experts in business education a numerical score based on completeness, correctness and linkages between ideas. After aggregated scores to rank the participants in terms of their subject-matter and pedagogical content knowledge had been generated, each participant was administered the Margerison-McCann Personal Team Management Profile (TMP) Questionaire to determine their team role preference.

Following this, the participants were divided into teams of three. Where possible, each team of three consisted of two on-campus students and one external student. The nine off campus students formed the base for nine of the ten teams; the tenth team consisted of on-campus students. Six of the teams were balanced in terms of team role preference (as measured on the Margerison-McCann TMP); that is, members were allocated so that there was a balance of roles and where all work preferences were covered. The other four teams had members randomly allocated in terms of team role preference[1]. To ensure academic equivalence between the 'balanced' and 'random' teams, minor adjustments were made to the membership of each of the teams to ensure that the average aggregated scores for subject-matter and pedagogical content knowledge of the balanced and random teams were as equivalent as possible. In the end, the average of the aggregated scores for the six balanced groups was marginally lower (2%) than average for the four random groups.

Orientation

To ensure that all participants had access to, and were able to navigate their way through the Online Teaching (OLT) site, the participants engaged in two orientation activities. The first activity required them to identify a useful website resource in the area of business education and to then post the web site URL to a discussion forum of the same type to be used for the online activity. The second activity required each participant to reflect on what it means to be a business education teacher in

Queensland, Australia. Having reflected on this topic, the participants were then required to post their reflection to an online discussion forum. Both these activities were scaffolded by sets of explicit instructions.

Computer Supported Collaborative Learning activity

During this phase of the study, each team was required to engage in the online collaborative development of a 'Guiding Principles Model' that could be used to inform the development of business curriculum units and lesson plans. This online collaboration involved each member of a team in the processes of generating and posting models on to the OLT discussion forum, providing questions, comments and propositions to other members of the team via the discussion forum, and in the iterative online revisions of the group's model(s).

The discussion forum provided the researchers with a rich source of both quantitative and qualitative data. Frequency and patterns of participation (giving the date and time of each participant's contributions) were recorded. The nature and content of the contributions of the team members to the online discourse also were analysed. In particular, this analysis focused on whether the contributions were *knowledge-building*, *organizational*, or *social* in nature. Knowledge-building contributions were defined as statements that focused on conceptually advancing the progress of the model; organizational contributions were defined as statements that focused on the organization of producing the model; social contributions were defined as statements that focused on social interactions between members of the team.

Evaluation

The ten models collaboratively generated by the teams were evaluated by a panel of ten academics within the Education Faculty who had expertise in the areas of business education, teaching and learning theory and practice, and curriculum studies. They first were asked to individually rank the models in terms of integration of theory within the model, structure and organization of the model, and applicability of the model. The academics were subsequently asked to attend a focus group where each academic was asked to present and justify their rankings. Following this, the final ranking of the models was achieved through group process and consensus.

Findings

Two clear sets of findings emerged from the analysis of data:

1. The balanced teams generally produced better models than the random teams
2. The balanced teams tended to focus more on knowledge-building than the random teams with a diversity ideas emerging.

Balanced teams produced better models

As is illustrated in Table 1, four of the five top-ranked models were generated by balanced teams (Teams A, B, C and D). This trend was broken by random Team G which generated the third-ranked model. However, when the composition of Team G was analysed, it was found that this team was by pure chance essentially balanced in terms of TMP profiles. Within this team were the major team roles of Explorer-Promoter, Thruster-Organiser and Controller-Inspector and a fortuitous spread of related roles.

Balanced Teams E and F also ran counter to the general trend. They produced the seventh and tenth ranked models. An analysis of Team E's online discourse, however, revealed that one member only read what other members of the team had posted and did not contribute to the development of the model. This member's actions annoyed the other members of the team. To compensate for this member's lack of contribution, the other two members tried to collaboratively develop the model without the input of the third member. Thus, this team to an extent became an unbalanced team of two members rather than a balanced team of three members.

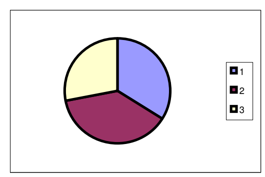
The analysis of Team F's online discourse revealed that none of the team members took up a linking role. Thus, in contrast to Teams A, B, C, D, and G, Team F was not well linked. As was noted earlier in this paper, Margerison and McCann (1995) cautioned that if a team is to be successful, it must not only be well balanced in respect to role preferences - it also must be well linked. The finding with respect to Teams F thus lends further credence to Margerison and McCann's assertion that well-balanced teams can fail if linking is not carried out to a high standard.

Therefore, the outlier results from Teams E, F and G do not detract from the general finding that balanced teams tended to produce better models than the random groups. However, the findings from Teams E and F clearly indicate that team balance by itself is not a sufficient condition to ensure the levels of participation that lead to online knowledge-building activity.

Team Number	Type of Team	Number of Posts to Forum	Ranking of Model	Issues
A	Balanced	48	1	
B	Balanced	66	2	
C	Balanced	38	4	
D	Balanced	47	5	
E	Balanced	81	7	Non-contributing team member
F	Balanced	46	10	Poorly linked
G	Random	71	3	De Facto Balanced
H	Random	86	6	
I	Random	123	8	
J	Random	56	9	

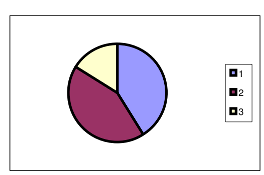
Table 1. Information about teams

Balanced teams tended to focus more on knowledge-building



The analysis of the online discourse revealed that Teams A, B, C, D, and G engaged in more knowledge-building discourse relative to organizational and social discourse than the other five teams. The other five teams' discourse mainly focused on organizational and/or social issues. This is epitomized by what happened in Teams A and J as they went through the process of generating their models. Team A was a balanced team and their model was ranked as best by the panel of experts. Team J was a randomized team and their model was ranked ninth. However, both these teams had essentially the same aggregated SMK/PCK score.

Team A consisted of Chris and Kia (internal students) and Brian (external student). Within this team, the team role preferences of these individuals were as follows: Chris (Major role - Creator-Innovator; Related roles – Reporter-Advisor and Upholder-Maintainer), Kia (Major role - Controller-Inspector; Related roles – Upholder-Maintainer and Concluder-Producer) and Brian (Major role - Thruster-Organiser; Related roles – Concluder-Producer and Assessor-Developer). Represented in the graph opposite is the relative number of postings that each person made during the development of the model. As can be seen, each person in this team made an equitable contribution.



Team J consisted of Jo and Kim (internal students) and Paul (external student). Within this team, the team role preferences of these individuals were as follows: Jo (Major role - Controller-Inspector; Related roles – Creator-Innovator and Upholder-Maintainer), Kim (Major role - Controller-Inspector; Related roles – Upholder-Maintainer and Concluder-

Producer) and Paul (Major role - Explorer-Promoter; Related roles - Creator-Innovator and Assessor-Developer). The graph opposite again illustrates the relative number of postings that each person made during the development of the model. In this team, the greatest number of contributions were made by Jo, closely followed by Paul.

Initial model development was much the same in both teams. Following the pleasantries, the teams 'jigsawed' the activity, with individuals taking responsibility to research some aspect(s) of the task. Team A was more effective in drawing the divergent research into a meaningful whole. As is illustrated by the contribution presented in Figure 2a below, Kia, the Controller-Inspector sought very early clarification as to where the team was heading. Chris, the creator-innovator immediately came back with a concept that embodied the network idea that Kia had proposed, provided a workable framework on which to hang the 'jigsawed' components and a symbolic representation of a guiding light (Figure 2b). Brian, the Thruster-Organiser in pushing for the assembly of the model initiated the use of the text boxes and then over the duration of the activity the document was 'digitally' passed backwards and forward as each team member added to the completion of the final model presented in Figure 2c. True to form, the final statement to the forum was made by Kia, the Controller-Inspector who commented, "Hi, I just proof read the model. There were no major changes just a few small things."

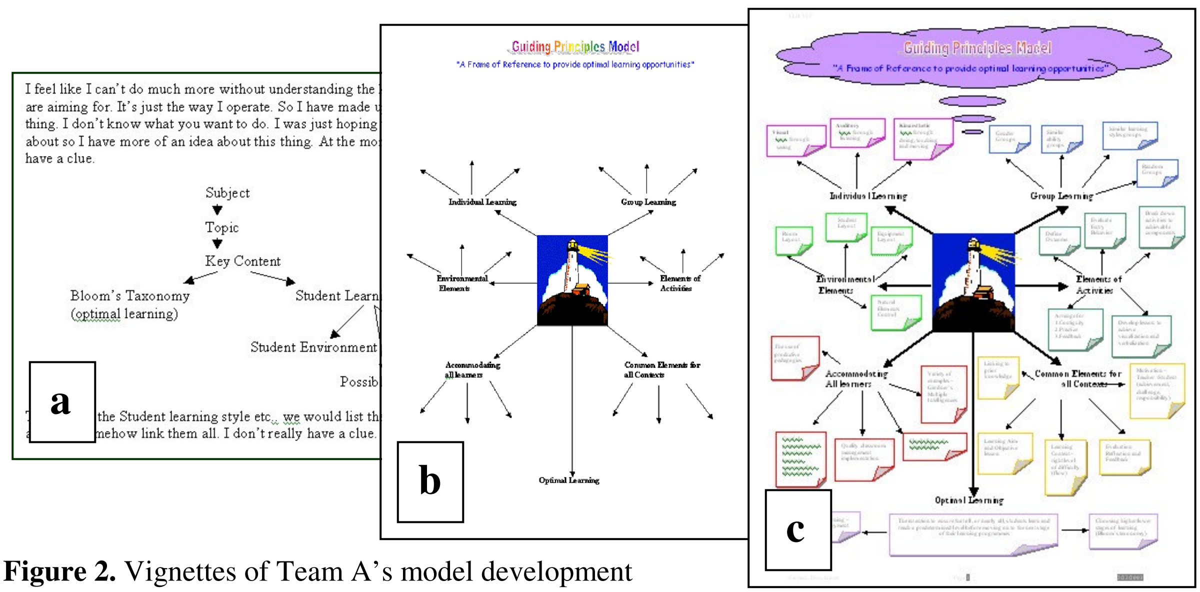


Figure 2. Vignettes of Team A's model development

In Team J, again it was a Controller-Inspector (Kim) who sought early clarification of the shape of the final model, adding the suggestion that it might take the form of a brochure. The other members enthusiastically embraced the brochure idea also. However the dialogue between Paul, the Explorer-Promoter and the two Controller-Inspectors Jo and Kim vacillated between it being "a great idea" and being "too difficult to achieve", such that the idea of a website emerged. Again there was ultimately an empty exchange of ideas. Seemingly, and unlike Team A where the model was honed over the duration of the activity, Team J spent the majority of the time trying to simply organize themselves. There were countless parallel/circular discussions that led nowhere - they just couldn't get it together. Jo's contribution was often through the provision of data dumps from the Internet (that were not used) until in some measure of desperation when 75% of the task duration had elapsed, the team seized on a model included in one of Jo's data dumps (Figure 3a) and within four versions 'cobbled together' the semblance of a model that ultimately the panel of experts found to be of dubious value (Figure 3c). Figure 3b presents one of their interim models.

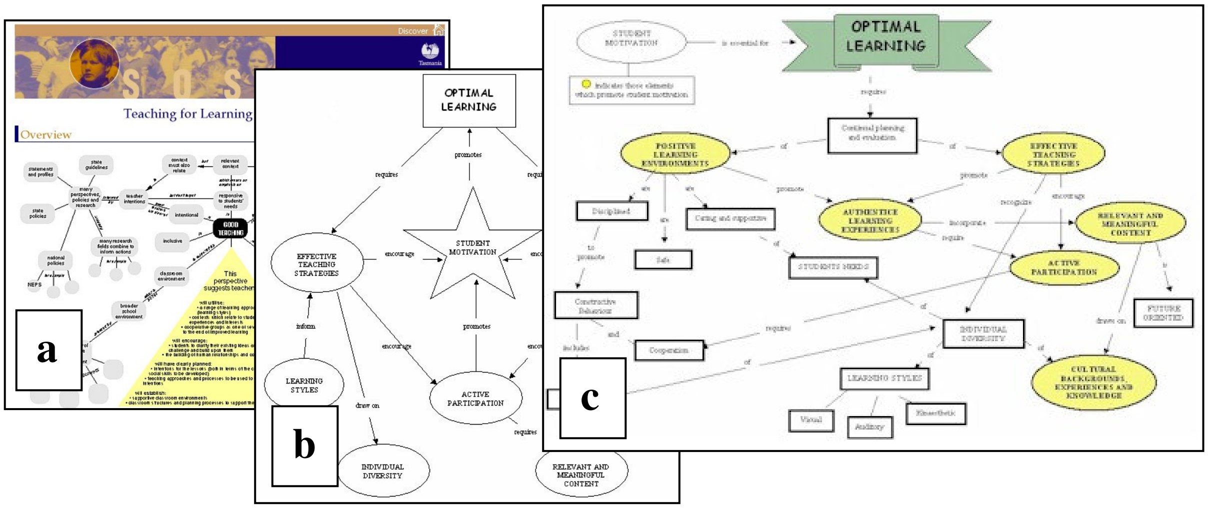


Figure 3. Vignettes of Team J's model development

To varying degrees, the other balanced and randomized teams replicated the patterns of contribution illustrated here by Teams A and J. The skewed nature of the random teams without exception produced a narrow range on uncontested ideas such as those provided by Team J. In contrast, with the balanced teams a diverse range of ideas was presented. The diverse range of ideas presented by the members of the balanced teams seemed to provide the catalyst for knowledge-building activity that led to the advancement and progression of these teams' models. This finding is consistent with Scardamalia's (2002) principle of *idea diversity*. She argues that idea diversity is one of the social conditions necessary for knowledge-building activity.

Conclusions and Discussion

The goals of this study were to investigate if engagement and knowledge-building activity can be enhanced in a CSCL environment through the use of groups 'balanced' by Team Role Preference (Margerison, 1995, 1998), and if so, the nature and ways that engagement and knowledge-building activity are enhanced.

The findings from this study indicate that both engagement and knowledge-building activity may be enhanced through the use of groups 'balanced' by team role preference. However, the findings also indicate that team role balance by itself is not enough to ensure that the type of engagement that leads to knowledge-building activity will occur. Other factors such as lack of linkage and some participants' unwillingness to concretely contribute to the groups' advancement of knowledge that may seriously inhibit knowledge-building activity also need to be considered.

The analysis of the data indicated that within balanced groups, a diversity of ideas was more likely to emerge than from within random groups particularly when the random groups were heavily skewed towards one team role preference. The findings from this study confirm Scardamalia's (2002) principle of idea diversity and furthermore provide a compelling reason for explaining why balanced groups may lead to better engagement and knowledge-building activity.

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[1] Originally, there were six random teams. However, the fifth and sixth random teams were lost due to withdrawal of team members from the course