Journal of Teaching and Learning with Technology, Vol. Vol. 13, Special Issue, pp.3-6.
doi: 10.14434/jotlt.v13i1.38247

Implementation of Moodle, an Open-Source Solution for Team-Based Learning

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Abstract: Conventional team-based learning (TBL) uses a paper-based system to deliver a team-quiz component of the instructional method. We observed the use of this paper-based system in various settings and identified it could be challenging in a large classroom. Challenges include distributing paper answer cards, time to grade them, and additional personnel required to facilitate the process. The need for an electronic platform to reduce the logistical burdens of TBL was identified. We implemented Moodle as a secondary learning management system specifically configured to support team activities. Moodle supports an answer-until-correct function along with additional quiz question formats such as fill in the blank and select all that apply, thus allowing greater flexibility compared to the paper-based system. In addition to supporting the team quiz, this instance of Moodle has been used to effectively support other components of TBL. Two classes of professional pharmacy students were surveyed to capture perceptions of this novel use of the Moodle system. In addition, system usage data were also collected. Ninety-four percent of the students surveyed indicated that the Moodle system had worked well for each TBL session. Since the fall of 2018, we have used this system to support delivering over 360 TBL class sessions with no technical incidents reported. This novel use of Moodle to support TBL has proven to be effective, reliable, and cost friendly. Further development and application of Moodle to support TBL is warranted.

Keywords: team-based learning, Moodle, active learning, pharmacy education, instructional technology

Framework

Team-based learning (TBL) is a cooperative learning method that emphasizes small-group work while incorporating individual accountability. It is a flipped classroom approach that promotes self-directed learning and problem solving within a team context. TBL offers several benefits for student learning, including improved communication, professionalism, and performance on higher level cognitive skills (Allen et al., 2013; Michaelsen et al., 2023). Also, TBL has been favorably perceived by students (Allen et al., 2013; Attia & Mandour, 2023; Livingston et al., 2014). The Mercer University College of Pharmacy (MUCOP) launched a collegewide effort to integrate TBL within our curriculum in the fall of 2018 but faced logistical challenges with the traditional paper-based approach with large classes that tended to have 100 or more students (Robinson & Walker, 2008; Whitley et al., 2015).

For an in-depth discussion of the pedagogy of TBL, please see Michaelsen and Sweet (2008). Here, we briefly summarize the three phases of TBL. The first phase is student preparation (prework) prior to the TBL class session, which may involve reviewing class notes, viewing a recorded lecture, or completing a reading assignment. During the second phase, the readiness assurance process (RAP), students complete an individual assessment—the individual readiness assurance test (iRAT)—followed by a team of students taking the same assessment together—the team readiness assurance test (tRAT). The iRAT and tRAT are typically paper based and often align with lower levels of Bloom's

taxonomy to gauge student comprehension of the prework (Whitley et al., 2015). The tRAT is conventionally delivered with the help of scratch-off cards. As a team selects a multiple-choice answer, the corresponding option on a card is scratched off, thereby revealing if the selection is correct or incorrect. If the selection is incorrect then the team can keep scratching off options until the correct answer is identified. This answer-until-correct function is a key element of TBL as it promotes team discussion and peer teaching. After the iRAT and tRAT, facilitators may review questions or provide a minilecture to aid students' understanding of concepts assessed during the RAP. The third phase focuses on application exercises in which students work together in teams to solve problems that align with higher levels of Bloom's taxonomy (e.g., apply, analyze; Whitley et al., 2015).

We sought to eliminate challenges that could have reduced the effectiveness and adoption of TBL at the MUCOP, for instance, time-consuming tasks such as preparing team folders and the need for additional personnel to collect and grade the paper-based tRATs (Whitley et al., 2015). Although beneficial, the scratch-off cards incur some logistical requirements and limitations. For example, RAP quiz question choices must be designed to match premade scratch-off cards; quiz items can only be single-answer multiple-choice questions; and scratch-off cards must be placed with the other TBL materials before a class session starts and collected and graded by the instructor or other support personnel during class time. For these reasons, we wanted to implement an alternative system to deliver the tRAT with our large classes. Thus, an opportunity to implement a novel approach was identified.

Making It Work

Two primary requirements for an electronic platform to facilitate TBL were that the system had to support the secure delivery of the tRAT and support an answer-until-correct function similar to the scratch-off cards. Owing to its availability, cost friendliness, and range of functions, we decided to proceed with a novel implementation of Moodle (Moodle Pty Ltd, Perth, Australia). Moodle is a multifaceted open-source learning management system (LMS) that we configured to specifically meet our needs for TBL. This supplemental LMS was dubbed Spark.

Classroom Implementation

To implement Spark to deliver the tRAT (team quiz), we first had to establish a Moodle system. The free Moodle software was downloaded from Moodle.org and installed on a web-based server. The server was rented from the IONOS web-hosting company. A user account was created for each team of students that would be using Spark. A course within Spark was created that corresponded to each course that would be incorporating TBL. These courses within Spark housed the tRAT for each TBL class session. The tRATs were input into Spark using the Moodle quiz tool. Each tRAT within Spark was configured for an answer-until-correct interface.

To administer a tRAT, at the appropriate time during a TBL class session the instructor gives a password to the teams so they can start the tRAT. Each team selects a designated answer submitter to log in on their laptop computer and input the quiz answers as they work through each question together. Because the tRAT is scored automatically, the instructor can quickly view how each team has performed on it and select which questions warrant further discussion, if necessary.

Eventually, our implementation of Spark included the delivery of the application phase of TBL as well. For each classwide application activity, a corresponding item in Spark was created using the Moodle Feedback tool. These Feedback items would be where the teams would indicate their responses to the application activities. As in the tRAT procedure, the designated answer submitter would input the response for an application activity after the team had reached consensus. Using the

Feedback tool, instructors could design the application questions to be multiple choice, free response, or other formats. The instructors would monitor the application activity responses in real time as they would be collected by the system and then use these data to drive the classroom discussions for this phase of a TBL class session. All response data to both the tRAT and the application activities are stored in the Spark system for later retrieval as needed.

Instructors wishing to use Moodle in a similar fashion should keep in mind two key considerations: selection of a low-cost hosting solution and protection of student privacy. We rented a very robust web server from the IONOS company as a hosting solution, but this far exceeded our needs to use Moodle for TBL. An example of a low-cost and effective hosting solution for Moodle would be a company such as Gnomi, which offers sufficiently robust Moodle hosting for as little as $9.95 per month. Even this entry-level hosting solution could support multiple courses delivering TBL in this way.

Regarding student personal data and the use of Moodle as described, student identities are not specifically associated with the team-user accounts. The instructor creates an account for each team and the number of accounts per course corresponds to the number of student teams. Each student team receives a single login they share for a course. So, for example, within a course (say, Math 205), Team 3 may have login credentials as follows:

- Team username: math205team3
- Team password: 583426

There is no need to input student names or other identifying information into the system.

Student Feedback

We were interested in the students' perceptions of Spark and administered a survey to two classes of students. The aggregate results (Table 1) indicate that the students had positive perceptions of Spark. Majorities of those surveyed indicated that Spark had worked well for each TBL session, that the system enhanced the application phase of TBL, and that the Spark system was easy to use.

Table 1. Student perceptions of Spark (*N* = 107).

Survey item	Percentage agreeing or strongly agreeing
The Spark system has worked well for each TBL session	94
The Spark system facilitated a greater range of application exercises beyond standard multiple-choice questions	86
The ability to check each answer during team quiz and reattempt the question promoted group discussion	96
My team found the Spark system easy to use for the team quiz	95

Note. TBL = Team-based learning.

Conclusion

To date, we have delivered over 360 TBL sessions via Spark with no reported issues. We have found that Spark countered many logistical challenges of a paper-based approach to TBL and fostered faculty adoption of this teaching method. Using Spark allowed for efficient delivery and timely grading of the tRAT and provided flexibility in question types for quizzes and application activities. Furthermore, our results show that students had positive perceptions of Spark. The MUCOP continues to develop how Spark is used for TBL and other collaborative teaching methods.

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