CHAPTER 12

Peer-Led Case Study Methodology in the Learning of Statistics

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The best thing about being a statistician is that you get to play in everyone else's backyard.

John Tukey (1977)

INTRODUCTION

Students in today's classroom are not confined just to four walls (Bonk & Graham, 2012) and they are not willing to learn from just one subject expert. To illustrate this point, according to Roberts and Weaver (2006, p. 97) learning is now "leaving the classroom" and Johnson and Lomas (2005) concur that digital devices are turning any spaces outside the classroom into informal learning spaces. Learning today happens through

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collaboration, cooperation, and mutual sharing of knowledge. Technologies and many web-based tools have aided this new method of learning. Transformations that have happened in teaching and learning scenarios have linked students, instructors, resources and activities into a collaborative learning environment, which redefines the teacher's position and enables students to transform the learning process according to their individual needs (Chiriac & Granström, 2012; McClellan, 2015; Mejias, 2006). Few studies have shown that collaborative active learning (CAL) increases engagement, alters learning attitudes, enhances self-efficacy and promotes collaboration (Baepler & Walker, 2014; Ge et al., 2013; Park & Choi, 2014; Salter et al., 2013). Another study on active learning in science, engineering and mathematics shows a six-percentage average increase in student assessment results and a substantial reduction in the number of students failing (Freeman et al., 2014). The above studies suggest that CAL positively influences student learning. In a collaborative learning environment, knowledge is shared or transmitted among learners as they work towards common learning goals, for example, a shared understanding of the subject in hand or providing a solution to a problem. To this end, Arvaja et al. (2007) added that it is not enough to cumulatively share knowledge, students have to construct and build on one another's ideas and thoughts (Mercer, 1996) through collaborative activities like a mutual explanation, elaborative questioning and analytic reasoning. These changes enable a student-centred learning environment, which creates classrooms with minimal support from instructors, where they only facilitate and foster peer discussions. Nevertheless, according to Panadero and Järvelä (2015), collaboration alone does not always lead to effective group work. It has to be supported by a regulatory mechanism to increase students' attention to the given tasks and group awareness. The mechanism also allows students to consolidate their learning awareness by providing them a platform to set learning goals and monitor their learning processes (Lai, 2021).

Introductory Statistics is an integral part of the undergraduate business course syllabus as students need to make inferences about a population parameter when faced with real-world business situations and challenges. The statistical concepts they learn together with the tools used in data analysis prepare students to deal with real-life situations as they become more skilled in teamwork, collaboration and communication. Hence, statistics instructors have to be more innovative in their teaching strategies. Implementing active learning strategies using real-life situations

helps encourage discovery learning and develop statistical reasoning and thinking skills. We allowed students to collect and analyse authentic data which meant that the learning tasks required students to reflect on real-life consequences of the outcomes of the tasks given. In this chapter, we discuss specific collaborative active learning strategy used to teach hypothesis testing, which can be implemented at the tertiary level to encourage active learning and collaboration among students.

The CAL strategy discussed here is a combination of peer-led team learning and case study methodology which is addressed as peer-led case study methodology. This CAL strategy, that we deployed in our introductory statistics class, enabled the engagement of the whole class rather than a small group of students who actively participated by responding to the lecturer's questions. This strategy is more than allocating tasks across the group and individual learning spaces as it encourages students to think independently (Tullis & Goldstone, 2020). Felder and Brent (2016) found that CAL strategies expect learners to perform meaningful learning activities and reflect upon how they solve statistical problems. Learning statistics using this strategy can be considered a major transformation from the traditional approach. Cousin (2010) and Reagan (2018) are of the view that students find hypothesis testing a troublesome and unpleasant concept where they have identified the difficulties students face when learning hypothesis testing.

Over the years of teaching statistical hypothesis testing, we have observed that Introductory Statistics students struggle to develop a robust and connected understanding of the real meaning of statistical hypothesis testing. Though they can perform the procedures, students do not have a strong understanding of the concepts, the logic and uses of the methodology. This is especially noticeable when tests and assignments are conducted relating to hypothesis testing concepts. We observed that students face difficulties when they state the null and alternative hypotheses, make a hypothesis decision, compute the test statistic value and write the decision and conclusion statement. We successfully implemented peer-led case study methodology in our classroom practices to make the teaching and learning process more effective. Similarly, Carlson et al. (2016) have successfully conducted peer-led learning in a STEM discipline. Studies have shown that students have benefited from peer instruction (Trout et al., 2014) across many fields, including Physics (Pollock et al., 2010), Biology (Knight et al., 2013), Chemistry (Brooks & Koretsky, 2011), Calculus (Lucas, 2009), Computer Science

(Porter et al., 2013), Entomology (Jones et al., 2012) and even Philosophy (Butchart et al., 2009). This pedagogical approach shifts the focus from teacher-centered instruction to peer instruction which improves learners' conceptual understanding, reduces student attrition in difficult courses (Lasry et al., 2008), decreases failure rates (Porter et al., 2013), improves students' attendance (Deslauriers et al., 2011), and bolsters student engagement and attitudes to their respective course (Lucas, 2009). Nevertheless, according to Mazur (1997) peer instruction—as used in our methodology—is a pragmatic transition from a teacher-centered approach to an engaging active learning pedagogy. Specifically, during peer instruction students are in complete control of the learning process and they self-regulate the discussion (Arico & Lancaster, 2018). As such, they must negotiate meanings and be empowered to "talkback" in order to reconstruct understanding in accordance with their own terms (Green, 2019) as well as to afford them space to critique the institutional conventions and underlying practices (Lillis, 2006). Our goal was to improve our students' understanding of the concept of hypothesis testing by the end of a semester.

The statistics course is a four-credit hour course which is conducted three times a week over a period of fourteen weeks. It is a supporting course required for Business major students at the university. Students usually take this course during their first or second year of study. Hypothesis testing is a topic that is usually taught after teaching sampling distribution and estimation of confidence intervals. As such, students have the basic knowledge of inferential statistics. In our study, online self-check exercises were administered to gauge the students' level of understanding with regards to estimation and confidence intervals. A medium-class size of 50 to 100 students were taught the topic of hypothesis testing, delivered in a blended mode for four weeks. Students had access to the notes and videos that showed the practical applications of hypothesis testing in Blackboard, the learning management system currently used at the university. The students were expected to read the notes and watch the videos before attending the class the next day. For a CAL approach to be effective, students must have a strong sense of commitment and responsibility towards the group's preparation which is essential for the learning process (Perumal, 2008).

Peer-Led Case Study Methodology

The class session commenced with an instructor-led briefing where the students gathered together for a detailed discussion regarding the information sent on the learning management system and summarized what was expected to be completed by the end of four weeks. Since part of the course requirement was to complete a case-based group project, the instructors required the students to work as a group on a case that demands a high level of collaboration among peers. This is because learning together with peers in collaborative learning enables students to build a supportive community that can raise the performance of each student (Nokes-Malach et al., 2015). Peer instruction benefits not just the specific questions posed during the discussion but also improves accuracy in relation to similar problems encountered later (Smith et al., 2009). The peer-led case study methodology is a pedagogical student-centred approach that provides small group instruction led by peers. Each team member takes equal responsibility in guiding and mentoring group members to develop their understanding of the concepts. Students need to remember and recognize certain concepts in hypothesis testing before they can understand and apply them in an analysis to arrive at relevant conclusions. In the context of peer instruction, it is pertinent to acknowledge the significance of self-assessment which according to Arico and Lancaster (2018) enables students to appraise their levels of knowledge and skills before engaging in peer instruction. In this regard, students learn more when they teach others. This is because when they reflect on observation of any inconsistencies, it may lead to improved learning (Kolb, 2015).

The worksheets were used to prepare students for a case study adequately. The students were asked to form groups of 4-5 members before they attended the day's class where they had to work as a group on the statistical topic designated for the day's worksheet. They were allowed to choose their group members as they were aware of each other's mastery of the subject and readiness. Therefore, they were able to work better together. By knowing the group capabilities, it enabled the instructors in providing the necessary guidance, support and ideas for the group in guiding them to the successful completion of their case study. Nevertheless, according to Zhang et al. (2016) homogeneous grouping where all members of a group have a similar knowledge base may hinder sharing of information because it is difficult to obtain "superior" knowledge from

another member. Similarly, to enhance group-based learning through collaborative learning the cognitive load theory dictates the need to have an incomplete knowledge base so that students can interact to fill the knowledge gap (Retnowati et al., 2018; Sangin et al., 2011).

Within our classes were students of mixed abilities. For this particular research, the learning style of the students in the class was established by using a well-known instrument originally formulated by Felder and Silverman (1988). Knowing students' learning styles was extremely beneficial as we were able to adjust our instructions leading to better classroom management. It is noteworthy that for statistics, it is beneficial to design and implement student-centred approaches like blended learning, computer-aided instruction and role-play because these approaches are favoured by students of the Visual learning style which is positively correlated to the Teaching Presence of the Community of Inquiry framework (Chang-Tik, 2018). Even though the students had different styles of learning, once the group was formed peer teaching encourage independent learning. It strengthened their relationship with each other. They communicated well about their reasoning and also explained, described and reflected upon their knowledge. We noticed that students could do much more when they were in a group rather than on their own. They had benefited remarkably from peer instruction explanations, comments and discussions from their teammates (Chang-Tik, Chapter 3 this volume). The conversations, interactions and explanations in group settings support intelligent collaborative learning activities that enhance group learning and provide essential support whenever necessary. If the students are in an environment where they can communicate freely, exchange ideas and contribute to the outcome, they will feel comfortable, and hence collaborative active learning may occur. After all, according to Hood et al. (2021), an environment that supports academic self-efficacy and social anxiety may significantly affect students' engagement in an active learning situation (Cooper et al., 2017). Students were advised that the groups should also meet outside the classroom regularly to develop more understanding of the concepts and help build their problem-solving skills.

Curran et al. (2013) used peer-led team learning as a collaborative learning technique that engaged students in problem-solving and found that students acquired significantly greater content mastery in statistics compared to non-participating peers. In that study, students were advised not to focus on finding the correct answers to the task but on

the problem-solving process itself, including conceptual understanding, communication skills, and teamwork. In the study, no specific roles were assigned to the group members. Berli (2018) concurred that this type of collaborative activity learning process offered a positive learning environment that helped build self-confidence and increased individual participation. In Roth et al. (2001) peer-led team learning model, team leaders were students who previously performed well in the course. We did not want a team leader to lead the activity as we wanted everybody in the team to be given equal importance and to participate without any sense of prejudice. We wanted our students to be responsible for their learning, to discuss and explain to the team members without any fear of their conceptual understanding and facilitate an active collaborative learning environment. This is in line with Fransen et al. (2011) findings that shared leadership is more beneficial to group learning than directive leadership which tends to limit discussion due to strong leadership. By implementing the peer-led case study model in learning the concepts of hypothesis testing, we noticed that students learned through experience, interacted with each other by facilitating discussions, and developed meaningful learning experiences. In a traditional classroom, higher-order thinking skills will not be achieved purely through a lecture delivered. This is because learning is not achieved by the transfer of knowledge but by achieving understanding through the integration of new concepts into prior knowledge, preferably through active participation both by students and instructors.

Students in the group worked together as they gained knowledge and social skills by merging teamwork and individual accountability. It was noticed that even though the group members were individuals with various aptitudes, talents, and skills, they worked together to achieve an expected outcome. Each team member was responsible for learning the material and also for helping the other members of the team to learn. A sense of ownership of the activity's outcome was developed among the students. The students' actions are in line with the Social Interdependence Theory developed by Johnson and Johnson (2013), particularly, the elements of positive interdependence and individual accountability which are used to maximise the collaborative potential of the groups. In terms of the cognitive demands of the team in solving problems, the team members have to accommodate construction, co-construction and constructive conflicts among themselves in order to achieve mutually shared cognition (Van den Bossche et al., 2006). The instructor

could notice that each group member ensured that everyone in the team understood and successfully completed the given task. This whole process gave the students a deeper understanding and better retention of the hypothesis concept. Forming groups allows students to develop trust, communicate opinions and views and in turn helps to reduce fear, anxiety, and nervousness (Gregersen, 2017). We believe that students who learn effectively in groups will encourage each other to ask questions, explain and justify their opinions, communicate well about their reasoning, describe and reflect upon their knowledge. In subsequent sections, we discuss how the peer-led case study methodology was implemented in four weeks linking worksheet activities with the case study.

First Week—Worksheet Activities

We were well aware that the basic elements of active learning are student activities and engagements in the learning process. Keeping this in mind, the topic of hypothesis testing was divided into many subtopics and the worksheet was designed accordingly. To successfully complete a case to be presented to the students from Week 2 onwards, the worksheet activities were designed to provide them specific skills needed to draw a conclusion after formulating and testing a hypothesis. Emphasis was given on applying theoretical knowledge gained to real-life situations so that their decision-making and problem-solving skills would be developed. Learning to use statistical inference concepts that emphasize estimation and hypothesis testing of means and proportions was part of the learning outcomes to be achieved by this course. Students need to know certain specific procedures to arrive at the correct conclusion when solving a hypothesis testing question. Questions in the worksheets guided them on the appropriate methods. A typical worksheet contained mostly real-life application questions related to each procedure. To ensure the procedures were correctly done, null and alternative hypotheses should be stated correctly. A few questions were assigned to emphasize the importance of this step. An example is given below:

Question: The average room rate in hotels in Malaysia is $200 per night. A tour operator believes that the average room rate in hotels near Kuala Lumpur International Airport is higher or different.

The students discussed and peer instructed one another in groups to propose the null and alternative hypotheses. The instructors had experience dealing with students' misconceptions regarding the null and alternative hypotheses through the assessments given. To correct this misconception, a few questions of the same format were given in the worksheets. They were guided with the help of examples to distinguish between the sample mean and population mean and the symbols used to differentiate the null and alternative hypotheses. After discussing and working together through peer instruction on these questions, students became well-versed in writing null and alternative hypotheses suitable for the situation. Nevertheless, they were encouraged to refer to the instructors for guidance but not answers when they were doubtful. Once the worksheet was done, another worksheet was distributed, allowing them to master the next step collaboratively where they argued and defended their responses. Importantly, they were empowered to "talk back" in order to reconstruct understanding in their own terms (Green, 2019) particularly where their responses differed from the group consensus. The peer instruction practiced here allowed students to have complete control of the learning process and they both co- and self-regulate the discussion (Arico & Lancaster, 2018). The alternative hypothesis stated in this worksheet required the students to decide the tails of the test. Appropriate activities through peer instruction and discussions allowed them to gain a better understanding of the step. The critical value approach and p-value approach followed as the knowledge of this concept is essential to arrive at the correct decision of whether to reject or not reject the null hypothesis. This was followed by a conclusion that allowed the students to make an inference about the population. The worksheets that were provided helped in mastering all these procedures.

All the processes mentioned above were repeated until the students mastered all the hypothesis testing procedures. The peer-led discussion was encouraged with minimal intervention from the instructors. The instructors offered encouragement, feedback and positive reinforcement, but they did not directly teach, tutor, or confirm the answers provided by the students. Instead, they asked scaffolding questions to assess students' learning and help to guide students toward solving the problems on their own. For example, the questions assisted in clarifying any misconceptions and also in ensuring students progressed towards an understanding of the subsequent concepts. In addition, the scaffolding questions also provide opportunities for students to think of the relevancy of the responses and

to check whether they are aligned with the hypothesis testing concepts (Ortega & Jambaya, Chapter 9 this volume). If the students were unsure of any procedures, the instructors encouraged more discussions, allowing learning opportunities through sharing of ideas, arguments and elaborative questioning from more capable team members. Students had to understand the situation clearly and with proper discussion, came to a commonly agreed co-shared solution whereby everyone was equally responsible for the outcome attained. Students were constantly reminded that the focus was on their responses and not correct answers. This approach was to encourage more participation and to take away any fears of not knowing the correct answers and to avoid students staying silent and being non- participative. Based on the above actions, the instructors just led them to the right path with minimal intervention.

There was a structure for the students to work on and encouragement was provided while they made progress. The design of the worksheets allowed the student to build knowledge through incremental steps starting from the basics of stating the correct null and alternative hypotheses to finally drawing a correct conclusion. In this manner, the new knowledge that the students attained from the worksheets was based on the previous knowledge they acquired, which helped them to make connections. Thus, the student's interest and motivation to learn the topic increased. Open discussion among peers allowed students to guide the ongoing conversation without fear. The open communication among the team members that we observed in the class supported a healthy class environment which heightened student engagement and reduced social anxiety. The students had authority and individual accountability and felt relaxed to continue with their work as they did not face any barrier or obstruction from the instructors. This is possible because, through peer instruction, they control the learning process and co- and self-regulate the discussion (Arico & Lancaster, 2018). Another interesting aspect noticed during these peer-led teaching sessions is that some team members became 'experts' on a particular topic and that members started teaching other members in line with the view that this approach embraces Vygotsky's Zone of Proximal Development where the development level of individual may be higher depending on peer support (Yildiz Durak, 2022). In addition, according to Van den Bossche et al. (2006), task cohesion, interdependence, psychological safety and group potency are crucial interpersonal contexts needed for engagement in team learning which may lead to higher perceived team effectiveness. The discussion

on the worksheets among the peers promoted learning which saw many meaningful information rich discussions led by team members in line with the positive interdependence element of the Social Interdependence Theory (Johnson & Johnson, 2013). The mutual respect given to each other's opinions was noteworthy and students realised that by working together on an activity made the job easier in the true spirit of shared leadership. This was evident in the last activity which combined all the procedures needed to solve a hypothesis test question. Let us have a look at one of the examples given.

> Question: It was reported that the average starting salary of all graduates with a master's degree two years ago was $4,300. The sample mean and sample standard deviation of the starting salaries of a random sample of 50 graduates with a master's degree last year was $4,100 with a sample standard deviation of $400. Test at 1% level of significance whether there is sufficient evidence to show that the mean starting salary of all graduates with master's degree last year is less than the mean of all graduates with master's degree two years ago?

By the time this worksheet was given to the students, most group members were well versed with the necessary procedures needed to solve the activity offered. The instructors noted that the majority of the group members had a firm grasp of the concepts at hand, they learned together and when needed, they assisted a few group members in clarifying some misconceptions. Practice time given in the class helped the students to reinforce the concepts through group-based learning where they were collectively accountable for the outcome of the activity.

The students were ready to work with the case study now as they understood the use and necessity of hypothesis testing procedures which allowed them to test claims regarding a characteristic of a population based on sample evidence and probability. The worksheet activities had prepared them to read and identify the details necessary to answer the questions required by the given circumstances. They were trained to check and draw out information needed to complete the analysis of real-life situations. They were actively involved in the group discussions inside and outside the classroom where they shared their opinions, ideas and knowledge. In the weeks that followed, they worked with the sample data they collected and used the statistical tools learned to analyse it.

Second Week—Case Study Preparation

Students were expected to develop an idea to work on a particular case where they could relate or carry out the analysis based on the hypothesis testing concept. They were advised to look for something around them so that data could be collected easily. Real-life scenarios and case studies that used hypothesis testing concepts had already been given to the students using notes and videos in the first week. Students were expected to use Wiki in the Blackboard (Learning Management System (LMS) used by the university) to discuss and agree on the case they would like to carry out. Wikis promote active learning where students can actively participate in educational activities. Wiki helps to support collaborative learning activity among group members by making it possible for them to contribute towards a jointly assessed outcome, which supports inquiry-based learning and the co-construction of knowledge (Yukawa, 2006) as well as the internalisation and externalisation of knowledge (Cress & Kimmerle, 2008).

Additionally, Wiki supported the collaborative learning environment, which nurtured online and offline collaboration, making it possible to work on the case outside the classroom, developing collaborative networks among peers which facilitated and assessed peer feedback and most importantly managed team performance (Ben-Zvi, 2007). Students took into consideration their peers' responses and appropriate changes were made. Team members used the "discussion page" to facilitate and promote discussions and to explore possibilities, thus forming a community of collaboration. In this community, students internalise the information available in Wiki and subsequently integrate it to develop new knowledge (Cress & Kimmerle, 2008). The features in Wiki allowed the group members to rewrite or reorganize the content. The instructors were in touch through the LMS emailing system to guide students' queries and to provide socio-constructivist feedback. This process helped students to think out of the box and to collaboratively react to the feedback to arrive at a shared consensus. Sample videos on the application of hypothesis testing such as salary comparison based on gender, the horsepower of different brand cars, etc., were given to students in the Week 1 content posted on Blackboard. These videos allowed the students to understand and use the p-value approach in analyzing the data. The decision and conclusion of the case needed to be clearly stated based on the requirements of the test.

Third Week—Case Study Brainstorming

Each group had a personal discussion with the instructors. During the meeting, students had a brainstorming session regarding the case study with the instructors in an atmosphere of staff-student partnership. Specifically, in the first week, the students had already discussed and collectively agreed upon the case they were planning to conduct through group-based self-assessment as to why the case was a simple one with an easy data collection process. Consequently, in the partnership together with the instructors, they co-assessed the suitability and the scope of the case study. If it had a wide scope, then the instructors narrowed it down so that the case study could be completed within the time frame given. This partnership strengthened the students' self-regulating process and enabled them to become more active in their learning (Deeley & Brown, 2014). The students had to submit the finalized case in a week. There were some cases where the study was not suitable to be conducted. For example, a group came up with an idea to conduct a study on food preference by university students. This study was not appropriate as they dealt with categorical variables, whereas for hypothesis testing we needed numerical variables. There were cases where students were too ambitious on the sample size. Lack of experience and exposure on data collection could have led them to choose a big sample. The instructors wanted them to collect data easily so that they wouldn't lose motivation and lament that they would not finish the work within the time allocated. So, during the brainstorming session, the instructors guided them in the correct direction and instructions. If the case was rejected appropriate guidance was given, for example on the type of variables to be considered.

Once they got the approval from the instructors, they prepared a simple questionnaire which helped them to start with the data collection. The students were expected to collect their data within a week. At the same time, they worked on a short report on the preparation of the case study they were conducting, which was graded. Continuous discussion among the group members on data collection, data analysis and report writing took place in Wiki. Therefore, even though the report was graded, the collaboration in Wiki aided student learning. This platform was very useful to conduct this case study as it made the quantity and quality of each group member's contributions more transparent and hence encouraged participation. The team members could add comments, share ideas, commence discussions and post their feedback on the Wiki page. The

students considered the responses of their peers and it was found that it enhanced learning when they challenged one another's ideas and debated on other alternatives. This process allowed the instructors to monitor the students' work from time to time and helped identify the group's sleeping partners who were not contributing to the group effort. It also gave an idea to see whether the team members were on the right track, whether they were doing their designated job and the data collection done by individual members. The instructors could also use Wiki's "My Contribution" page to evaluate each student's contributions to the activities and discussions. The main aim of this evaluation process was to mitigate the free rider's problem which according to Abernethy and Lett (2005) and Kayes et al. (2005) may cause students to feel frustrated over the grades received for group work. From time to time, the instructors provide appropriate feedback, which allows an increased understanding of the topic. It helped us ensure that everybody was in line with the objective and this in turn helped make the case study a success. To this end, Zheng et al. (2022) added that personalized feedback may significantly improve the students' collaborative knowledge-building level and better co-regulate the behavioural patterns of the group members.

Fourth Week—Case Study Findings

Students as a group submitted a report and also presented their findings by using Microsoft PowerPoint. Presentation skills shown by the group members were taken into consideration in the marking criteria. The instructors and other group members were encouraged to give constructive comments on their peers' presentations. The evaluation rubric focused on the structure of the final report, data collection method, data analysis, and recommendations and conclusions. To this end, the instructors set clear learning outcomes and performance criteria (rubric) in the activities. The criteria in the rubric and the expectations of the learning outcomes were explained to the students to enable them to self-regulate their learning. Furthermore, each group was also given a different rubric or marking sheet to evaluate their group members' contributions. This rubric checked whether the team members attended meetings regularly, contributed meaningfully to discussions, completed the designated job on time and contributed cooperatively to the successful completion of the project. This encouraged students to be engaged throughout the sessions and gave a better idea of the topics of discussion. As explained earlier,

it was not about the right answers, but about the understanding of the concept and the decision-making process.

During the activity, group members maintained a learning atmosphere. To illustrate, when some group members asked questions to seek further clarifications of the findings, the more capable members were seen explaining the concepts and helping others who had difficulty understanding in line with the peer instruction practices. This activity mirrors the role of instructors acting as a guide and emphasizes the importance of selecting relevant learning materials to support active student participation. We noticed that after this activity, the students performed better in other topics and developed an enthusiasm for learning statistics. These batch of students performed better specifically in the topic of hypothesis testing compared with the previous semester students who learned it in a traditional setting. We found that the students had better confidence in approaching this particular topic in statistics and this in turn had motivated us to design the consequent topics using collaborative active learning strategies. We believe this approach can be implemented in any other courses and hence, it can increase students' confidence, effectively support the students' ability to solve problems, generate new knowledge through discussion between peers and improve students' understanding.

Conclusion

We have explained and described the positive impact of implementing collaborative active learning (CAL) using peer-led case study methodology in an Introductory Statistics class and it has shown that CAL strategy has improved students' performance in the subject, increased learner engagement and enhanced learning outcomes in Statistics. This strategy is time-consuming yet it gives a very positive improvement in students' understanding of the application of hypothesis testing theory in the decision-making process. The planning started a semester ago, approximately three months, choosing appropriate materials and methodology. The worksheet materials need to be challenging, relevant to the topic, directly related to the notes posted on LMS, and suitable for working in a small group. This is because when the learning materials are designed with proper interaction, they may influence the quality of information exchange leading to a higher level of cognitive processing by the students (Wang et al., 2018). More than that, students become more confident and comfortable with their peers and the instructors.

As instructors, we felt that the students had an excellent opportunity to work together with instructors and classmates and obtained a positive, unforgettable experience by playing an essential role in assisting their peers through a seemingly difficult course. We observed that the students became more engaged. They interacted by using real data, incorporated active learning, emphasized conceptual understanding rather than memorization, enhanced their written and oral communication skills, learned to work as part of a team and provide constant feedback. Furthermore, the feedback provided by the instructor, which followed the peer discussion, guided the students and helped improve their performance and also corrected their misconceptions which benefited their learning. This CAL strategy has allowed an opportunity to form a staff-student partnership which enabled students to become more active and self-regulated learners (Deeley & Brown, 2014). Consequently, through this partnership, students can respond and reflect upon information together with their instructors and peers leading to more enriched learning and significant constructive feedback.

To increase the use of active learning, instructors must be allowed to choose and implement appropriate instructional strategies for their class size, instructional goals and teaching preferences in a constructive way. The CAL strategy, such as peer-led case study methodology where students have meaningful discussions facilitated by their peers, has helped students learn the content in a more meaningful and more profound way. Additionally, as a collaborative active learning strategy, peer-led case study methodology assists in students learning together and also changes the role of the teacher from knowledge giver to a facilitator of learning. It creates and provides a more interactive and active learning environment that promotes communication and collaborative learning among the students throughout the semester.

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