

Multi-faceted impact of small group work to cooperative learning: A strategy for course design and delivery

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ABSTRACT

The teaching methodologies, pedagogies of engagement, classroom practices and the strategy of these are the most important for course design and delivery. Teaching in a routine style may not attract students towards learning the concepts. So it is important to relate the concept to present-day situations. The Instructor modifies the course design every time to improve the result, to engage students in effect and to deliver the content to make all the students learn the course. The paper shows the details of various activities conducted during the course delivery and the reflections. It is essential to consider the strategy to design a new course and delivery. The activities should be chosen properly based on the topic so that the students are effectively involved in the activities as well as learn the concepts with interest. The proposed paper shows the details about the selection of the title for the activities, announcement, description of the activities, rubrics, and evaluation for the team and the individual. The reflection of each activity is the key point for the course design and delivery. The expectation of the Educator and the learner must be fulfilled by the proper course design and delivery.

Keywords

Teaching-learning methods, Cooperative learning, and team-based learning

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Introduction

The course design is distributed to the students with 2- 3 pages which include the syllabus and books referred, schedule and names of the activities, assignments, project opportunities, career opportunities, credits, lecture sessions and tutorial session week for the theory courses. The course design varies based on the course name, theory course, laboratory course, project-based course, etc., The ultimate aim of course design is to proper and prior information about the subject given to the students so that they can be prepared before the start of the course and perform well. To achieve this proper course design experience and strategy are important and it is considered. The course design not only gives the idea to the students about the course but also the educator to have the confidence and satisfaction about the course and good start on the day one. In the curriculum design of the program, a set of outcomes is required to be mapped to all the courses under the program [1]. The set of outcomes are delivered in such a way that it is mapped with the program. So, the titles and activity selection is essential in the course design. This is because the time of the educator and the students will be wasted, the content may not be delivered properly, the satisfactory level of both educator and the learner may be reduced if the proper course design is not done. It is necessary to plan to base on the capability of the students because if they plan beyond the expected outcomes it may result in losing basic achievements [2]. The strategy shown in this paper explains the selection factors for the activity and title selection to design the course and

conduct. The impact of small work group to cooperative learning reflects in all the classroom practices and course project. The course project is human centered with deep understanding of user [3-4].

Classroom practices.

The classroom practices are started with a small workgroup. The activities and its details are framed by the instructor before commencing the course.

Activity 1: Think pair share

The topic was about the key elements of mechatronics. In this activity, the Instructor poses the question to the class and the students write a response. The duration is 5-6 minutes to complete this part. Then the students pair up with another student as voluntarily pair up. Each student explains his/her response to the other student. If the students disagree within the pair up, each student clarifies his/her position and determine how/why they disagree and why using. Finally, each pair presents the best among the work they have done. This activity will be useful for understanding the activities of a small group and before they were randomly grouped in bigger groups, for example, groups of three, then groups of four.[5].

The rubrics for the activity for the team are given in Table 1 and Table 2 respectively. The performance of the individual and team is given in Figure 1 and Figure 2 respectively.

Table I: Rubrics for the activity think pair share (team performance)

| Grades/Task | 0-1points | 2-3points | 4-5 points |
|-------------|---|---|---|
| On Task | None of the mechatronics systems are identified | At least two mechatronics systems are identified with correct key elements for one system | Three mechatronics systems identified with key elements |

Table II: Rubrics for the activity think pair share (individual performance)

| Points/Task | 0-1 points | 2-3 points | 4-5 points |
|--------------|--|---|--|
| On Task | Students were partly involved in the task. | Students were on task most of the time. | Students were on task the whole time. |
| Co-operation | Students partly listened to each other. Students didn't discuss their answers. | Students listened to each other most of the time Only one student shared answers. | Students listened to each other completely. Both students shared answers |
| Report | No relevant information | Partly relevant information | Completely relevant information. |

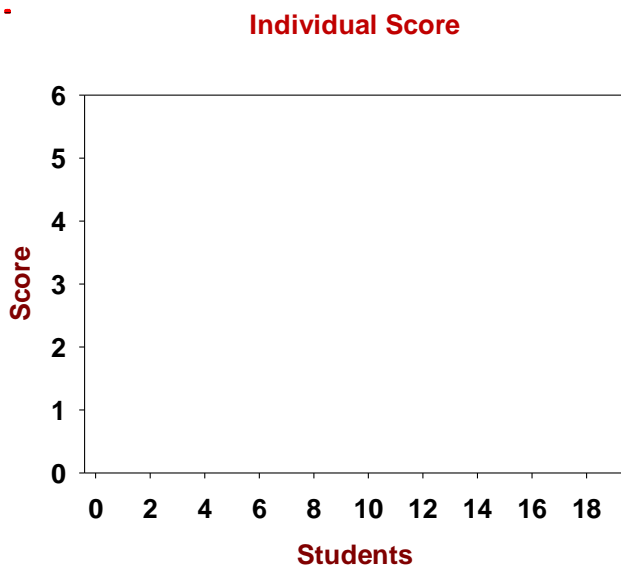


Fig.1 Individual scores of the students for the activity Think pair share

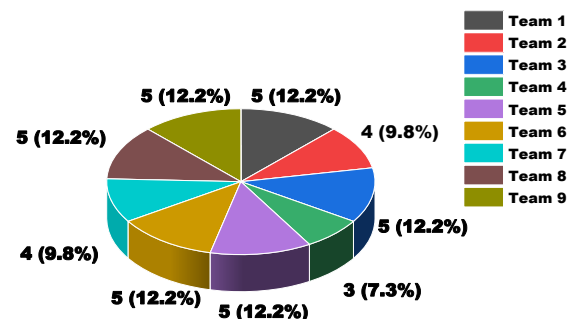


Fig.2 Teams' score details for the activity Think pair share

As a part of the activity, the reflection was considered. The instructor felt that the students performed well in the activity even though they are new to the subjects. They discussed mechatronics systems very interestingly. The students gave feedback that the activity was useful to discuss the topic effectively. The role of the individual was realized as there were only two members. Each member has played the role for the best score of the individual and the pair.

Activity 2: Stump your partner

Description of the Activity:

Collaborative group work has great potential to promote student learning, and increasing evidence exists about the kinds of interaction among students that are necessary to achieve this potential.[6]. This activity is related to individual preparation to interact with neighbors in the class or ask questions. It educates the students to pitch their mind and warm up to involve in small group activity. The topic given was Sensor characteristics and classifications, Selection of the sensor. Students take a minute to create challenging questions for the given topic. Students question the neighbor person. To step up this activity further, students are asked to write down their questions and to submit to the instructor. These questions can be used to create tests or exams. They can also be reviewed to gauge student understanding. The individual scores of the students for this activity are furnished in Fig.3.

activity. An individual multiple-choice quiz on the above topic was given to the students for an online test during the activity. The heterogeneous team formation was done with a team size of 4 members and reviewed the answers within the team. The discussed answers were submitted by each group. Individual marks and teams mark was added to the final score. Challenging Assignment was given to the team. Table 3 shows the activity modules and their details. Fig. 4 and Fig.5 shows the team performance and the statistics of the team and individual performance respectively.

Table III: Activity Modules, duration, and Conduction for team-based learning

| Stages | Description | Duration |
|--------|------------------------------------|------------|
| 1 | Introduction about the activity | 5 minutes |
| 2 | Rapid Quiz | 20minutes |
| 3 | Team formation | 5 minutes |
| 4 | Discussion within the team members | 20 minutes |
| 5 | Challenging Assignment | 70 minutes |

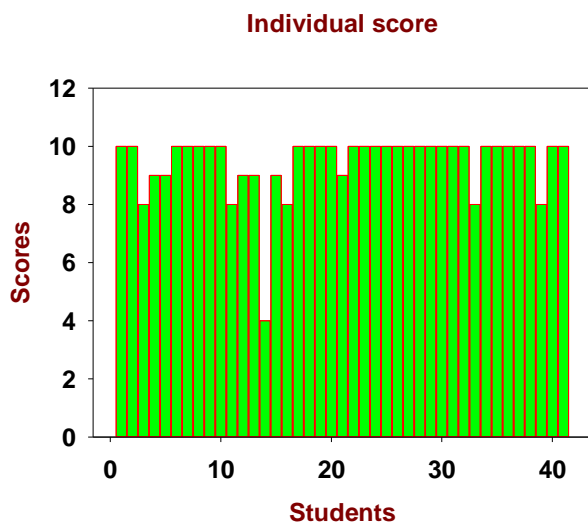


Fig.3. Individual scores of the students for the activity stump your partner

As a part of the activity, the reflection was considered. The instructor felt that with this activity every student got a clear idea about the feature of sensors and 90% of students score more than 9 points. Students can interpret the effect of one character of the sensor to another. The student felt that asking the question to the neighbor was interesting. To question one should know the content and be able to justify the question that was created. So this activity is captivating. The difficulty among the students was interpreting between the characteristics became challenging because it needs depth knowledge of the content and more examples and study.

Activity 3 Team-based learning(TBL)

TBL appears to have several benefits compared to conventional lecture-based teaching and traditional small group learning models [7]. The topic for the students to be completed by this activity was the Electrical actuator. Study of Electrical Actuators- Diode, Transistor and MOSFET was completed by the students before commencement of the

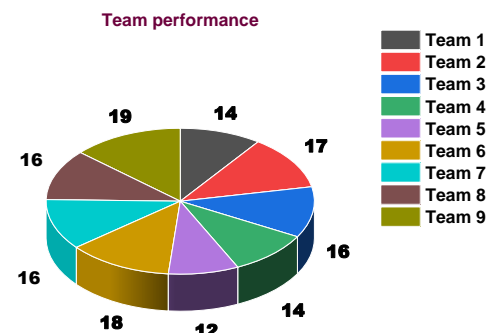


Fig. 4. Team score details for the activity team-based learning

Average 13.42/20 median 13/20 range 6-19 points
Total points distribution

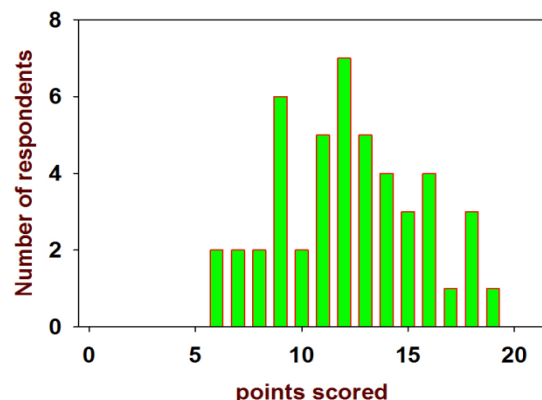


Fig.5. Statistics of the students' performance

The instructor felt that students attended the quiz individually and formed the teams and repeated quiz after discussing with team members. They discussed with full of interest and everyone understand concepts. The questions were analyzed to obtain possible practical output. Team-based learning has improved the self-learning capabilities and active involvement in the team. The students gave feedback that the activity was interesting. Few students who did not prepare were suffering during the challenge given but they performed better than they expected. This improvement was due to team involvement.

Activity 4: Jigsaw

Jigsaw is a strategy that emphasizes cooperative learning by providing students an opportunity to actively help each other build comprehension.[8] Jigsaw includes following some steps; pre-activity, team formation, the team leader selection, group reviewing activity, assignment submission and evaluation [9]. Mechanical Actuators was the topic given to the students during the activity. Each student was given one sub-topic under Mechanical Actuators one week before the commencement of the activity. Students prepared the allotted topic before the activity within this one-week duration. Heterogeneous team formation was done by the students within 5 minutes during the activity. The heterogeneity in this activity meant that a team should have members with different subtopics. i.e each member should have a unique sub-topic within a team. Members of different teams who have studied the same topic meet and discuss their topic for 15 minutes and return to your team and take turns teaching their teammates about your topic for 45 minutes. After this, the students wrote the test on the topic. The instructor conducted the test by issuing the question paper which includes multiple-choice, short answers and descriptive type answers to cover all the subtopics under Mechanical actuators. The duration of the test was 20 minutes. The answers were analyzed by the instructor during the next session and also he explained all the contents of mechanical actuators. Since the students were already familiar with the title and content, too many questions were asked and the consecutive session was very interactive. Fig. 6 shows the individual score of the students for the activity jigsaw.

The reflection by the instructor was that the activity is more effective for engaging in large classes with more content. This enhanced the self-learning and collaborative learning abilities of the students. Based on the student understanding of the topic it is concluded that this activity's success rate is 80%.

Cooperative learning:

The activities described above gave the understanding of small work groups and teamwork which leads to cooperative learning. The performance of the students in a small group and cooperative learning under various activities are summarized and reflection is furnished in tables 4,5 and 6. Cooperative learning is an instructional method in which students work in small groups to help each other learn.[10]. The small group is beneficial to make the students engaged for large time and large students' strengths. Cooperative learning is further tested with a course project which is one of the parts of the curriculum. The heterogeneous team formed during the activity jigsaw is continued to complete the course project. After the formation of teams, the students will go through multiple brainstorming sessions [11]. The team includes multiple abilities among the students and such a team is required to complete the course project within the stipulated time duration. Integrated Multidisciplinary skill development is already introduced to the students through the earlier courses like product design studio [12]. The students select the projects based on societal issues, human assistive technology or industrial demand and implementation of new technologies. They focus on how the concepts of design thinking can be applied in the course project as the major outcome. Introduction to Engineering [9], product design studio and Foundation to Product Design [14-15] are the pre-requisites of the Mechatronics course and the basics of the product design are taught and practices in these two preliminary courses.

The practice of teamwork as seen in the above activities is helpful to accomplish the task of course projects. For a class strength of 60, 13-14 teams are formed and each team submits their title finalized by the instructors and the projects are submitted by the students' team during the end of the semester.

One of the projects selected for illustration is "Smart Food quality testing and ordering system at restaurants". A team of 4 members came with this idea and this project is approved by the instructor. In this project, they learned to interface sensors like Passive infrared (PIR) sensor, MQ3 sensor, display device namely Liquid Crystal Display (LCD) and transmitting and receiving device Bluetooth HC-05 and input device which is keypad as shown in fig 7 and fig 8. The objective of the system is to test the quality of the food and support in billing and delivering the ordered food. The supervisor gets the ordered details as messages and uses it for billing as shown in fig.9.

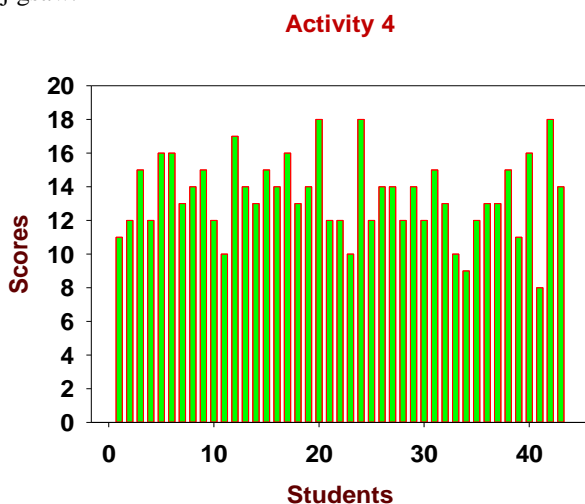


Fig.6. The individual score of the students for the activity jigsaw.



Fig. 7. Selection of the food item



Fig.8. Project kit –Food ordering and quality checking system



Fig.9. Message received by the supervisor

Table IV. Reflection from the learners

| Activity and the topic | Reflection from the learner |
|--|--|
| Think pair share (Key elements of mechatronics) | <ul style="list-style-type: none"> The topic was discussed effectively The individual role is achieved. Individual played for team score and individual. |
| Stump your partner (Sensor characteristics and its classifications) | <ul style="list-style-type: none"> Interesting to perform Content is prepared Interpreting between the characteristics was difficult and need depth of knowledge. |
| Team-based learning (Electrical Actuator) | <ul style="list-style-type: none"> Interesting activity. Motivated all the team members Team spirit is improved. |
| Jigsaw (Mechanical Actuators) | <ul style="list-style-type: none"> Interdisciplinary topic. Discussed effectively Interested to attend the test Confident improved |

Table V. Reflection from the Instructor

| Activity and the topic | Reflection from the instructor |
|--|---|
| Think pair share (Key elements of mechatronics) | As a novice they started, the topic is familiar to all the students |
| Stump your partner (Sensor characteristics and its classifications) | 90% of students score more than 9 points. Students can interpret the effect of one character of the sensor to another. |
| Team-based learning (Electrical Actuator) | Students discussed with full of interest. The questions were analyzed to obtain the possible practical output. Team-based learning improved the self-learning capabilities and active involvement in the team |
| Jigsaw (Mechanical Actuators) | The activity is more effective for engaging in a large class with more content. This enhances the self-learning and collaborative learning abilities of the students |

Table VI. Impact of the activity in exam

| Activity and the topic | Impact during the Term-end exam. |
|--|---|
| Think pair share (Key elements of mechatronics) | One question was asked which carries two marks. It was Level 1 question so the students answered easily. The activity was useful to remember. |
| Stump your partner (Sensor characteristics and its classifications) | One question was asked based on the interpretation between two characteristics which carries two marks. 90% of the students attended and scored full marks |
| (Team-based learning) Electrical Actuators) | The descriptive question was asked. Students answered well with examples. They answered some analytical questions which were not discussed during the activity. |
| Jigsaw (Mechanical Actuators) | Descriptive type question was asked and Students answered well with suitable examples. |

Conclusion

The selection of activity and the title is an important factor in course design and delivery. The title selection for the activity may be done based on the strategy of the success rate of activities performed in earlier semesters and to include new activity and titles, the strategy may be considered. The advantages of homogeneous, heterogeneous and voluntary team formation are analyzed and included in the course design. The homogeneous team has the team members of the same ability, the heterogeneous team has the team members of multiple abilities and the voluntary team formation is done by students of their interest. The voluntary team may have members with the same ability or multiple abilities. The restriction of the activity such as evaluation of all the team members following the rubrics, reducing students' confidence level, challenges faced by the students in following the rules of the activity, challenges faced by the instructor in the evaluation of single and team, etc are considered.

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