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By the Students, for the students: A New Paradigm for Better Achieving the Learning Objectives

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"By the Students, For the Students"
A New Paradigm for Better Achieving the Learning Objectives

Abstract

Motivating students is one of the main daily challenges of academia. In today's era, higher education institutions are facing a new generation of college students who are harder to motivate with old tedious methodologies such as long lectures or outdated long lab activities. As a result, the process of transferring knowledge is inefficient and cumbersome. Some of the signs that have been observed through the classroom with old technologies are higher rate of absentees; low interaction between lecturer and students; very few interactions among the students in the class; and sometime no interaction among the different sections of the same course with the same subjects.

This study is attempting to share some of the ground experience that has been achieved through the idea of transferring knowledge by our new methodology that we call it "by the students, for the students" in one of our freshman course entitled "ET 100: Introduction to Engineering Technology". Through this methodology, we not only achieved cooperation between students and lecturer but also we have achieved and promoted the cooperation and constructive competition among the students within one section and among the different sections of the same course with related topics. The gist of our methodology is about motivating our freshman students in College of Technology at Eastern Michigan University and creating a continuous thirst of knowledge that not only drives individuals but also drives each team and the whole class. Moreover, this paper will attempt to compare the outcome of previous methodologies that had been used in "ET100, introduction to Engineering technology", with the outcome of the new introduced methodology in the same class.

Introduction

The traditional lecture methods in which professors talk and students listen have dominated college and university classrooms [1]. Although these methodologies have been widely used to teach college students, they are not adequate for new generation of college students who are intelligent, talented and energetic [2-3].

Today's students need to do more than just "sit and listen" to the tedious lectures. They need to actively be involved in instructional activities; continuously be challenged by exiting problems, and work in a team [1, 2, 7]. It has been reported that students' retention of the information will not be gained only by receiving it verbally or visually. It rather needs to be utilized toward problem solving [2, 8-10].

Active learning has been defined [6] as the process of having students engaged in some activities that forces them to reflect upon ideas and how they are using those ideas. This requires students to regularly assess their own degree of understanding and skill at handling concepts or problems for attainment of knowledge by participating in project activities in a particular discipline. In another words, the process of keeping students mentally and often physically active in their learning through activities that involve them in gathering information, thinking, and problem solving is known as active learning. Some of the advantages of utilizing active learning are [2-5, 11-13]:

- Increased information retention,
- Increased student-faculty interaction,
- Improved student-student interaction,
- Improved academic achievements,
- Enhanced higher-level thinking skills,
- Improved teamwork,
- Improved attitude towards the subject and motivation to learn.

In [9], Paulson, et al. have used active learning concepts by requesting students to generate Quiz/Test Questions. This activity will encourage students to think more deeply about the course materials and explore major themes, comparison of views, applications, and higher-order thinking skills [2].

Chatmon et al. [2] use virtual hands-on laboratory exercises, online cooperative group discussions, think- pair-share activities, student-generated laboratory exercises, and student-led current event reviews in information assurance courses to advocate the active learning. One of the main finding of this study suggests that the active learning activities are welcomed by students as they have a sense of being involved in their learning experience.

Engineering Technology is one of the popular fields in College of Technology at Eastern Michigan University that provides wide range of program of studies for students interested in this profession.

In the process of reviewing and updating the curriculum, it was revealed that the courses which were taught using old teaching methodologies, especially freshman courses, had higher rate of absentees, low interaction between lecturer and students, very few interaction among the students in the class, and sometime no interaction among the different sections of the same course.

As a result, in Winter semester of 2012, we decided to change the teaching practice that was used in one of the freshman courses to find the effect of a new teaching methodology on these issues. Thus, active learning and project based was used as a core methodological framework for one of our freshman classes, ET100: Introduction to Engineering Technology.

In this paper, the assessment and outcomes of this successful implemented methodology is presented.

Methodology

The freshman course, ET 100: Introduction to Engineering Technology, is one of the courses that used to be taught fully theatrical with the concept of "sit and listen" to the lecture. In this teaching practice, the following characteristics were present:

- Low interactions between lecturer and students;
- Very few interactions among the students in the class;
- Sometime no interactions among the different sections of the same course;
- No team work,
- Low students' motivation and satisfaction

In order to improve the course outcomes, it was decided to change the methodology and utilize active and project based concepts in this course. Thus, the class time was divided into two parts of lectures and lab activities. In teaching this course, we implemented a model as presented in figure 1, which is made of two main parts that define both students and lecturer roles.

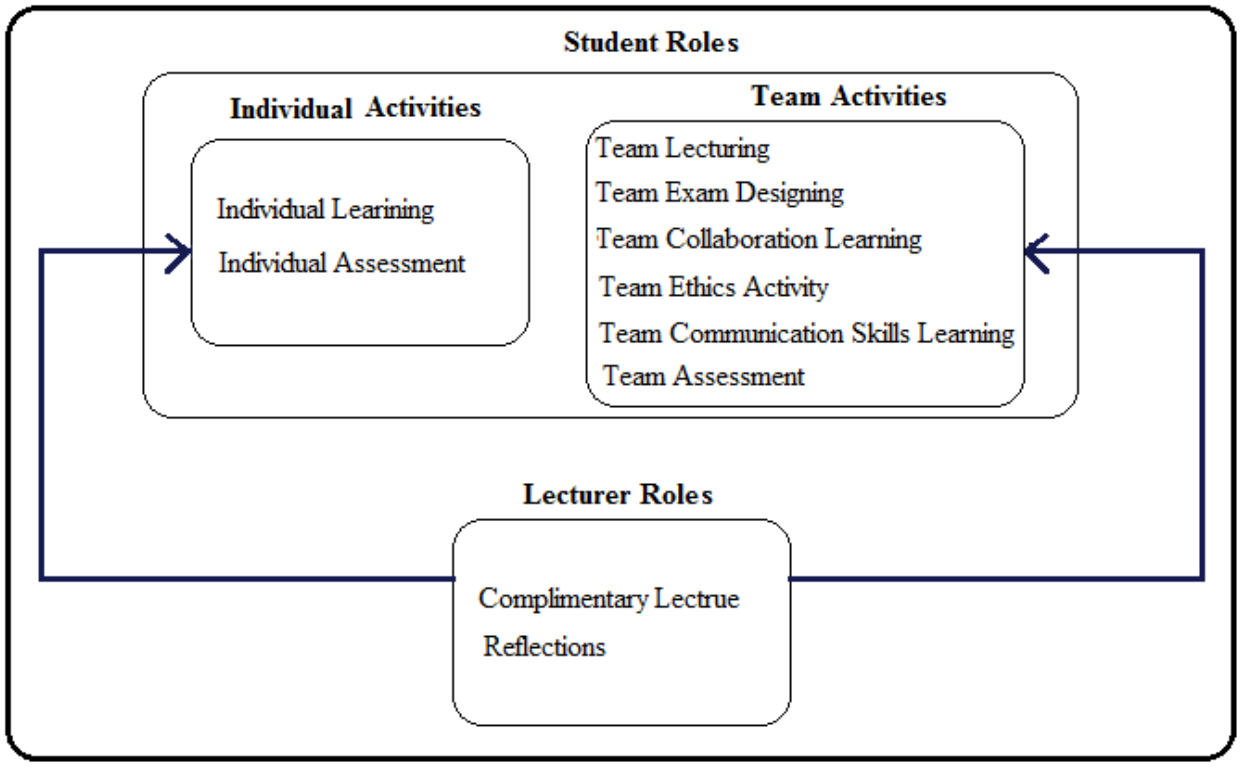


Figure 1: By the Students, For the Students Model

The Student Individual Activities consist of:

1. *Individual Learning:* at the end of covering each chapter of the textbook, each student is required to submit an individual assignment on the subject of the chapter.

2. *Individual Assessment:* Each student is individually evaluated through two exams, which assess the student's knowledge of the materials presented in the textbook, lectures, and hands-on activities.

The Student Team Activities consist of:

1. *Team Lecturing:* through this activity, students are provided with an opportunity to present a lecture on one of the class subjects. In order to provide the paradigm of by the students and for the students, students are forming their own teams. Then, each team is required to select a topic for class lecturing from the textbook.

2. *Team Exam Designing:* Each team is required to create a list of 20 questions on the topic of their presentation. These questions will be used as a database for selecting the exam questions.

3. *Team Collaboration Learning:* researchers believe that students can learn through doing better than just reading [2]. To accomplish this task, two types of hand-on activities are utilized.

   First one is three lab activities based on LEGO Mindstorm kits. During the first four weeks of the class, students are provided with lab instructions for three activities that are designed to familiarize them with construction, control, and programming of robots. In these activities, students become familiar with each components of the kit, learn how to construct robotic structures, and learn how to program their robots. After completing each activity, each team is required to write and submit a report on their activity and accomplishments.

   The second activity is a team project. This is one of the key elements of the student active learning strategy and has widely been used to enhance learning experience of students [2, 5]. For this activity, by the end of the fourth week of the class, each team is required to prepare and submit a project proposal for evaluation and approval by the instructor. The project proposal should consist of the following items:

   - Cover page: title of project, team members name, course code and name
   - Summary of proposed project
   - Objectives of the project
   - Detail description of the projects
   - Anticipated outcomes
   - Timeline for completion
   - References

   Each team through collaboration and dialog between the team members identifies and proposes a project. Different robotic projects are proposed for this activity. Each team is required to prepare and submit a final project report along with a PowerPoint presentation on the last day of the course.

4. *Team Ethics Activity:* Each team is assigned an ethical case study by the instructor. The team members have to prepare a PowerPoint presentation for it and present and act the case in the class by the middle of the semester.

5. *Team Communication Skills Learning:* Each team members is required to demonstrate his/her collaborative communication skills through team oral presentation of their ethics case study and their team oral project report. They also are required to provide collaborative written reports for their lab reports and their final project. The final project report should consist of the following sections:
    - Cover page that include title of the project, team members name, course code and name
    - Summary of the project
    - Objectives of the project
    - Detail description of the project that should include complete Labview programs, pictures and figures, list of parts and material used, any drawing, if applicable
    - Data and result of any testing done
    - Discussion of Obstacles encountered and Outcomes achieved
    - Contribution made by each team members
    - Conclusions and Recommendations
    - References

    Also, each team needs to prepare and submit a 30-minutes PowerPoint presentation for their final project presentation, which includes the time for demonstration of the project on the last day of the course.

6. *Team Assessment:* Each team is evaluated through written lab reports, project written proposal, project written report, project oral presentation, and ethics oral presentation.

The Lecturer role consists of:

1. *Complementary Lectures:* At the end of each class session, the lecturer provides a complementary Lecture related to the concept that has been presented by the teams and provides real world examples on the presented topics for the class.

2. *Reflection:* This is one of the main tasks of the instructor toward motivating and directing the students through their individual and team activities.

Assessment Instrument

The Course Experience Questionnaire [15] was utilized in this work to assess the outcomes of the student learning in this course. This questionnaire has been validated and widely used to assess the students' experience. The instrument is made of 36 questions that are grouped into six

main factors. Each question is scored from 1 to 5 in Likert scale [15] in which 1 means "Strongly Disagree" and 5 means "Strongly Agree". The factors are defined as follows:

1. Good Teaching scale (GT)
2. Clear Goals and Standard scale (CG)
3. Generic Skills scale (GS)
4. Appropriate Assessment scale (AA)
5. Appropriate Workload scale (AW)
6. Emphasis on Independence (IN)

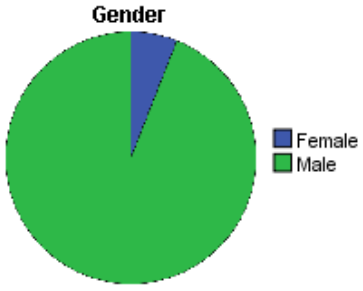
In addition to questionnaire, some custom made questions were added to the course survey to cover specific student activities such as lecturing and demographic information [16].

Assessment Results

The course consists of three sections. The survey was used in all sections of the course. The collected data from all three sections of the course are from Fall 2012 semester. There were 50 completed responses, which represented 6 percent of female and 94 percent of male students. The age of students ranges from 18 to 41. The major of students were Computer Engineering Technology (CET), Electrical Engineering Technology (EET), Mechanical Engineering Technology (MET), Finance, and Simulation and Gaming. Figure 2 represents the demographic information of the course.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	3	6.0	6.0	6.0
	Male	47	94.0	94.0	100.0
	Total	50	100.0	100.0	



Major

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	CET	14	28.0	28.0	28.0
	EET	8	16.0	16.0	44.0
	Finance	1	2.0	2.0	46.0
	MET	26	52.0	52.0	98.0
	Simulati	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

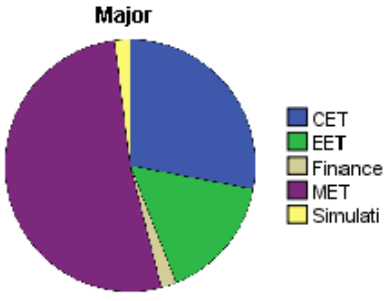


Figure 2: Demographic information of the course

1. *Good Teaching scale (GT)*

The GT has been constructed to measure the teaching effectiveness from students' point of view. Good Teaching has been measured by 5 questions. Two of these questions are presented in figures 3 and 4. As shown in figure 3, more than 68 percent of the students have positively rated staff efforts to motivate students. In figure 4, 56 percent of the class strongly agreed that staff spends enough time into commenting on students' work.

GT1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	7	14.0	14.0	14.0
	3.00	9	18.0	18.0	32.0
	4.00	20	40.0	40.0	72.0
	5.00	14	28.0	28.0	100.0
	Total	50	100.0	100.0	

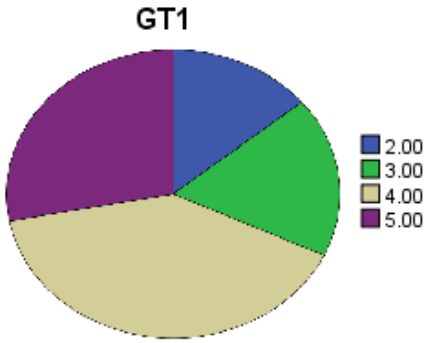


Figure 3: (GT1) The teaching staff of this course motivates students to do their best work?

GT2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	6	12.0	12.0	14.0
	3.00	15	30.0	30.0	44.0
	4.00	21	42.0	42.0	86.0
	5.00	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

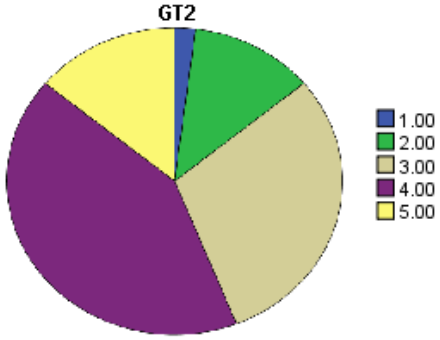


Figure 4: (GT2) Staff have put a lot of time into commenting on students' work?

2. *Clear Goals and Standard scale (CG)*

Providing clear goals and standard are very important part of the course experience scale. This construct is attempting to measure instructor's effort toward clarifying the main goals of the course with 5 questions. Two of these questions are presented in figures 5 and 6. As illustrated in figures 5, 74 percent of the students strongly agreed that expected work and class standards were clear. Figure 6 shows that only 2 percent of the students were not sure about the class expectations.

CG1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	2	4.0	4.0	4.0
	2.00	4	8.0	8.0	12.0
	3.00	7	14.0	14.0	26.0
	4.00	28	56.0	56.0	82.0
	5.00	9	18.0	18.0	100.0
	Total	50	100.0	100.0	

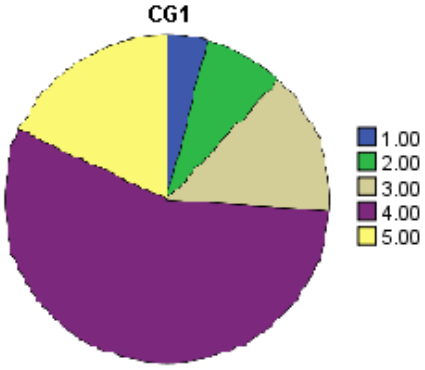


Figure 5: (CG1) It's always easy here to know the standard of work expected?

CG2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	4	8.0	8.0	10.0
	3.00	10	20.0	20.0	30.0
	4.00	27	54.0	54.0	84.0
	5.00	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

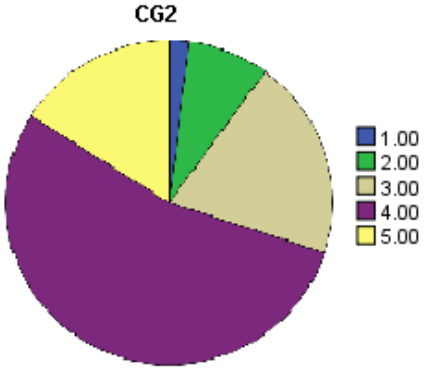


Figure 6: (CG2) You usually have a clear idea of where you're going and what's expected of you?

3. <u>Generic Skills scale (GS)</u>

Generic Skills scale addresses the problem solving, analytical thinking, and team playing skills of the students. The survey results present a high rate of agreement on increase of Generic skills among the surveyed students. Figures 7 and 8 present two questions of the 6 main Generic Skill's questions. As shown in figure 7, 78 percent of the respondents strongly agreed that this course has helped them to develp their problem-solving skills. Figure 8 indicates that 74 percent of the respondents strongly agreed that this course has shapped their anayltical skills.

GS1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	2	4.0	4.0	4.0
	2.00	3	6.0	6.0	10.0
	3.00	6	12.0	12.0	22.0
	4.00	23	46.0	46.0	68.0
	5.00	16	32.0	32.0	100.0
	Total	50	100.0	100.0	

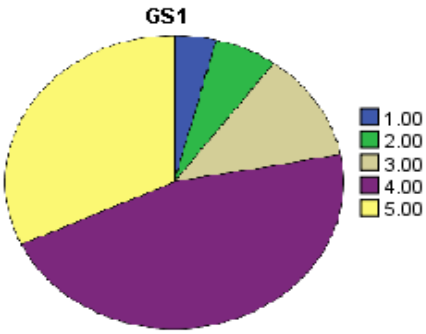


Figure 7: (GS1) This course has helped me to develop my problem-solving skills

GS2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	7	14.0	14.0	16.0
	3.00	5	10.0	10.0	26.0
	4.00	31	62.0	62.0	88.0
	5.00	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

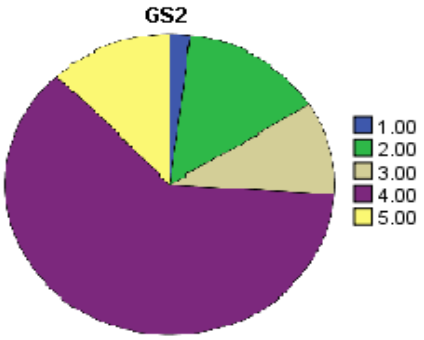


Figure 8: (GS2) This course has sharpened my analytic skills

4. <u>Appropriate Assessment scale (AA)</u>

AA measures the degree of appropriateness of the assessment and the feedback that students have received from their instructors. Appropriate Assessment scale is constructed with 6 questions. Two of them are presented in figures 9 and 10. As the result in figure 9 shows, most of the students agree that there is a mutual learning between students and lecturer. In figure 10, most of the students disagree that the whole course is dependent on memorization.

AA1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	6	12.0	12.0	12.0
	2.00	14	28.0	28.0	40.0
	3.00	20	40.0	40.0	80.0
	4.00	9	18.0	18.0	98.0
	5.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

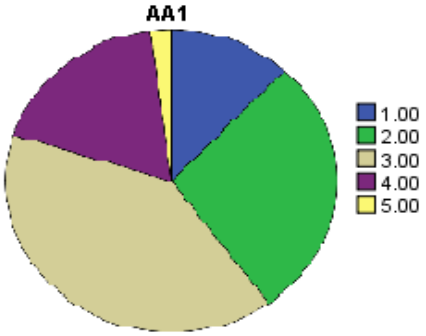


Figure 9: (AA1) Lecturers here frequently give the impression they have nothing to learn from students?

AA2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	4	8.0	8.0	8.0
	2.00	17	34.0	34.0	42.0
	3.00	15	30.0	30.0	72.0
	4.00	13	26.0	26.0	98.0
	5.00	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

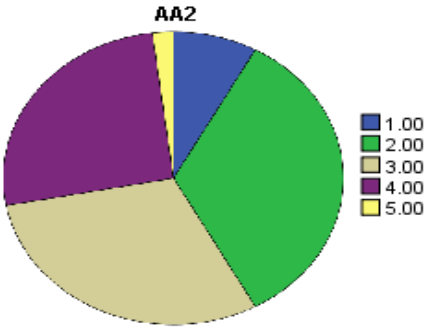


Figure 10: (AA2) To do well on this course all you really need is a good memory?

5. *Appropriate Workload scale (AW)*

AW construct measures the appropriateness of workload from students' point of view. This construct consists of 5 questions and we have presented 2 of the main questions in figures 11 and 12. Based on the collected data, the workload appears not to be very heavy and course does not cover a wide range of topics. According to the results in figure 11, only 44 percent of the students agree that there was too much work load. Also according to AW2, 56 percent agreed that the syllabus didn't try to cover wide range of topics as shown in figure 12.

AW1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	4	8.0	8.0	8.0
	2.00	24	48.0	48.0	56.0
	3.00	16	32.0	32.0	88.0
	4.00	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

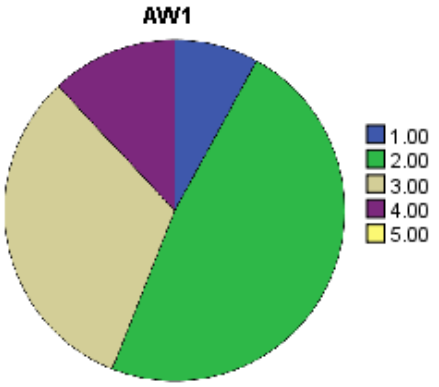


Figure 11: (AW1) The workload is too heavy?

AW2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	28	56.0	56.0	58.0
	3.00	14	28.0	28.0	86.0
	4.00	5	10.0	10.0	96.0
	5.00	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

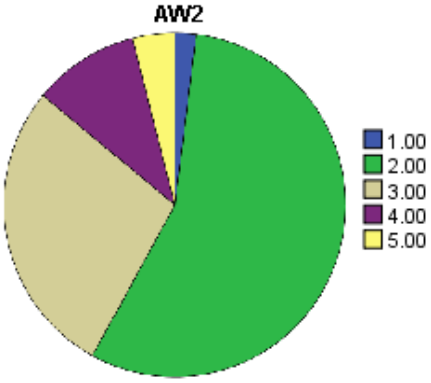


Figure 12: (AW2) It seems to me that the syllabus tries to cover too many topics?

6. *Emphasis on Independence (IN)*

This scale demonstrates whether the course provides enough opportunities for students to work on their area of interest. This construct is made of 6 questions. Two of them are presented in figures 13 and 14. As illustrated in figure 13, 10 percent of students are strongly agreed, and 32 percent agreed that they can focus on their area of interest. According to the figure 14, students are more agree that the course encourages them to develop projects that are more related to their academic area.

IN1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	12	24.0	24.0	26.0
	3.00	16	32.0	32.0	58.0
	4.00	16	32.0	32.0	90.0
	5.00	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

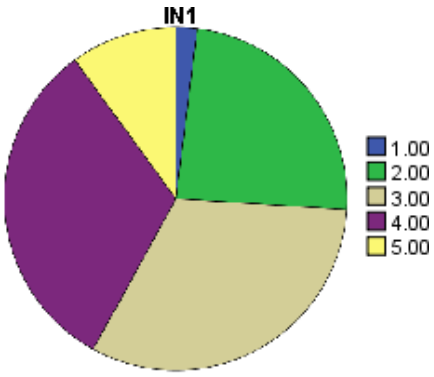


Figure 13: (IN1) There are few opportunities to choose the particular areas you want to study?

IN2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	2.0	2.0	2.0
	2.00	3	6.0	6.0	8.0
	3.00	9	18.0	18.0	26.0
	4.00	31	62.0	62.0	88.0
	5.00	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

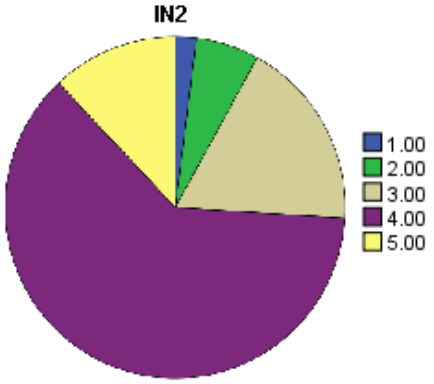


Figure 14: (IN2) The course has encouraged me to develop my own academic interests as much as possible?

7. *<u>Creating presentation for the class</u>*

Requiring students to prepare presentation for the class helps them to be more confident in their oral presentation skill. As it is presented in figure 15 and 16, most of the students strongly agree that preparing presentation for the class enhanced their understanding and their confidence in oral presentation in front of a group of people.

CL1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	3	6.0	6.0	6.0
	2.00	4	8.0	8.0	14.0
	3.00	11	22.0	22.0	36.0
	4.00	22	44.0	44.0	80.0
	5.00	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

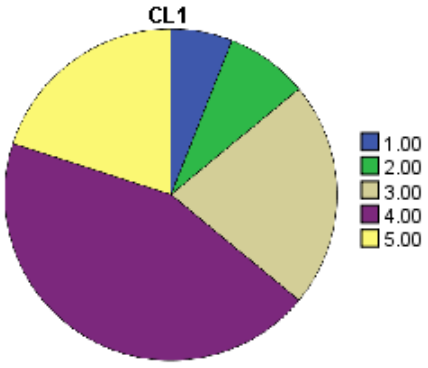


Figure 15: (CL1) I feel confident in creating presentation for this course?

CL2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	4	8.0	8.0	8.0
	2.00	2	4.0	4.0	12.0
	3.00	14	28.0	28.0	40.0
	4.00	20	40.0	40.0	80.0
	5.00	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

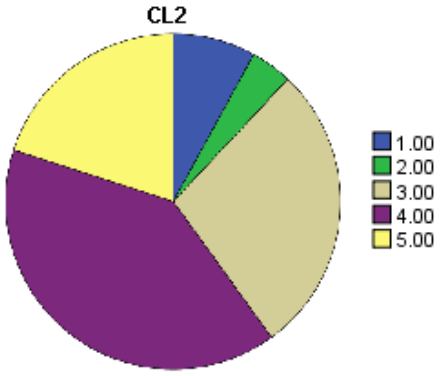


Figure 16: (CL2) I feel confident presenting in front of the whole class?

8. Satisfaction

Finally, we asked the students to rate their overall satisfaction of the course. 20 percent were strongly agreed; 42 percent were agree; 28 percent were natural; and only 10 percent were disagreed.

Satisfaction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	3	6.0	6.0	6.0
	2.00	2	4.0	4.0	10.0
	3.00	14	28.0	28.0	38.0
	4.00	21	42.0	42.0	80.0
	5.00	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

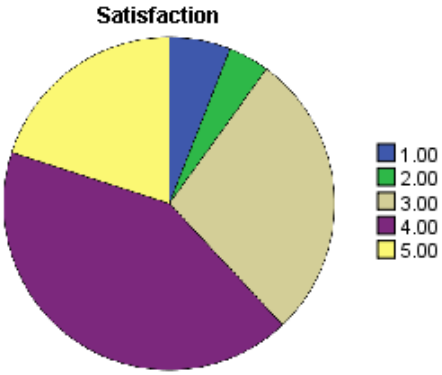


Figure 17: (Satisfaction) Overall, I am satisfied with the quality of this course?

Conclusion

This study tried to bring projects and exercises that stimulate students' interest by being entertaining rather than dry and boring. Through class observations and the feedbacks that were provided by the students, we learned that students could add a lot of creativity to the class activities when they are provided an opportunity to work on their own and entertaining projects rather than those tedious and predefined projects that are provided by the instructor. Students had successfully completed projects that included robot line follower, robotic garbage collector, digital dog, beer pong bot, robotic card dealer, and many other fun projects.

By utilizing LEGO Mindstorm and Tetrix kits, we introduced activities that students can perform in teams to build their own favorite robotic projects. The new introduced methodology helped

students to work in groups and learn to be a better team player. Moreover, by focusing on the fun projects, not only the course increased student motivation but also the course enhanced the students problem solving and analytical skills. We have observed very low number of student absentees and improvement in student final grades.

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