Student Engagement and Learning using an Integrated Student-Lecturer Engagement Design Framework

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***Abstract*—In different forms of educational learning, student engagement was very important. Many research papers had focused on one teaching method to increase learning and the lecturer tasks were not grouped. This paper presents a framework, Integrated Student-Lecturer Engagement Design Framework (ISLEDF) that uses many in and outside classroom student engagement activities and teaching techniques to promote learning and create applicable knowledge. ISLEDF allows the flexibility to implement the engagement activities. In ISLEDF, the lecturer and students roles are defined and clustered. For this model to show very good results, the lecturer is required to be actively and positively engaged too. In general, the lecturer must also understand the characteristics and wants of students today. ISLEDF was successfully implemented in Java Computing module. The survey results and comments from students were very positive. After using ISLEDF, strong evidences from student coursework showed that the students were actively engaged in the module. The survey results, student exercise solutions and final examination results indicated that the students had generally learnt from this module. ISLEDF can be used to teach any module with adjustments if necessary.**

Keywords—student, lecturer, engagement activities, teaching techniques, understanding students

I. INTRODUCTION

Student engagement is crucial in different forms of learning activities, and students are likely to learn from an activity if they are engaged and motivated [1]. Student engagements focus on three areas: behavioural engagement, emotional engagement, and cognitive engagement. Behavioural engagement covers academic involvement and learning tasks. Emotional engagement includes attitude towards instructors and interests. Cognitive engagement comprises of motivation and effort.

Many reported research papers in the literature concentrates on one teaching technique to support student learning [2-14]. Just-in-time teaching technique (JITT) was used in teaching basic programming courses [2][3], database course [4], online project unit [5], system and design courses [6], program design course [7], video art course [8], and mobile learning [9]. Problem-based learning (PBL) was reported in [10-14]: Understand the use of PBL in remote and virtual labs [10], use of PBL in wind energy [11], PBL in mobile environment [12], PBL in first year graduate heat transfer module [13], and PBL in engineering education [14]. Active learning research in a group to improve student problem solving competency [15], through presentation during lecture [16] and PBL [17] were carried out.

Engaging students through advanced research [18], novelty [19], collaboration [20], interesting coursework [21], badges achievement system [22], different places [23], computer games competition [24], and “live” project [25] were reported. Student-centered learning in a collaborative learning environment for developing communication skills [26] and improve students activities [27] were published in the literature. The main emphasis [18-27] was on students learning. The lecturer engagement activities to improve student learning was vague and not organized.

The proposed framework, ISLEDF (Fig. 1), integrates many student and lecturer engagement activities (inside and outside classroom), outlined and organized engagement activities, and allows flexibility to implement the engagement activities. ISLEDF covers more than one teaching techniques in some forms compared with many papers that focus only on one teaching method. The teaching techniques currently included in ISLEDF are JITT (preparatory questions before class), peer instruction (in-class discussion questions), PBL (solving homework and in-class problems), team-based or collaborative learning (preparatory questions in a team and in-class discussion questions), and active participation (student presentation, student feedback, ask questions, preparation for assessments, and solve problems). This framework is a hybrid of student-centered approach and teacher-centered approach. ISLEDF uses a repertoire of carefully selected engagement activities to maintain student interest and cultivate learning in the entire module.

Section two covers the framework of ISLEDF. Section three describes the implementation of ISLEDF. Section four discusses the results of implementation. Section five concludes this paper.

II. FRAMEWORK

ISLEDF depicts the student lecturer engagement to promote learning and create applicable knowledge. This form of engagement activities is contained in the field of behavioural engagement because the activities covered academic participation and learning from the exercises. Student engagement is defined as involvement in effective educational practices (outside or inside the classroom) which may lead to any measurable outcomes. ISLEDF covers the epistemology, methodology, and pedagogy levels of education. The epistemology level refers to the acquiring of knowledge. The methodology level refers to the methods used for foster learning. The pedagogy level refers to the study of teaching activities and methods. Quantitative methods are mainly used in our model to measure effectiveness of student engagement, for example attendance, academic achievement like exam scores, student surveys, home work and in-class tasks completion.

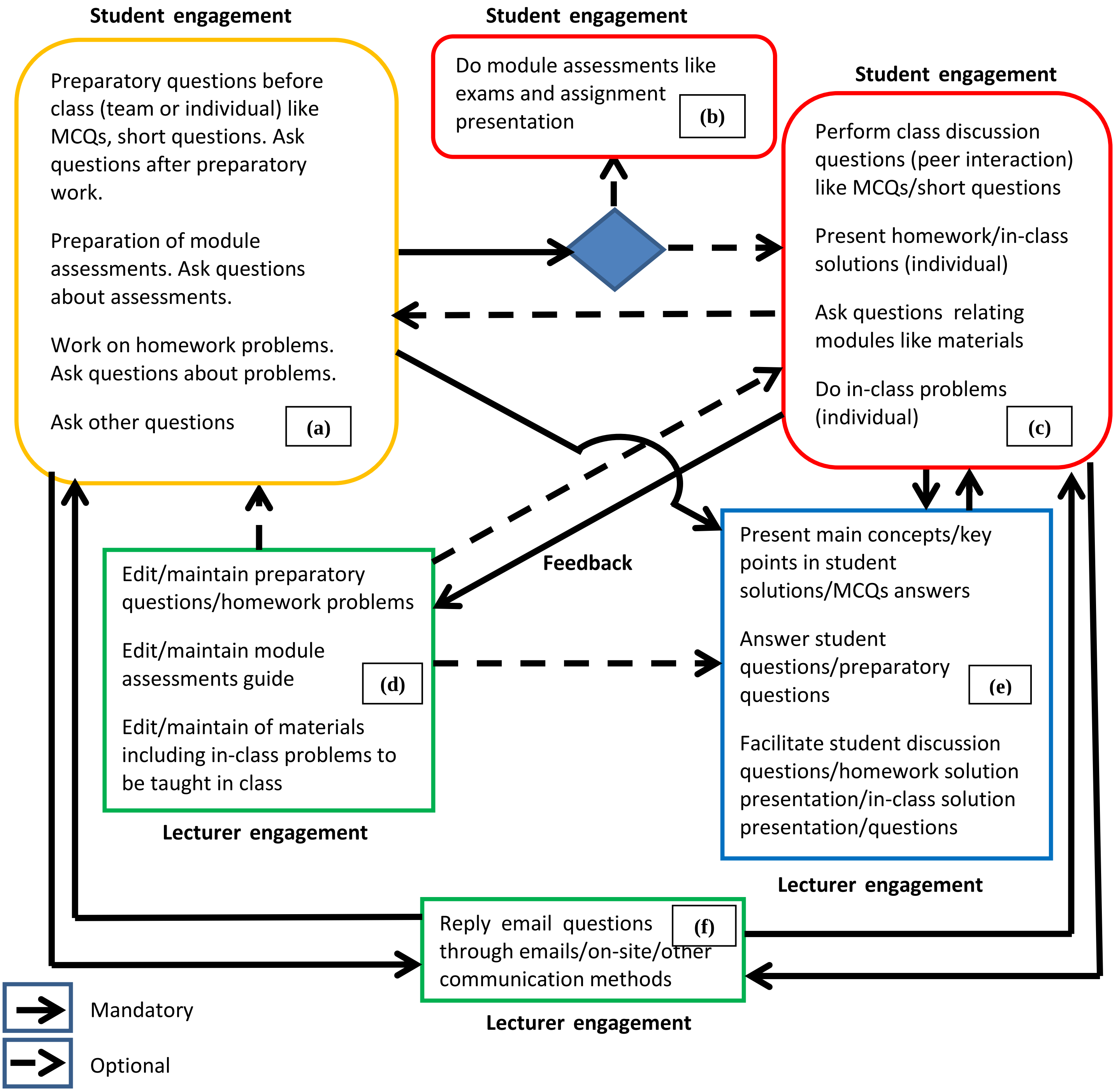

Fig. 1. Integrated Student Lecturer Engagement Design Framework (ISLEDF)

This framework focuses on student engagement activities to foster learning and apply knowledge to solve problems with the aid of lecturer engagement activities. The instructor chooses what and how the student will learn. The instructor also determines the students' assessments on their learning. Hence, the proposed framework is a hybrid of the student-centered learning approach and the traditional method, teacher-centered approach.

ISLEDF provides the implementation flexibility of student engagement activities. Below are three examples.

- Answer questions confidentially using Moodle (an open source course management system) after peer discussion instead of class voting as used in peer instruction [28]. This encourages active participation from students because each student is required to provide an answer.

- An open source course management system, Moodle, is used to provide immediate multiple-choice questions feedback in preparatory exercise instead of short essay questions. Thus, students know the results and comments very quickly. In this way, students are motivated to learn more from the materials (survey question 6 (96.67 strongly agree and agree)).

- Lecturer is to answer most questions from the preparatory activity instead of misconceptions and difficult ones for the immediate class as documented in JITT [3][4]. By doing so, students are encouraged to ask questions (relate to active participation) because their questions are being answered and shared with the class.

ISLEDF has two main groups: student engagement and lecturer engagement (Fig. 1). Expected student engagement activities outside classroom (yellow rounded rectangle box (a)) include preparatory questions before class, homework problems, and preparation of module assessments. Students are encouraged to ask questions through emails. Preparation in this box leads to student engagement in class (red rounded rectangle boxes – (b) or (c)) and lecturer engagement boxes (blue rectangle box (e) and green rectangle box (f)).

The red rounded rectangle boxes ((b) and (c)) are for expected student engagement in class. If the preparation is for exams, students will be engaged in taking the exam in class (red rounded rectangle box (b)). Otherwise, students will be engaged (red rounded rectangle box (c)) through class discussion questions, presentation of homework or in-class solutions, asking questions relating to module, and attempt in-class problems. Student feedback to lecturer about preparatory questions, homework problems, power point presentation, and module assessment guide (green rectangle box (d)) is important because adjustment can be carried as and when is required. Based on the feedback, lectures may choose to edit the materials that will be directed to the relevant engagement boxes (yellow rounded rectangle box (a), red rounded rectangle box (c), and blue rectangle box (e)).

The green rectangle boxes ((d) and (f)) are expected lecturer engagement outside class. Lecturer is to reply student emails and possibly answer student questions outside classroom. Lecturer may edit preparatory questions, homework problems, and power point presentations based on student feedback. The blue rectangle box (e) is expected lecturer engagement in class. In class (blue rectangle box (e)), lecturer present main concepts, highlight key points of student solutions, explain multiple-choice-questions answers, answer student questions, and facilitate student discussion questions, homework solution presentation and in-class solution presentation.

In order to maximize the positive outcome of ISLEDF, active lecturer engagement is a must and quality attributes of lecturers such as passion for students, enthusiasm to the topic, honesty, caring emphatic approach [29], nurturing and supportive [30], establish positive teacher-student relationship [31-33], understand class dynamics, shares classroom assessments with students that motivate student effort and achievement [34] are very important.

Understanding the psychological aspects of the 21st century students is crucial so as to effectively support and facilitate student engagement activities for learning in ISLEDF. The main points are as follows:

- Students are motivated by getting good grades [35]. Thus, informing module assessments to students should be important to enhance learning.

- Student presentation is a crucial skill [36]. Hence, class presentation should be carried out.

- A combination of student emotional and cognitive interests which yield student engagement [37]. Therefore, teacher communication behaviours (immediate and clarity) such as smile, positive vocal cues, provide relevant examples, review main points, and provide connection between concepts and examples should be exhibited.

- Positive relationships among students and group dynamics affect student engagement in group work [38]. For this reason, students should be allowed to form their own teams.

III. FRAMEWORK IMPLEMENTATION

The framework (Fig. 1) had been successfully implemented in teaching Java Computing for 30 students with the support of Moodle. This was a 40-hour module. Each meeting was two hours per day. Students were to meet with the lecturer five times a week. In addition, Moodle had helped to perform administration of student coursework marks, submission of student work, provided instant feedback, and other functions. The lecture materials were scheduled to be available for students ahead of time so that they could refer to them as the students attempt to answer the preparatory exercises.

Each student was to install the Integrated Development Environment for Java, Eclipse, into his/her personal computer before Day 1. Eclipse had many versions and could be installed into computers with 32-bit or 64-bit Windows operating system (OS) and Mac OS. With individual copy of free Eclipse software from the Internet, every student was expected to be actively engaged (related to active participation) solving programming problems (related to PBL) in and outside class.

TABLE I. had shown the contents that were covered in this module. The contents were divided into four main sections.

TABLE I. Topics

Topics
Basic Eclipse features, common computer terminologies, variables, constants, operators, expressions, assignment, statements, strings, if and switch statements, input and output, simple dialog boxes
While, do-while, and for loops, break and continue statements, advanced dialog boxes, methods, scope of variables, recursion fundamentals, different implementation approaches
Single and multi-dimensional arrays, passing arrays into methods, simple search algorithms, class and objects, class for GUI components, basic UML
Static variables and methods, passing objects into methods, private fields, immutable objects and classes, class abstraction, class encapsulation, object composition, object aggregation, different modifiers for visibility, inheritance, polymorphism

Before day 1, positive student-lecturer relationships were built through emails, interaction in and outside class. At day 1, modules assessments were succinctly informed to the students (relates to engagement because of grades [35]): 40% coursework and 60% final examination. There was no mid-term for this module. The coursework marks include individual preparatory exercises (related to JITT) and team preparatory exercises (related to JITT and team based learning), discussion questions (related to peer-instruction and collaborative learning) in class and class participation including asking questions and presentation of solutions (related to active participation). The preparation of final examination related to active participation and PBL. The three examples (stated in section II) to show flexibility in implementing the student engagement activities were also implemented successfully in this module. The first two examples were done with the aid of Moodle. As for the third example, questions were replied by emails and interesting and important solutions were shared in class.

As to optimize the effectiveness of ISLEDF, the lecturer was constantly engaged in teaching the Java computing module. For example, student emails were quickly replied by the lecturer, relevant and practical examples were given and explained to students, and review main points taught for the day.

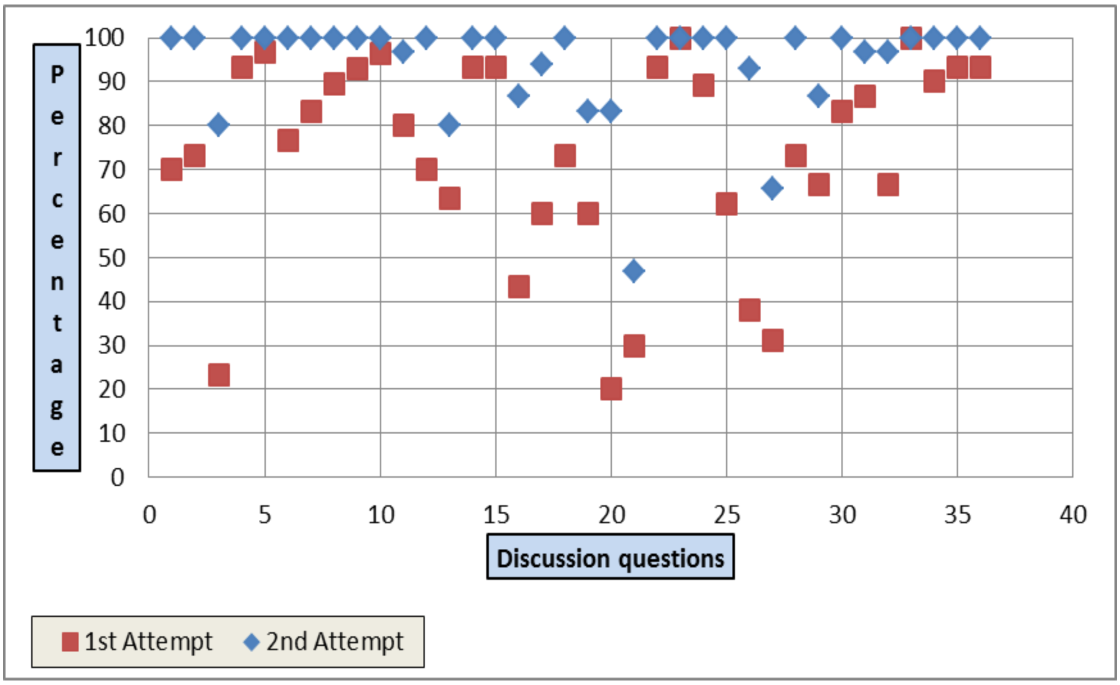

Fig. 2. Student performances in discussion questions

In addition, the lecturer exhibited caring of student needs like giving students more time to submit their home work if valid reasons were given, support of student learning such as provide practical questions for students to solve, honesty and discussed solutions in class. The lecturer always asked for feedback about the lesson and whether the students could cope with the materials. By listening to the student's comments, subsequent materials, exercises and assessment guide may be adjusted and edited with discretion by the lecturer. In class, the lecturer facilitated different student presentations, provided key points/solutions to student questions, for example questions asked in preparatory exercises, and went through main concepts, for instance important facts of the day or student solutions.

In view of the psychological aspect of students, module assessments were informed in day 1, and the lecture had always showed a smiling face and gave positive encouragement words to students such as good work, fantastic and awesome. Also, the importance of group work [35] was made known to students in day 1. Students were encouraged to ask questions and present their solutions (relate to active participation) in class. Finally, students were allowed to choose their own teams.

IV. RESULTS AND DISCUSSION

Quantitative techniques were mostly applied to measure the effectiveness of this model, for instance tasks completion, exam scores, and attendance. A qualitative method called observation was also being utilized.

There were 36 discussion questions in 14 class meetings. In Fig. 2, every red square box represents the percentage of correct answer for each discussion question in the first attempt. The blue diamond shape means the percentage of correct answer for the corresponding discussion question in the second attempt. Fig. 2 had showed the student performances of the first attempt and second attempt discussion questions.

After each submission of these questions, the system was set up not give any feedback. Hence, the students did not know whether their answers were correct/wrong. The second attempted answers were recorded after discussion with peers. The time difference between the first and second attempt was about 15 minutes.

The percentage of correct answers was higher in the second attempt compared with the first for each discussion question. There were two instances where the first and second attempts had 100% correct answers. We had observed that more energetic and louder group/peer discussion if the questions were more difficult and open-ended. The average percentage of each discussion answer submission for both attempts was about 98%. Therefore, the students were actively engaged.

Altogether the students had completed four team preparatory exercises and 10 individual preparatory exercises. There were functional programming questions in team preparatory exercises. Some questions such as "I am confused about the meaning of float and double", "what was the difference between string and other numeric variables", "was every program that could be done by a for loop could also be done by a while loop", "what was a nested loop", "ragged array was a little bit difficult to understand", and "the difference between ClassZ item1=new ClassX() and ClassX item1 = ClassZ()" were raised after completion of the exercises. Many questions of various difficulty levels were asked after completion of each exercise. There were 100% submission for team exercises and almost 100% submission for individual exercises. Nevertheless, there were very few late submissions. These gave evidences of active student engagement. The exercise solutions submitted by students showed that they had learnt the concepts to a certain degree.

Survey questions and results were tabulated in TABLE II.

TABLE II. Survey results

Questions	**Strongly agree and agree**
Q1. Completing preparatory questions help me to know about the materials to be taught in class.	100%
Q2. Preparatory questions provide a forum for raising questions to instructor before class time.	96.67%
Q3. Working in a team for preparatory questions help me to understand the materials to be taught in class.	96.67%
Q4. Discussion questions during class actively engage me.	93.33%
Q5. Discussion questions with fellow students help me to better understand the topics.	93.33%
Q6. Quick feedback of preparatory questions motivates me to learn more about the materials.	96.67%
Q7. Completing preparatory questions help me to be more interactive like asking questions during class	96.67%
Q8. Solving programming problems during class actively engage me.	96.67%

From the results of Q3 and Q5, team working in preparatory questions and discussing with other students in class during discussion exercises had helped the students to learn. The results of Q1, Q2, Q4, Q7, and Q8 indicated that the students were engaged in learning the course.

Some of the comments from students about the course received in the survey were listed below:

- It was a helpful course
- It was an interesting class
- I think this was an interesting course
- I think the pre-reading was useful
- The whole lectures were interesting. I learned a lot.
- This course was a good beginning for my programming. It made me interested in programming.
- I found discussion questions difficult and preparatory questions suitable for me
- I appreciated the section of answering questions and discussion questions. It helped a lot. I had learned a lot from this course.

Generally, the students did well in the 2-hour final examination which includes a few practical programming questions. The overall results were excellent. This gave evidences of student learning. All students had passed this module. Average marks were above 80. The class attendance throughout the module was almost 100%. Students had performed presentations of their programming solutions in class.

V. CONCLUSION

In this paper, the proposed framework, ISLEDF, to actively engaged students through a series of different student engagement activities and teaching techniques were successfully implemented in the Java Computing module as the survey results and individual student comments were positive. By being engaged, students had learnt [1]. After using ISLEDF, strong indications from student coursework had revealed that the students were actively engaged for the entire module. Moreover, the final examination results, survey results and exercises solutions by students displayed that the students had somewhat learnt from this module. This framework could be adjusted to implement other student engagement activities and could be used to teach any other modules with modifications as when were required. In order to optimize the effectiveness of ISLEDF, the lecturer should be actively engaged too. Both the lecturer and students must be positively working together. To be effective, the lecturer on the whole would support learning, passionate about the topic, understand the needs and behavior including class dynamics of the 21st century students. The combination of ISLEDF, selected teaching practices, physical surroundings, and instructor chosen assessments had provided a suitable student learning environment.

In future, this framework will be fine-tuned so that students can learn more from Java Computing module and continue to be actively engaged. Moreover, the framework may be used to teach other modules and bigger cohort modules.

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