

Peer-supported Independent Study (psis) - an Effective Model for Enhancing Student Engagement and Optimizing Class Time in Engineering Courses – A Case Study From India

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Abstract : Two well-recognized constraints faced by engineering educators in India are sustaining student engagement and completing the prescribed course work within the semester. This paper explores the potential of using a new concept - Peer-supported Independent Study (PSIS) developed by the author to address both these constraints.

The concept of PSIS is very different from the traditional independent study as it remains an integral part of the regular course delivery and assessment. Based on a solid theoretical framework of social constructivist theory and peer-instruction theory, PSIS requires the instructor to identify sections of the regular coursework that students can manage by themselves. The instructor then creates tasks from the identified course content that are completed independently by peer groups of 3 to 5 students. The entire PSIS activity is conducted online which helps to save class sessions. The topics identified for PSIS are included in the regular summative assessment. A survey of over 300 instructors across disciplines

confirmed that 15% to 18% of the course content regularly taught in classes can be comfortably managed by students themselves and is hence suitable for PSIS.

This study was initiated with 106 engineering educators across disciplines from 12 engineering institutions in India though only 63 completed the experiment. A preparatory workshop was conducted to train the instructors for designing and implementing PSIS. Two specially designed instruments were used to collect feedback from 63 instructors and 2865 students (from 63 classes). Results showed increased student engagement at all three - cognitive, behavioral & emotional, levels. 83% instructors reported improvement in class attendance and participation while 58.6% instructors confirmed having saved class time. 92% of participating students found PSIS interesting and rewarding. The study brought out the need for developing more structured guidelines for i) designing PSIS tasks and ii) using the saved time more efficiently.

Keywords : Student Engagement, Active Learning, Student Autonomy, Peer-instruction, Cooperative Learning

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I. Introduction

This reflective practice study was undertaken to validate the efficacy of a new model, Peer- supported

Independent Study (PSIS), developed by the author to address the two most common issues faced by engineering educators in India, pertaining to i) sustaining student engagement and

ii) facilitating faculty to optimize class time and complete their courses in time. These two issues have been consistently rated as the two top-most constraints by Indian engineering faculty in surveys conducted during the IUCEE International Engineering Educator Certification Program (IIEECP) designed by the author and conducted by IUCEE over the past seven years <https://iucce.org/wp-content/uploads/2021/11/IIEECP-Brochure.pdf>

In India, most engineering educators confirm that they end up scheduling several additional classes after college or on the weekends to complete the 10% – 15% of the coursework that they are unable to complete during the semester. On the other hand, students' declining motivation and consequent disengagement in courses is a 'live' problem that is reflected in poor attendance, late and low-quality assignments, absenteeism, and rampant incidents of plagiarism. Although several reasons have been identified for these behaviours, yet no concrete solution has been found. PSIS is an attempt in that direction.

PSIS offers a win-win solution for both the instructors and the students. It allows students the opportunity to engage in peer study, enjoy autonomy, and gain confidence while developing several key graduate attributes such as teambuilding, critical thinking, problem-solving, improved communication, and life-long learning. At the same time, being an online activity, PSIS offers instructors some release time to complete the course work in time.

2 The Psis Model & Its Implementation

The concept of PSIS is very different from that of the traditional independent study or self-study. Miriam-Webster defines Independent Study as a course of study done by a student with or without the help of an instructor but 'not as a part of an organized class.' While PSIS is an integral part of the organized class. PSIS involves small groups of students working together online to complete tasks set from an identified section of the prescribed course content. Thanks to students' newly acquired competency in managing online learning during disruption caused by

COVID in 2019-2020, the time is ripe for integrating PSIS in traditional classroom teaching.

The PSIS activity involves: i) selecting topics/portions from the prescribed course content that students can manage themselves; ii) designing interesting and challenging tasks based on the selected topics to be completed online by small groups iii) selecting/setting-up an online platform

iv) creating groups, v) designing assessment. Each of these six steps needs careful planning and implementation.

A. Selecting Content for PSIS

Selecting content for PSIS requires the instructor to sift the course content carefully ahead of the start of the semester, and identify sections that the students can manage themselves. During IIEECP and other faculty development workshops, feedback from over 300 instructors from different disciplines of engineering and pure sciences confirmed that at least 15 – 20% of the course content can be comfortably managed by students and hence, fit for PSIS. It is interesting to note that this matches the %age of content that typically faculty need to cover the content in additional classes. With an early sorting and pre-planning of PSIS, the faculty will be able to easily carve out about 4 - 6 class sessions that can be used to focus on completing the course in time.

B. Designing Tasks to be Submitted as Assignments

This step is crucial to the success of PSIS. Once the area/topics have been selected, the instructor will need to design 4-5 tasks addressing different skill sets - analysis, application, problem-solving, and research. Some possible options are:

- Review (and cite) two/ three scholarly articles, create a report on the history of the concept – beginning, evolution, and future scope.
- Study two/three scholarly papers to write a review report on the applicability of the concept.
- Identify three applications where this concept is used directly or indirectly. Explain each application.
- Explore/Suggest possible new application/s based on the concept.

- Explore/suggest how the concept can be used to improve the efficiency of an existing product/process.

C. Guidelines for Implementing PSIS

- Explain the concept of PSIS to students to get them excited about PSIS by emphasizing how the activity will help develop skills for their professional growth.
- Provide learning materials and all instructions in short, clear, handouts
- Create or ask students to form groups.
- Choose an appropriate online platform for conducting PSIS.
- Monitoring student engagement. The easiest way to keep an eye is to become a part of each group (on LMS or WhatsApp). That way, the instructor is able to provide subtle but timely support and guidance. A discussion thread can be created for posting questions

D. Designing Assessment

- Students must be informed right in the beginning that PSIS will be a graded activity and the content will be also included in summative assessment. Students should be asked to post their completed tasks (written reports, video- reports, simulations, ppt. presentations) online. Evaluation may be done by the instructor, a colleague, or a course alumnus. Access should be provided to students to review and learn from each group's submission.

3. Literature Survey For Concept Validation

As the concept is new and involves two main theoretical constructs, literature survey was carried out in two areas: i) student engagement in the online mode and ii) potential of collaborative learning.

A. Understanding Student Engagement

It is well-known that the term 'Student engagement' is very hard to define. Even though no universally accepted definition exists, there is little debate about the powerful impact student engagement has on student success [1]. It is generally accepted that student engagement is a three-dimensional process

involving behavioural, emotional, and cognitive constructs.

Behavioral Engagement	Emotional Engagement	Cognitive Engagement
Students' involvement in social, academic & extra-curricular activities	Students' feelings about the instructor, peers & school environment	Students' personal investment and effort to master the academic content

Fig. 1 : Forms of Student Engagement

Opportunity to learn together with peers promotes social interaction which in turn stimulates student engagement. The direct benefit of students working together has been emphasized by scholars such as Vygotsky [2]. In the 'zone of proximal development', Vygotsky brings out the difference between what students can perform by themselves and what they can perform while working collaboratively with others [2]. This zone is the reason why student-instructor and student- student interaction becomes so important for reinforcing learning.

PSIS also draws reinforcement from Piaget's theory of cognitive development as working in small groups on new content provides opportunity for both the key processes of cognitive development: Assimilation (by adding new knowledge to pre-existing knowledge), and Accommodation (by modifying the pre-existing knowledge by new knowledge). Here, learning involves the integration of new information into existing knowledge, and sharing explanations facilitates that integration process [3]. Research celebrates and strongly advocates the benefits of collaborative learning. A well-designed group task 'allows the group members to combine different abilities, skills, knowledge or other physical or cognitive resources that is more than any group member can produce alone' [4].

However, the online mode, poses tough challenges for student interaction because of the lack of synchronicity and proximity [5]. If online instruction is to be effective, strong methodology and opportunities for students to interact with each other and the instructor are crucial [6]. That is why it is important that online courses must be designed to provide 'social presence, community, and meaningful interaction' [7]. Social interaction becomes meaningful when students get an opportunity to share, discuss, argue, and negotiate. According to social constructivism, this type of interaction/engagement is

necessary for learning [7], [8]. Recommendations made by constructivists for learning in the traditional mode can be directly applied to learning in the online mode. In both cases, active learning and effective use of collaborative and cooperative methods allow students to construct knowledge and make learning more meaningful [8]. According to Farrell & Brunton [9], successful online student engagement is influenced by a number of psycho-social factors such as peer community, an engaging onlineteacher; and by structural factors such as life load and course design.

A. Peer instruction & Collaborative Learning

An important trend in 21st-century higher education is including collaborative activities in course delivery – making students think and work together [10]. Peer instruction is a cooperative learning technique that promotes critical thinking, problem-solving, and decision-making skills [11]. Typically, in group- work, students are more engaged in the learning process and are likely to become more interested in the learning process [12]. Peer learning helps students to perform better at all levels of cognitive outcomes ranging from simple recall to synthesis questions [13]. Another study that compared responses to the same question by peer groups and individual students reports the former being significantly better [14].

The enormous benefits of learning collaboratively have never been questioned. 'it's all about connections' [15]. The list of benefits is long and includes 'higher achievement, greater productivity, more caring, supportive, and committed relationships; and greater psychological health, social competence, and self-esteem.' [16].

4. Methodology

A. The Sample

A total of 150 instructors from 13 engineering institutions in India were invited to be a part of this study. A total of 106 volunteered to be a part of the study and attended the Preparatory Workshop on Designing & Implementing PSIS.

The profile of the sample had two note-worthy features: first, majority of the instructors were from computer science, computer applications, and electronics departments, and only a small percentage were from other departments. Secondly, both the

instructors and the students participating in the study had little to no practical experience of implementing or participating in cooperative learning as a part of regular classroom instruction. Moreover, students in India, even at the university level, seldom have any experience of working independently.

B. Preparatory Workshop for Designing & Conducting PSIS

As a part of the IIEECP program, 106 instructors were trained to implement PSIS. Training included selecting segments of the course content suitable for PSIS; designing assignments to be completed online by peer-groups; and designing assessment and student feedback.

C. Data Collection

PSIS has two well-defined objectives: i) increasing student engagement and ii) optimizing classroom instruction time. As PSIS is designed as an online activity, initially, mixed methods were chosen as the research methodology. For measuring student engagement, the Online Student Engagement (OSE) model was chosen, and for evaluating the efficacy of PSIS, a conventional survey method was planned. The survey also included items related to student engagement.

Later, the methodology for data collection had to be restructured mainly because of the limited access to computers. In India, most students use cell phones and mostly collaborate through apps like WhatsApp or Facetime which made the use of the OSE scale impractical.

Eventually, it was decided that CANVAS INSTRUCTURE will be used as the online platform for hosting and assessing all components of PSIS. These included uploading learning materials, tracking group-work, submitting completed assignments, and conducting assessment. Instructor and student feedback was collected through TWO specifically developed instruments.

Instrument I was designed to collect instructor feedback. It comprised of 10 items eliciting both quantitative and qualitative responses. Questions sought to get Instructor feedback on both objectives: i) student engagement at all three – cognitive, emotional, and behavioral levels, and ii) optimizing class instruction time Instrument II comprised of 6

items and was designed to collect student feedback on all three dimensions of student engagement. A couple of selected items were repeated in both instruments to get instructor and student perspective on the same aspect.

5. Results And Discussion

Even though 106 instructors participated in the PSIS experiment right from attending the preparatory workshop to setting up the groups and tasks, many of them did not complete the assessment and feedback phase. Finally, only 63 completed responses were found worthy of being included in this study - 27 responses were incomplete, and 16 responses were found to be unreliable because all items in the survey were checked 'strongly agree' or 'neutral'. The results presented and discussed here are based on the 63 accepted responses.

A. Results obtained from Instrument I (Instructor Feedback)

Results obtained from different questions are discussed below:

Item I.1-Preparatory workshop helped me to implement PSIS more successfully: Most responses confirmed that the inputs and hands-on experience provided during the preparatory workshop were very helpful in planning and implementing PSIS. 47.3% chose 'Strongly Agree' and 35% chose 'Agree'. Only 9% instructors chose 'Strongly Disagree'.

Item I.2 Percentage of students who found PSIS a positive addition to the course delivery: Instructors collected this feedback from the students participating in the PSIS activity. More than 85% students found PSIS a positive addition to traditional course delivery. Under additional comments, some instructors mentioned that sharing of the objectives of PSIS was helped to get students motivated.

Item I.3 A more friendly ambiance was observed after students completed PSIS: Responses to this question (28% 'Strongly Agree' and 68.7% 'Agree') were very significant and confirmed the value of PSIS in enhancing the emotional dimension of student engagement

Item I.4 An increase in class participation by previously non-participating students was noted: The positive response displayed in the figure 2 clearly

establishes the value of PSIS in enhancing emotional and behavioural dimensions of students engagement.

An increase in class participation by previously non-participating students was observed
63 responses



Fig. 2 : Item I. 4 – An increase in Class Participation for Previously Non-participating Students

Item I.5 An increase in class attendance was observed: Nearly 72% instructors confirmed (by choosing 'Strongly Agree' and 'Agree') that attendance in classes following PSIS increased. This result of PSIS re-confirmed enhancement in the behavioural engagement of the participating students.

Item I.6 How would you rate the success of PSIS? The very positive response received for this question (25.4% 'Outstanding' 61.7% 'Good') was very encouraging and reinforced the positive responses regarding enhanced participation and attendance

Item I.7 Would you like to include PSIS in your next course? This was the key question of the instrument. Positive response by nearly 86% instructors expressing their approval and intention of including PSIS in their next course not only re-validated the results shown in Fig. 1.6 but also endorsed the overall value of PSIS.

Would you like to include PSIS in your next course?
63 responses

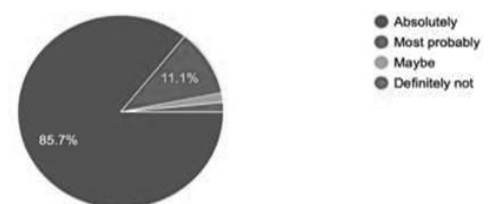


Fig.3 : Item I.7- Would you like to include PSIS for another unit or in your next course

Item I.8 – To what extent the set learning outcome was achieved: Responses to this item were fairly surprising. Although most groups completed and submitted assignments, most instructors (64%) were unsure whether the set outcomes were achieved. Only 22% faculty confirmed that the set outcome was achieved while approx. 14% faculty were sure that the set outcome had not been achieved. As one question

from the content identified for PSIS is to be included in the final exam, the instructors will be in a better position to assess the achievement of set outcome/s as well as to plan any modifications to the tasks set for PSIS. Item I.9 - PSIS helped me to save time: Responses to this item were also very encouraging: 26% instructors chose “strongly agree” and 58.7% chose “Agree”. This was in spite of the fact that nearly 15% instructors misunderstood the evaluation process for PSIS and scheduled in-class presentations for the groups and that ate away a lot of time.

Item I.10 - Constraints faced while implementing PSIS: Most responses to this item were very honest and reflective. Main issues recorded included: flawed planning, late start by some groups; misreading of instructions, struggling to complete the assignments in time, poor quality of assignments, and incidents of plagiarism. Clearly, there is scope for much improvement in the planning and implementation process.

B. Results obtained from Instrument II (Student Feedback)

This instrument was used to collect feedback from 2865 students from 63 classes. The analyzed results are discussed below.

Item II.1 - PSIS helped me to master the identified content: A very high %age of students confirmed PSIS' role in giving an in-depth understanding of the content even though some groups were unable to successfully complete the assigned task.

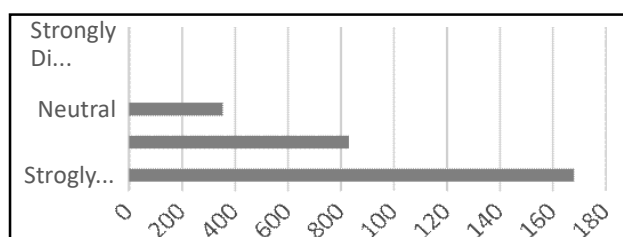


Fig.4 : Item II.1 - PSIS helped me to learn the content better

Item II.2 – Assignment tasks were well-designed: Responses to this question were mixed and many respondents registered their dissatisfaction. Under Item II. 6, they provided more detail about the types of constraints they faced mainly because of poor design of tasks and incomplete or faulty instructions provided by instructors.

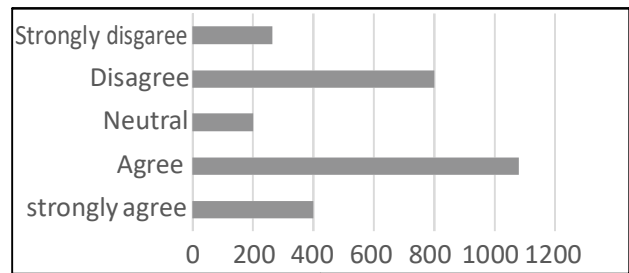


Fig. 5 : Item II.2 - The Assignment Tasks were well-designed

Item II.3 – Working online with my peers was enjoyable: This is perhaps the most significant feedback in favour of PSIS. These numbers (76.7% 'Strongly Agree'; 11.8% 'Agree'; 3% 'Neutral' and 9.2% 'Disagree') become very significant considering that i) PSIS was conducted online, ii) students had never done any independent study, and iii) they had little to no prior experience of working collaboratively. These figures confirm the impact PSIS in promoting cognitive as well as emotional engagement.

Item II.4 - PSIS helped me to gain confidence as a learner: Responses to this question were quite surprising. A large number of respondents seemed undecided (33.8 % 'Neutral'). Indirectly, it highlights the lack of exposure to self-evaluation and reflective exercises that strategies like PSIS can help to inculcate.

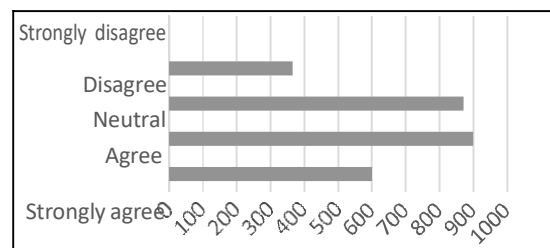


Fig. 6 : Item II.4 – PSIS helped me to gain confidence

Item II.5 - I would like to repeat this activity in this or another course: This question was intentionally included in both instruments to get instructors' and students' perspective. The overwhelmingly positive response showed that students, like the instructors, saw PSIS as a valuable addition to regular class instruction.

Item II.6 - Constraints recorded by students while completing PSIS: Constraints recorded in responses in this segment related to lapses by instructors as well as by students. Instructors were held responsible

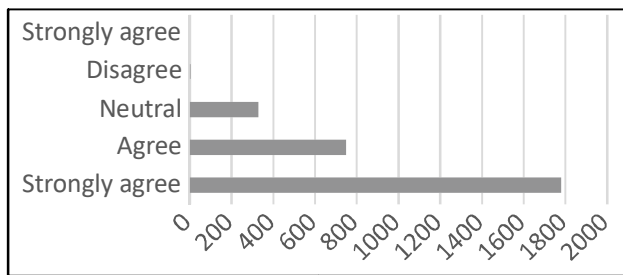


Fig.7: Item II.5 – Would you like to repeat this activity in this or another course?

for incomplete or confusing instructions; poorly designed assignment tasks, poor planning of time required to complete assignments. Students fell short in effective management of learning materials and CANVAS, and timely completion of assigned tasks. This feedback is very valuable for instructors for future planning and implementation of PSIS.

6. Conclusion

Responses received from Instruments I (63 instructors) & II (2865 students) provide sufficient evidence endorsing PSIS as an effective strategy for achieving both objectives of enhancing student engagement and optimizing class instruction time.

For objective 1 - Enhancement of Student Engagement - PSIS was found effective in enhancing student engagement at all three levels – cognitive (items I.9; II.1 & II.5), emotional (items I.2; I.6; I.7; II.3 & II.5), and behavioral (items I.3; I.4; I.6). A high percentage of participating students found the entire learning experience more interesting and meaningful.

For Objective II - Optimizing Class Instruction Time - results were also positive but a little less impressive. One reason could be the loss of time incurred by approximately 15% instructors by planning in-class presentations as the assessment for PSIS (as opposed to evaluating them online).

If planned and implemented as per design, PSIS can prove invaluable for both the instructors (in optimizing their classroom instruction time) and the students (in becoming more engaged and moving towards sustained investiture in their own learning).

Future Work

Even though both the instructors and the students found the PSIS model viable and valuable, and expressed eagerness to see it being incorporated into

their regular coursework, yet, constraints listed by instructors (item I.10) and students (item II.6) show that further work is warranted in refining the PSIS model specially in the areas of designing tasks from the identified content and designing assessment. Moreover, other related aspects such as the impact of PSIS in enhancing i) student motivation, and ii) student academic performance would be rich and ripe areas for further investigation.

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