

Outline Notes, Student Retention and Achievement During the 2020 Online Lectures

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Abstract: This paper evaluates the outcomes of the teaching initiatives implemented in March 2020 when lessons transitioned from the classroom to the Internet due to the health crisis. They are concerned with delivering an introductory Analogue Electronics course to first-year engineering students. The strategies included partial instructor-provided (pi-p) notes, recorded video lectures, and continuous assessment through phase exams. The evaluation of these initiatives was based on student performance and survey data. Although students reported satisfaction with the partial instructor notes, participation in the phase exams declined towards the end of the semester. Despite this decline, the overall student pass rate and average marks increased in 2020 compared to the previous academic year when teaching and assessment were conducted in person. The overall picture highlighted the absence of an effective mechanism for retaining class participation. Reflecting on the collected data, the course's managing team planned an educational intervention for the 2020-2021 academic year to ensure consistent improvement. The feedback from the 2020 course delivery served as a foundation for designing a new remote teaching process which improved student achievement in 2021.


1 INTRODUCTION


The sudden transition from in-person to online teaching during the COVID-19 hygienic crisis posed significant challenges in engineering education, superseding those that appeared in previous crises (Gelles et al., 2020). Students and instructors struggled with increased workload, inappropriate learning environments, and communication difficulties (Manierre et al., 2022; Simonova et al., 2023; Vukašinović et al., 2023).


The sudden shift from classrooms to online platforms in March 2020 raised concerns about increased student passivity during classes (Krapf & Pfefferkorn, 2022; Photopoulos et al., 2021; Photopoulos & Triantis, 2022). In the remote environment, students were challenged to decide which part of the teaching was important enough to note and what could be skipped (Krapf & Pfefferkorn, 2022). During synchronous online lectures, students had to simultaneously pay attention, understand the


material, process information, and take notes—often at a fast pace (Wong & Lim, 2023). While note-taking is linked to higher attentiveness and academic achievement (Credé et al., 2010; Mathews, 2021) it can also overwhelm students, who usually end up copying mechanically from the board or screen without understanding (Freitag, 2020). Note-taking is far more demanding than simply listening and jotting down a few words. As a result, less engaged students often avoid it altogether.

Quality note-taking increases students' connection to teaching and learning. However, big auditoria and remote classes increase the likelihood of students feeling neglected and marginalised, avoiding in-depth cognitive activities and taking poor notes (Freitag, 2020; Gao et al., 2024; Krapf & Pfefferkorn, 2022). Given these challenges, partial instructor-provided notes were a solution to assist students in note-taking and remaining cognitively engaged during remote classes.

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1.1 Partial Instructor-Provided Notes

As Partial instructor-provided (pi-p) notes assist the students in making quality notes (Fang et al., 2022). Pi-p notes vary in the level of structure and guidance they provide to the student. In STEM courses, they may focus on concepts and definitions or applications and problem-solving. Pi-p notes enhance students' engagement and concentration during lectures, reducing unnecessary writing and enhancing encoding, assimilation and production functions (Biggers & Luo, 2020; Feudel & Panse, 2022; Freitag, 2020). While these benefits are visible in any teaching mode, they are more pronounced in face-to-face environments. The students report more organised notes that are easier to take when using pi-p notes. Additionally, because they have fewer writing responsibilities, they are more relaxed, and they can exercise their understanding and critical faculties (Chen et al., 2017).

Outline notes contain blank spaces for students to fill in through free note-taking, making them suitable for activity-oriented teaching environments. One of the authors used the Logbook, a particular type of outline notes, during in-person classes for over five years to deliver an eighth-semester course, "Nanoelectronic Devices." During this time, student retention and examination pass rates remained consistently satisfactory. The Logbook effectively orchestrated students' activities, fostering understanding and engagement during in-person classes (Blyth, 1994; Huang et al., 2024). The quality of teaching materials and classroom social dynamics were the critical success factors for active learning (Fang et al., 2022).

1.2 The Logbook and the Class

As an instructional material, the Logbook breaks down "theory" into a series of carefully designed questions, reducing the professor's monologue and emphasising collaboration for learning and understanding. During a typical in-person class with the Logbook, students worked in groups (Ben Ammar & Minalla, 2024) to complete the Logbook tasks. The instructor/facilitator patrolled the room, listening to student discussions and, when necessary, intervening and guiding the students in the learning process. Interaction between groups was encouraged. Occasionally, the teacher asked students from one group to explain their answers to the whole class. In this way, the groups could compare their answers and resolve any contradictions. The Logbook transformed lectures into learning and understanding sessions

articulating learning and understanding in the present time instead of postponing it to the future (Blyth, 1994).

1.3 The Sudden Online Transition

During the academic year 2018-2019, the course was delivered through traditional lectures, but student retention and pass rates were lower than expected. The success of the Logbook in "Nanoelectronic Devices" inspired its adoption for Electronics, a compulsory first-year course. The first part of the Logbook was available to the students two weeks before the pandemic broke out. However, when lectures transitioned online in March 2020, the interactive nature of Logbook-based classes faced significant challenges.

Creating groups on the online teaching platform initially seemed a viable solution. Soon, it became evident that the collaboration among students working in isolated groups, without direct teacher support, created confusion and questions. Most importantly, it diminished the opportunity to openly discuss good and less good ideas. Learning and understanding during classes depend on students taking learning into their own hands and developing a community of learners where the teacher's role as a source of knowledge is less crucial than in ordinary lectures (Freire, 2021; Servant-Miklos & Noordegraaf-Eelens, 2021). However, the online environment hindered this dynamic.

Faced with limited options and under time pressure, using the Logbook was left to the student's discretion (Fabian et al., 2024). To support student learning, video lectures, additional instructional material in the form of solved problems, and free access to a simulation program were implemented. The students had the option to participate in a continuous assessment scheme comprising seven phase exams. Prior to these exams, the lecturer organised meetings on the online teaching platform where the students worked independently to compile questions and direct them to the tutor. Students who did not pass a phase exam could retake the test.

How did the Logbook impact students' engagement and achievement when in-person communication was impossible? To answer this question, the present study stated the following objectives:

To examine students' perception of the Logbook during the 2020 remote synchronous lectures.

To examine the Logbook's impact on student achievement and retention.

To propose improvements concerning the Logbook and the instructional method for future courses.

2 METHODS AND MATERIALS

Students' attitudes toward the Logbook as instructional material were recorded using a 17-item Likert-type questionnaire, including one text question, in which the students had the opportunity to express their views on the Logbook. The data were collected in May 2020. Data on students' performance were collected from the course records.

3 RESULTS AND DISCUSSION

Sections 3.1 and 3.2 present the research findings regarding students' perceptions of the Logbook during the 2020 remote synchronous lectures derived from a survey.

3.1 Quantitative Research Findings

Sixty-four students responded to the survey. Nineteen per cent of the participants were female, and 81% were male. According to the survey results, the students found the Logbook to be a valuable tool for note-taking, supporting active engagement during remote lectures and enhancing their learning experience. A large majority (84%) expressed a positive overall view of the Logbook as instructional material. Over 80% of the students agreed that with the Logbook, note-taking was straightforward; their notes were well organised, coherent, easy to understand and easy to study.

In addition to note-taking, using the Logbook helped the students improve their confidence as learners, with 90% agreeing that during the lectures, they felt like active participants and stopped being passive listeners. Moreover, 77% of the participants disclosed that they could rely on their notes for exam preparation, indicating that the Logbook facilitated independent studying. Sixty-seven per cent stated that the Logbook "forced them" to remain engaged with note-taking.

Furthermore, 94% appreciated the time and energy saved by the Logbook's provision of graph templates and problem texts, which allowed them to remain focused on the lectures. However, only 55% of the participants agreed that the Logbook helped them avoid distractions and stay focused throughout the lectures. Opinions were divided regarding the

Logbook's effectiveness in identifying key lecture points, with 37% agreeing that the Logbook provided a good overview of these points and 40% disagreeing. The Logbook was well-received as an instructional tool, with 65% expressing interest in expanding its use in other courses.

Criticisms about the Logbook received little support. Only 4% believed it restricted teaching, and just 7% considered it made remote lectures dry and standardised. A substantial majority (83%) disagreed with the idea that the Logbook was unsuitable for higher education, and 93% disagreed with the assertion that it was overly controlling or insulting to university students.

3.2 Findings from the Text Answers

Twenty survey participants submitted text responses that resonated with the satisfaction expressed in the survey. Two students declared they used the anonymity of the survey to express their gratitude to the tutors. The comments received were organised in the following categories: Engagement, participation, and Learning; Structure and Organisation; The pace of teaching and learning; The balance between theory and applications; and Practical Orientation.

3.2.1 Engagement, Participation and Learning

The comments emphasised the Logbook's role in enhancing student engagement and participation in the lectures, understanding of the material, reducing stress and cognitive overload and overall effectiveness compared to traditional lectures.

The participants found that the Logbook facilitated active participation, with one noting, "The Logbook assisted my participation in the lectures," while another emphasised, "I remained active for longer." They also explained that it helped them remain focused despite fatigue or home distractions. One student remarked, "It helped me remain concentrated, even when I was tired," and another highlighted, "It helped me to overcome the disturbance of home noise or emails."

The Logbook helped students understand the material, with one student mentioning, "It improved my understanding of the course content," while another stated, "My understanding of the course improved as lectures proceeded." The Logbook's structure made it easier to follow the lectures and prevented students from feeling lost, with one student noting, "It helped me not to get lost during the remote

lectures." Students characterised the Logbook as a "smart" and "excellent" idea.

Furthermore, the Logbook reduced stress and cognitive overload. It minimised unnecessary handwriting and allowed students to focus on problem-solving. One student expressed relief, stating, "I did not have to write long texts because most were already written. I saved time for thinking." Another referred to the advantage of using structured notes instead of looking at the PowerPoint slides, noting, "The Logbook is much better than the whiteboard or the screen, which is boring and difficult to understand."

Students also found the Logbook to be a more effective way of presenting the course material, with one explaining, "It is a much smarter way to present the material than the PowerPoint presentations." The Logbook's structured approach helped students who struggled with concentration; one participant remarked, "It motivated the students who have difficulties concentrating for longer periods." The Logbook improved students' problem-solving skills, with one student enthusiastically sharing, "I learned how to solve problems in electronics!!". Another student suggested its broader adoption, "Excellent idea! It would be nice if used in other courses."

3.2.2 Structure and Organisation

The participants valued the Logbook's structure and its role in reducing stress while helping students engage more effectively with synchronous remote classes. They noted that the Logbook made the course structure explicit, allowing them to understand its flow. One participant remarked, "It made the structure of content explicit". Additionally, the high degree of structure provided a sense of security because it was easier to identify key points. The Logbook was praised for offering a "complete picture of the course material," which helped prevent feeling overwhelmed. Students also appreciated the Logbook's "rigid set-up" because it guided them to discover answers independently. Three students mentioned that it improved the quality of their notes and class attendance. There were also suggestions for improving the Logbook's organisation, by numbering all sections and subsections. Students noted that they would prefer to have the entire document at the beginning of the course to maximise its benefits. Overall, students felt that the Logbook aided their engagement with learning.

3.2.3 The Pace of Teaching and Learning

The participants expressed mixed feelings regarding teaching speed when using the Logbook. On the one hand, they appreciated the fast flow, stating that the fast pace of the lectures allowed for covering the entire material and exercises: "The Logbook goes much faster, and that is probably why it has worked well". On the other hand, some students found the fast pace challenging to follow, and one student noticed, "Because of the speed, I lose contact". They also referred to the difference between ordinary teaching and Logbook teaching, with one student commenting that "There was more time to think and understand compared to the classroom." For some students, it was challenging keeping up with note-taking: "I had to write mechanically to have time to catch the next exercise." Overall, the Logbook facilitated a faster and more structured learning experience. However, some students considered that it was not easy to fully engage and absorb the material because of the fast pace of teaching. One student explained that s/he addressed the problem of fast pace by visiting the videos uploaded on the internet. To accommodate the divergent learning needs, instructors should consider incorporating strategic pauses for reflection.

3.2.4 The Balance Between Theory and Applications

The Logbook became the essential learning material, and some respondents have requested a greater emphasis on theory. They commented that the Logbook could include "a special section on theory", "more extensive presentation of theory", and "more emphasis on understanding theory". Some students asked for a more balanced presentation of theory next to applications, with one student commenting, "The theory would be better if it were written in boxes".

3.2.5 Practical Orientation

The participants appreciated using specification sheets during lectures to emphasise the practical aspect of electronics. Some participants valued real-world application-oriented knowledge, stating, "I enjoyed learning practical things, e.g., how to use specification sheets". Overall, the students valued the Logbook for providing practical insights, noting that specification sheets "helped in understanding certain practical things."

The quantitative findings revealed that students generally perceived the Logbook positively. However, four specific items indicated areas requiring improvement. For example, only 37% of

participants agreed that the Logbook effectively highlighted the most important points of the lectures. Similarly, just 55% felt it helped them stay focused during lectures. Additionally, around 65% reported that the Logbook encouraged them to take notes or wanted to see it used in other courses.

On the positive side, in the text answers, the students appreciated the structure and organisation the Logbook brought into their learning. They also highlighted its positive impact on their learning and problem-solving abilities and noted that it helped them cope with the disturbances of the remote environment and remain concentrated during the lectures. They also valued the emphasis given by the Logbook on practical knowledge.

On the negative side, the students criticised the fast pace of the course, although they recognised its positive effect on covering the entire material. There were also complaints regarding the inadequate emphasis given by the Logbook on theory and theory-related tasks. Overall, the research findings indicate that the Logbook was a helpful learning tool for the students, but its integration into the course and its content required interventions for the following year.

3.3 Student Performance

Despite students' satisfaction with the Logbook, the course delivery did not yield satisfactory results. Over time, participation in class sessions and phase exams declined. Out of 69 students who took the first phase exam, only 28 completed all subsequent tests (Table 1). Similarly, views of the recorded video lectures decreased by 50% within 4 weeks, with occasional spikes occurring only before exams.

Table 1: Phase Exams 2020.

Phase exam	N students	Highest mark	Lowest mark	Average mark
Electronic Circuits 1	69	90	0	64
Electronic Circuits 2	55	100	0	64
Diodes 1	50	100	0	48
Diodes 2	42	100	0	42
BJT 1	51	93	18	62
BJT 2	43	90	0	41
FET	28	72	24	49

Overall, student retention and pass rates in phase exams were below expectations. The researchers focused on the text responses to identify points of improvement to increase success rates and student retention during lectures.

A comparison of the success rates in "Electronics" between 2019 and 2020 shows that in 2020, the success rate nearly doubled (Table II). This improvement can be attributed to the introduction of

the Logbook in 2020. However, it is important to note that this comparison is not entirely reliable since, during 2019, both lectures and exams were conducted in person, while in 2020, they were held remotely (Chirumamilla et al., 2020; McMurtrie, 2024; Noorbehbahani et al., 2022).

Furthermore, when comparing the success rates of the 2019 "Electronics" course, delivered through ordinary lectures, with those of the "Nanoelectronic Devices" course, delivered using a Logbook, the advantages of the Logbook classes become evident. However, this comparison is less trustworthy because "Electronics" is a first-year course, and first-year students are in a transition period, making comparisons less reliable and a direct conclusion regarding the effectiveness of the Logbook obscure.

The transition effect becomes more prominent when comparing the 2020 success rates between "Electronics" and "Nanoelectronic Devices" both delivered using a Logbook. The success rate for "Electronics" is 33% lower than that for "Nanoelectronic Devices". Using the success rates in "Nanoelectronic Devices" as a benchmark, it becomes clear that there was significant room for improvement in using the Logbook in Electronics, making the need for interventions more urgent.

4 REDESIGNING THE LOGBOOK CLASSES FOR 2021

Based on students' comments, the researchers decided to redesign the course to increase student retention, well-being and success rates (Setia & Tichy, 2024). The objective was to reverse the 2019 pass-fail rates (40% pass—60% fail) despite the adverse conditions resulting from the lack of in-person communication. The course's managing team redesigned the Logbook and the whole course process (Griffiths & Dickinson, 2024).

Following students' recommendations, the Logbook was redesigned on two pillars: more emphasis on theory and theory-related questions and more emphasis on practical knowledge, introducing a circuit design assignment at the end of the course. The new Logbook version included a) Multiple-Choice tests and 'fill the blanks' exercises focusing on concepts and applications close to "theory", e.g. explaining the 0.7 Voltage drop across a diode, the role of the emitter feedback resistor, input-output impedance measurement circuits and device operation b) Emphasis on electronic circuit design rather than circuit calculations c) The content was

structured by circuit topology, instead of the type of analysis d) All questions and exercises were numbered e) The space between exercises increased f) The whole Logbook was made available before course commencement.

Table 2: Average Marks and Success Rates 2019-2021.

Year	Electronics		Nanoelectronic Devices	
	Success Rate (%)	Average Grade	Success Rate (%)	Average Grade
2019 (in-person)	21.0*	27*	73	61
2020 (remotely)	40.2	41	64	51
2021 (remotely)	76.6**	60**	73**	59**

* No – Logbook, ** Submitted Notes

To emphasise the importance of quality note-taking, it was decided to upgrade student notes to in-class assignments. At the end of each lecture, students would make an electronic copy of their notes and upload it to the Learning Management System as an in-class assignment. The instructor would review the submitted material, providing both numerical and written feedback. Grading the class assignments would be based on the following criteria: completeness of the notes, originality of solutions and quality of explanations. The average grade from 12 or more submitted assignments would contribute 20% to the final mark, provided the student has passed the phase exams. This approach had four objectives: 1. To motivate students to take quality notes, 2. to allow the tutor to monitor students' daily progress, 3. to identify misconceptions and points needing further elaboration, and 4. to establish a non-verbal communication channel between each student and the tutor.

During the last three weeks of the semester, students would form groups of two or three to complete a group project on designing a 3-stage audio amplifier. The Design Project would contribute to the final grade by 20%, provided that the student has obtained a passing mark in the phase exams.

The number of phase exams was reduced to four, and the total marks (10) would be distributed across multiple assessment components. The average mark of the phase exams would account for 60% of the final grade. Additionally, class assignments and the design project would each contribute 20% to the final grade.

Redesigning the Logbook and the course process and, most importantly, establishing frequent communication between each student and the tutor positively affected students' retention, participation and performance. In 2021, students' achievement improved matching those of the students attending the "Nanoelectronic Devices" course (Table II).

5 CONCLUSIONS

This study indicates that effective in-person teaching practices remained relevant during the online shift in 2020, although their results were less satisfactory. The any-time-any-place convenience undermined the class as a collective, putting student retention and participation at stake. However, personally motivated and capable students could leverage the available learning resources for better performance.

Pi-p notes are beneficial instructional material for online lectures. They provide structure and organisation for independent study and help the persistent students remain engaged with learning. However, without proper accountability mechanisms in place, their effectiveness remained limited. Submitting student notes to the instructor and receiving feedback is an effective accountability mechanism, resulting in improved student retention and performance.

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