Enhancing Student Performance through Smart Classrooms

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Abstract: *This study aims to assess the efficacy of Smart Classrooms in enhancing teaching and learning at UiTM. A comparative analysis was conducted between students utilizing Smart Classrooms and those engaged in conventional learning settings across UiTM campusses. The study encompasses a total of 5046 students from various campuses. The results reveal a noteworthy disparity in the first semester, with students in Smart Classrooms achieving an average CGPA of 3.358, compared to 3.222 for conventional classrooms. Similarly, in the second semester, Smart Classroom students attained an average CGPA of 3.34, whereas conventional classrooms record an average of 3.217. However, the intricate nature of individual Smart Classrooms, incorporating diverse technologies, and the academic staff's adoption of multifaceted teaching methods, driven by contemporary technological capabilities, warrant a more comprehensive investigation.*

1. INTRODUCTION

Smart Classrooms represent technologically enhanced learning environments that facilitate effective teaching and learning by seamlessly integrating resources like computers, specialized software, audience response technology, assistive listening devices, networking, and audio/visual capabilities. This analysis focuses on monitoring the utilization of Smart Classrooms across all UiTM campuses in alignment with the evolution of pedagogy to cater to the demands of emerging technologies and the Gen-2 learning approach. Furthermore, the Smart Classroom infrastructure serves as a pivotal component in elevating the academic stature of the university, contributing to the vision of UiTM, which is to become a globally recognized institution. It does so by enhancing the proficiency of educators in delivering content through innovative methods and nurturing well-rounded students. This concerted effort ultimately bolsters graduate employability and positions UiTM as a distinguished academic entity.

2. PROBLEM STATEMENT

Despite the availability of Smart Classrooms for academic staff, their utilization remains limited due to scepticism among many educators. This scepticism stems from the belief that varying learning environments, such as Smart Classrooms, may not exert a substantial influence on student performance.

3. OBJECTIVE

The first objective of this study is to assess and evaluate the academic performance of students through the utilization of Smart Classrooms. Second, to monitor the effectiveness of smart classroom training provided to the academic staff towards the teaching & Learning delivery.

4. LITERATURE REVIEW

Smart classrooms have been recognized as a valuable tool for improving student understanding and performance. Several studies have highlighted the positive impact of smart classrooms on various aspects of education. One key influencing factor on college students' higher-order thinking skills in the smart classroom environment is the stimulation of learning motivation and promotion of active learning (Lu et al., 2021). The smart classroom environment can enhance students' engagement and academic performance. Additionally, the infusion of technology into pedagogy in smart classrooms has the potential to further improve student achievements (Yang et al., 2018). Future research can explore the alignment of technologies, pedagogies, and smart classrooms to optimize student outcomes.

The architecture of smart classrooms also plays a crucial role in enhancing student understanding and performance. A context-aware smart classroom architecture can create a conducive learning environment and contribute to positive learning outcomes (Huang et al., 2019). However, it is important to address technology-related problems that may cause user dissatisfaction and hinder the effectiveness of smart classrooms. Information literacy is another area where smart classrooms can make a significant impact. Researchers and education practitioners should investigate the effect of smart classrooms on improving students' information literacy skills (Yu et al., 2022).

Furthermore, the tangible interactive interface in smart classrooms can improve students' social skills and learning ability (Su, 2021). The flexibility of smart classrooms allows for the stimulation of students' learning motivation and the promotion of active learning behavior, leading to better learning performance (Li et al., 2015).

Empirical evidence supports the effectiveness of smart classrooms in teaching and learning (Phoong et al., 2019). However, it is worth noting that some research suggests that the use of technology may not always influence students' performance. Therefore, further investigation is needed to understand the specific conditions under which smart classrooms can have a positive impact on student outcomes. Different teaching modes within smart classrooms have also been explored. The application of smart flipped classrooms (FC) has shown promise in improving students'

knowledge and skills, engagement, and self-efficacy (Wang & Liu, 2023). Additionally, the use of smart classrooms in specific subject areas, such as financial accounting, has been found to enhance a teacher's teaching effectiveness (Dai, 2019).

These new approaches altered classroom interactions, rendering students more active and participative in a classroom. Given these changes and the seamless integration of technologies to complement teaching, it makes no sense to continue utilizing traditional 2018). In a similar research, Zhonggen and Wang (2016) used the FC model to determine its effectiveness in English writing courses, and the results showed that students scored higher relative to students in the control group, who were taught using traditional methods. Contrarily,

Edu comp Smart class room for teaching Mathematics in elementary schools using a sample of 40 students and indicated that the academic performance exceeded that of the control group Chachra (2015) compared the academic performance of students in traditional and smart classrooms, and the results showed that technology attracts students and they prefer smart classrooms.

The results supported previous research highlighting the effectiveness of smart classrooms for teaching and learning (Kumari & Denisia, 2013; Malik & Shanwal, 2017; Zengin, 2017), while contradicting research indicated that the use of technology does not i performance (Cabi, 2018). This shows that using technology in different contexts and settings can result in different outcomes, suggesting that the successful use of technology for teaching and learning rely on many other factors, such as familiarity of the students and instructors with the technology, attractiveness of the course for the students, student engagement, and the process of exploration and knowledge sharing between the instructors and students.

In conclusion, the literature supports the notion that smart classrooms can contribute to improving student understanding and performance. The stimulation of learning motivation, promotion of active learning, enhancement of information literacy, and the flexibility of smart classrooms all play important roles in achieving positive learning outcomes. However, further research is needed to explore the specific conditions and teaching modes that maximize the benefits of smart classrooms.

5. UITM SMART CLASSROOM

UiTM has strategically established 14 Smart Classrooms across each of its campus branches in Malaysia. These technologically advanced learning spaces are equipped with essential infrastructure, including a dedicated internet network and strategically placed display panels in every corner of the room. This configuration allows for optimal visibility and engagement, accommodating a group of 20 to 30 students in each session. Central to the Smart Classroom concept is the "Bring Your Own Device" (BYOD) philosophy. Unlike traditional computer labs, Smart Classrooms do not provide individual computers for students. Instead, students and instructors are encouraged to bring their personal devices, such as laptops, tablets, or smartphones, that align with their specific learning and teaching needs. This approach recognizes the diversity of technological preferences and requirements among the academic community.

One of the standout advantages of the Smart Classroom model is its seamless integration of technology into the learning experience. A notable feature is the utilization of the MirrorOp application, which empowers students to share content from their devices onto the display screens. What sets this system apart is its ability to foster collaborative content sharing on a much larger scale. In conventional settings, content sharing might be limited to a single screen. However, within the Smart Classroom environment, this application enables content to be simultaneously displayed across all screens, maximizing visual engagement and promoting active participation. This innovative approach transcends traditional teaching methods by harnessing technology's potential to create a dynamic and interactive learning environment. It not only encourages students to actively contribute to discussions but also facilitates a multifaceted exchange of ideas among peers. The Smart Classroom's emphasis on collaborative technology usage aligns with contemporary educational trends, where digital fluency and cooperative learning are highly valued.

In essence, UiTM's implementation of 14 Smart Classrooms signifies a forward-looking approach to education that capitalizes on technology's transformative capabilities. By providing students and instructors with a collaborative platform that promotes versatile content sharing and engagement, these Smart Classrooms contribute to fostering a more interactive and enriched learning experience.

Plate 1: Student Presentation

Plate 2: Student Review

Plate 3: Student Discourse

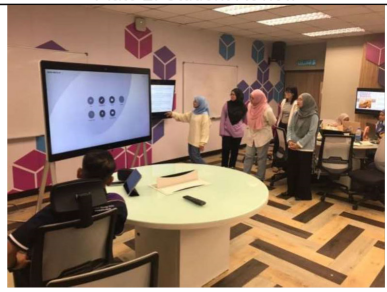

Plate 4: Student Self-Reflection

Plate 5:Smart Classroom @ Arif 1

Plate 6: Smart Classroom @ Arif 2

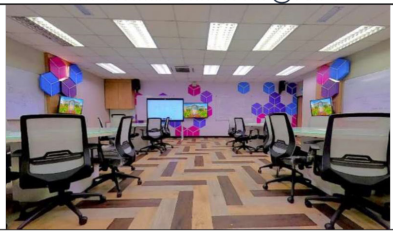

Plate 7: Smart Classroom @ Arif 3

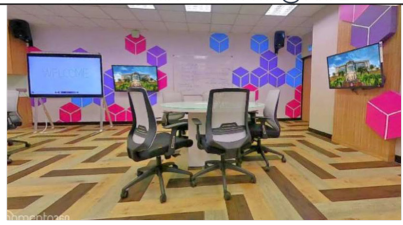

Plate 8: Smart Classroom @ Arif 4

Plate 9: Smart Classroom Training 1

Plate 10: Smart Classroom Training 2

Plate 11: Smart Classroom Training 3

Plate 12: Smart Classroom Training 4

Plate 13: Smart Classroom Training 5

Plate 14: Smart Classroom Training 6

6. METHODOLOGY

This descriptive study aimed to assess the disparities in academic performance between students and instructors who engaged in smart classroom learning. It involved 18,732 students who received instruction from faculty who had completed smart classroom training and 39,895 students taught by instructors who did not participate in CIDL's smart classroom training program. Student achievement was evaluated based on GPA and CPGA over two semesters, spanning the 20192 and 20194 academic sessions, encompassing a one-year duration.

7. RESULTS

This comprehensive study encompassed 784 lecturers, 58,627 students, 21 faculties, 112 programs, and 328 courses. Below, you will find specific information regarding the faculties and lecturers engaged in Smart Classroom training for enhanced learning.

Faculty	Percent Attend Smart Classroom Training (%)	Percent not attend Smart Classroom Trainng (%)
Academy of Language Studies	48.99	51.01
Arsyad Ayub Graduate Business School	100	0.00
Faculty of Hotel & Tourism Management	73.92	26.08
Faculty of Pharmacy	45.85	54.15
Faculty of Civil Engineering	27.67	72.33
Faculty of Mechanical Engineering	32.26	67.74
Faculty of Communication & Media Studies	0.00	100
Faculty of Plantation & Agrotechnology	32.18	67.82
Faculty of Information Management	43.13	56.87
Faculty of Business Management	33.84	66.16
Faculty of Accounting	25.71	74.29
Faculty of Applied Sciences	29.56	70.44
Faculty of Health Sciences	67.86	32.14
Faculty of Computer & Mathematical Sciences	26.69	73.31
Faculty of Administrative Science & Policy Studies	33.10	66.90
Faculty of Sports Science & Recreation	100	0.00
Faculty of Architecture, Planning & Surveying	28.73	71.27
Faculty of Art & Design	36.74	63.26

Figure. 1 The proportion of instructors who completed smart classroom training

The following data outlines the number of students engaged in smart classroom learning, along with a distinction between lecturers who have undergone training in smart classroom methods and those who have not. Additionally, it includes students who do not utilize smart classrooms for their learning. This comparative analysis is conducted within the context of the same course, featuring various lecturers and instructional approaches.

Lecturers Participation in the smart classroom training	Numbers of Students	Percentage of Students (%)
Lecturer Participated	18, 732	68.05
Lecturer not Participated	39, 895	31.95
Total	58, 627	100

Figure. 2 Lecturers Participation in The Smart Classroom Training

This statement presents a comparison between the number of students participating in learning activities within smart classrooms and those who are not utilizing this modern educational technology. In detail, it reveals that there are 18,732 students who are actively engaged in educational activities within smart classrooms. These classrooms likely feature technology enhancements, such as digital tools, interactive displays, and online resources, to facilitate and enhance the learning experience. On the other hand, there are 39,895 students who are not participating in learning through smart classrooms. This suggests that they are a likely part of traditional classroom environments that do not incorporate these advanced technological features or are using conventional teaching methods. In essence, this statement highlights the contrast between the two groups of students, one benefiting from the advantages of smart classroom technology and the other following more conventional educational approaches.

Faculty	Percentage of Students (%)
Academy of Language Studies	51.01
Arsyad Ayub Graduate Business School	0.00
Faculty of Hotel & Tourism Management	26.08
Faculty of Pharmacy	54.15
Faculty of Civil Engineering	72.33
Faculty of Mechanical Engineering	67.74
Faculty of Communication & Media Studies	100
Faculty of Plantation & Agrotechnology	67.82
Faculty of Information Management	56.87
Faculty of Business Management	66.16
Faculty of Accounting	74.29
Faculty of Applied Sciences	70.44
Faculty of Health Sciences	32.14
Faculty of Computer & Mathematical Sciences	73.31
Faculty of Administrative Science & Policy Studies	66.90
Faculty of Sports Science & Recreation	0.00
Faculty of Architecture, Planning & Surveying	71.27
Faculty of Art & Design	63.26

Figure. 3 The student enrolments participating in the study

Figure 3 illustrates the distribution of students across 18 faculties, encompassing both main campuses and branch campuses. Notably, the Faculty of Communication & Media Studies boasts the highest student enrollment, while the Faculty of Sports Science and Recreation has the lowest student representation in this study.

Faculty	Parcentage of student achieved (%)							
	0-0.5	0.5-1	1-1.5	1.5-2	2-2.5	2.5-3	3-3.5	3.5-4
Academy of Language Studies	0.00	0.00	0.00	0.00	0.68	8.22	47.26	43.84
Arsyad Ayub Graduate Business School	2.22	0.00	0.00	0.00	0.00	0.00	40.00	57.78
Faculty of Hotel & Tourism Management	0.46	0.09	0.37	2.04	11.67	20.56	41.48	23.33
Faculty of Pharmacy	0.00	0.00	0.00	2.97	4.15	21.36	36.20	35.31
Faculty of Civil Engineering	1.43	0.00	1.43	2.86	27.14	34.29	28.57	4.29
Faculty of Communication & Media Studies	0.66	1.32	1.97	1.32	14.47	17.76	34.87	27.63
Faculty of Mechanical Engineering	1.08	3.78	9.19	10.81	20.54	27.57	21.62	5.41
Faculty of Plantation & Agrotechnology	2.89	0.41	0.41	2.89	24.79	33.47	21.49	13.64
Faculty of Information Management	0.32	0.00	0.11	1.18	6.97	30.69	44.42	16.31
Faculty of Business Management	0.23	0.20	0.45	1.80	7.61	23.82	41.27	24.62
Faculty of Accounting	0.25	0.39	0.85	2.77	7.56	18.49	27.57	42.12
Faculty of Applied Sciences	0.05	0.05	0.52	2.79	6.62	31.13	30.32	28.52
Faculty of Health Sciences	0.00	0.00	0.00	0.00	0.00	10.53	44.21	45.26
Faculty of Computer & Mathematical Sciences	0.28	0.28	0.94	3.29	13.40	22.43	32.39	26.99
Faculty of Administrative Science & Policy Studies	0.50	0.63	1.00	4.26	17.92	22.93	35.34	17.42
Faculty of Sports Science & Recreation	3.85	0.00	3.85	0.00	9.62	80.77	1.92	0.00
Faculty of Architecture, Planning & Surveying	0.34	0.00	0.34	1.08	4.93	20.42	45.55	27.34
Faculty of Art & Design	0.18	0.72	0.18	1.44	8.30	20.58	40.43	28.16

Figure. 4 Students performance by faculty

The following data presents the breakdown of student achievement percentages for each faculty within this study, encompassing a total of 58,627 students. Notably, three faculties - Arsyad Ayub Graduate Business School, Faculty of Accounting, and Faculty of Health Science
- stand out with the highest achievement percentages falling within the 3.50 to 4.00 range.

Meanwhile, several other faculties, including the Academy of Language Studies, Faculty of Hotel & Tourism Management, Faculty of Pharmacy, Faculty of Communication & Media Studies, Faculty of Information Management, Faculty of Business Management, Faculty of Computer & Mathematical Sciences, Faculty of Administrative Science and Policies Studies, Faculty of Architecture, Planning & Surveying, and Faculty of Art & Design, achieved the highest percentage in the 3.00 to 3.50 range.

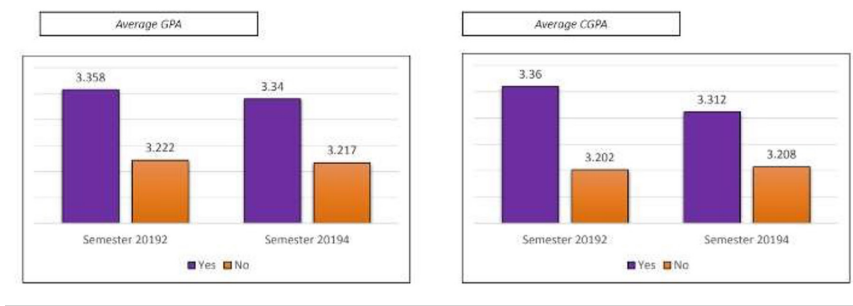

Figure. 5 The contrast in the performance of students and instructors who have undergone smart classroom training

Figure 5 illustrates the variation in student achievement among those taught by instructors who have undergone smart classroom training at Universiti Teknologi MARA. While no drastic shifts are observed, there are noteworthy changes for both semesters. These changes, although not exceedingly dramatic, hold significance. It's important to note that all students are exposed to smart classroom technology to some degree. However, there is a discernible uptick in student achievement when they are taught by instructors who have received more comprehensive training in smart classroom utilization.

In the 20192 semester, students under the guidance of lecturers with smart classroom training achieved an average GPA of 3.358, whereas those taught by instructors without such training attained an average GPA of 3.222. Similarly, in the 20194 semester, students taught by lecturers with smart classroom training achieved an average GPA of 3.34, compared to the 3.217 GPA of students under instructors lacking smart classroom training. Likewise, in the 20192 semester, students under lecturers who had undergone smart classroom training achieved an average CGPA of 3.36, whereas students under instructors without this training achieved an average CGPA of 3.302. In the 20194 semester, students taught by lecturers with smart classroom training achieved an average CGPA of 3.312, while those under instructors without such training had an average CGPA of 3.208.

In conclusion, the emergence of Smart Classrooms as a technological advancement in education holds significant promise for addressing existing challenges and improving learning outcomes. By leveraging technology, innovative teaching methods, and adaptive learning approaches, Smart Classrooms offer a pathway toward a more effective and engaging education system.

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