Cawangan Melaka

PCMJ

Progress in Computing and Mathematics Journal

volume 1

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Progress in Computing and Mathematics Journal
College of Computing, Informatics, and Mathematics
Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin
77300, Merlimau, Melaka Bandaraya Bersejarah

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EDITORS

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PREFACE

Welcome to the inaugural volume of the **Progress in Computing and Mathematics Journal (PCMJ)**, a publication proudly presented by the College of Computing, Informatics, and Mathematics at UiTM Cawangan Melaka.

This journal represents a significant step in our commitment to fostering a vibrant research culture, initially providing a crucial platform for our undergraduate students to showcase their intellectual curiosity, dedication to scholarly pursuit, and potential to contribute to the broader academic discourse in the fields of computing and mathematics. However, we envision PCMJ evolving into a beacon for researchers both nationally and internationally. We aspire to cultivate a space where groundbreaking research and innovative ideas converge, fostering collaboration and intellectual exchange among established scholars and emerging talents alike.

The manuscripts featured in this first volume, predominantly authored by our undergraduate students, are a testament to the hard work and dedication of these budding researchers, as well as the guidance and support provided by their faculty mentors. They cover a diverse range of topics, reflecting the breadth and depth of research interests within our college, and set the stage for the high-quality scholarship we aim to attract in future volumes.

As editors, we are honored to have played a role in bringing this journal to fruition. We extend our sincere gratitude to all the authors, reviewers, and members of the editorial board for their invaluable contributions. We also acknowledge the unwavering support of the college administration in making this initiative possible.

We hope that PCMJ will inspire future generations of students and researchers to embrace research and innovation, to push the boundaries of knowledge, and to make their mark on the world of computing and mathematics.

Editors
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WEB-BASED PERSONAL STUDY HELPER BASED ON LESSON PLAN USING GAMIFICATION

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Article Info

Abstract

Study is defined as the activity or process of learning by reading, memorising facts, attending school, etc. To study effectively, students need to have aids that facilitate their learning process. With technology nowadays, students can use many applications as aids or study tools. However, not all students have the same motivation to learn, which might result in low academic achievement. Students also disengage during their classes and have difficulty understanding the interconnections between concepts. To address these challenges, the research project aims to develop web-based personal study helpers with gamification elements to enhance student engagement, motivation, and comprehension of academic content. Gamification is the use of game elements such as badges, achievements, levels, points, and progress to make learning more interactive. The development project also has a generated mind map for note-taking as the visualisation aids in learning. This project also makes use of the traffic light colour code system for the pending assessment tracking for the students. This project follows the Modified Waterfall Model as its Software Development Life Cycle (SDLC), which has four phases: requirement analysis, design, implementation, and testing. To test the usability of the developed project, it used the System Usability Scale (SUS) questionnaire given to the UiTM students. The result of the SUS score for this project is 64.64, which indicates a moderate level of usability. In conclusion, the gamification elements, generated mind maps, and use of a traffic light colour code system for a pending assessment tracker have been successfully implemented in a web-based application, with all the functionality working as intended. By implementing gamification, this application also successfully increases the engagement of the students and enhances their learning experience.

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Keywords: Study; Motivation; Disengagement; Gamification; Mind Map; Note-Taking; Visualisation; Traffic Light Colour Code; Modified Waterfall Model; System Usability Scale

1. INTRODUCTION

Understanding students' different learning styles and motivations is critical for solving the complex difficulties that arise in higher education environments. With numerous learning styles discovered, ranging from group to visual, kinesthetic to auditory, it is critical to adapt to individual preferences in order to improve learning outcomes (Xing, 2023). However, variations in student motivation levels frequently lead to concerns such as disengagement and, as a result, worse academic performance (Robbi et al., 2020). Motivation, whether intrinsic or extrinsic, drives active participation in academic activities, emphasising its importance in the educational environment (Abu Bakar et al., 2022).

To address these issues and create a conducive learning environment, gamification appears to be a potential technique, as it uses game elements to increase student engagement and boost problem-solving abilities (Sadovets et al., 2022). Furthermore, using this approach with techniques like mind mapping helps improve comprehension and interconnection of concepts, giving students vital tools for effective learning (Mammen & Mammen, 2018; Idris & Kamaruddin, 2018).

The project aims to improve the learning experience for students at Universiti Teknologi MARA (UiTM) by systematically addressing prevalent issues like disengagement, lack of motivation, and difficulties in concept interconnection. The project's approach is based on the use of lesson plans provided by UiTM lecturers, which allows for the development of a personalised learning platform with gamification elements such as badges, levels, points, and progress bar. Furthermore, the platform creates interactive mind maps based on lesson plans, providing students with intuitive visual aids for improved comprehension and concept synthesis. Emphasising web-based platforms for deployment ensures accessibility and scalability, aligning with modern educational trends and technological advancements.

2. LITERATURE REVIEW

Learning problems refer to a variety of challenges that students face during the educational process, which are influenced by personal experiences, cognitive abilities, and environmental factors (Shemshack and Spector, 2020). Learning styles, such as those identified by the Felder-Silverman Learning Style Model, provide details about individuals' preferred approaches to learning, which shape how students learn (Nguyen et al., 2022). Despite these models, students may encounter challenges to their learning progress, such as disengagement, lack of motivation, and cognitive load (Yarmis Syukur et al., 2019; Feldon et al., 2019). Disengagement is defined as withdrawal from the educational process, which is influenced by factors such as challenging experience and psychological well-being (Greener, 2018; Chipchase et al., 2017).

Motivation, whether intrinsic or extrinsic, increases students' commitment and engagement in learning activities, but a lack of motivation may affect academic performance (Filgona et al., 2020; Mauliya et al., 2020). Cognitive load theory highlights the cognitive demands imposed by educational materials, distinguishing both intrinsic and extrinsic cognitive load as important elements affecting learning outcomes (Duran et al., 2022; Krieglstein et al., 2022). Addressing these problems is critical for developing effective learning solutions and improving student learning experiences in a variety of educational environments.

Learning aids include a variety of materials and approaches for improving learning and knowledge retention (Kwantlen Polytechnic University, 2023, May 19). These aids include collaborative learning, time management, self-testing, note-taking techniques such as the outline, Cornell, and mind mapping methods, as well as the traffic light colour code system (Suleman et al., 2019; Van Leeuwen & Janssen, 2019; Yen et al., 2023).

Collaborative learning encourages students to discuss and solve problems, whereas effective time management increases productivity and achieves objectives (Van Leeuwen & Janssen, 2019). Self-testing allows for active recall and the discovery of knowledge gaps (Vaughn et al., 2021), while note-taking methods help to organise and summarise information (Yen et al., 2023). Furthermore, the traffic light colour coding system acts as a visual indicator to convey urgency or status. These tools are critical for aiding students' learning processes and enhancing academic achievements.

Technology in learning refers to a variety of digital technologies and resources used to enhance education (Haleem et al., 2022). Gamification, game-based learning (GBL), and augmented reality (AR) are three major technologies in this sector. Gamification combines game elements with learning to increase engagement and motivation (Sadovets et al., 2022). Badges, points, levels, and progress bars are common features of gamification (Dicheva et al., 2020; Oktaviati & Jaharadak, 2018).

GBL uses games to help students learn and solve problems while also developing critical thinking skills (Fernández-Raga et al., 2023). However, GBL implementation may encounter difficulties, such as being complicated and costly (Liu et al., 2020). AR integrates virtual information into real-world environments to provide interactive learning experiences (Kumar et al., 2020). While AR increases engagement, it requires suitable technology and may cause navigation issues (Ali et al., 2022). These technologies have the potential to alter education, but they must be carefully considered in consideration of implementation issues. Each technology presents unique opportunities and challenges in enhancing learning outcomes.

The application platform serves as the foundation for deploying educational technologies, with web-based systems, mobile applications, and stand-alone platforms being key considerations (SAP Insights, 2023, May 18). Web applications run on web servers and are accessed through web browsers, offering cross-platform compatibility and cost-effectiveness (Dzhangarov et al., 2021). Mobile applications, designed for smartphones and tablets, provide native device support and portability but have higher development costs (Jayatilleke et al., 2019). Each platform offers specific advantages and considerations in delivering educational content and activities.

In the realm of study helper applications, notable platforms like Quizlet, MyStudyLife, and Mindomo offer diverse functionalities catering to students' organisational and learning needs (Pham, 2022; Okuboyejo et al., 2019; Sabourin, 2020). Quizlet provides interactive study tools such as flashcards and quizzes, while MyStudyLife aids in academic scheduling and task management. Mindomo facilitates visual organisation through mind mapping and concept outlining.

In contrast, gamification platforms such as Kahoot!, Duolingo, and Codecademy use game elements to improve learning experiences (Taesotikul et al., 2021; Savvani, 2019; Toth & Tovolgyi, 2017). Kahoot! engages students with interactive quizzes, Duolingo gamifies language learning, and Codecademy provides hands-on coding courses. These applications use elements like points, levels, and rewards to increase student motivation and engagement.

The Study Helper application, incorporating elements from both study helpers and gamification, aims to provide a dynamic and interactive solution for academic success, offering organisational tools alongside engaging game-like features. This combination provides a comprehensive approach to supporting student learning and productivity.

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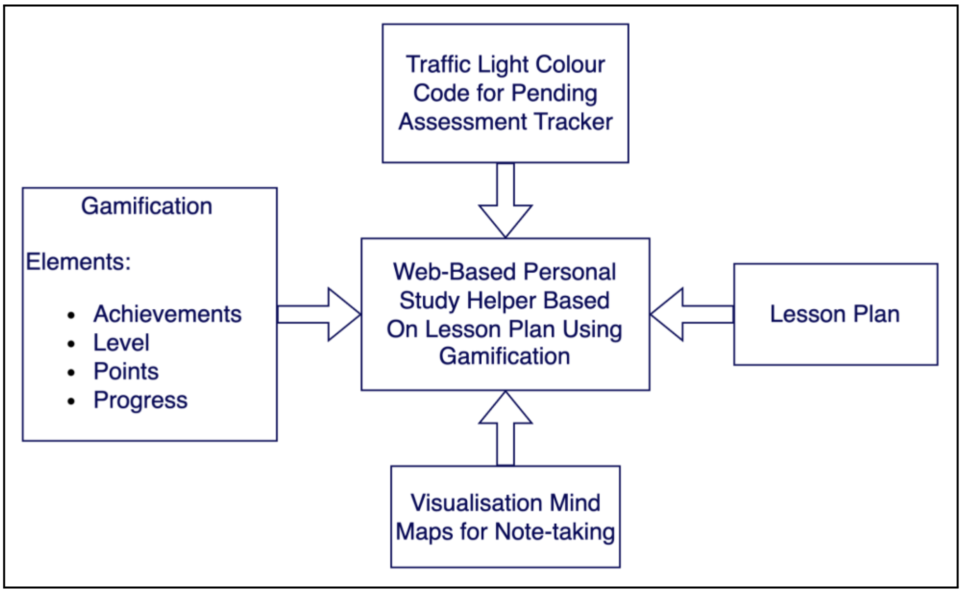
3. METHODOLOGY

3.1 Conceptual Framework

The conceptual framework is a set of guidelines or design principles that explain how the system works and what it aims to achieve. The system is a web-based personal study helper that uses gamification elements, such as achievements, levels, points, and progress, to motivate and engage students in their studies. The system also provides a traffic light colour code on the pending assessment tracker, which indicates the status and urgency of each assignment. Additionally, the system allows students to create and organise their notes in a visual and interactive way. The system is based on a lesson plan that covers the learning objectives and outcomes of each topic. Figure 1 shows the conceptual framework diagram of the system.

Figure 1: Conceptual framework diagram



3.2 Flowchart Diagram

A flowchart is a graphical representation that shows the sequence of steps or actions in a process. It uses different shapes and symbols to represent different types of activities, decisions, inputs, outputs, and connections within a process. The flowchart in Figure 2 shows the overall process of the users that interact with the system starting with viewing the homepage until user logout from the system.

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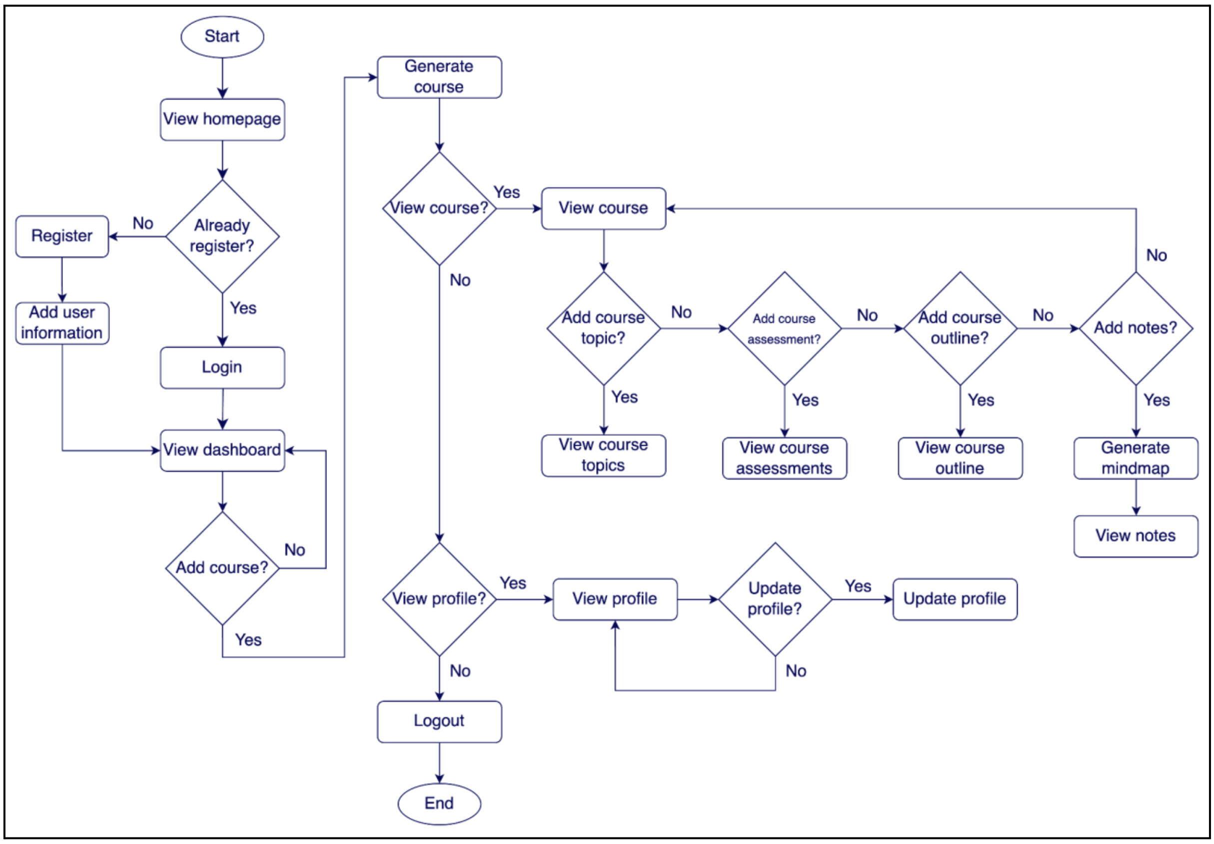

Figure 2: Flowchart diagram

3.3 Visualisation

The visualisation implemented in the system includes the use of a mind map for note-taking and a pending assessment tracker. The system's visualisation component aims to transform student notes into visually appealing mind maps, which are generated from markdown notes. The system utilises Markmap.js to ease the creation of these mind maps, hence improving the visualisation of student notes and providing an interactive learning experience. The mind maps update in real-time as users type to add a note. Figure 3 shows the mind maps generated from markdown notes.

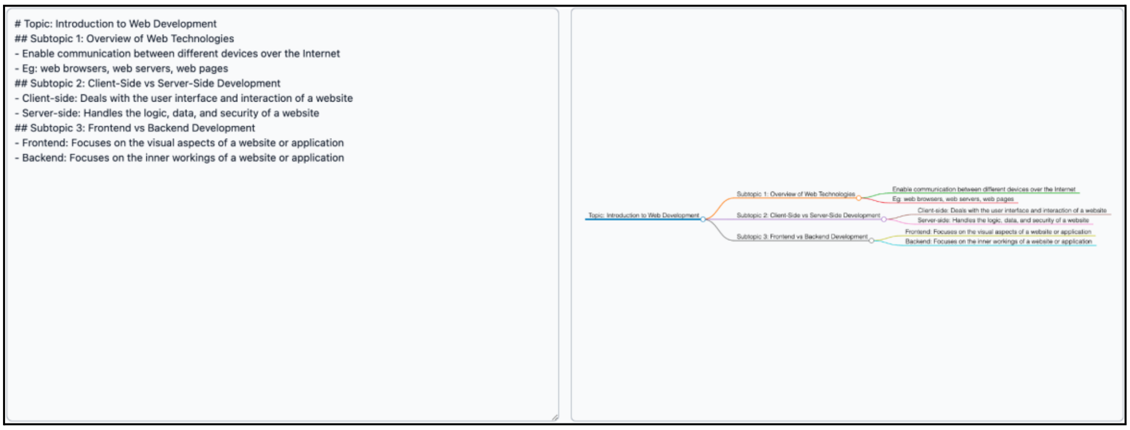

Figure 3: Generated mind maps from markdown notes

The assessment tracker is a feature that helps users keep track of their upcoming assessments and due dates. It can provide reminders and help users manage their time effectively. It can also motivate users to prioritise and complete their tasks, as well as avoid procrastination. In this system, the assessment tracker is displayed using a traffic light colour code to indicate the urgency of the assessments. Red signifies that the pending assessment is due in less than 24 hours or that the due date has already passed. Yellow signifies that the pending assessment is due within a week or seven days. Green signifies that the due date for the pending assessment is more than a week away. Figure 4 shows the pending assessment tracker.

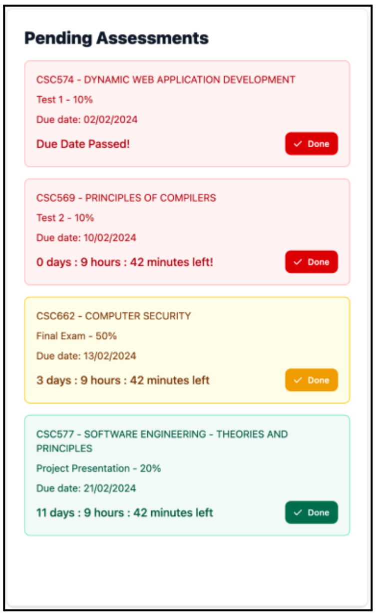

Figure 4: Pending assessment tracker

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3.4 Gamification

The system implements a gamification mechanism, which includes achievements, badges, levels, points, and progress. The purpose of implementing gamification is to boost motivation and engagement among students in their studies. By turning learning into a more interactive and rewarding experience, it encourages students to participate more actively.

3.4.1 Achievements

Achievements are rewards that users can earn by completing certain tasks or reaching certain milestones within the system. They provide a sense of accomplishment and motivation to continue using the application. In this application, achievements are represented by badges that have different levels and points. For example, the "Daily Login" badge has three levels, each requiring a different number of days of logging in. The "Add Notes" badge has three levels, each requiring a different number of notes to be added. The same goes for the "Assessments Done" badge, which also has three levels, each requiring a different number of assessments to be completed. Figure 5 shows all achievements in the system.

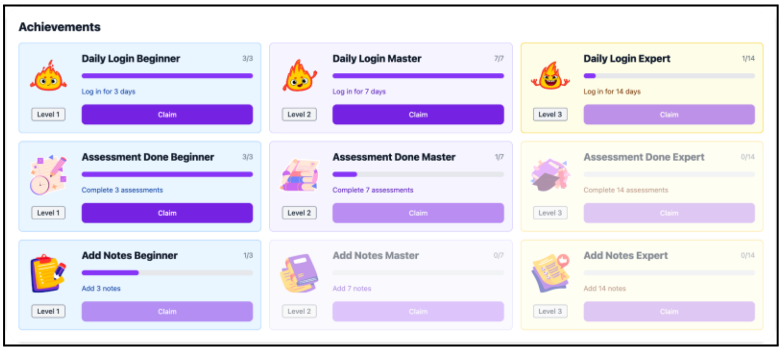

Figure 5: All achievements in the application

3.4.2 Levels

The level feature represents a user's progress within the system. As users complete tasks and earn achievements, they can go to the next level, which gives them a bonus experience to increase their personal level. The level feature can also create a sense of challenge and achievement, as well as provide feedback and guidance to the users. In this application, the Level feature for users is displayed at the top of the profile page, showing the user's name, institution, programme, email, and current level. The level is calculated based

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on the points earned from the achievements, daily login, pending assessment, and adding a note for the first time. The higher the level, the more points are required to reach the next level. Figure 6 shows the level feature for the user's progress.

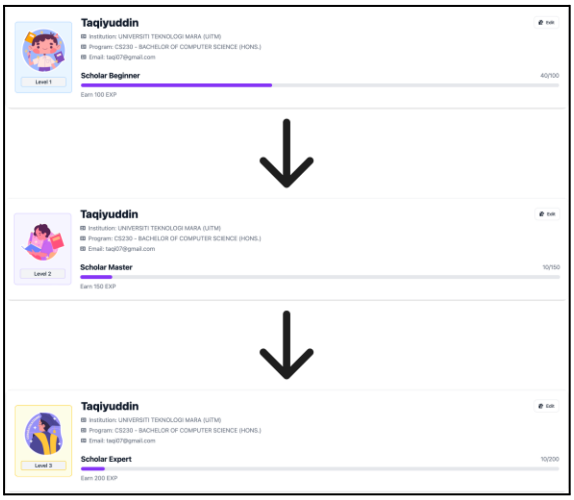

Figure 6: Level feature for user's progress

3.4.3 Points

Points are a numerical representation of a user's achievements and progress within the system. In this application, points are called experience (EXP) and are earned by daily login to the system, completing pending assessments, adding notes for the first time, and claiming the reward from completing the achievements. Table 1 shows the situation when a user gets EXP.

Table 1: User actions and corresponding EXP rewards

User actions	EXP rewards
Login for the first time of the day	Users get 10 EXP
Complete a pending assessment	Users get 10 EXP
Adding a note for the first time for each topic	Users get 5 EXP
Claim reward for completed achievement at level 1	Users get 20 EXP
Claim reward for completed achievement at level 2	Users get 40 EXP
Claim reward for completed achievement at level 3	Users get 60 EXP

3.4.4 Progress

The Progress feature shows the advancement or development of users within the application. It can also help the users monitor their progress, identify their difficulties, and improve their performance. In this application, users advance through different achievement levels, each requiring a certain amount of experience points (EXP). These levels, which are visually distinct and accompanied by progress bars and changing icons, provide a clear indication of the user's current status and the effort needed to reach the next level.

3.5 System Usability Scale (SUS)

The System Usability Scale (SUS) is a widely used questionnaire-based tool developed by John Brooke in 1986 to evaluate the usability of a system, product, or service from the user's subjective perspective (Derisma, 2020).

3.5.1 System Usability Scale (SUS) Questionnaire

SUS consists of 10 statements that users can rate on a scale of 1 (strongly disagree) to 5 (strongly agree). The SUS statements cover aspects such as ease of use, complexity, confidence, and satisfaction. Table 2 shows the 10 statements of the SUS questionnaire.

Table 2: 10 statements of the SUS questionnaire

No.	Statements of SUS questionnaire
1	I think that I would like to use this web application frequently.
2	I found the web application unnecessarily complex.
3	I thought the web application was easy to use.
4	I think that I would need the support of a technical person to be able to use this web application.
5	I found the various functions in this web application were well integrated.
6	I thought there was too much inconsistency in this web application.
7	I would imagine that most people would learn to use this web application very quickly.
8	I found the web application very cumbersome to use.
9	I felt very confident using the web application.
10	I needed to learn a lot of things before I could get going with this web application.

3.5.2 System Usability Scale (SUS) Score

All of the SUS questionnaire results will be used to obtain the SUS score, which indicates the grade for the application. The SUS score is calculated based on the responses to the 10 questions in the SUS questionnaire, where each question is rated on a 5-point scale: 1 (strongly disagree), 2 (disagree), 3 (neither agree nor disagree), 4 (agree), and 5 (strongly agree). The scoring method involves assigning contribution scores to each question item based on the position of the scale chosen by the respondent. For odd-numbered questions (1, 3, 5, 7, 9), the contribution score is the position of the scale chosen by the respondent minus
1. For even-numbered questions (2, 4, 6, 8, 10), the contribution score is 5 minus the position of the scale chosen by the respondent. These contribution scores are then used to calculate the overall SUS score by multiplying the total contribution score by 2.5 to obtain the overall SUS

score, which ranges from 0 to 100. So, the formula to calculate the total SUS score is given as follows.

Total score of SUS = ((Q1 − 1) + (5 − Q2) + (Q3 − 1) + (5 − Q4) + (Q5 − 1) + (5 − Q6) + (Q7 − 1) + (5 − Q8) + (Q9 − 1) + (5 − Q10)) × 2.5

Then, the average score of SUS is found by summing up all the total SUS scores for each participant and dividing it by the total number of participants. The formula to calculate the average score of SUS is given as follows.

Average score of SUS = total score of SUS / total number of participants

4. RESULT AND DISCUSSION

4.1 Usability Testing

Usability testing is a type of testing that assesses how user-friendly and satisfying a product's user interface and overall user experience are. In this project, usability testing involves observing real or potential users and collecting their feedback as they interact with the system. This feedback is collected through a questionnaire, which uses the System Usability Scale (SUS). Usability testing helps to identify and improve the usability issues and user satisfaction of a product. A total of seven UiTM students participated to evaluate usability testing in this project. The result of the SUS score will be used to determine the grade of the system. Based on the calculation, the average SUS score for this system is 64.64. Table 3 shows the result of SUS score calculation.

Table 3: Result of SUS Score Calculation

Participants	**Questions**										**SUS total score**
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	
P1	4	3	4	4	5	2	3	2	4	3	65
P2	4	2	4	2	4	3	4	2	4	3	70
P3	4	3	5	4	4	2	3	2	4	3	65
P4	4	2	4	4	4	2	3	3	2	4	55
P5	4	2	4	4	5	1	1	3	4	4	60
P6	5	4	4	3	5	2	5	1	5	2	80
P7	4	4	5	3	3	3	5	4	4	4	57.5
								SUS average score			64.64

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This score will be converted into percentile ranks and letter grades. According to Sari & Henim (2021), this score indicates a moderate level of usability, as it falls within the Grade D range on the SUS score grade scale. The score is also in the marginal highs for the acceptability ranges. Figure 7 shows the SUS score grade scale, including the acceptability range, the grade scale, and the adjective ratings.

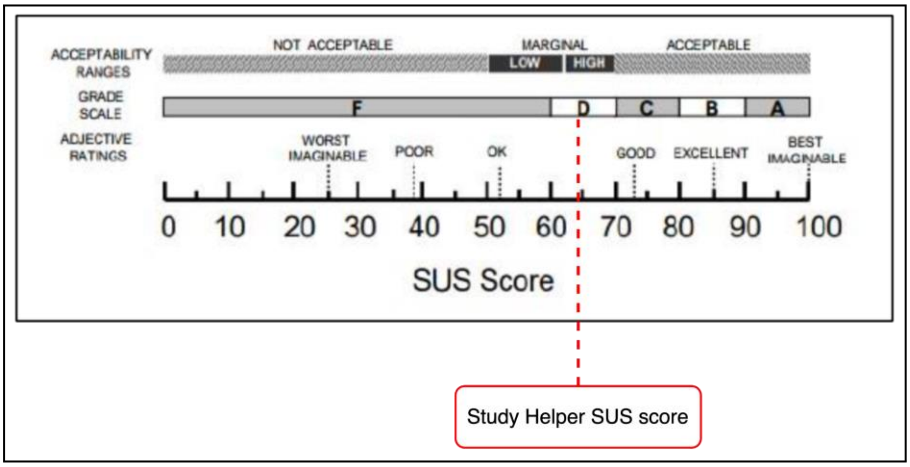

Figure 7: SUS score grade scale (Derisma, 2020)

The percentile ranks show the usability rate of the application in the form of a percentage (%). The SUS score of this application corresponds to a percentile range of 20% to 40%, which means that it is in Grade D rank. Table 4 shows the percentile rank based on the SUS score.

Table 4: User actions and corresponding EXP rewards

SUS Score	Percentage	Grade
>= 80.3	>= 90%	A
74 <= score < 80.3	70% <= percentile < 90%	B
68 <= score < 74	40% <= percentile < 70%	C
51 <= score < 68	20% <= percentile < 40%	D
< 51	< 20%	E

(Source: Sari & Henim, 2021)

CONCLUSION

The project started by exploring the issues related to the student disengagement, lack of motivation, and difficulty in understanding the interconnection between concepts. The developed system is started to cater the issues by providing a platform for students to help them in their study by implementing gamification for the interactivity and using mind maps for note taking. The project has successfully met the objectives set out at the beginning of this project which are to design a web-based personal study helper based on lesson plan using gamification, to develop the designed web-based personal study helper application, which is based on a lesson plan and using gamification elements, and to test the functionality and usability of the developed system. The usability testing, which used the System Usability Scale (SUS), demonstrated the system's effectiveness, efficiency, and user satisfaction levels. The result of usability testing for this system is 64.64, which indicates a moderate level of usability as it falls within the Grade D range on the SUS score scale.

REFERENCES

Abu Bakar, N., Alsmadi, M. S., Ali, Z., Shuaibu, A., & Solahudin, M. H. (2022). Influence of Students' Motivation on Academic Achievement Among Undergraduate Students in Malaysia. Journal of Positive School Psychology, 6(2), 3443–3450.

Ali, N. A., Sadiq, M. H., Albabawat, A. A., & Salah, R. M. (2022). Methods and Applications of Augmented Reality in Education: A Review. Proceedings of the 2nd 2022 International Conference on Computer Science and Software Engineering, CSASE 2022, 175–181. https://doi.org/10.1109/CSASE51777.2022.9759807

Chipchase, L., Davidson, M., Blackstock, F., Bye, R., Colthier, P., Krupp, N., Dickson, W., Turner, D., & Williams, M. (2017). Conceptualising and Measuring Student Disengagement in Higher Education: A Synthesis of the Literature. International Journal of Higher Education, 6(2), 31–42. https://doi.org/10.5430/ijhe.v6n2p31

Derisma. (2020). The usability analysis online learning site for supporting computer programming course using System Usability Scale (SUS) in a university. International Journal of Interactive Mobile Technologies, 14(9), 182–195. https://doi.org/10.3991/ijim.v14i09.13123

Dicheva, D., Caldwell, R., & Guy, B. (2020). Do Badges Increase Student Engagement and Motivation? SIGITE 2020 - Proceedings of the 21st Annual Conference on Information Technology Education, 81–86. https://doi.org/10.1145/3368308.3415393

Duran, R., Zavgorodniaia, A., & Sorva, J. (2022). Cognitive Load Theory in Computing Education Research : 22(4). https://doi.org/10.1145/3483843

Dzhangarov, A. I., Pakhaev, K. K., & Potapova, N. V. (2021). Modern web application development technologies. IOP Conference Series: Materials Science and Engineering, 1155(1), 012100. https://doi.org/10.1088/1757-899x/1155/1/012100

Feldon, D. F., Callan, G., Juth, S., & Jeong, S. (2019). Cognitive Load as Motivational Cost. Educational Psychology Review, 31(2), 319–337. https://doi.org/10.1007/s10648-019-09464-6

Fernández-Raga, M., Aleksić, D., İkiz, A. K., Markiewicz, M., & Streit, H. (2023). Development of a Comprehensive Process for Introducing Game-Based Learning in Higher Education for Lecturers. Sustainability (Switzerland), 15(4), 1–18. https://doi.org/10.3390/su15043706

Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in Learning. Asian Journal of Education and Social Studies, 10(4), 16–37. https://doi.org/10.9734/ajess/2020/v10i430273

Greener, S. (2018). Student disengagement: is technology the problem or the solution? Interactive Learning Environments, 26(6), 716–717. https://doi.org/10.1080/10494820.2018.1498235

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. Sustainable Operations and Computers, 3(May), 275–285. https://doi.org/10.1016/j.susoc.2022.05.004

Idris, S., & Kamaruddin, N. (2018). The Effectiveness Use of Mind Maps in the Learning of History. International Journal of INTI, 22(December), 84–88.

Jayatilleke, B. G., Ranawaka, G. R., Wijesekera, C., & Kumarasinha, M. C. B. (2019). Development of mobile application through design-based research. Asian Association of Open Universities Journal, 13(2), 145–168. https://doi.org/10.1108/AAOUJ-02-2018-0013

Krieglstein, F., Schneider, S., Beege, M., & Rey, G. D. (2022). How the design and complexity of concept maps influence cognitive learning processes. Educational Technology Research and Development, 70(1), 99–118. https://doi.org/10.1007/s11423-022-10083-2

Kumar, Dr. J. R. A., Rajan, Dr. M. S., Ramasamy, Dr. A., & Singh, D. B. K. (2020). Efficient Cognitive Skill Based Learning System using Augmented Reality. International Journal of Recent Technology and Engineering (IJRTE), 9(3), 723–727. https://doi.org/10.35940/ijrte.c4581.099320

Kwantlen Polytechnic University. (2023, May 19). Learning Aids. Retrieved May 19, 2023, from https://www.kpu.ca/learningcentres/learning-aids#:~:text=A%20learning%20aid%20is%20something,or%20any%20other%20appropriate%20item.

Liu, Z. Y., Shaikh, Z. A., & Gazizova, F. (2020). Using the concept of game-based learning in education. International Journal of Emerging Technologies in Learning, 15(14), 53–64. https://doi.org/10.3991/ijet.v15i14.14675

Mammen, J. R., & Mammen, C. R. (2018). Beyond concept analysis: Uses of mind mapping software for visual representation, management, and analysis of diverse digital data. Research in Nursing and Health, 41(6), 583–592. https://doi.org/10.1002/nur.21920

Mauliya, I., Relianisa, R. Z., & Rokhyati, U. (2020). Lack of Motivation Factors Creating Poor Academic Performance in the Context of Graduate English Department Students. Linguists: Journal Of Linguistics and Language Teaching, 6(2), 73. https://doi.org/10.29300/ling.v6i2.3604

Nguyen, H. H., Nguyen Duc, L., Do Trung, K., Dang Hoang, L., Vu, T., Vu, T. Van, & Nguyen, V. A. (2022). Applying machine learning techniques to detect student's learning styles. ACM International Conference Proceeding Series, 456–462. https://doi.org/10.1145/3572549.3572622

Oktaviati, R., & Jaharadak, A. A. (2018). The impact of using gamification in learning computer science for students in university. International Journal of Engineering and Technology(UAE), 7(4), 121–125. https://doi.org/10.14419/ijet.v7i4.11.20786

Okuboyejo, S., Aremo, S., & Sowunmi, O. (2019). Implementing an Academic Task Manager: Findings from a Pilot Study. Indian Journal of Science and Technology, 12(4), 1–5. https://doi.org/10.17485/ijst/2019/v12i4/141142

Pham, A. T. (2022). University Students' Perceptions on the Use of Quizlet in Learning Vocabulary. International Journal of Emerging Technologies in Learning, 17(7), 54–63. https://doi.org/10.3991/ijet.v17i07.29073

Robbi, A. A., Gusnardi, & Sumarno. (2020). Analysis of the Effect of Learning Motivation on Learning Achievement. Journal of Educational Sciences, 4(1), 106–115.

Sabourin, B. M. (2020). Using Mindomo to Engage Students in Higher-Order Thinking. Compass: Journal of Learning and Teaching, 13(2), 1–7. https://doi.org/10.21100/compass.v13i2.1080

Sadovets, O., Martynyuk, O., Orlovska, O., Lysak, H., Korol, S., & Zembytska, M. (2022). Gamification in the Informal Learning Space of Higher Education (in the Context of the Digital Transformation of Education). Postmodern Openings, 13(1), 330–350. https://doi.org/10.18662/po/13.1/399.

SAP Insights. (n.d.). SAP- What Is a Technology Platform? Retrieved May 18, 2023, from https://www.sap.com/sea/products/technology-platform/what-is-a-technology-platform.html

Sari, R. P., & Henim, S. R. (2021). The application of system usability scale method to measure the usability of electronic learning system (e-learning) of politeknik caltex riau. ILKOM Jurnal Ilmiah, 13(3), 266–271. https://doi.org/10.33096/ilkom.v13i3.920.266-271

Savvani, S. (2019). State-of-the-Art Duolingo Features and Applications. In Advances in Intelligent Systems and Computing (Vol. 917). Springer International Publishing. https://doi.org/10.1007/978-3-030-11935-5_14

Shemshack, A., & Spector, J. M. (2020). A systematic literature review of personalized learning terms. Smart Learning Environments, 7(1). https://doi.org/10.1186/s40561-020-00140-9

Suleman, M., Hashmi, S., & Tabassum, A. (2019). Study Guides - Perceptions of Medical Students. Liaquat National Journal of Primary Care, 1(1), 3–5. https://doi.org/10.37184/lnjpc.2707-3521.1.8

Taesotikul, T., Chinpaisal, C., & Nawanopparatsakul, S. (2021). Kahoot! gamification improves learning outcomes in problem-based learning classroom. ACM International Conference Proceeding Series, 125–129. https://doi.org/10.1145/3468978.3468999

Toth, A., & Tovolgyi, S. (2017). The introduction of gamification: A review paper about the applied gamification in the smartphone applications. 7th IEEE International Conference on Cognitive Infocommunications, CogInfoCom 2016 - Proceedings, January 2018, 213–217. https://doi.org/10.1109/CogInfoCom.2016.7804551

Van Leeuwen, A., & Janssen, J. (2019). A systematic review of teacher guidance during collaborative learning in primary and secondary education. Educational Research Review, 27(February), 71–89. https://doi.org/10.1016/j.edurev.2019.02.001

Vaughn, K. E., Fuegen, K., Goddard, P., & Krull, D. S. (2021). The influence of self-testing websites on college exam performance. Scholarship of Teaching and Learning in Psychology, December 2021. https://doi.org/10.1037/stl0000258

Yarmis Syukur, Y., Syukur, Y., Tania, I., & Nuzila Zahri, T. (2019). Student's Problems Learning and Guidance Counseling Services in the Era of Industrial Revolution 4.0. 5th International Conference on Education and Technology (ICET 2019), 382(Icet), 728–732. https://doi.org/10.2991/icet-19.2019.174

Yen, P. H., Thi, L., Tu, C., & Thao, L. T. (2023). Students' perceptions of using note-taking in consecutive interpreting assignments. 15(1), 8–21. https://doi.org/10.22144/ctu.jen.2023.002

Xing, B. (2023). A review of research on Learning Style. Open Journal of Modern Linguistics, 13, 263–275. https://doi.org/10.1080/00206814.2019.1702592.

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