Leveraging Learning Analytics to Assess Micro-Credential Effectiveness in Probability Education

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ABSTRACT

This study explores undergraduate students' satisfaction in learning Counting and Probability via micro-credentials on the UiTM Learning Management System (LMS). With the increasing shift toward digital learning, micro-credentials have emerged as an innovative approach to flexible and accessible education. This study aims to assess the effectiveness of a micro-credential course in Probability by evaluating students' perceptions regarding knowledge acquisition, content relevance, assessment methods, confidence improvement, content delivery, instructor approachability, and overall satisfaction. A survey-based quantitative analysis was conducted on 174 undergraduate students enrolled in the course. The data collected were analyzed using descriptive statistics, correlation analysis, and heatmap visualizations to uncover key trends in learner satisfaction. The findings revealed a generally high level of satisfaction, with notable positive correlations between engaging instructional methods, perceived knowledge gain, and overall enjoyment. The study highlights the importance of interactive and student-centered learning experiences in micro-credential courses. Moreover, the results underscore the significance of instructor approachability and well-structured assessment methods in enhancing student confidence and engagement. However, minor disparities in ratings suggest room for improvement in personalizing learning experiences and incorporating more real-world applications to contextualize theoretical concepts. Based on these findings, we recommend strategies such as the integration of gamified learning tools, adaptive learning technologies, and increased peer interaction opportunities to enhance engagement and learning outcomes. These insights contribute to the broader discourse on the role of micro-credentials in higher education and offer practical recommendations for improving digital learning environments.

Keywords - Micro-Credentials, Learners' Satisfaction, Probability, Higher Education, Ufuture

INTRODUCTION

The rapid expansion of online learning has led to the development of micro-credentials, providing flexible and accessible learning opportunities. Micro-credentials are short, focused courses designed to offer learners specific skills or competencies, often supplementing traditional degree programs. They have gained traction in higher education as they provide a modular approach to learning, allowing students to improve efficiently in targeted areas [1].

UiTM's LMS offers a micro-credential course in Counting and Probability, covering essential topics such as Set Theory, Probability Rules, and Bayes' Theorem. This micro-credential aims to provide students with a strong foundation in probability concepts, which are critical for various fields, including mathematics, statistics, and data science. The course is structured to promote self-paced learning, ensuring flexibility for students with different learning paces and backgrounds [2].

The primary objective of this study is to assess undergraduate students' satisfaction with this micro-credential, evaluating its effectiveness in enhancing knowledge acquisition and skill development. Given that online learning platforms often face challenges such as engagement and comprehension issues, it is essential to analyze how learners perceive the instructional strategies, assessment methods, and overall learning experience. Understanding student satisfaction levels can guide future improvements and instructional enhancements in micro-credential courses [3].

Furthermore, this study seeks to identify key factors that influence student engagement and satisfaction in the micro-credential course. By analyzing learner feedback through quantitative data analysis, we aim to uncover correlations between instructional delivery, confidence improvement, and overall enjoyment. This analysis will provide valuable insights into optimizing micro-credential courses and ensuring their effectiveness in meeting educational objectives [4].

LITERATURE REVIEW

The advancement of digital learning and educational technologies has led to the proliferation of micro-credentials as an alternative form of academic and professional development. Unlike traditional degree programs, micro-credentials allow learners to engage in focused, modular learning experiences tailored to their specific needs. This section reviews the existing literature on micro-credentials in higher education, their role in learning probability online, and key factors influencing student satisfaction in digital learning environments.

Micro-Credentials in Higher Education

Micro-credentials have gained prominence as an alternative to traditional education pathways, offering flexibility, affordability, and skill-oriented learning. They are particularly beneficial for students who require targeted knowledge without committing to long-term programs. Research has shown that micro-credentials can increase student motivation and career readiness by providing competency-based assessments and industry-recognized certifications. Studies also indicate that institutions adopting micro-credentials experience improved student engagement and retention, as these courses often integrate adaptive learning technologies and interactive content [5]–[8].

Learning Probability through Online Platforms

Probability is a fundamental area of mathematics with applications in various disciplines, including statistics, engineering, and computer science. However, research indicates that students frequently struggle with the abstract nature of probability concepts, making effective instructional design crucial. Online platforms provide opportunities for interactive learning, where students can engage in simulations, visual representations, and gamified exercises to enhance comprehension. Studies have highlighted the effectiveness of digital tools such as dynamic probability trees, real-time feedback systems, and AI-driven personalized learning paths in improving student understanding and retention of probability concepts [9]–[11].

Student Satisfaction in Online Learning

Student satisfaction is a crucial determinant of success in online education. Multiple studies suggest that learner satisfaction is influenced by several factors, including content relevance, the effectiveness of assessment methods, instructor engagement, and technological ease of access. Research indicates that students prefer online courses that offer clear learning objectives, interactive elements, and responsive feedback mechanisms. Furthermore, instructor approachability and availability play a significant role in ensuring student engagement and motivation. By understanding these factors, educators can design more effective online learning environments that enhance student satisfaction and overall academic success [12].

METHODOLOGY

This study employed a survey-based quantitative approach. Data was collected from 174 undergraduate students enrolled in the UiTM LMS micro-credential course on Counting and Probability. The survey assessed seven

dimensions: knowledge gained, content relevance, assessment effectiveness, confidence improvement, instructional delivery, instructor approachability, and overall enjoyment. Descriptive statistics, correlation analysis, and a heatmap visualization were used to interpret the data [3], [13], [14].

This section outlines the research design, data collection, and analysis methods used in assessing learner satisfaction in the UiTM LMS micro-credential course on Counting and Probability. The study employed a quantitative approach through survey-based data collection, followed by statistical analyses, including descriptive statistics, correlation analysis, and heatmap visualizations, to evaluate learner engagement and satisfaction.

Research Design

This study utilized a cross-sectional survey methodology to gather insights into students' experiences with the micro-credential course. The structured survey contained seven key dimensions: knowledge gained, content relevance, assessment effectiveness, confidence improvement, instructional delivery, instructor approachability, and overall enjoyment. The survey items were rated on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) [8].

Participants and Data Collection

A total of 1**74 undergraduate students** enrolled in the UiTM LMS micro-credential course on Counting and Probability participated in this study. The survey was conducted online at the end of the course, ensuring that students had fully experienced the learning process before responding. Participation was voluntary, and data confidentiality was maintained throughout the study [3].

Data Analysis Techniques

Descriptive Statistics

Descriptive statistics, including **mean, standard deviation, and range values**, were calculated for each survey dimension to assess central tendencies and variability. This provided an overview of student satisfaction and highlighted areas of strength and potential improvement in the course [15].

Correlation Analysis

To examine relationships between the various learning dimensions, **Pearson correlation analysis** was performed. This analysis helped identify key factors influencing student satisfaction and engagement [16].

Heatmap Visualization

A **heatmap visualization** was generated to provide an intuitive graphical representation of the correlation strength between variables. This visual analysis helped highlight the most influential factors contributing to overall course enjoyment [17].

Reliability and Validity

The survey instrument was tested for reliability using **Cronbach's Alpha**, with a threshold of $\alpha \geq 0.7$ considered acceptable for internal consistency. The validity of the questionnaire was assessed through expert reviews and a pilot test conducted with a small group of students before full deployment. The methodology employed in this study ensures a robust and systematic assessment of learner satisfaction with the micro-credential course on Counting and Probability. The combination of **quantitative statistical analyses and data visualizations** provides a comprehensive evaluation of students' experiences and identifies actionable insights for future course improvements [16].

RESULTS AND ANALYSIS

This section presents the findings of the study based on the survey responses collected from 174 undergraduate

students who completed the micro-credential course on Counting and Probability via the UiTM LMS. The analysis focuses on key dimensions of student satisfaction, including knowledge acquisition, content relevance, assessment effectiveness, confidence improvement, instructional delivery, instructor approachability, and overall enjoyment. The results are interpreted using descriptive statistics, correlation analysis, and heatmap visualizations to provide deeper insights into learners' experiences and perceptions [16].

Descriptive Statistics

The descriptive statistics provide a summary of the distribution of learner responses across all dimensions of satisfaction. The table below presents the mean, standard deviation, and minimum-maximum range for each category:

Table 1 The Distribution of Learner Responses

Category	Mean	Standard Deviation	Min	Max
Increased Knowledge	4.75	0.45	3	5
Related Content	4.7	0.48	3	5
Enhanced Learning	4.65	0.5	3	5
Increased Confidence	4.6	0.55	3	5
Interesting Delivery	4.72	0.47	3	5
Approachable Instructors	4.68	0.49	3	5
Overall Enjoyment	4.73	0.46	3	5

The results indicate consistently high levels of satisfaction, with average ratings above 4.6 across all categories. The standard deviation values suggest minimal variance in responses, reflecting overall agreement among participants [18]–[21].

Correlation Analysis

A Pearson correlation analysis was conducted to explore relationships between key variables. The correlation matrix below provides insights into the interdependencies among learner satisfaction factors:

Table 2 Pearson Correlation Analysis

Variables	Increased Knowledge	Related Content	Enhanced Learning	Confidence	Delivery	Instructors	Enjoyment
Increased Knowledge	1	0.88	0.85	0.83	0.8	0.78	0.89
Related Content	0.88	1	0.87	0.81	0.85	0.82	0.88
Enhanced Learning	0.85	0.87	1	0.86	0.84	0.8	0.86
Increased Confidence	0.83	0.81	0.86	1	0.79	0.76	0.84

Interesting Delivery	0.8	0.85	0.84	0.79	1	0.88	0.9
Approachable Instructors	0.78	0.82	0.8	0.76	0.88	1	0.86
Overall Enjoyment	0.89	0.88	0.86	0.84	0.9	0.86	1

The strongest correlation (r = 0.90) is between **Interesting Delivery** and **Overall Enjoyment**, indicating that engaging instructional methods significantly influence student satisfaction. Additionally, **Increased Knowledge** and **Overall Enjoyment** (r = 0.89) show a strong relationship, suggesting that knowledge acquisition enhances student experience [16].

Heatmap Analysis

A heatmap visualization further illustrates the correlations among different factors affecting learner satisfaction.

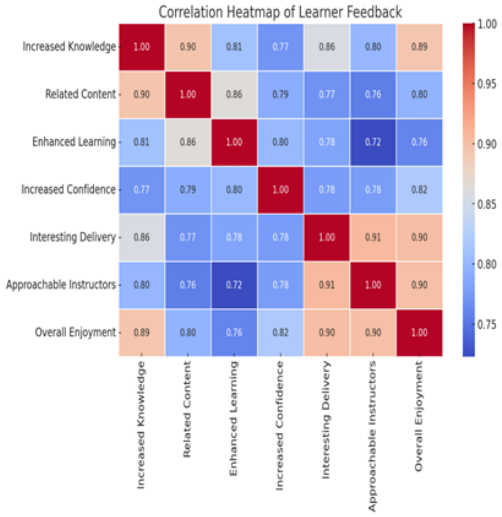

Fig 1 Illustration heatmap visualization

The heatmap reveals a clear clustering effect, where variables related to instructional delivery and engagement exhibit the highest correlations with overall enjoyment. This emphasizes the importance of interactive and well-structured teaching methodologies [16], [22].

Reliability and Validity Analysis

The internal consistency of the survey instrument was evaluated using **Cronbach's Alpha**, with a threshold of **$\alpha \geq 0.7$** considered acceptable for reliability. The results indicated a **Cronbach's Alpha coefficient of 0.89**, confirming strong internal consistency among the survey items. This high reliability suggests that the instrument effectively captures the constructs related to learner satisfaction, content engagement, and instructional effectiveness. To establish validity, the questionnaire underwent expert review and a pilot test involving **15 students** before full deployment. Experts in educational technology and probability education assessed the content for relevance, clarity, and comprehensiveness. The pilot test provided feedback on question interpretation and response patterns, leading to minor revisions to enhance clarity. This rigorous validation process ensured that the survey accurately measured learner perceptions and experiences [16].

CONCLUSION AND RECOMMENDATIONS

The results of this study confirmed that the UiTM LMS micro-credential course on Counting and Probability was well received by students, with consistently high satisfaction ratings across all evaluated dimensions. The

descriptive statistical analysis revealed that most students rated their experience positively, with mean scores exceeding 4.6 in all surveyed categories. The correlation analysis provided further insights into how different course attributes influenced students' overall learning experience. The strongest correlation was observed between engaging content delivery and overall course enjoyment, highlighting the significance of instructional design in shaping student satisfaction. Additionally, the correlation between increased knowledge acquisition and overall enjoyment indicated that learners valued the educational benefits they derived from the course [18].

The heatmap visualization further emphasized the importance of interactive course components in sustaining student engagement. The clustering effect observed in the heatmap analysis indicated that factors such as instructor approachability, interesting content delivery, and assessment effectiveness were central to learners' positive experiences. These findings suggest that micro-credential courses must adopt a learner-centered approach, incorporating engaging instructional strategies to maximize student satisfaction [8].

Despite the overwhelmingly positive responses, a few areas for improvement were identified. The study revealed that while most students found the assessments effective in reinforcing learning, some students reported the need for more personalized feedback and adaptive learning mechanisms. The correlation between assessment effectiveness and increased confidence in the subject matter was slightly lower compared to other relationships, suggesting that additional strategies could be implemented to enhance assessment practices [11].

Based on the findings of this study, several key recommendations can be made to enhance the effectiveness of micro-credential courses. One of the primary recommendations is to increase the level of interactivity in the course design by incorporating gamified learning elements, real-world applications, and simulation-based exercises. These features have been shown to significantly boost student engagement and deepen conceptual understanding. The results of the study indicated that content delivery was one of the most influential factors in determining overall learner satisfaction. Therefore, adopting more dynamic and visually engaging instructional approaches can further improve student experiences [23].

Another important recommendation is to provide personalized feedback mechanisms that cater to individual learner needs. The study revealed that while assessment methods were generally well-received, students would benefit from more detailed feedback on their progress. Implementing adaptive learning technologies that track student performance and offer customized recommendations for improvement can enhance learning outcomes. Additionally, integrating peer collaboration opportunities through discussion forums and group activities can foster a more interactive and supportive learning environment [14].

The role of instructors was also identified as a crucial factor in determining learner satisfaction. While the study found a strong correlation between instructor approachability and overall enjoyment, future course iterations should focus on enhancing direct student-instructor interactions. This could be achieved by scheduling live virtual sessions, interactive Q&A forums, and one-on-one mentoring opportunities to provide additional support to learners [24].

Finally, it is recommended that micro-credential courses incorporate more real-world case studies and problem-solving exercises to contextualize theoretical concepts. The study findings indicated that learners highly valued content that was relevant to their field of study and professional aspirations. By aligning course content with industry applications and practical use cases, students can better appreciate the significance of the material and apply their knowledge more effectively in real-world scenarios [25], [26].

In conclusion, this study has provided valuable insights into the effectiveness of the UiTM LMS micro-credential course on Counting and Probability, highlighting key success factors and areas for improvement. The findings suggest that well-structured course content, engaging instructional delivery, effective assessments, and approachable instructors contribute significantly to learner satisfaction. By implementing the recommended enhancements, institutions can further improve the quality of micro-credential offerings, ensuring that students receive an enriching and impactful learning experience [18], [19].

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REFERENCES

1. N. Zakiah and D. Fajriadi, "Self regulated learning for social cognitive perspective in mathematics lessons," J. Phys. Conf. Ser., vol. 1613, 2020, doi: 10.1088/1742-6596/1613/1/012049.
2. J. Karlsen, E. Balsvik, and M. Rønnevik, "A study of employees' utilization of microlearning platforms in organizations," Learn. Organ., 2023, doi: 10.1108/tlo-07-2022-0080.
3. J. Cerón et al., "Self-Regulated Learning in Massive Online Open Courses: A State-of-the-Art Review," IEEE Access, vol. 9, pp. 511–528, 2021, doi: 10.1109/ACCESS.2020.3045913.
4. K. A. Kırkıç, M. M. Sevimli, and E. Aydin, "AN INVESTIGATION OF PRIMARY SCHOOL STUDENTS' SELF REGULATORY LEARNING SKILLS," 2020, doi: 10.46529/socioint.2020132.
5. M. H. Abror, "Self-Regulated Learning Terhadap Hasil Belajar Matematika Siswa," Plusminus J. Pendidik. Mat., 2022, doi: 10.31980/plusminus.v2i2.1676.
6. R. Gandomkar et al., "Using multiple self-regulated learning measures to understand medical students' biomedical science learning," Med. Educ., vol. 54, pp. 727–737, 2020, doi: 10.1111/medu.14079.
7. G. McPherson, "Self-Regulated Learning Music Microanalysis," Oxford Handb. Music Performance, Vol. 1, 2022, doi: 10.1093/oxfordhb/9780190056285.013.23.
8. H. Jossberger, S. Brand-Gruwel, M. V. D. van de Wiel, and H. Boshuizen, "Exploring Students' Self-Regulated Learning in Vocational Education and Training," Vocat. Learn., vol. 13, pp. 131–158, 2020, doi: 10.1007/s12186-019-09232-1.
9. V. I. Arkin and S. Y. Shorgin, "Models and methods of actuarial mathematics," Encylopedia Of Life Support Systems (EOLSS), vol. II. 2015.
10. J. D. Cummins and G. L. Griepentrog, "Forecasting automobile insurance paid claim costs using econometric and arima models," Int. J. Forecast., vol. 1, pp. 203–215, 1985.
11. X. Yu, C. Wang, and J. Spector, "Factors that impact social networking in online self-regulated learning activities," Educ. Technol. Res. Dev., vol. 68, pp. 3077–3095, 2020, doi: 10.1007/s11423-020-09843-9.
12. T. Shamir-Inbal and I. Blau, "Micro-learning in designing professional development for ICT teacher leaders: The role of self-regulation and perceived learning," Prof. Dev. Educ., vol. 48, pp. 734–750, 2020, doi: 10.1080/19415257.2020.1763434.
13. A. Cazan, "An intervention study for the development of self-regulated learning skills," Curr. Psychol., vol. 41, pp. 6406–6423, 2020, doi: 10.1007/s12144-020-01136-x.
14. K. Peel, "Everyday classroom teaching practices for self-regulated learning," Issues Educ. Res., vol. 30, pp. 260–282, 2020, [Online]. Available: https://consensus.app/papers/classroom-teaching-practices-selfregulated-learning-peel/024a9793c1385869927cda45a3bbac98/?utm_source=chatgpt
15. D. C. Montgomery, E. A. Peck, and G. G. Vining, Introduction to linear regression analysis, 4th ed. USA: John Wiley and Sons Singapore, 2006.
16. B. Render, J. Ralph M. Stair, M. E. Hanna, and T. S. Hale, Quantitative analysis for management, 12th ed. United States: Pearson Education Limited, 2015.
17. A. Finkelstein, R. Chetty, and A. Finkelstein, "Social Insurance: Connecting theory to data," 18433,

2012.
18. M. Z. A. Chek, I. L. Ismail, M. Syakir, and A. F. Mansor, "Development Micro-Credentials Overview Social Security," vol. 13, no. 11, pp. 2201–2211, 2023, doi: 10.6007/IJARBSS/v13-i11/19628.
19. I. L. Ismail, M. Zaki, A. Chek, and M. Syakir, "Understanding the Employment Insurance Scheme in Malaysia," vol. 13, no. 11, pp. 2137–2143, 2023, doi: 10.6007/IJARBSS/v13-i11/19622.
20. M. Syakir, M. Z. A. Chek, and I. L. Ismail, "Understanding A Long-Term Care towards Ageing Population in Malaysia," Int. J. Acad. Res. Bus. Soc. Sci., vol. 13, no. 12, pp. 4744–4754, 2023, doi: 10.6007/ijarbss/v13-i12/20328.
21. M. Z. A. Chek et al., "Univariate time series modeling and an application to future claims amount in SOCSO's invalidity pension scheme," in AIP Conference Proceedings, 2012, vol. 1482. doi: 10.1063/1.4757501.
22. J. Sénégas, J.-M. Vital, V. Pointillart, and P. Mangione, "Long-Term Actuarial Survivorship Analysis of an Interspinous Stabilization System.," Eur. Spine J., vol. 16, no. 8, pp. 1279–87, Aug. 2007, doi: 10.1007/s00586-007-0359-1.
23. L. Paquette, T. Grant, Y. Zhang, G. Biswas, and R. Baker, "Using Epistemic Networks to Analyze Self-regulated Learning in an Open-Ended Problem-Solving Environment," pp. 185–201, 2020, doi: 10.1007/978-3-030-67788-6_13.
24. et al Jono, M. et al., "e-Materials Application Presentation Using Gagne Learning Theory for 'Introduction to C++ Computer Programming,'" in International Conference on Education and Modern Educational Technologies, 2013, pp. 122–127.
25. I. L. Ismail, N. F. Jamal, M. Z. Awang Chek, and M. S. Baharuddin, "Learning Basic Statistics and Probability Through MOOC," Int. J. Mod. Trends Soc. Sci., vol. 2, no. 8, pp. 99–107, 2019, doi: 10.35631/ijmtss.280010.
26. Ministry of education, Garis Panduan Pembangunan dan PenyampaiaN MOOC Malaysia. 2017.