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A Metacognition-Based Digital Microlearning Platform: The Usability Evaluation

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ABSTRACT

This study examined the usability of a metacognition-based microlearning platform developed through a design-based research (DBR) framework. The evaluation was carried out in the sixth stage of the DBR cycle, evaluation and reflection, to validate its practicality and effectiveness as an instructional tool. A quantitative approach was applied using the Usefulness, Satisfaction, and Ease of Use (USE) Questionnaire, administered to 252 students enrolled in the Automotive Vocational Teacher Education program in 4 different universities. The questionnaire consisted of 30 items on a 7-point Likert scale, assessing four dimensions: usefulness, ease of use, ease of learning, and satisfaction. Data were analyzed descriptively by calculating means, standard deviations, and categorical levels. The results indicated very high usability across all dimensions, with mean total scores of 53.33 for usefulness, 73.46 for ease of use, 26.63 for ease of learning, and 46.62 for satisfaction. These findings demonstrate that the learn-ing platform is highly usable, functionally effective, and well received by students.

Keywords: automotive vocational education, design-based research, metacognition, microlearning platform, usability

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INTRODUCTION

The rapid advancement of digital technologies has profoundly transformed educational practices across all levels, particularly in higher education. Learning environments are now increasingly designed to leverage technology to enhance flexibility, accessibility, and personalization, enabling students to engage in learning at their own pace and according to their individual preferences. This digital shift has also driven a pedagogical transition from teacher-centered to learner-centered approaches, where students play a more active role in directing and managing their own learning processes. Consequently, understanding how learners interact with, adapt to, and benefit from these technology-enhanced environments has become a central concern for improving educational quality and effectiveness.

Central to this transformation is the concept of self-regulated learning (SRL), which emphasizes learners' ability to plan, monitor, and evaluate their cognitive, motivational, and behavioral processes (Zimmerman, 2002). Closely related to SRL is metacognition, defined as awareness and control of one's own thinking and learning strategies. Together, these constructs form the foundation of autonomous and lifelong learning; skills that are indispensable in today's complex, rapidly changing, and information-rich world. Importantly, in digital learning environments, the successful exercise of SRL and metacognitive skills determines whether students can effectively navigate diverse learning materials, maintain motivation, and achieve meaningful learning outcomes without constant external guidance.

In recent years, researchers have increasingly examined how digital learning environments can be designed to promote metacognitive development and SRL. For example, Braad demonstrated that self-explication prompts; which encourage learners to articulate their reasoning processes; significantly improved metacognitive awareness, even when such support was provided parallel to domain-specific instruction (Braad et al., 2022). Similarly, Michalsky found that metacognitive scaffolding enhanced preservice teachers' ability to design higher-order thinking tasks and fostered deeper reflective learning (Michalsky, 2024). Taken together, these studies highlight that embedding metacognitive support within digital tools can strengthen learners' ability to plan, monitor, and reflect on their learning, leading to more effective knowledge construction.

Building upon these findings, more recent studies have explored the integration of SRL-supportive features directly into digital learning platforms. Elmabaredy and Gencel, for instance, redesigned Moodle to include features such as progress tracking, goal setting, and personalized feedback, which resulted in significantly higher student performance compared to conventional setups (Elmabaredy & Gencel, 2024). In addition, a systematic review by Junaštíková confirmed that modern educational technologies consistently enhance self-regulation and academic outcomes (Junaštíková, 2024). However, the review also emphasized ongoing challenges in the consistency of usability evaluations and user experience metrics across studies. Extending these innovations further, Ge et al. developed SRLAgent, a hybrid system that integrates gamification with large language model (LLM)-based scaffolding, effectively improving learners' goal-setting, strategic monitoring, and reflective engagement (Ge et al., 2025). Collectively, these advances represent the current state of the art in designing adaptive and intelligent learning environments that actively nurture SRL and metacognitive skills.

Despite these promising developments, an important aspect that remains underexplored is the usability of SRL-supportive digital platforms; particularly the ease of learning dimension. While previous research has primarily focused on cognitive and motivational outcomes, fewer studies have investigated how learners perceive and experience the usability of the digital systems that

facilitate metacognitive and self-regulated learning. In practice, if learners find a system difficult to understand or operate, it may hinder their engagement and reduce the overall effectiveness of the intended learning interventions. Therefore, evaluating usability dimensions such as usefulness, ease of use, satisfaction, and ease of learning is essential for ensuring that digital learning environments not only promote SRL but also remain accessible, intuitive, and supportive of diverse learners.

In light of this gap, the present study aims to evaluate the usability of a learning platform developed to enhance students' metacognitive and self-regulated learning abilities. Specifically, it examines four key dimensions; usefulness, ease of use, ease of learning, and satisfaction; to assess how effectively the platform supports students in managing and regulating their learning processes. By focusing on learners' perceptions and experiences, this study seeks to provide practical insights into how usability contributes to learner engagement and the successful adoption of SRL-based digital tools. The results are expected to inform the design and development of future educational technologies that not only deliver content efficiently but also empower learners to take ownership of their learning journey through self-regulation and metacognitive control.

The didactic design of the learning platform was informed by metacognitive principles and microlearning theory. Implemented in a digital format, the platform adopts a blended-learning model using a flipped-classroom approach, requiring students to engage in three structured learning phases: (1) pre-class preparation, (2) in-class activities, and (3) post-class consolidation. Its conceptual foundation integrates several major learning theories; constructivism, adult learning, metacognition, experiential learning, and reflective practice, which collectively guided the development process. In the automotive maintenance module, students progress through thirty-one structured stages, each consisting of multiple procedural steps accompanied by embedded self-reflection prompts delivered through microlearning videos. At every step, teachers can provide formative feedback, and students participate in peer discussions at the conclusion of each stage. The combination of self-reflection, instructor feedback, and peer interaction functions as a regulatory mechanism for enhancing learners' metacognitive awareness, self-monitoring, and self-regulation. The figure below illustrates the didactic triangle that underpins this metacognition-based digital microlearning platform.

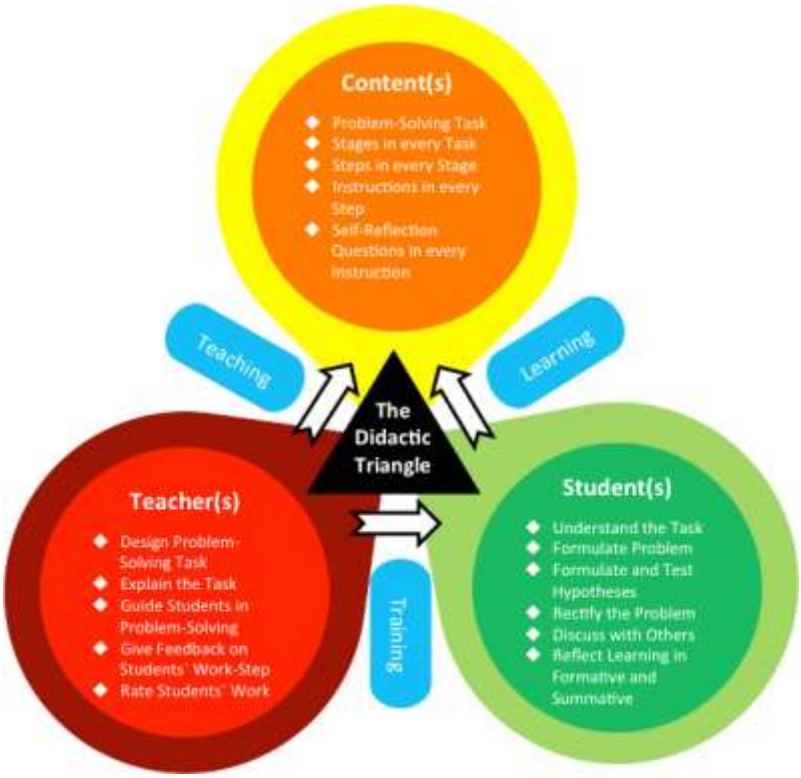

Figure 1. The Didactic Design of the Metacognition-Based Digital Microlearning Platform

METHOD

Research Design

This research adopted a design-based research (DBR) framework, adapted from Pool and Laubscher (Pool & Laubscher, 2016), which emphasizes the iterative processes of designing, developing, and evaluating educational innovations within authentic learning settings. The DBR approach was considered particularly appropriate for this study, as it aligns with the pragmatic paradigm that values methodological pluralism and the selection of research methods according to their utility in addressing complex educational problems. Within this framework, the usability evaluation was situated in the sixth stage of the DBR cycle, evaluation and reflection, a critical phase intended to validate both the practicality and effectiveness of the intervention. The primary goal of this stage was to systematically investigate the usability of the metacognition-based digital microlearning platform as an instructional resource to support teaching and learning practices. To this end, a quantitative research design was implemented through the administration of a structured questionnaire survey. The evaluation focused on four key usability dimensions commonly cited in the literature; usefulness, ease of use, ease of learning, and user satisfaction (Lund, 2001). This multidimensional assessment was designed to capture not only the functional performance

of the training kit but also the experiential perspectives of its users, thereby providing a comprehensive understanding of its potential as an educational tool.

Research Participants

A total of 252 students enrolled in the Automotive Vocational Teacher Education program in 4 different universities participated in this study. The participants were invited to complete a structured questionnaire designed to conduct a summative usability evaluation of the metacognition-based digital microlearning platform.

Research Instrument

The primary instrument employed was the Usefulness, Satisfaction, and Ease of Use (USE) Questionnaire, originally developed by Lund (Lund, 2001). This questionnaire has been widely acknowledged for its validity and reliability and has been extensively adopted in both academic and industrial contexts to assess user perceptions of digital and technological tools. The instrument consists of 30 items measured on a seven-point Likert scale and evaluates four key usability dimensions: usefulness, ease of use, ease of learning, and satisfaction. To ensure cultural and linguistic appropriateness, the questionnaire was translated into Bahasa Indonesia by Hariyanto et al. (Hariyanto et al., 2020) through a rigorous process conducted by a certified translator from a university language center. The translation emphasized semantic, conceptual, and contextual equivalence, ensuring the instrument's reliability and validity within the Indonesian context.

Justification of Using USE Questionnaire

The USE (Usefulness, Satisfaction, and Ease of Use) Questionnaire is widely recognized as a robust and comprehensive instrument for evaluating the usability of digital learning systems. Developed by Lund (Lund, 2001), the questionnaire measures four core dimensions; Usefulness, Ease of Use, Ease of Learning, and Satisfaction, which align closely with the conceptualization of usability in human–computer interaction research. These dimensions provide a holistic assessment that captures both functional and experiential aspects of user interaction. In the context of evaluating a metacognition-based digital microlearning platform, the USE Questionnaire is particularly appropriate because it addresses the primary usability indicators most relevant to digital learning environments. The constructs of Ease of Use and Ease of Learning directly reflect students' ability to navigate the platform and acquire operational skills, while the Usefulness and Satisfaction dimensions capture perceived pedagogical value and user engagement. These dimensions collectively support a meaningful assessment of how the platform facilitates learning processes and supports user performance. Although qualitative insights could enrich understanding, the USE Questionnaire alone provides a valid, reliable, and sufficiently comprehensive measure of usability for determining the platform's overall effectiveness at this stage of research. Its

established psychometric properties, ease of administration, and widespread use in educational technology studies further justify its selection as an adequate standalone instrument for usability evaluation.

Research Procedure

The Indonesian version of the USE Questionnaire was administered to the participants for systematic usability assessment of the training kit. A structured questionnaire method was selected for its efficiency in collecting standardized data from a relatively large sample, its ability to produce quantifiable results suitable for statistical analysis, and its comparability with previous usability studies. This approach enabled the evaluation to capture both the functional performance and the experiential perspectives of users, thereby providing comprehensive evidence of the training kit's usability.

Research Data Analysis Techniques

The summative usability of the metacognition-based digital microlearning platform, after its final revision, was evaluated using the USE Questionnaire. A descriptive quantitative approach was employed to analyze the collected data. The analysis involved calculating both total and mean scores for each usability dimension; usefulness, ease of use, ease of learning, and satisfaction, as well as for overall usability.

To ensure systematic interpretation, the resulting scores were categorized into five performance levels: very low, low, medium, high, and very high. The categorization was guided by Azwar Saifuddin's framework (Saifuddin, 2012), which provides standardized benchmarks for interpreting quantitative data. The use of descriptive analysis was considered appropriate for this study because it allows clear summarization of participants' responses, facilitates interpretation of Likert-scale data, and provides straightforward comparisons across usability dimensions. This approach also ensures that the evaluation outcomes can be easily understood and effectively linked to the practical implications of the learning platform. The categorized results are presented in Figure 1 and Table 1 for clarity and comprehensiveness.

		x	≤	μ-1.5 σ	=	Very Low
μ-1.5 σ	<	x	≤	μ-0.5 σ	=	Low
μ-0.5 σ	<	x	≤	μ+0.5 σ	=	Average
μ+0.5 σ	<	x	≤	μ+1.5 σ	=	High
μ+1.5 σ	<	x			=	Very High

Note:

x	=	The Achieved Score (aspect`s average score)
μ	=	Mean (max score + min score: 2)
σ	=	Standard Deviation

Figure 2. Categorization Formula

Based on the formula above, the calculation was done to categorize every aspect of the USE Questionnaire. Below is the guide table for doing such categorizations.

Table 1. Guide Table for Categorizing the USE Questionnaire Average Total Score

No	Aspect	Categorization						
1	Usefulness			x	≤	20	=	Very Low
		20	<	x	≤	28	=	Low
		28	<	x	≤	36	=	Average
		36	<	x	≤	44	=	High
		44	<	x			=	Very High
2	Ease of Use			x	≤	27.5	=	Very Low
		27.5	<	x	≤	38.5	=	Low
		38.5	<	x	≤	49.5	=	Average
		49.5	<	x	≤	60.5	=	High
		60.5	<	x			=	Very High
3	Ease of Learning			x	≤	10	=	Very Low
		10	<	x	≤	14	=	Low
		14	<	x	≤	18	=	Average
		18	<	x	≤	22	=	High
		22	<	x			=	Very High
4	Satisfaction			x	≤	17.5	=	Very Low
		17.5	<	x	≤	24.5	=	Low
		24.5	<	x	≤	31.5	=	Average
		31.5	<	x	≤	38.5	=	High
		38.5	<	x			=	Very High
5	Total Score			x	≤	75	=	Very Low
		75	<	x	≤	105	=	Low
		105	<	x	≤	135	=	Average
		135	<	x	≤	165	=	High
		165	<	x			=	Very High

RESULTS AND DISCUSSION

Data Set Overview

The dataset comprised responses from 252 university students who assessed the metacognition-based digital microlearning platform using the USE Questionnaire (Lund, 2001). This instrument evaluates four dimensions of usability: usefulness, ease of use, ease of learning, and satisfaction. Each item was rated on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The complete dataset is provided in Table 1.

Table 2. The Data Set of USE Questionnaire Answers

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
1	6,88	55	6,55	72	7,00	28	6,29	44	199
2	6,50	52	6,55	72	6,00	24	6,43	45	193
3	7,00	56	6,73	74	6,50	26	6,29	44	200
4	7,00	56	6,82	75	7,00	28	6,86	48	207
5	6,75	54	6,91	76	7,00	28	7,00	49	207
6	6,38	51	6,64	73	6,25	25	6,29	44	193
7	6,38	51	6,36	70	6,50	26	6,43	45	192
8	6,38	51	6,36	70	6,00	24	6,00	42	187
9	7,00	56	6,73	74	6,50	26	6,29	44	200
10	7,00	56	6,82	75	7,00	28	6,86	48	207
11	6,75	54	6,91	76	7,00	28	7,00	49	207
12	6,50	52	6,82	75	6,25	25	6,57	46	198
13	6,88	55	6,64	73	6,50	26	6,86	48	202
14	6,50	52	6,82	75	6,25	25	6,86	48	200
15	6,13	49	6,36	70	6,50	26	6,71	47	192

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
16	7,00	56	7,00	77	6,50	26	6,71	47	206
17	6,88	55	6,73	74	6,75	27	6,86	48	204
18	6,88	55	6,64	73	6,25	25	6,71	47	200
19	6,88	55	6,64	73	6,75	27	6,57	46	201
20	6,63	53	6,64	73	7,00	28	6,43	45	199
21	6,88	55	6,82	75	6,75	27	6,57	46	203
22	6,75	54	6,73	74	6,75	27	6,29	44	199
23	6,88	55	6,55	72	6,50	26	6,71	47	200
24	6,88	55	6,73	74	7,00	28	6,86	48	205
25	6,38	51	6,55	72	6,75	27	6,57	46	196
26	6,63	53	6,64	73	6,25	25	6,29	44	195
27	6,88	55	6,64	73	6,50	26	6,71	47	201
28	6,50	52	6,82	75	6,75	27	6,71	47	201
29	6,38	51	6,45	71	6,50	26	6,71	47	195
30	6,88	55	6,73	74	6,75	27	6,43	45	201
31	6,50	52	6,91	76	6,75	27	6,86	48	203
32	6,75	54	6,91	76	6,50	26	7,00	49	205
33	6,75	54	6,73	74	6,50	26	6,57	46	200
34	6,63	53	6,73	74	6,75	27	6,57	46	200
35	6,63	53	6,91	76	6,25	25	6,86	48	202
36	6,88	55	6,73	74	6,50	26	6,43	45	200
37	6,88	55	6,64	73	6,25	25	6,71	47	200
38	6,75	54	6,91	76	6,75	27	6,86	48	205
39	6,63	53	6,73	74	6,25	25	6,43	45	197
40	6,75	54	6,64	73	6,00	24	6,71	47	198
41	6,63	53	6,55	72	6,75	27	7,00	49	201
42	6,75	54	6,64	73	6,75	27	6,29	44	198
43	6,75	54	6,82	75	6,50	26	6,29	44	199
44	6,88	55	6,73	74	6,75	27	6,57	46	202
45	6,75	54	6,45	71	6,75	27	6,71	47	199
46	6,38	51	6,82	75	6,50	26	6,43	45	197
47	6,50	52	6,64	73	7,00	28	6,43	45	198
48	6,75	54	6,73	74	6,50	26	6,71	47	201
49	6,75	54	6,55	72	6,75	27	6,86	48	201
50	6,75	54	6,73	74	6,75	27	6,86	48	203
51	6,50	52	6,73	74	6,75	27	6,86	48	201
52	6,50	52	6,55	72	6,75	27	6,71	47	198
53	6,63	53	6,64	73	7,00	28	6,71	47	201
54	6,63	53	6,73	74	6,75	27	6,57	46	200
55	6,75	54	6,91	76	6,50	26	6,57	46	202
56	6,38	51	6,73	74	6,50	26	6,86	48	199
57	6,88	55	6,73	74	6,50	26	6,71	47	202
58	6,75	54	6,82	75	6,25	25	6,43	45	199
59	6,63	53	6,55	72	6,50	26	6,57	46	197
60	6,50	52	6,64	73	7,00	28	6,43	45	198
61	6,63	53	6,73	74	6,50	26	6,86	48	201
62	6,63	53	6,82	75	6,75	27	6,57	46	201
63	6,88	55	6,73	74	6,75	27	6,57	46	202
64	6,63	53	6,73	74	6,75	27	6,57	46	200
65	6,75	54	6,82	75	6,25	25	6,57	46	200
66	6,63	53	6,73	74	6,75	27	6,43	45	199
67	6,75	54	6,82	75	6,50	26	6,86	48	203
68	6,50	52	6,64	73	7,00	28	6,57	46	199
69	6,63	53	6,82	75	6,75	27	6,86	48	203
70	6,38	51	6,73	74	6,75	27	6,86	48	200
71	6,88	55	6,82	75	6,50	26	6,43	45	201
72	6,75	54	6,64	73	6,50	26	6,57	46	199
73	6,38	51	6,82	75	6,75	27	6,29	44	197
74	7,00	56	6,73	74	6,75	27	6,86	48	205

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
75	6,63	53	6,82	75	6,50	26	6,71	47	201
76	6,50	52	6,73	74	6,00	24	6,86	48	198
77	6,75	54	6,45	71	6,75	27	6,43	45	197
78	6,25	50	6,82	75	6,25	25	6,71	47	197
79	6,50	52	6,64	73	6,75	27	6,57	46	198
80	6,75	54	6,82	75	6,75	27	6,57	46	202
81	6,38	51	6,73	74	6,25	25	6,43	45	195
82	6,63	53	6,73	74	7,00	28	6,71	47	202
83	6,50	52	6,91	76	6,75	27	6,57	46	201
84	6,75	54	6,73	74	6,50	26	6,86	48	202
85	6,38	51	6,73	74	6,75	27	6,29	44	196
86	6,75	54	6,45	71	7,00	28	7,00	49	202
87	6,38	51	6,64	73	7,00	28	6,86	48	200
88	6,75	54	6,36	70	6,50	26	6,86	48	198
89	6,63	53	7,00	77	6,50	26	6,71	47	203
90	6,38	51	6,82	75	6,50	26	6,57	46	198
91	6,63	53	6,55	72	6,75	27	6,57	46	198
92	6,75	54	6,73	74	6,75	27	6,71	47	202
93	6,75	54	6,55	72	6,75	27	6,86	48	201
94	6,50	52	6,36	70	6,50	26	6,71	47	195
95	6,75	54	6,55	72	6,50	26	6,57	46	198
96	6,88	55	6,55	72	6,50	26	6,43	45	198
97	6,38	51	6,45	71	6,75	27	6,43	45	194
98	6,75	54	6,64	73	6,75	27	6,71	47	201
99	6,50	52	6,91	76	6,50	26	6,86	48	202
100	6,75	54	6,64	73	6,50	26	6,43	45	198
101	6,75	54	6,91	76	6,50	26	6,57	46	202
102	6,75	54	6,64	73	6,50	26	7,00	49	202
103	7,00	56	6,82	75	7,00	28	6,29	44	203
104	6,75	54	6,64	73	6,50	26	6,57	46	199
105	6,75	54	6,45	71	6,50	26	6,86	48	199
106	6,50	52	6,55	72	6,75	27	6,86	48	199
107	6,88	55	6,73	74	6,50	26	6,71	47	202
108	6,50	52	6,55	72	6,75	27	6,57	46	197
109	6,50	52	6,73	74	6,25	25	6,71	47	198
110	6,38	51	6,82	75	7,00	28	6,71	47	201
111	6,75	54	6,64	73	6,25	25	6,86	48	200
112	6,75	54	6,55	72	6,50	26	6,57	46	198
113	6,38	51	6,64	73	6,75	27	6,71	47	198
114	6,63	53	6,73	74	7,00	28	6,71	47	202
115	6,75	54	6,45	71	6,50	26	6,29	44	195
116	6,63	53	6,73	74	6,50	26	6,71	47	200
117	6,50	52	6,82	75	7,00	28	6,43	45	200
118	6,75	54	6,55	72	6,75	27	7,00	49	202
119	6,50	52	6,64	73	7,00	28	6,43	45	198
120	6,50	52	6,64	73	6,75	27	6,71	47	199
121	6,75	54	6,73	74	7,00	28	6,71	47	203
122	6,75	54	6,55	72	6,75	27	6,43	45	198
123	6,63	53	6,91	76	6,50	26	6,71	47	202
124	6,75	54	6,73	74	6,50	26	6,71	47	201
125	7,00	56	6,73	74	6,75	27	6,71	47	204
126	6,50	52	6,64	73	6,50	26	6,86	48	199
127	6,75	54	6,73	74	6,25	25	6,86	48	201
128	7,00	56	6,82	75	7,00	28	6,71	47	206
129	6,75	54	6,55	72	6,75	27	6,71	47	200
130	6,50	52	6,64	73	6,50	26	6,86	48	199
131	6,75	54	6,73	74	6,50	26	6,71	47	201
132	6,75	54	6,73	74	7,00	28	6,71	47	203
133	6,63	53	6,64	73	6,25	25	6,71	47	198

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
134	6,63	53	6,73	74	7,00	28	6,71	47	202
135	6,63	53	6,91	76	6,75	27	6,71	47	203
136	6,88	55	6,64	73	6,75	27	6,57	46	201
137	6,50	52	6,82	75	6,75	27	6,86	48	202
138	7,00	56	6,82	75	6,50	26	6,29	44	201
139	6,63	53	6,73	74	7,00	28	6,86	48	203
140	6,50	52	6,73	74	6,50	26	6,14	43	195
141	6,75	54	6,82	75	6,75	27	6,86	48	204
142	6,38	51	6,55	72	6,50	26	6,57	46	195
143	6,63	53	6,64	73	7,00	28	6,71	47	201
144	6,75	54	6,82	75	7,00	28	6,86	48	205
145	6,75	54	6,73	74	6,75	27	6,57	46	201
146	6,75	54	6,73	74	6,25	25	6,71	47	200
147	6,38	51	6,55	72	7,00	28	6,57	46	197
148	6,63	53	6,82	75	7,00	28	6,86	48	204
149	6,63	53	6,73	74	6,50	26	6,71	47	200
150	7,00	56	6,55	72	6,75	27	6,43	45	200
151	6,38	51	6,27	69	6,75	27	6,86	48	195
152	6,63	53	6,45	71	7,00	28	6,57	46	198
153	6,63	53	6,64	73	6,75	27	6,57	46	199
154	6,75	54	6,91	76	6,75	27	6,57	46	203
155	6,63	53	6,73	74	6,50	26	7,00	49	202
156	6,88	55	6,64	73	6,50	26	6,86	48	202
157	6,75	54	6,82	75	6,75	27	6,57	46	202
158	6,75	54	6,73	74	6,50	26	6,71	47	201
159	6,63	53	6,64	73	6,50	26	6,86	48	200
160	6,88	55	6,73	74	6,75	27	6,71	47	203
161	7,00	56	6,64	73	6,50	26	6,86	48	203
162	6,88	55	6,64	73	7,00	28	6,71	47	203
163	6,75	54	6,64	73	6,50	26	6,71	47	200
164	6,75	54	6,55	72	6,25	25	6,43	45	196
165	6,88	55	6,45	71	6,75	27	6,71	47	200
166	6,50	52	6,73	74	6,50	26	6,71	47	199
167	6,75	54	6,55	72	6,50	26	6,71	47	199
168	6,88	55	6,82	75	7,00	28	6,71	47	205
169	6,38	51	6,64	73	6,50	26	6,57	46	196
170	6,75	54	6,64	73	6,50	26	6,43	45	198
171	6,75	54	6,55	72	6,75	27	6,86	48	201
172	6,88	55	6,64	73	6,50	26	6,86	48	202
173	6,63	53	6,82	75	6,75	27	6,86	48	203
174	6,25	50	6,45	71	6,50	26	6,71	47	194
175	6,75	54	6,64	73	6,50	26	7,00	49	202
176	6,75	54	6,82	75	7,00	28	6,71	47	204
177	6,88	55	6,73	74	6,75	27	6,29	44	200
178	6,75	54	6,82	75	6,50	26	6,71	47	202
179	6,50	52	6,64	73	7,00	28	6,86	48	201
180	6,63	53	6,55	72	6,75	27	6,43	45	197
181	6,38	51	6,55	72	6,50	26	6,71	47	196
182	6,75	54	6,73	74	6,25	25	6,71	47	200
183	6,63	53	6,91	76	7,00	28	6,71	47	204
184	6,50	52	6,82	75	7,00	28	6,71	47	202
185	6,75	54	6,64	73	6,75	27	6,57	46	200
186	7,00	56	6,45	71	6,75	27	6,57	46	200
187	6,38	51	6,45	71	6,50	26	6,71	47	195
188	7,00	56	6,82	75	6,75	27	6,57	46	204
189	6,38	51	6,64	73	6,50	26	6,71	47	197
190	6,50	52	6,45	71	7,00	28	6,57	46	197
191	6,75	54	6,82	75	6,75	27	6,71	47	203
192	6,88	55	6,64	73	6,75	27	6,71	47	202

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
193	6,38	51	6,73	74	6,75	27	6,71	47	199
194	6,63	53	6,73	74	6,50	26	7,00	49	202
195	6,50	52	6,55	72	7,00	28	6,71	47	199
196	6,88	55	6,73	74	6,50	26	6,86	48	203
197	6,50	52	6,91	76	6,75	27	6,57	46	201
198	6,63	53	6,55	72	6,50	26	6,71	47	198
199	6,75	54	6,45	71	6,75	27	6,71	47	199
200	6,75	54	6,55	72	6,75	27	6,43	45	198
201	6,75	54	6,64	73	7,00	28	6,86	48	203
202	6,75	54	6,64	73	6,75	27	6,71	47	201
203	6,88	55	6,55	72	6,75	27	6,43	45	199
204	6,63	53	6,73	74	6,75	27	6,29	44	198
205	6,50	52	7,00	77	6,75	27	6,86	48	204
206	6,50	52	6,64	73	6,75	27	6,86	48	200
207	6,38	51	6,55	72	6,50	26	6,43	45	194
208	6,75	54	6,64	73	7,00	28	6,57	46	201
209	6,88	55	6,73	74	6,25	25	6,57	46	200
210	6,75	54	6,45	71	7,00	28	6,57	46	199
211	6,63	53	6,82	75	6,75	27	6,86	48	203
212	6,50	52	6,91	76	6,75	27	6,57	46	201
213	6,50	52	6,73	74	6,50	26	6,57	46	198
214	6,50	52	6,73	74	7,00	28	6,43	45	199
215	6,88	55	6,82	75	6,50	26	6,57	46	202
216	6,63	53	6,45	71	6,50	26	6,57	46	196
217	6,50	52	6,55	72	6,50	26	6,86	48	198
218	6,13	49	6,55	72	7,00	28	6,86	48	197
219	6,63	53	6,73	74	6,75	27	6,86	48	202
220	6,75	54	6,73	74	7,00	28	6,57	46	202
221	6,75	54	6,82	75	7,00	28	6,71	47	204
222	6,75	54	6,73	74	7,00	28	6,57	46	202
223	6,38	51	6,82	75	6,25	25	6,86	48	199
224	6,63	53	6,64	73	6,75	27	6,57	46	199
225	6,63	53	6,45	71	6,75	27	6,43	45	196
226	6,75	54	6,55	72	7,00	28	6,57	46	200
227	7,00	56	6,36	70	6,50	26	6,71	47	199
228	6,38	51	6,45	71	6,75	27	6,86	48	197
229	6,63	53	6,64	73	6,50	26	6,43	45	197
230	6,88	55	6,73	74	6,75	27	6,86	48	204
231	6,63	53	6,91	76	7,00	28	6,86	48	205
232	6,50	52	6,55	72	6,75	27	6,71	47	198
233	6,75	54	6,55	72	7,00	28	6,29	44	198
234	6,75	54	6,64	73	7,00	28	6,57	46	201
235	6,88	55	6,55	72	6,50	26	6,71	47	200
236	6,88	55	6,82	75	6,75	27	6,71	47	204
237	6,88	55	6,73	74	6,50	26	6,57	46	201
238	6,75	54	6,82	75	6,50	26	6,71	47	202
239	6,75	54	6,55	72	6,50	26	6,71	47	199
240	6,88	55	6,73	74	6,75	27	6,71	47	203
241	6,88	55	6,73	74	6,50	26	6,86	48	203
242	6,63	53	6,55	72	6,50	26	6,86	48	199
243	6,75	54	6,73	74	6,50	26	6,43	45	199
244	6,63	53	6,55	72	6,50	26	7,00	49	200
245	6,75	54	6,82	75	6,75	27	7,00	49	205
246	6,75	54	6,45	71	6,75	27	6,71	47	199
247	6,50	52	6,73	74	6,25	25	6,57	46	197
248	6,63	53	6,55	72	7,00	28	6,86	48	201
249	6,38	51	6,73	74	6,75	27	6,71	47	199
250	6,38	51	6,73	74	6,50	26	6,29	44	195
251	6,38	51	6,73	74	6,50	26	6,71	47	198

Participants' Number	Aspects' Scores								Total Score
	Usefulness		Ease of Use		Ease of Learning		Satisfaction		
	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	Mean Score	Total Score	
252	6,63	53	6,55	72	6,50	26	6,57	46	197

Descriptive Statistics

To present an overview of the overall usability evaluation, the students' responses were compiled and analyzed across the four dimensions of the USE Questionnaire. Each dimension was rated using a seven-point Likert scale, with higher scores reflecting stronger agreement with positive usability attributes. The analysis reported measures of central tendency (mean), variability (standard deviation), and range (minimum and maximum values), along with categorizations guided by the criteria outlined in Table 1. A summary of these findings is provided in Table 2.

Table 3. The mean scores, standard deviation, and minimum and maximum values of the findings

No	Dimension	1-7 Mean Score	Mean Total Score	SD	Min	Max	Categorization
1	Usefulness	6,67	53,33	0,21	6,13	7,00	Very High
2	Ease of Use	6,68	73,46	0,15	6,36	7,00	Very High
3	Ease of Learning	6,66	26,63	0,28	6,00	7,00	Very High
4	Satisfaction	6,66	46,62	0,24	6,00	7,00	Very High

Discussion

With regard to the usability evaluation, the results indicate that the overall usability scores, encompassing the dimensions of usefulness, ease of use, ease of learning, and satisfaction, were classified in the very high category. This categorization followed the criteria established by Saifuddin Azwar, which distinguish five levels of performance: very low, low, medium, high, and very high (Saifuddin, 2012). Figure 2 presents a bar chart depicting the normalized scores on a 0–100 scale for each dimension of the USE Questionnaire. The conversion of raw scores into a 0–100 scale is recommended, as it facilitates more straightforward interpretation and enables comparative analysis across variables (Debevc M., Bele, J., 2008). The chart demonstrates that while all four dimensions attained very high ratings, the ease of use dimension recorded the highest score, whereas ease of learning received a comparatively lower score. These findings suggest that the metacognition-based digital microlearning platform substantially enhanced students' satisfaction with the learning process. A more detailed analysis of the satisfaction-related items further indicates that the learning platform is perceived by students as simple, practical,

and user-friendly, requiring minimal effort to operate. The absence of inconsistencies, the ability to use it without written instructions, and the flexibility it provides further strengthen the perception of its usability. Moreover, the findings highlight that users across different skill levels found the application accessible and easy to engage with. Students also appreciated its reliability, as it could be successfully used every time, and valued its error recovery features that allow them to quickly and easily correct mistakes. Overall, the consistently high ratings across these indicators confirm that the application possesses excellent ease of use, thereby supporting effective and seamless learning experiences.

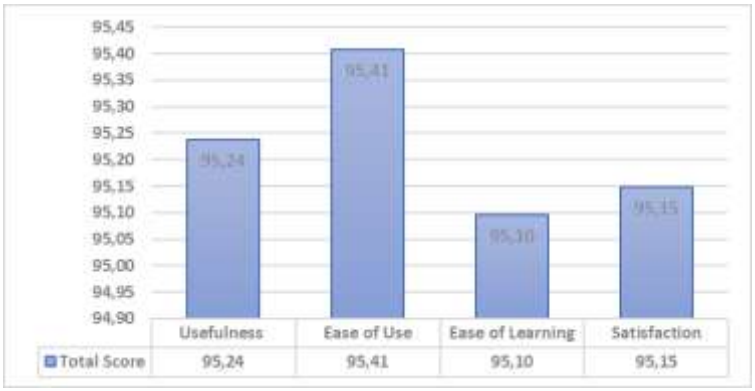

Figure 3. The 0-100 Scores of Usability Evaluation Variables

The ease of learning dimension yielded the lowest rating compared to the other variables evaluated; however, it remained classified within the very high category. Figure 3 displays the score distribution for the items measuring this dimension.

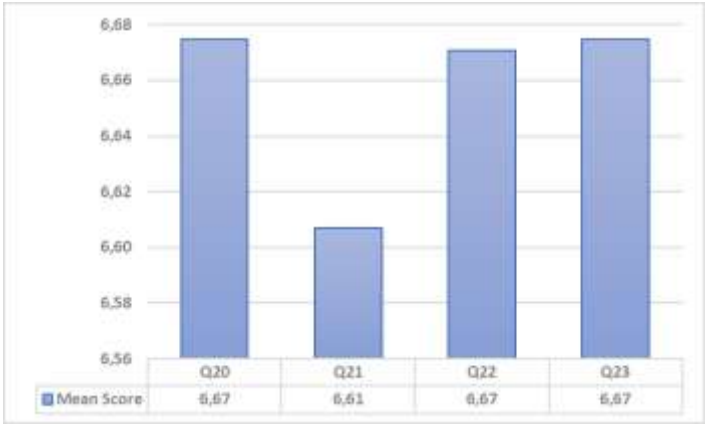

Figure 4. The Ease of Learning Questions' Scores

The results show that students generally rated the ease-of-learning dimension positively, with high scores on items related to learning new concepts quickly (Q20), engaging with the platform without difficulty (Q22), and efficiently acquiring procedural skills (Q23). These findings align with prior research indicating that microlearning structures;

characterized by short, focused tasks; can reduce cognitive load and promote rapid understanding. In addition, the platform's alignment with metacognitive principles likely supported learners' ability to monitor and adjust their learning processes effectively.

Although overall perceptions were positive, Question 21 (Q21) received a noticeably lower score, indicating that students experienced some difficulty remembering how to operate the platform. Research in digital learning environments often identifies navigation complexity and interface familiarity as key contributors to operational memory challenges. The platform's structure, which includes thirty-one stages, embedded microlearning videos, and multiple reflection prompts, provides pedagogical depth but may also increase intrinsic and extraneous cognitive load. Furthermore, studies show that learners require repeated exposure before digital platform routines become fully internalized. In vocational education contexts, where procedural knowledge and tool operation are central, interface clarity plays a significant role in supporting memory and task fluency (Billett, 2011).

Despite the localized challenge indicated in Q21, the overall ease-of-learning dimension still fell within the very high usability category. This suggests that the operational difficulty did not substantially impede students' learning experiences. Instead, it points to opportunities for iterative refinement. Usability research underscores the value of onboarding tutorials, contextual help features, and consistent interface patterns to aid operational memory and reduce cognitive burden (Nielsen, 2010). Integrating brief interactive tutorials, scaffolding features, or tooltips embedded at key navigation points may support smoother onboarding and reinforce procedural recall. Such enhancements align with best practices in both user-experience design and digital pedagogy, which emphasize learner-centered interaction and the minimization of unnecessary cognitive demands (Mayer, 2009).

In summary, while students found the platform generally easy to learn and navigate, the lower score on Q21 highlights the importance of optimizing interface intuitiveness and operational support. Addressing this issue will not only improve user experience but also strengthen the platform's capacity to foster metacognitive regulation, skill acquisition, and learning efficiency, consistent with recommendations from the broader literature on digital learning and instructional design (Mayer, 2009).

Limitation and Future Work

Although this study provides valuable insights into the usability and ease of learning associated with the metacognition-based digital microlearning platform, several limitations must be acknowledged. First, the study relied solely on quantitative survey data to capture students' perceptions. While this approach offers broad patterns and measurable trends, it does not fully illuminate the complexities of learners' experiences, nor does it capture the

contextual factors that may influence their interactions with the platform. Quantitative ratings alone may also mask individual differences in metacognitive engagement, digital literacy, or learning preferences that could meaningfully shape usability perceptions.

Second, the study was conducted within a single institutional and disciplinary context, vocational automotive education, which may limit the generalizability of the findings to other learning environments. Learners in different disciplines or institutions may have distinct expectations, technological backgrounds, or cognitive demands that influence how they perceive and use microlearning platforms. Additionally, the study did not examine longitudinal changes over time, such as how repeated exposure to the platform might influence operational familiarity, metacognitive development, or perceived usability.

Given these limitations, several avenues for future research are recommended. To complement the quantitative findings, future studies should incorporate qualitative methods such as semi-structured interviews, focus group discussions, learner diaries, or think-aloud protocols. These approaches would provide deeper insight into how students interpret the platform's metacognitive scaffolding, how they navigate each learning stage, and what specific challenges or affordances they experience. A mixed-methods design would allow researchers to triangulate findings, thereby producing a more holistic understanding of the platform's effectiveness.

Future research should also explore the adaptation and evaluation of this platform in other academic disciplines and institutional settings. Comparative studies across fields, such as engineering, health sciences, or teacher education, could examine whether the platform's metacognitive design principles are broadly applicable or require contextual modification. Longitudinal studies would also be valuable for examining changes in students' operational memory, self-regulation skills, and sustained usability perceptions across multiple learning cycles.

Finally, further work could investigate how specific design features, such as interface layout, reflection prompts, feedback mechanisms, or onboarding tutorials, contribute to learners' ease of use and metacognitive engagement. Such insights would support iterative refinement and ensure that the platform continues to evolve in alignment with learner needs and evidence-based design principles.

CONCLUSION

Conclusion

The usability evaluation of the metacognition-based digital microlearning platform, conducted with 252 university students using the USE Questionnaire, revealed consistently high scores across all four dimensions: usefulness, ease of use, ease of learning, and satisfaction. The mean ratings, which predominantly ranged between 6.3 and 7.0 on a seven-point Likert scale, demonstrate that the platform is perceived as highly effective, user-friendly, and conducive to learning. These results confirm that the integration of metacognitive principles into digital microlearning enhances learner engagement and satisfaction, while also supporting self-regulated learning.

Practical Implication

The results of this study provide several practical implications for stakeholders in education and technology development. For educators, the platform can serve as a valuable supplementary tool to foster independent and reflective learning, particularly in higher education where metacognitive strategies play a critical role. Instructional designers may also benefit from these findings by emphasizing the integration of metacognitive prompts and scaffolding into digital learning environments, as these design elements were shown to positively influence usability and learner satisfaction. At an institutional level, universities and vocational schools may consider adopting this platform as part of blended or fully online learning models to enhance teaching efficiency and cultivate active, self-directed learning habits among students. Finally, the outcomes also carry significance for technology developers, highlighting the importance of prioritizing simplicity, flexibility, and learner-centered features when creating educational applications.

Future Research Direction

Future research should expand on these findings by validating them in broader and more diverse contexts. Studies involving students from different disciplines, institutions, and cultural settings will help determine whether the observed usability strengths are generalizable. In addition, longitudinal investigations are needed to assess the long-term impact of sustained platform use on students' metacognitive awareness, academic achievement, and knowledge retention. Comparative studies between this platform, other digital learning tools, and traditional instructional methods would also provide deeper insights into its relative advantages and limitations. Moreover, future exploration of advanced feature, such as adaptive feedback, gamification, or AI-driven personalization, could reveal new ways to improve usability and learning outcomes. Integrating learning analytics into future evaluations may further enrich the evidence by connecting usability

ratings with actual interaction data, offering a more comprehensive understanding of how learners engage with metacognitive scaffolding in authentic educational settings.

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