Development and Validation of Interactive Teaching Materials Based on Universal Design for Learning for Digital Marketing Learning at the Open University

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ARTICLE INFO

ABSTRACT

The research aimed to develop and validate an interactive learning module effectively applicable in distance education. Using an Educational Research and Development (R&D) model with a mixed-methods approach, the study collected quantitative and qualitative data. Quantitative data were obtained from pre-tests and post-tests to measure cognitive improvement, analyzed using descriptive and inferential statistics (paired t-test or Wilcoxon test) and effect size calculation. Learning analytics from the LMS—such as clicks, video-watching duration, and quiz scores—supported the analysis. Qualitative data were gathered through semi-structured interviews, participant observation, and thematic analysis by Braun and Clarke, complemented with Likert-scale questionnaires, observation rubrics, and LMS logs. The findings revealed a significant improvement in students' cognitive performance, with post-test scores (M = 13.24, SD = 1.07) much higher than pre-test scores (M = 3.67, SD = 1.41), $t(19) = 25.43$, $p < 0.001$, Cohen's d = 5.69. LMS analytics showed high engagement, with 82% average video completion and frequent quiz participation. Over 85% of students reported greater satisfaction and motivation using the interactive module. The integration of short videos, diagnostic quizzes, and web simulations proved effective for self-directed learning and comprehension, supporting the Universal Design for Learning (UDL) framework in inclusive digital education.

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1.   INTRODUCTION

Digital technology has transformed every sphere of life, including higher education (Fernández et al., 2023; Matsieli & Mutula, 2024; Talib et al., 2021). This revolution prompts learning institutions to constantly be creative in delivering learning materials that are not only up-to-date with scientific advancements but also able to handle the challenges of the global age (Deroncele-Acosta et al., 2023; Zawacki-Richter, 2020). Higher education worldwide is undergoing accelerated digital transformation, characterized by the increasing use of online devices to facilitate distance learning, assessment, and academic services for students.

Graph 1. Digital Transformation in the Global Higher Education World
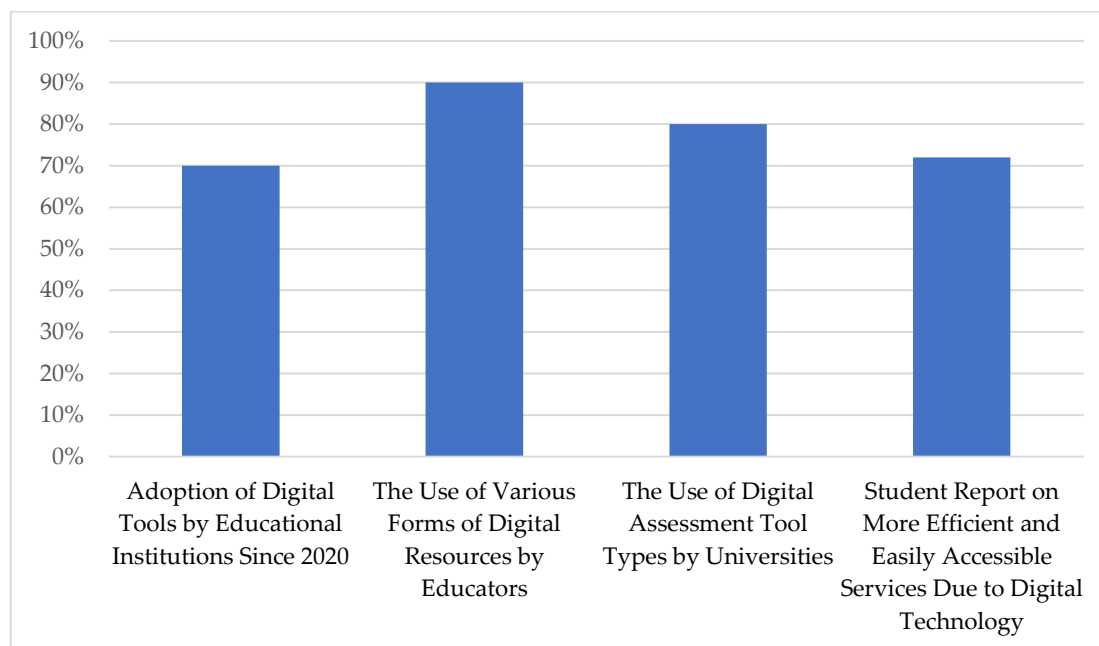
Source: Zipdo Education Report (Eser, 2025)

According to the report, approximately 70% of higher education institutions have adopted digital tools since 2020, 85% of educators use various forms of digital learning resources, 78% of universities utilize digital assessment tools, and 72% of students report increased efficiency in academic services due to the implementation of digital technology (Eser, 2025). This data shows that higher education globally has been widely digitized, with the main focus on improving learning effectiveness and academic governance.

Digital technology is becoming a need in the modern education system. The majority of the institutions do not just apply it in learning but also in the effectiveness of the academic services. It can also be established that digital technology can optimize educational management (Sharlovych et al., 2023), mobile-based digital assessment can positively impact the quality of evaluation and academic management (Junaidah et al., 2024), and leadership, which facilitates adoption of digital technology, can make universities more productive and efficient (Kelder et al., 2025). The digital transformation state has become a strategy imperative to ensure the quality of education. Digital marketing, in these words, is a tactical nucleus of the modern business world and one of the main skills sets that a graduate of a higher educational facility must possess to compete in the global market effectively (Grewal et al., 2024; Kovacs, 2021). Therefore, the urgent necessity is to take into account the Digital Marketing course with the delivery of the current, dynamic, and situational teaching content.

The challenges of distance learning are becoming more complex, particularly at the Open University (UT), the largest distance education institution in Indonesia based on the number of registered students. UT students have diverse educational, social, and geographical backgrounds

(Suwardika et al., 2022). Therefore, the teaching materials used must be able to accommodate this diversity without lowering academic quality (Open, 2025). Research findings from 15 regions in Indonesia indicate heterogeneity in students' academic profiles and learning conditions (Isman et al., 2024). Additionally, UT students are categorized as digital citizens with varying levels of media literacy and digital engagement, which directly impacts the quality of their learning experience (Alrakhman et al., 2024). This condition makes the diversity of UT students both a challenge and an opportunity to develop inclusive interactive teaching materials in the context of distance higher education.

This distance learning problem is even more complex (Anastasakis et al., 2023; Cortés-Albornoz et al., 2023; Fidalgo et al., 2020; Yeh & Tsai, 2022). In Universitas Terbuka (UT), the largest distance education institution in Indonesia by number of enrolled students, the students possess diverse educational, social, and geographical backgrounds (Suwardika et al., 2022). The teaching materials therefore need to be in a place to accommodate this diversity without compromising the quality of academic work (Terbuka, 2025). Learning materials must be considered and accepted to facilitate the learning process of UT students due to the heterogeneous nature of their learning profile that has been proven by the empirical research in 15 regions of Indonesia that confirms the heterogeneity of academic profiles and learning conditions (Isman et al., 2024). The most recent research also classifies the students of UT as digital citizens who have varying rates of digital media use that affect the quality of learning services (Alrakhman et al., 2024). Thus, student diversity at UT is both a threat and an opportunity to create interactive pedagogic materials in the distance higher education system.

Teaching materials are also of great importance in determining the quality of learning (Alciso et al., 2023; Irambona & Chang'ach, 2023; Megavitry et al., 2023). Not only do well-designed modules transfer knowledge but also develop critical thinking skills, creativity, and collaboration. Research on instructional design in distance education underlines the significance of a systemic approach to the process of teaching resource development (Abuhassna & Alnawajha, 2023; Almeqdad et al., 2023; Cortázar et al., 2021; Song & Cai, 2024; Spatioti et al., 2022). Formal learning constructs assist different students in learning. Research-based teaching material is becoming more and more important in the context of digital marketing because of the power of technological progress, social media algorithms, and dynamic consumer behavior online (Pascucci et al., 2023).

However, most previous studies still focus on face-to-face or hybrid learning models, while research on the effectiveness of interactive teaching materials in pure distance education is still limited (Ichikura et al., 2024; Wang et al., 2021). Existing literature tends to highlight the use of digital technology to enhance learning motivation (Adarkwah, 2020; Zhang et al., 2020) or the acquisition of specific skills (Bond et al., 2021; Bygstad et al., 2022), but there hasn't been much development and validation of interactive modules specifically for the Digital Marketing course within a fully online distance learning system. This gap underscores the need for research focused on developing and validating interactive teaching materials suitable for the characteristics of UT students. To address this gap, this study developed an interactive learning module based on the principles of Universal Design for Learning (UDL), which emphasizes three main principles: representation, expression, and engagement. UDL was chosen because it can ensure accessibility and inclusivity for students with diverse learning styles while also aligning with the mastery of 21st-century skills such as critical thinking, digital communication, and cross-platform collaboration (Choi & Seo, 2024; Redstone & Luo, 2024; Rusconi & Squillaci, 2023).

Thus, the main objective of this research is to develop and validate a UDL-based interactive module for the Digital Marketing course at Universitas Terbuka. This research is expected to improve the effectiveness of distance learning, enrich the design of inclusive digital teaching materials, and provide a theoretical contribution to the application of the UDL framework in the context of open and distance higher education.

2.   METHODS

Research Design

This research makes use of Research and Development (R&D) using the Systems Approach Model of Educational Research and Development by Gall, Joyce, and Borg (2007), as this is a broad-scale approach to research-based design, development, and assessment of educational interventions. The model focuses on the process of creating viable, efficacious, and practical educational products through systematic and sequential phases (Gall et al., 2007).

Research Procedure

The research stages were summarized into five operational steps, as follows:

a. Needs analysis was conducted through interviews with the course instructor, document studies, and an initial survey of students to identify the gap between conventional modules and digital learning needs.

b. The product design was conducted according to the principles of Universal Design of Learning (UDL) the following way:
    1. Representation, which entails display of the material in text, video, and interactive infographics.
    2. Action and expression, incorporating the activity based on diagnostic quizzes, marketing simulation, and project-based assignments.
    3. Interactive, including gamification features and case scenario-based activities that result in the desire to make learning more vivid.

c. The prototype development in the UT LMS, which will operate on H5P, will be provided with the interactive navigation, automated quizzes, and brief learning video

d. The testing of the product was done during two phases:
    1. Minimal testing on 30 respondents to evaluate the content clarity and the interface;
    2. Tested on a large scale (49 students) and tested by three experts (digital marketing, educational technology, and instructional design).

e. Depending on professional validation, student commentary and learning analytics (LMS logs) are revised and shared. The end product becomes part of the LMS of the Open University to be implemented in terms of regularity.

The principles of UDL are implemented on an ongoing basis at all periods of development. The principle of representation is used at the stage of needs analysis by means of the determination of the learning media preferences of the students. The principle of action and expression is applied at the design and development level through offering a number of forms of interactive tasks (quizzes, simulations, and projects). During the testing and revision phase, the concept of engagement is maximized by the feedback of the users to enhance interactivity, ease of navigation, and applicability of learning context.

Subjects and Sampling Techniques

The participants in the research were 79 students who studied at the Open University Management program and 3 specialist lecturers. This type of sampling was purposive, and the sample was based on the following criteria: the students who have successfully taken at least one course on digital marketing and the students that have been actively logged into the UT LMS during the previous two semesters. The sample size was also decided by the representativeness of the active student population on the LMS and the possibility of the statistical analysis in the format of the paired t-test, where it is necessary to have at least 30 subjects at each stage of the trial (limited and extensive).

Instruments and Validity

The process of data collection in this study was conducted through different instruments, which are efficiently designed with the aim of contributing to the validity of results. Every instrument plays a varied role in accordance with the emphasis of the analysis as well as in the measurement of learning

outcomes or exploration of learning experiences of the students. The instruments used were as detailed in:

1. Cognitive test (Bloom C1-C6 domains) to estimate the level of learning, pre-posttests;
2. Perception questionnaires (in the form of a 1-5 Likert scale) on usability, motivation, and satisfaction;
3. Skilled validation rubrics to factor the validity of material, media, and didactical worth;
4. Qualitative data Semi-structured interviews and LMS logs.

The relevance of the new tool was checked by three professionals with the Aiken V formula, which has shown a value of above 0.80 (high range). Cronbach's alpha was applied to determine the reliability of the questionnaire, and it was excellent since it was 0.89. During the evaluation of the learning product as to its validity, three experts representing the areas of educational technology, instructional design, and digital marketing were also involved to determine the validity of the learning product via the prism of content accuracy and the media's appropriateness, pedagogical value, and ease of usage. The validation was done with the help of a Likert scale (1-5) assessment sheet; the results of this assessment have been introduced in the discussion and the results section.

Data Analysis Techniques

The mixed-method technique was utilized. The analysis of quantitative data was conducted with the help of descriptive statistics, t-tests/Wilcoxon tests, and effect sizes (Cohen's d) to assess the improvement of learning outcomes. The thematic analysis of qualitative data by Braun and Clarke (2006) was carried out to examine the perceptions and technical obstacles and to provide recommendations on the ways to improve them (Braun & Clarke, 2006). Engagement and academic performance were correlated with LMS analytics (clicks, video length, and quiz scores).

3. FINDINGS AND DISCUSSION

3. Result

3.1.1. Limited Trial and Learner Feedback

The mean score during the pre-test and post-test and the satisfaction survey of 20 students and 49 students, respectively, increased by 63.8 percent, i.e., from 3.67 (SD = 1.41) to 13.24 (SD = 1.07). The paired t-test revealed $t(19) = 25.43$, $p = 0.001$ with a very large effect size (Cohen's d = 5.69). These findings support the efficiency of Digital Marketing BAI to enhance student cognition, as (Mayer, 2009) multimedia theory, affirms that text, images, and interactivity improve retention. It provided positive responses in the satisfaction survey, with means of 3.96-4.55 (3.17 in total); more than 80% of them felt that BAI has helped them to improve their understanding, increase their self-directed learning motivation, and provide an engaging interactive design.

Table 1. Results of the Student Satisfaction Survey (N = 49)

Statement	Mean	Percentage Agreeing (4-5)
BAI helps understand the basic concepts of digital marketing	3.96	79.6%
BAI material is relevant to the needs of the digital business world	4.45	95.9%
BAI improves my ability to analyze marketing strategies	4.55	91.8%
BAI provides practical insights to apply in real projects	4.16	89.8%
Learning using BAI is more effective than conventional teaching materials	4.25	83.7%
Students find it easy to access and navigate the content of BAI	3.96	73.5%
Tasks/activities in BAI can be completed within a reasonable time	4.10	85.7%
The instructions for using BAI are clear enough and not confusing	4.04	81.6%

Statement	Mean	Percentage Agreeing (4-5)
Students did not experience significant technical difficulties when using BAI	4.00	83.7%
The BAI interface makes the learning process comfortable	4.16	79.6%
Students enjoy learning using BAI	4.00	77.6%
BAI increases my motivation for independent learning	4.16	85.7%
Interactivity in BAI increases my engagement in learning	4.27	81.6%
Students are satisfied with the learning experience provided by BAI	3.98	75.5%
Students want to use this type of teaching material in other courses	4.27	87.8%
After using BAI, students are more interested in entering the digital business world	4.08	83.7%
Students are more confident in starting a business based on digital marketing	4.14	81.6%
BAI opens students' horizons about digital business opportunities	4.27	91.8%
Students want to develop digital business ideas based on the material in BAI	4.31	91.8%
This BAI is relevant to supporting students' career plans in the field of digital business	4.27	91.8%

As Table 1 reveals, the overall positive student satisfaction is achieved (M = 3.96-4.55; overall = 4.17, good category). The score was the highest on the improvement of analytical skills (M = 4.55), then on the relevance to the digital business world (M = 4.45) and the knowledge of opportunities (M = 4.27-4.31). Reduced access/*navigation* (M = 3.96) and usage instructions (M = 4.04) scores indicate that there are slight technical problems that require enhancement.

The quantitative results are supported by the student responses, as they indicate an improvement in the state of understanding and learning satisfaction. There were three general themes identified based on the analysis of the interviews: preferability and relevance of the content, self-provision and self-esteem regarding learning, and technical limitations that were less significant. In the first theme, the students mentioned that the material taught by BAI was delivered in a straightforward way, using real-life cases and examples, which could help to grasp the concept of digital marketing. Some of them, however, added that they still found some of the terms hard to grasp without further explanation. The second theme is connected with motivation and self-confidence, as students were more interested and brave to develop the digital business idea as the content was contextual and could be applied to real-life practice. In the meantime, in the third theme, there were minor technical challenges, including the inability to comprehend specific parts and work with data and analytics-driven learning tasks. This notwithstanding, the students were still very willing to use BAI in their other courses. Again, these results showed that the perceptions of BAI are mostly positive and in understanding the tenets of Universal Design of Learning (UDL), which puts emphasis on clear representation, active expression, and high level of learning. This implies that though BAI has a positive effect on students, cognitively and practically, it does not imply that the terminology and interface are not in need of improvement. These findings align with (Vlachopoulos & Makri, 2019), where the significance of usability and user experience has been observed, and (Wright et al., 2023), which had established a connection between satisfaction and engagement and design, interactivity, and navigation.

3.1.2. *Expert Validation Results*

Three experts who represented the educational technology, instructional design, and digital marketing fields conducted the product validation. The evaluation is conducted based on four domains: content accuracy, media appropriateness, pedagogical value, and usability. The mean of the three professionals who participated in the validation exercise rated above 85 percent (very feasible category), which shows that the BAI qualifies as content quality and can be used in distance learning.

The revision stage resulted in a significant improvement in product validation; a comparison of the assessment score before and after revision by the experts is provided in Figure 2.

Graph 2. Expert Validation Results Before and After Product Revision
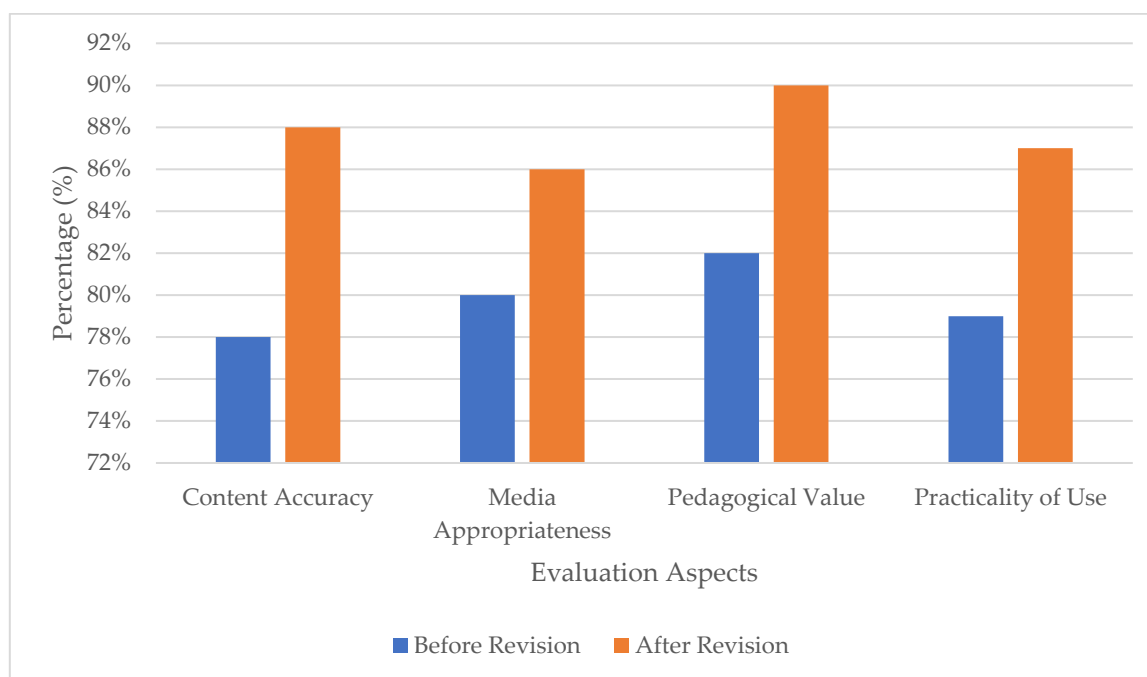
Source: Compiled by authors from expert validation results (2025)

Graph 2 shows an increase in expert validation results across four main aspects. Content accuracy increased from 78% to 88%, media suitability from 80% to 86%, pedagogical value from 82% to 90%, and ease of use from 79% to 87%. All aspects after revision were above 85%, indicating that the product is highly suitable for use in distance learning.

3.1.2. *Effectiveness of Interactive Teaching Materials*

The effectiveness of the interactive materials was evaluated by pretest and posttest besides student feedback. The pretest involved the initial understanding, whereas the posttest involved achievement upon learning. The two comparisons gave a pure gauge on the extent to which the materials enhanced the learning outcomes. Table 2 indicates the pretest results.

Table 2. Pretest Results of Students

Statistics	Value
Number of Respondents (N)	20
Average	3.67
Median	4.5
Mininum	1
Maximum	6
Standar Deviation (SD)	1.41

In Table 2, the pretest results reveal a mean of 3.67 (median = 4.5) of 15 with a low level of initial understanding. There were also differences in scores between 1 and 6 with some variation among students, but there was a standard deviation of 1.41 that indicated there was a great variation in the initial abilities of students.

This observation demonstrates that the initial knowledge of students was unequal before the application of interactive teaching materials. This is consistent with (Megavitry et al., 2023), who highlight the relationship between the quality of teaching material and teacher-student interaction on early achievement, and (Isman et al., 2024), who point out the heterogeneity of academic profiles in distance universities that contributes to the large range of pretest results.

The posttest results were very high after students studied using interactive teaching materials, as indicated in Table 3.

Table 3. Student Posttest Results

Statistics	Value
Number of Respondents (N)	20
Average	13.24
Median	13.5
Mininum	11
Maximum	15
Standar Deviation (SD)	1.07

The posttest outcome in Table 3 reveals a better performance of students with a mean of 13.24 out of 15 and a median of 13.5. The highest score was 15, putting all the students in the high achievement category. The standard deviation is comparatively low (1.41), which denotes the homogeneity of the learning results following the utilization of interactive teaching materials.

The results indicate that interactive instructional materials enhance the students' understanding and cognitive skills to a significant degree. Their success is reflected in the even distribution of the achievement, which is consistent with (Wang et al., 2021), who concluded that interactive online learning strategies outperform traditional ones. Therefore, the posttest scores are good indicators that interactive materials do improve learning outcomes and narrow achievement gaps.

The pretest and posttest results were compared through the paired statistical tests, where a summary was given in Table 4.

Table 4. Statistical Analysis of Pretest and Posttest Comparison

Analysis	Results
Average Pretest	3.67
Average Posttest	13.24
Average Difference	9.57
Paired t-test	$t(19) = 2.10$; $p = 0.048$
Uji Wilcoxon	$W = 0$; $p < 0.001$
Cohen's d	0.47 (moderate effect)

Table 4 analysis indicates that the score has significantly increased from 3.67 (pretest) to 13.24 (posttest), with the average difference of 9.57 between the pretest and posttest. The paired t-test $t(19) = 2.10$, $p = 0.048$) and the Wilcoxon test ($W = 0$, $p < 0.001$) both testify that the improvement was significant and was present across all students. The Cohen's d of 0.47 demonstrates the effectiveness of the interactive teaching materials as a moderately effective means of learning outcomes improvement, which leaves improved outcomes to be achieved.

Such results correspond to (Wang et al., 2021), who demonstrated that online interactive methods are more effective compared to the traditional ones; the developers of interactive tools confirm the

importance of digital interactive materials in distance learning, as the tools can substantially improve cognitive achievement and the quality of learning.

3.2. Discussion

3.2.1. *Relevance to Theory*

The findings of the current paper resonate with the concepts of the Cognitive Theory of Multimedia Learning provided by Mayer (2009), according to which the most efficient way of presentation is the combination of informative text, visuals, and the interactive components (Mayer, 2009). The results of better learning performance following the usage of BAI depict that the multimodality of material presentation (text, video, and interactive simulations) assists students to process the information with two major channels, verbal and visual, and thereby enhances knowledge retention and conceptualization.

In addition, the findings of the given research are conforming to the concepts of Universal Design for Learning (UDL), which focuses on three primary aspects, namely, representation, action and expression, and engagement (Hills et al., 2022; Seymour, 2024; Wells, 2022). The representation in the context of this study is achieved by posting the material in different media formats; the action and the expression are achieved by using quiz-based exercises, simulating, and digital projects; and the engagement is reflected by the motivation and the active involvement of students in online education. They have found that the UDL principle can be used to accommodate the heterogeneous learning patterns of open university students because they are heterogeneous in their inclination to different forms of media and speed of learning.

In the constructivist theory viewpoint, interactive learning enables students to build knowledge through the exploration and reflection process in an active way (Jing & Li, 2021; Pratama et al., 2025). BAI aims at facilitating the bridging of the digital marketing concepts and the real-world experiences and contexts, and this is shown by the qualitative finding that students are more assured and able to apply the digital business concepts after utilizing this module. Therefore, the findings of this research show that the interactive-based design of instructional material is consistent with the principles of teaching under constructivist learning, where students learn to be meaning-makers as opposed to information receivers.

All in all, the relationship between the research results and the three theories proves that the efficiency of Digital Marketing BAI is not only due to the innovation of the media but also due to the correspondence of its design to the principles of the contemporary learning psychology, i.e., active cognitive processing, flexibility of the access to the learning, and self-constructed knowledge.

3.2.2. *Comparison with Previous Research*

The findings made in this study are not unique to a number of other researches that have established the usefulness of interactive digital teaching materials in enhancing learning outcomes and engagement of the students. Vlachopoulos and Makri (2019) demonstrated that user experience and digital interactivity are the valuable factors that affect student satisfaction and motivation to learn online (Vlachopoulos & Makri, 2019). This result is in line with the findings of other studies, as students of BAI assess the interface and activity design as one that leads them to learn better on their own and gain a deeper insight into digital marketing concepts.

The study by Wang et al. (2021) also indicated that the learning that depends on interactivity played a major influence on cognitive success and emotional involvement in education when compared to the traditional approaches (Wang et al., 2021). The same findings were noted in the pre-posttest of the study; the mean value had an increase of 63.8 percent, and the effect size was moderate (Cohen d = 0.47), showing a strong positive effect of BAI on enhancing the cognitive abilities of the students.

Also, these findings are supported by the heterogeneity of student academic profiles in distance education emphasized in the study conducted by Isman et al. (2024). They emphasize the capability of the achievement gap between students to be reduced due to the use of adaptive digital media (Isman

et al., 2024). At Universitas Terbuka, BAI serves the same purpose by offering flexible, interactive, and contextual access to enable students with various backgrounds and abilities to contribute equally.

The findings of the research, therefore, contribute to the overall agreement that digital interactive instructional resources are not only effective in promoting conceptual knowledge but also learning engagement and motivation, especially in the framework of distance learning, which requires autonomy and interaction through technologies.

3.2.3. Implications for Digital Learning at UT

The results of the research have important practical consequences regarding the creation of digital learning in Universitas Terbuka (UT). Being a distance learning institution, UT has a challenge of keeping the students engaged and independent to learn in an online environment. The introduction of Interactive Learning Materials (ILM) to Digital Marketing demonstrates that a learning design that incorporates the concepts of interactivity, the presence of multimodality, and flexibility of access may enhance student learning, their satisfaction, and their motivation in self-directed learning.

The implementation of BAI on the Learning Management System (LMS) at UT could contribute to the enhancement of the student-centered learning process, in which students are not only the consumers but are also engaged in the exploration and reflection process. Such characteristics as automated quizzes, simulations organized in accordance with the context of the Indonesian digital business, and immediate feedback can also be used as an example of creating other digital learning resources at UT.

Also, the results of the current research outline the significance of partnership between lecturers and educational technology developers in creating the teaching materials, which are not only content-heavy but also easily readable and attractive. The Universal Design of Learning (UDL) principle should be extended in order to provide all students with an equal chance to learn regardless of their academic background, digital experience, or location.

Such a BAI implementation could be a new approach that UT may apply in the long term to enhance the quality of distance learning and online courses, enhance the interactivity of the latter, and create a more inclusive, more sustainable culture of self-directed learning based on technology.

According to this, the general findings of this paper support the idea that applying Interactive Learning Materials (ILM) to Digital Marketing can effectively facilitate the learning and motivation and satisfaction of the Open University students. Not only does this effectiveness reflect as a substantial pre-post score increase and a moderate effect size, but students also perceived the ability to understand the learning material clearly, understand its relevance, and engage in the learning process.

The correlation between the findings of the research and the theory of Mayer, UDL, and constructivism suggests that the effectiveness of BAI is in the implementation of the learning design that allows processing multimodal information, learning access flexibilities, and active knowledge construction. This reinforces the empirical findings that digital interactivity-based learning strategies can effectively solve the issues of distance learning, which requires student control and involvement.

Therefore, BAI is not only a technological innovation but also a model of pedagogy in accordance with the 21st-century learning paradigm: digital-based and participatory, as well as inclusive. The discovery is likely to be used as a foundation to come up with such teaching materials in other courses in Universitas Terbuka and to constantly enhance the learning experience of the students.

4.   CONCLUSION

This study is expected to create and pilot Interactive Learning Materials (ILM) for digital marketing to enhance the quality of distance education at Universitas Terbuka. The results of the research reveal that BAI can be successfully used in improving the cognitive knowledge, involvement, and learning interest of students, which is shown by the fact that post-test scores significantly increase ($p < 0.05$; Cohen d = 0.47) and students have a positive attitude toward the quality, actuality, and interest of the teaching material.

Theoretically, the study validates the practices of the Multimedia Learning Theory based on Mayer, the concepts of Universal Design of Learning (UDL), and the constructivist concept in designing the digital teaching materials. In practice, the results have the effect of informing the learning development in Universitas Terbuka, especially in the introduction of inclusive, adaptive, and active participation-based interactive media in learning.

The research directions in the future are proposed to expand the use of BAI to more courses, integrate AI-based adaptive learning capabilities, and implement longitudinal testing to quantify the long-term effects of the achievement of students in terms of their cognitive, affective, and practical skills.

Conflicts of Interest: The authors state that there are no conflicts of interest that could affect the representation or interpretation of the research results reported in this article.

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