Development of interactive media based on Google Sites for independent learning of extracurricular computer-aided design and drafting students

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ABSTRACT

The implementation of Computer-Aided Design and Drafting (CADD) extracurricular training at Vocational High School Turen still relies on printed books and teacher demonstrations, which limit students' independence in learning and restrict the duration of practice. This development was carried out to help students learn independently, without time constraints, and to make it accessible from anywhere. This research is a development study using the ADDIE development model, which consists of five stages: 1.) Analyse; 2.) Design; 3.) Develop; 4.) Implement; 5.) Evaluate. The research and development process began with analysing student characteristics and needs, designing the concept, creating the product, validating it with subject matter experts and media experts, and testing the product using simple random sampling on three trial subjects participating in the CADD extracurricular activity at Vocational High School Turen, followed by evaluation based on improvement suggestions. The research instruments were based on media development theory, BNSP eligibility standards, and assessment standards set by the head of the standards, curriculum, and education assessment body. Based on expert media validation, the percentage was 88%, and expert material validation was 92%. The trial results yielded a 93% response rate from students regarding the developed product. The results of this research and development indicate that the interactive training media developed in Google Sites meet the criteria for suitability as training media. For future research, it is necessary to enhance the presentation and completeness of the material, as well as provide more complex exercises that keep pace with industry developments.

INTRODUCTION

The rapid development of Industry 4.0 is driving a positive transformation in the sustainability of technology-based learning, enabling students to learn, innovate, and utilise technology (Nugroho et al., 2024). Integrated implementation of digital technology enables interactive and efficient learning (Fitrianti et al., 2024). Vocational High Schools, as educational institutions at the vocational secondary level, have the responsibility to respond to current developments to realise interactive and efficient learning, thereby increasing the quality of graduates (Syarif & Janata, 2024). In this case, schools and teachers play a role in developing models, media, and learning resources to help students

keep up with current Industry 4.0 developments and become competent graduates (Nurtanto et al., 2020).

According to Alimuddin et al. (2023), the integration of technology enables students to learn flexibly, without being limited by space or time, as it can be accessed virtually. In addition, virtual learning allows students to access a broader range of learning resources, including learning videos, e-books, and other interactive digital learning platforms (Indarta et al., 2022). Utilising interactive digital learning media helps students learn. It enables teachers to enrich their teaching skills, thereby improving the efficiency and effectiveness of learning activities and enhancing the quality and productivity of learning (Tahir et al., 2024).

In addition to utilising technology to develop learning media, extracurricular activities are needed to develop students' character and skills to become competent (Azizah & Maknun, 2022). Extracurricular activities are effective in helping students develop and explore their talents and interests by extending learning beyond classroom hours (Salsabila et al., 2023; Yusriyah & Retnasari, 2023). Therefore, Vocational High School Turen established an extracurricular program in Computer-Aided Design and Drafting (CADD).

CADD Extracurricular at Vocational High School Turen demonstrates the school's commitment to forming students who are characterised by competence and ready to compete in competitions and the world of work. The routinely followed competitions are the Vocational High School Student Competency Competition (LKS SMK) in Mechanical Engineering, CAD, and Plastic Die Engineering. According to Ardianto et al., (2023), early preparation is key to success in the Student Competency competition, as it trains students through extracurricular activities facilitated by the school. In addition, these two fields of competition require advanced competence in operating Autodesk Inventor Professional, so the school's formation of this extracurricular activity is the right step. Through this application, students can create precise designs, perform simulations, and analyse designs before they are physically produced. To master this application, it is not enough to rely solely on classroom meetings (Akbar et al., 2024).

During implementation, the CADD extracurricular programme at Vocational High School Turen still uses printed modules and teachers' direct demonstrations. The use of printed modules and teacher-led demonstrations in extracurricular activities can lead students to become overly dependent on the provided material, hindering their independence in learning and limiting their study time. Therefore, it is necessary to use interactive learning media that are easily accessible to support student learning independence and student readiness to face the era of the Industrial Revolution 4.0 (Smaragdina et al., 2020). Supporting this statement, Fadilah & Dj (2023) found that the use of learning media in e-modules is more effective than that of printed teaching modules. In addition, printed teaching modules have limitations in displaying video, animation, and audio and require high printing costs, so e-modules are considered more effective because they are integrated with the internet, support interactive media, and increase student learning motivation (Ginting et al., 2024; Puspitasari, 2019). Therefore, it is necessary to develop an e-module in the form of an interactive media integrated through the Google Sites website. With the development of this integrated interactive media, it is hoped that it will support students' independence in learning and creativity with a positive attitude, thereby significantly improving the effectiveness of the learning process and student learning outcomes (Arifin et al., 2021; Ma, 2022).

The use of Google Sites as a supporting medium for interactive media development is based on the findings of Maharani et al., (2024), that Google Sites websites are one of the interactive media that contain various types of content in the form of videos, animations, audio, presentations, and so on, which can be shared according to user needs. Additionally, Google Sites is a free platform that is easy to access and integrates with Google Workspace, making it effective for developing interactive, collaborative, and adaptive educational media or training tailored to the needs of modern education (Islanda & Darmawan, 2023; Juwariyah et al., 2025).

This research and development of interactive media based on Google Sites aims to create an effective training media design as part of an effort to empower the CADD Extracurricular Programme at Vocational High School Turen, and to determine the product's feasibility based on practicality, interactivity, and efficiency. The materials are comprehensive, covering an introduction to Autodesk Inventor Professional 2024, website usage guidelines, 3D modelling, including 2D sketching,

standard 3D parts and sheet metal, standard assembly, welding, mould design, disassembly videos, Inventor Studio, 2D drawings, and practice questions. This media is practical because it is available on a website accessible anytime, anywhere, on any device, including smartphones, tablets, laptops, and computers. The interactive element of this media stems from the integrated content and the availability of a comment feature for users. The efficient aspect of this media development is due to the website's ease of integration and updating various materials, including files (PDF) and videos, as well as practice questions, all within one website. With the development of this media, it is hoped that it will assist extracurricular activities in providing practical and efficient training tools, thereby enhancing students' motivation and competencies in CAD, while also improving the quality of vocational high school graduates, particularly in the field of Mechanical Engineering, in facing competition in the era of the 4th Industrial Revolution.

METHOD

This study utilises research and development (R&D). The development aims to design interactive media in Google Sites for extracurricular activities. This research and development uses the ADDIE model because it is responsive and flexible, enabling it to accommodate any objectives set as its orientation (Branch, 2009). The ADDIE model also provides opportunities for evaluation at each stage of the development process, which positively impacts product quality by minimising error rates. Additionally, this model was chosen because it uses a systematic, sequential approach, enabling the effective and dynamic creation and development of training platforms while supporting the implementation of training (Fitriyah et al., 2021; Sugihartini & Yudiana, 2018). The ADDIE model development procedure is illustrated in Figure 1.
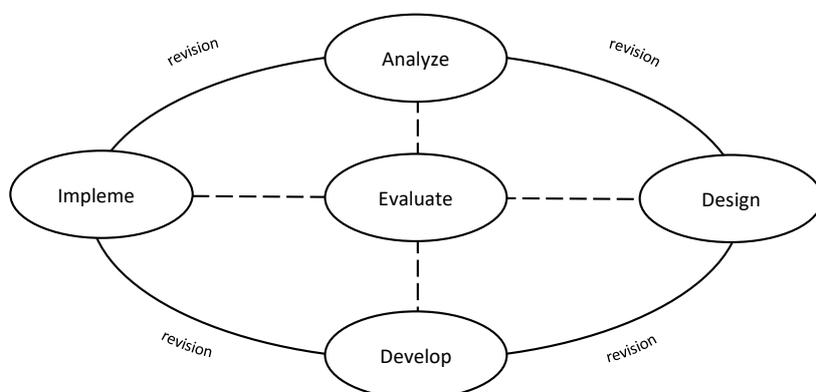

Figure 1. ADDIE Development Concept

Based on the concept Diagram above, the procedure for developing Google Sites-based e-modules is as follows.
1. The analysis stage serves to identify possible gaps during the implementation of extracurricular activities. Several gaps were identified, including the need to supervise teachers' busy schedules, limited learning resources for students, and a lack of student independence in their learning. This data was obtained through direct observation and brief interviews with the supervising teacher, leading to the conclusion that an integrated training medium is needed to present comprehensive materials, tutorial videos, and practice questions.
2. The design stage aims to create an initial concept that addresses the problems identified in the analysis and is reinforced by literature studies, resulting in a product development plan in the form of a website containing material in the form of module files (PDF), tutorial videos, and practice questions, the layout of which is designed in the form of a storyboard.
3. The development stage is the product development step based on the design stage, starting from website creation, material creation, tutorial video creation, and practice question creation. Website development integrates materials, video tutorials, and practice questions. The website

layout is based on the storyboard created in the design phase. After development is complete, media and content experts conduct validation, and the results are analysed.

4. The implementation phase is the testing phase of the product development process that has been validated by experts on test subjects, where the test subjects provide feedback through a questionnaire containing user assessment instruments, to allow users to express their opinions and suggestions.

5. The evaluation stage is used to assess product quality. Therefore, this evaluation stage is based on the results and suggestions from expert validation, as well as user responses after product testing. Product evaluation is conducted based on the assessments, critiques, and suggestions provided.

Validity Test

Validity testing was conducted using validation instruments, and the media and materials developed were validated with these instruments. The media and material validation instruments were given to lecturers from the Department of Mechanical and Industrial Engineering, Faculty of Engineering, State University of Malang, and CADD Extracurricular Supervisors from Turen Vocational School to act as validators. The validation results will be used to adjust the product development process.

Design of Product Trial

Product trials were divided into two stages. The first stage is by submitting a validation questionnaire to media experts with assessment aspects such as colouring, word selection and grammar, screen display, presentation, animation and sound, as well as notes and suggestions, and submitting a validation questionnaire to material experts with assessment aspects such as material feasibility, presentation feasibility, contextual feasibility and notes and suggestions. The second stage includes preparing questionnaires, distributing products, and distributing user assessment questionnaires to test subjects.

Test Subject

The test subjects were vocational school students in Turen who participated in the CADD extracurricular programme during the 2024/2025 academic year. The subjects were selected using simple random sampling, without regard to the abilities or strata of the extracurricular members (Fajar et al., 2021). The sample size for the product trial subjects was determined based on 10% of the large population or 20% of the small population (Long et al., 2025). With a total of 12 extracurricular participants, which constitutes a small population, the research sample consisted of 3 students selected at random.

Data Collection Instrument

This stage encompasses various methods, including interviews, questionnaires administered through the Media Expert Validation Instrument, Material Expert Validation Instrument, and User Assessment Instrument, as well as document acquisition to document the extracurricular process. Additionally, images are captured during observation and research activities. The development of instruments in this study was conducted systematically and based on theory to obtain valid and reliable data, in line with the research objectives. The interview guide was developed based on quality indicators for learning products derived from media development theory and National Professional Certification Agency standards to explore in depth users' perceptions and experiences with the developed products. The questionnaire was designed as a Likert scale with four levels of assessment, with each item developed based on indicators of material aspects, visual appearance, ease of use, and media interactivity. Meanwhile, a user assessment instrument, in the form of a product evaluation sheet, was used to evaluate the quality and suitability of the learning media against the assessment standards provided by the head of the standards agency, the curriculum, and educational assessment.

Data Analysis Technique

The data analysis technique uses two methods: descriptive qualitative analysis and descriptive quantitative analysis. Descriptive qualitative data are obtained through observations, interviews, and documentation from the distribution of validation and user questionnaires, which will strengthen the results of the quantitative data. Quantitative data is obtained through quantitative analysis of results from distributing validation questionnaires to media experts, material experts, and user assessment response questionnaires. The analysis was carried out using the formula referred to Pangestu et al., (2024), so that Formula 1 was obtained as follows.

$$P = \frac{\sum n}{\sum N} \times 100\% \tag{1}$$

The P is the percentage obtained by distributing the questionnaire, n is the number of values obtained, and N is the maximum number of values on the existing rating scale.

Evaluations conducted by media experts, material experts, and users yielded results as percentage assessments. The evaluation criteria for assessing product feasibility are determined using the following grouping in Table 4, as per Darnawati et al.. (2025).

Table 4. Percentage Determination Criteria

No.	Rating Scale	Interval	Category
1	4	81% < Skor < 100%	Very good
2	3	61% < Skor < 80%	Good
3	2	41% < Skor < 60%	Fairly good
4	1	21% < Skor < 40%	Not good

RESULTS AND DISCUSSION

Results

Analysis Result

The students were so engrossed in the teacher's explanation that the product to be developed was an interactive media-based Google Sites platform for the CADD extracurricular activity, comprising module files (PDF), tutorial videos, and practice questions, all integrated into a single website. The objectives of establishing this extracurricular activity are divided into three categories, each with expected competency outcomes, including: 1.) Technical skills, including the ability to operate software, understand the principles and standards of technical drawings in the industrial world, and create advanced technical designs; 2.) Soft skill development, including creativity and problem-solving through existing design projects; 3.) Career preparation through design portfolios, certification preparation, support for competition preparation, and facilitating industry-academia collaboration.

Based on the objectives of the extracurricular programme, some of the materials to be presented in product development to expand the participants' knowledge in manufacturing design include: 1. Tips and tricks for operating the Autodesk Inventor application; 2.) Creating 3D designs through the manufacturing process; 3.) Utilising all assembly features; 4.) Utilising presentation features and Inventor Studio.

Product Design and Storyboard Results

The results of the material formulation are divided into 13 topics, including: 1.) Introduction to Autodesk Inventor; 2.) Website usage guidelines: 3.) Tips and tricks for using Autodesk Inventor; 4.) Project features: 5.) 2D Sketching; 6.) 3D Partition Modelling; 7.) 3D Sheet Metal Modelling; 8.) Assembly Standards; 9.) Welding; 10.) Mould Design; 11). Inventor Studio; 12.) Video presentation on disassembly; 13.) 2D Drawing. The materials are organised according to the menus and features

available in Autodesk Inventor Professional 2024. Additionally, there are practice questions divided into several difficulty levels. All materials and practice questions will be integrated into a single Google Sites website link that includes several features to assist users, such as: 1.) Browser bar; 2.) Menu bar; 3.) Back button; 4.) Home button; and 5.) Next button. The website layout can be viewed through the storyboard in Figure 2 below.
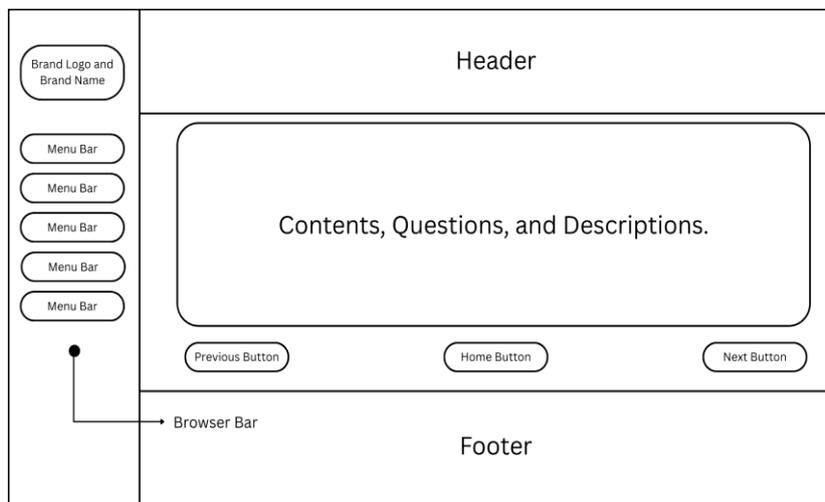

Figure 2. Website Storyboard

Results of Interactive Media Development Based on Google Sites

The results of developing interactive media in Google Sites for CADD Extracurricular are presented on a website that integrates all materials, including module files (in PDF format), tutorial videos, and practice questions. The materials, in the form of module files (PDF), consist of 13 modules, two tutorial videos, and two types of practice questions in the fields of Mechanical Engineering CAD and Plastic Die Engineering. Each question has three levels of difficulty: easy, medium, and difficult. The appearance of the interactive media development based on Google Sites is shown in Figure 3 below.

Figure 3. Initial View of the Google Sites Website on a Computer Screen

Like most websites, this development product can be accessed using any device, including laptops, computers, PCs, smartphones, and tablets. The e-module materials and practice questions, in the form of files (PDF) and video tutorials, are synchronised with Google Drive, allowing them to be accessed online by opening the website or downloaded to a device. There is also a task collection available in the media using the provided link. The steps for using the product are illustrated in Figure 4 below.

Figure 4. Product Usage Steps

Media Expert Validation Results

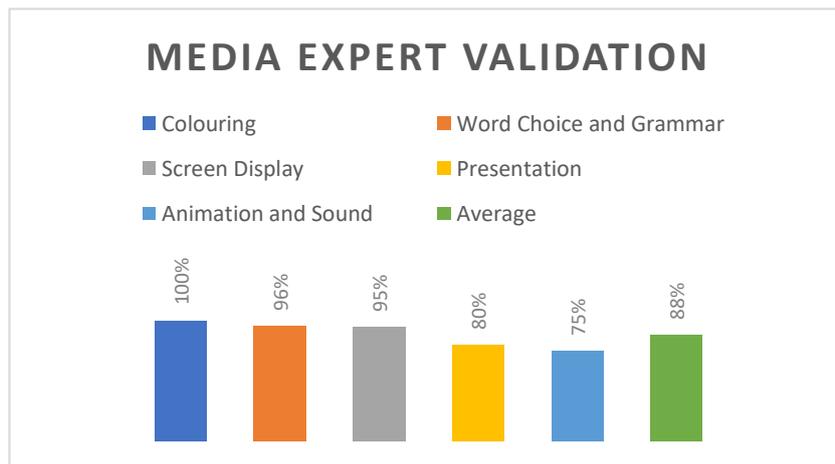The results of the media expert validation are presented in the diagram in Figure 5 below.

Figure 5. Media Expert Validation Results

The graph above shows the percentage of the five assessment aspects with 18 instrument items at 88%. The colouring aspect consists of 2 items with an average score of 4, the word choice and grammar aspect consists of 3 items with an average score of 3.8, the screen display aspect consists of 5 items with an average score of 3.8, the presentation aspect consists of 5 items with an average score of 3.2, and the animation and sound aspect consists of 3 items with an average score of 3. Based on the expert validation results, it was concluded that the interactive media developed using Google Sites for the CADD extracurricular activity is very good and therefore suitable for use and product testing. The suggestion was to add text to the tutorial videos and provide one for each material.

Material Expert Validation Results

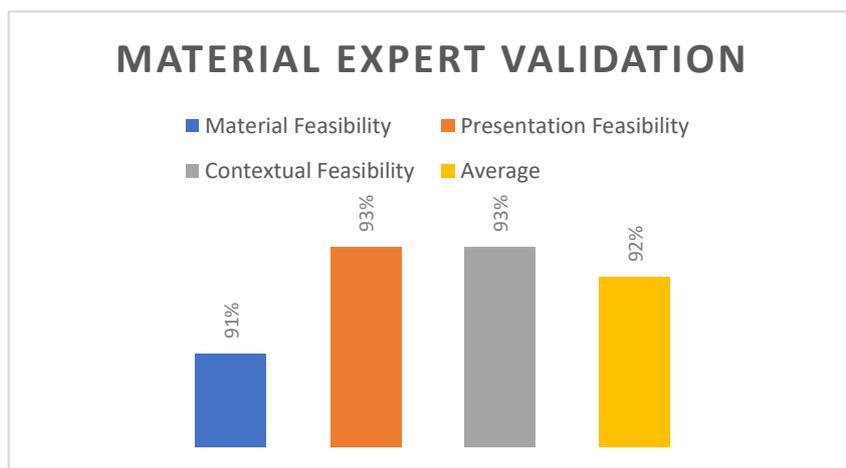The results of the material expert validation are presented in the diagram in Figure 6 below.

Figure 6. Material Expert Validation Results

The graph above shows the percentage of the three aspects with 14 instrument items at 92%. The material feasibility aspect consists of four items, with an average score of 3.6. The presentation feasibility aspect consists of five items, with an average score of 3.7. The contextual feasibility aspect comprises 5 items, with an average score of 3.7. Based on the expert validation results, it is concluded that the interactive media based on Google Sites for the CADD extracurricular activity is very good and therefore suitable for use and product testing. Additionally, it is recommended that the practice questions be aligned with the latest competition questions, specifically those from the past 1 to 2 years.

Results of Product Testing

Information on the results of product trials is presented in chart form in Figure 7 below.
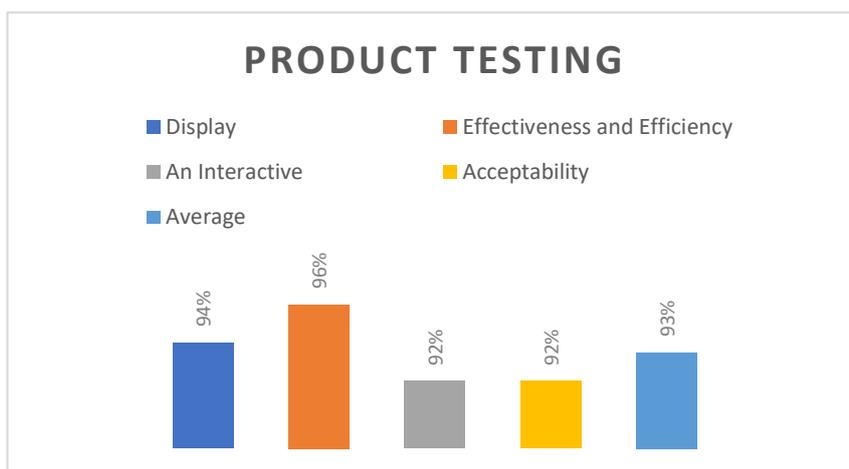

Figure 7. Results of Product Testing

The graph above shows the average score for the four aspects, each with 20 items, which is 93%. The appearance aspect consists of 4 items, with an average score of 3.8. The effectiveness and efficiency aspect consists of 6 items, with an average score of 3.8. The interactivity aspect consists of 6 items, with an average score of 3.7. The acceptability aspect consists of 4 items, with an average score of 3.7. Based on the user evaluation results, it was concluded that the interactive media developed using Google Sites for the CADD extracurricular activity is very good and deemed suitable for use as a training medium, with adjustments to the media and materials.

Discussion

The analysis of learners' needs and characteristics is a crucial initial stage in developing learning media. According to the ADDIE instructional design model by Branch (2009), the analysis stage identifies learning gaps and determines appropriate solutions based on user characteristics. In this context, the development of learning media aims to address students' needs for flexible, engaging, and easily accessible learning resources. This aligns with the research by Mislan & Santoso (2019), which states that understanding student characteristics is the key to the success of developing learning media and training media. The creation of appropriate training media, complete with module materials in the form of files (PDF), tutorial videos, and integrated practice questions, provides convenience and increases students' enthusiasm for learning, thereby helping them master the material (Shiddiqy & Saputra, 2022; Masdar et al., 2024; Regal & Widiasari, 2020). Therefore, the approach used in this study focuses on the utilisation of website-based technology, combined with materials in the form of files (PDF) and videos, and easy access through various devices without spatial or temporal limitations, thereby supporting self-directed and interactive learning.

The learning media developed consist of 13 modules in the form of files (PDF), two tutorial videos, and practice questions with three levels of difficulty: easy, medium, and difficult. The training material focuses on competencies in Mechanical Engineering, CAD, and Plastic Die Engineering, which are part of the students' primary programme expertise competencies. The presentation of the material, which combines text, images, and video, aligns with multimedia theory (Mayer, 2009), which emphasises the importance of simultaneously using verbal and visual elements in learning to enhance understanding and retention. The varied and structured design of the media also reflects the principles of cognitive load theory, presenting information in a way that does not overload students' working memory.

Given the developments made, it is necessary to evaluate the product in terms of interactivity, material accuracy, practicality, and suitability to needs (Kaniawati et al., 2023). To assess the feasibility of the developed media, validation was conducted by material and media experts. The validation results showed that the content aspect scored 92% and the media aspect scored 88%, both falling into the 'Very Good' category. This validation was based on indicators of content quality, alignment with the curriculum, clarity of presentation, and the effectiveness of the design. This study supports the formative evaluation theory proposed by Dick et al., (2015), which states that expert evaluation aims to ensure that the product meets quality standards before being implemented more widely. In addition to expert validation, a product trial was conducted with students and teachers, resulting in a 93% score in the 'Very Good' category, particularly in terms of interactivity, ease of use, and the usefulness of the media.

The results of this trial show that this website-based learning media has high user acceptance. From the perspective of Nielsen (1993) and usability theory, this media fulfils three main principles: learnability (ease of learning), efficiency (effectiveness of use), and satisfaction (user satisfaction). Teachers stated that this medium facilitates monitoring student engagement during training, while students felt it supports efficient independent learning. The medium's ability to provide immediate feedback through practice questions also strengthens student engagement in the learning process, which is the most important aspect of a student-centred learning approach.

Overall, the development of this training media is not only feasible but also relevant to current educational needs that demand critical thinking, collaborative skills, and digital literacy. The ease of access via digital devices allows teachers and students to stay connected throughout the learning process, including in extracurricular activities that often require flexible time commitments. Given the product's characteristics, supported by expert validation results and user evaluations, it is interpreted that the availability of this product will influence increased use of technological devices and enhance communication between teachers and students through the ease of teacher monitoring of student participation, thereby increasing student participation and supporting the success of training in extracurricular empowerment efforts (Amelia et al., 2025; Suleman & Idayanti, 2023; Wiryotinoyo et al., 2020).

CONCLUSION

Based on research and development of interactive media based on Google Sites, it can be concluded that: 1.) The developed product includes a Google Sites website accompanied by website usage instructions, an introduction accompanied by tips and tricks for Autodesk Inventor Professional 2024, project features, 2D sketches, standard 3D models, sheet metal 3D models, standard assemblies, welding, mould design, Inventor Studio, disassembly presentations, and 2D drawings in the form of module files (PDF), video tutorials, and practice questions integrated with the Google Sites website; 2.) The research and development process utilised the ADDIE development model 3.) The product has undergone expert validation of the media and materials, as well as testing by subjects, and is deemed suitable for use.

For further research, it is recommended to provide video tutorials for each material, with subtitles, to make it easier for students to understand and become interested in learning. Additional materials are needed based on the features available in Autodesk Inventor Professional 2024 or the latest version, starting from analysis features, cable and harness, tube and pipe, and surface design, as well as recommendations for creating more complex questions based on the latest competition guidelines, given its characteristics that always follow developments in the industrial world.

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