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INCLUSIVE GAME-BASED LEARNING WITH DESIGN THINKING FOR VOCATIONAL SLOW LEARNER STUDENTS

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ABSTRACT

Slow-learning students in the Visual Communication Design (DKV) Expertise Program face challenges in attention, working memory, and visual information processing that are often suboptimal for conventional learning environments. Information technology-based Game-Based Learning (GBL) offers an interactive learning experience that reduces cognitive load through visualization, structured navigation, and immediate feedback. This research aims to evaluate the effectiveness of Articulate Storyline-based GBL in improving ease of learning and design performance among slow-learning students at SMK Negeri 9 Surakarta. The GBL model is developed using a design thinking approach and tested on two slow-learning students. Effectiveness is measured using the Single Ease Question (SEQ), logo design quality analysis, and task completion time. Statistical analysis employs a paired t-test and effect size calculation (Cohen's d) to assess pedagogical impact. The SEQ results show a significant increase in perceived ease of use following GBL implementation. Student 1's score increases from 2.4 to 6.1, while Student 2's score increases from 2.3 to 6.2. These improvements indicate that GBL effectively supports slow-learning students in understanding learning tasks in a more structured and accessible manner. GBL features such as step-by-step interactions, mini-games, and immediate feedback help reduce cognitive barriers, improve focus, and strengthen students' confidence in completing visual design assignments. Overall, Articulate Storyline-based GBL demonstrates effectiveness as an inclusive pedagogical approach in DKV learning and shows strong potential for wider implementation in visual-based vocational education.

Keywords: *design thinking, Game-Based Learning, inclusive, slow learner, vocational school*

INTRODUCTION

Inclusive education in Indonesia is formally grounded in human rights legislation and national education policy, both of which affirm every child's right to equitable and dignified education (Dignath et al., 2022). In practice, however, inclusive education is frequently reduced to the physical placement of students with special needs in mainstream classrooms, without sufficient redesign of curricula, instructional strategies, and learning media (Goodall et al., 2022). Such practices risk perpetuating inequity, as learners with diverse cognitive profiles remain unsupported by instructional systems that are not intentionally designed for their needs. Inclusive education, therefore, must be understood as a proactive design responsibility rather than a reactive accommodation that responds only after difficulties emerge.

Universal Design for Learning (UDL) provides a robust framework for addressing this challenge by emphasizing flexibility in curriculum design through multiple means of representation, engagement, and action expression (Aghasafari et al., 2025). By shifting the focus from learner deficits to instructional adaptability, UDL enables diverse learners to access learning experiences without requiring individualized retrofitting. While empirical studies demonstrate that UDL-based instruction improves engagement and

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learning outcomes, its implementation, particularly in vocational education, remains uneven and inconsistent. Constraints related to instructional media design, institutional readiness, and pedagogical capacity continue to limit its practical impact across diverse learning contexts (Doyle et al., 2025).

These limitations are especially evident among slow learners, whose cognitive processing speed and learning pace fall between those of typical learners and students with intellectual disabilities (Joseph & Abraham, 2023). Slow learners generally do not present neurological impairments but experience persistent challenges in working memory, attention regulation, information processing speed, and motivation (Putri et al., 2023). Instructional practices that rely on abstract explanations, dense content, or rapid pacing frequently impose excessive cognitive load, thereby inhibiting schema formation and long-term knowledge retention. Cognitive learning theories, including Cognitive Load Theory, Working Memory Theory, and Dual Coding Theory, emphasize the importance of chunked content, multimodal representation, repetition, and timely feedback to effectively support learners with such cognitive profiles (Chumairo et al., 2022).

The demands of vocational education further intensify these challenges. The 9th State vocational high school (Sekolah Menengah Kejuruan Negeri, SMK Negeri 9) in Surakarta, particularly the Visual Communication Design (DKV) program, requires students to integrate procedural skills, visual literacy, aesthetic judgment, and practical problem-solving in applied learning settings (Lince, 2022). In practice-based, often asynchronous learning environments, slow learners frequently struggle to keep pace, which leads to disengagement and suboptimal learning outcomes over time. These conditions reveal a persistent misalignment between instructional delivery and learner capacity, underscoring the need for adaptive learning media that support gradual skill acquisition and repeated practice within authentic vocational contexts.

Educational technology offers opportunities to operationalize UDL principles within vocational education in more concrete and scalable ways. Among emerging approaches, Game-Based Learning (GBL) demonstrates strong potential to enhance motivation, engagement, and persistence when it is intentionally aligned with instructional objectives (Dahalan et al., 2023). GBL provides a structured organization of learning content into small units, such as levels, missions, and modules, which supports progressive learning (Jääskä et al., 2022). From a cognitive perspective, well-designed educational games integrate visual and verbal elements to support dual coding while reducing extraneous cognitive load (Barz et al., 2024). These features are particularly relevant for slow learners, who benefit from scaffolded progression and clear, consistent feedback throughout the learning process (Chang et al., 2025).

Despite growing interest in GBL, existing research largely focuses on general education settings. Studies that examine GBL for slow learners, especially within vocational education, remain limited and fragmented. Most studies that employ GBL (Dahalan et al., 2023; Jääskä et al., 2022; Lu et al., 2025; Wijaya et al., 2024) concentrate on general education contexts rather than vocational programs. Moreover, much of the literature conceptualizes GBL primarily as a motivational tool, rather than as a cognitively grounded instructional system that systematically supports learning processes (Lu et al., 2025). The integration of GBL with UDL principles and cognitive learning theory is therefore insufficiently explored, despite its importance for ensuring that game mechanics support, rather than overwhelm, learners' cognitive capacities (Saini et al., 2024).

This research addresses this gap by integrating UDL, cognitive learning theory, and GBL through a design thinking framework (Heliawati et al., 2022). Design thinking, which comprises empathy, problem definition, ideation, prototyping, and testing, offers a structured yet flexible methodology for developing learner-centered educational media (Muhtarom et al., 2025). The empathy stage foregrounds learners' cognitive characteristics, learning pace, modality preferences, and affective factors such as anxiety and self-confidence. Iterative prototyping and testing enable continuous refinement of instructional clarity, feedback mechanisms, and cognitive load management, ensuring alignment between pedagogical goals and learner needs. The integration of design thinking with UDL principles positions GBL as an inclusive instructional medium rather than a supplementary intervention. In this research, GBL operationalizes UDL through multimodal presentation, alternative learning pathways, scaffolded tasks, and adaptive feedback mechanisms. Cognitive learning theory informs design decisions regarding content sequencing, repetition, and visual–verbal balance, ensuring that instructional complexity aligns with learners' working memory capacity (Barz et al., 2024; Chang & Yang, 2023; Kala & Ayas, 2023).

This research contributes to the literature in three key ways. First, it proposes a conceptual model that integrates UDL, GBL, and cognitive load management to support slow learners in vocational education contexts. Second, it demonstrates the application of a participatory design-thinking methodology to develop inclusive instructional media tailored to vocational learning environments. Third, it produces a GBL prototype specifically designed for DKV programs, offering a replicable model for adaptive and inclusive vocational instruction.

Within the Indonesian context, where UDL implementation faces challenges related to variations in teacher preparedness and ICT infrastructure, this research extends beyond media development by incorporating teacher training components and contextual guidelines for curriculum adaptation. By reframing GBL as a cognitively informed and inclusive pedagogical strategy, this research advances both theoretical and practical understandings of

inclusive vocational education. It also contributes to the development of more equitable, responsive, and learner-centered instructional systems that better accommodate diverse cognitive profiles.

METHODS

This research adopts a mixed-methods framework, employing the design thinking concept to develop and implement learning games for slow learners in vocational streams (Wijaya et al., 2024). The mixed-methods framework is selected because it enables the integration of qualitative data, which capture students' experiences, perceptions, and emotions, with quantitative data, which assess learning outcomes, effectiveness, and usability in a reliable manner (Udeozor et al., 2023). Such integration strengthens the rationale for advocating GBL, as it is perceived to positively influence learning processes and outcomes. The research phases are structured according to the design thinking concept, which consists of the Empathize, Define, Ideate, Prototype, and Test phases (Darmawan et al., 2022). This phased structure ensures a systematic yet flexible development process that remains responsive to learner needs.

The scope of this research requires the selection of two slow-learning students as primary participants. At the outset, two students are selected from the target population, and they represent the intended user profile: students who exhibit low working memory capacity, inattentiveness, and a pronounced need for instructional repetition. These characteristics inform the design of the GBL media and learning materials developed in this research. The user-centered design approach recommends a small sample size to enable researchers to focus on understanding behavioral patterns, navigation challenges, and participants' emotional responses while engaging with the design prototype, as iteratively emphasized in the design thinking framework. Similarly, in prototype-oriented research design, the use of a small sample size is justified, as the primary aim is not to produce statistically driven generalizations but to identify and document learner needs, evaluate functional design elements, and determine whether the design is sufficiently robust for larger-scale testing. Within this framework, the two participating students are regarded as primary sources who embody the principal characteristics of slow learners in vocational education contexts.

Media development provides solutions to the real needs of users, students, and teachers, and improves learning media based on empirical data. In the Empathize phase, the researchers conduct classroom observations and unstructured interviews with students and teachers who experience slow learning to identify cognitive barriers, learning motivators, and preferred strategies for achieving learning outcomes. The results of this Empathize phase are used to define the core design challenge: to develop learning media that minimize cognitive load, present information visually, provide immediate feedback, reduce learning anxiety, and offer opportunities for more efficient learning. Based on these findings, educators and researchers draft a concept for a learning game that directly responds to learner needs. The first version of the game includes several foundational features, such as smooth navigation, colorful icons, multiple levels, feedback after each game session, and different learning modes. These features are aligned with cognitive load theory in GBL, which posits that instructional load should remain within an optimal range, neither overwhelming nor insufficient, to effectively facilitate learning.

Figure 1 Five (5) Stages of Design Thinking

Two-session testing is conducted with players who learn at a slower pace to examine usability and engagement. During gameplay, researchers generate multiple forms of data as participants interact with the game. Observational data focus on participation, where researchers observe players without intervening, paying attention to on-screen movement, concentration levels, and repeated attempts following mistakes. Additional structured data include open-ended questions regarding student experience, closed questions measuring game scores and completion time, and a Single Ease Question (SEQ) to evaluate system usability. Students provide feedback on their overall experience, including elements that facilitate learning, aspects that present difficulty, and their perceptions of challenge and feedback. Educators' feedback centers on observed changes in students, particularly in terms of challenge management, participation, and overall learning motivation.

Thematic analysis begins with data familiarization, involving repeated reading of interview transcripts and observation notes, before progressing to open coding. Codes include increased focus, satisfaction with points and feedback, confusion with initial instructions, and self-initiated retries. These codes are then grouped into broader themes and subthemes, including "motivation and engagement,"

"reduced anxiety and fear of failure," and "cognitive scaffolding through game structure." The themes are reviewed and refined through repeated comparison with the raw data and cross-checked against thematic definitions after coding is completed, using empirical confirmation from anonymous participant quotes. One student states, "If there are levels, I don't find it difficult right away, I can take it slowly." This quotation, together with gameplay feedback data, demonstrates how game features provide psychological benefits that support learner confidence and persistence. Quantitative data analysis uses descriptive statistics to calculate means, medians, and standard deviations. The analysis examines changes between sessions in game scores, task completion times, and SEQ results within the internal pre- and post-test game structure, as well as differences across levels. For example, increasing average scores across levels indicate gradual competency development, reductions in completion time suggest improved efficiency and decreased cognitive load, and higher SEQ scores imply that participants perceive the learning medium as usable, accessible, and acceptable.

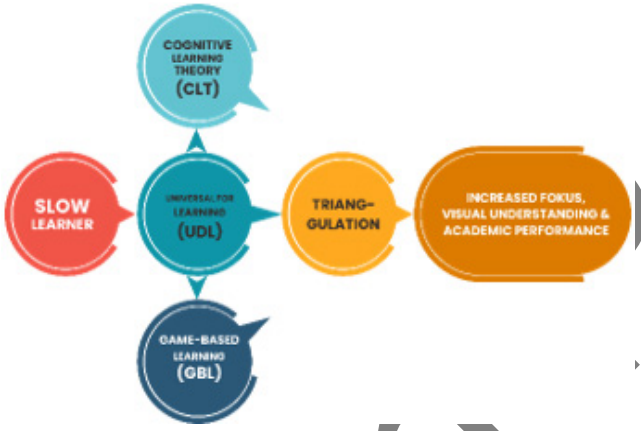

Figure 2 GBL–UDL–Cognitive Learning Triangulation Conceptual Diagram

Figure 2 illustrates the research model using triangulation of methods and data: (a) observation ↔ interviews; (b) interviews ↔ quantitative results; and (c) quantitative results ↔ usage data analyzed using an HCI-based data mining technique. However, the data indicate that students also feel safe and motivated to try again because of immediate feedback, as researchers observe that "students concentrate more, as they recognize that three or four failed attempts result in a clustered report of attempts." The score data suggest that these repeated efforts produce positive outcomes: scores increase, and task completion time decreases. This triangulation enhances internal validity, as multiple forms of data converge on the finding that GBL supports slow learners effectively.

To ensure validity, reliability, and objectivity, researchers adhere to several procedures: (1) two researchers conduct independent observations to verify subjective interpretations; (2) a two-stage coding process is applied in thematic analysis, with both researchers working independently before comparing and discussing discrepancies to reach consensus; (3) researchers document the entire analytical process meticulously as part of an audit trail approach to ensure transparency; (4) during interviews, researchers avoid pressure or suggestion, maintain neutral questioning, foster a relaxed conversational atmosphere, and guarantee anonymity; and (5) prototype testing maintains consistent instructions to minimize variation introduced by the control environment. Another significant element of this design lies in its methodological implications: through the use of design thinking, not only is the final media informed, but elements of GBL, such as leveling, immediate feedback, and visual representation, are causally connected to student needs identified during the empathy phase. This indicates that GBL is not merely implemented but is guided by a user-centered design that prioritizes learners' psychological and emotional needs. Furthermore, when positive indicators emerge across both quantitative and qualitative dimensions of impact, the results are attributed not to chance but to intentional instructional construction.

Naturally, the literature supports this argument. For example, in the STEM domain, a recent meta-analysis reveals that digital GBL has a moderate to large effect on knowledge acquisition compared with traditional methods and that the inclusion of game design features yields higher effectiveness than bare-game implementations (Gui et al., 2023). A further study reports that motivation and learning interest, critical factors for students who experience difficulties with traditional learning, are significantly enhanced by GBL (Wibawa et al., 2020). Therefore, this research method demonstrates strong internal validity through rigorous triangulation and systematic procedures and is supported by extensive global empirical evidence. The combined use of a design thinking approach, mixed-methods analysis, and literature-based justification allows this research to advance a well-substantiated claim that GBL, when designed in an inclusive, adaptive, and user-centered manner, constitutes an effective strategy for supporting slow learners in vocational education.

RESULTS AND DISCUSSIONS

This research adopts a qualitative approach grounded in design thinking to develop needs-focused strategies for GBL that are tailored to slow learners. Emphasizing learner-centered design, the research contributes to the development of effective and pedagogically grounded GBL while offering practical insights for educators, instructional designers, and technology developers who seek to improve technology-based learning environments. By positioning learners' cognitive and emotional needs at the center of the design process, this approach

strengthens the relevance and applicability of GBL in inclusive vocational education contexts.

The design thinking process begins with the Empathy and Define stages, which are essential for understanding learners' experiences and translating them into actionable design requirements. The empathy stage recognizes that slow learners often struggle with conventional, text-heavy, and fast-paced instruction, which limits comprehension and engagement. Accordingly, this stage identifies learners' challenges, preferences, and expectations through observations, interviews, surveys, and relevant literature (Rösch et al., 2023). The define stage synthesizes these insights to formulate core instructional problems that guide game design decisions. Key issues include limited concentration, difficulties in conceptual understanding, and low learning motivation. At this stage, slow learners in the DKV program at SMK Negeri 9 Surakarta are interviewed regarding visual character preferences to inform media design choices. The results show preferences for bright colors (30%), simple illustrations (25%), easy-to-read fonts (20%), smooth animation (15%), and clear visual markers (10%). These findings serve as empirical design parameters for developing an inclusive and cognitively accessible GBL framework that aligns with learners' visual and perceptual needs.

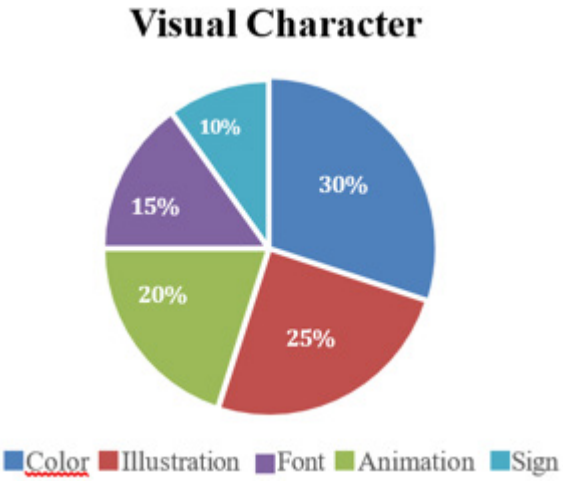

Figure 3 Results of Interviews on Preferred Visual Characters

Based on Figure 3, the interview results indicate the preferred visual characteristics of slow learners in the DKV program at SMK Negeri 9 Surakarta. The pie figure in Figure 2 shows that these students prefer simple visual traits that support clarity and focus during learning activities. They favor minimal visual elements, a clean layout, and the avoidance of excessive colors or animations that may distract attention. Key features include strong contrast between text or illustrations and the background, as well as clear, simple, and large font types that enhance readability. Sans-serif fonts, which lack decorative strokes, support easier reading because they present information in a straightforward and visually accessible manner (Ren et al., 2024).

For students who learn slowly, a learning model that incorporates repeated learning materials is applied to reinforce understanding. Information technology and visual aids support instruction, as these students generally require more time to process and comprehend learning content. As a result, instructional design must allocate sufficient time and structured repetition to ensure that learning objectives are achieved without increasing cognitive overload.

It is necessary to identify game models that appeal to slow learners in the DKV program at SMK Negeri 9 Surakarta. This identification helps students understand learning materials and complete assignments independently while progressing at a pace that is comparable to their peers without disabilities. According to interview findings, the games that attract students and are easy to understand include Puzzle Games (30%), Simulation Games (25%), Educational Games (20%), Action Games (15%), and Strategy Games (10%).

Figure 4 Interview Results of Preferred Game Models

Figure 4 shows that slow learners prefer puzzle games as their primary game model. The defining feature of these games lies in their use of multiple distinct images, which support visual recognition, pattern matching, and incremental problem-solving skills that contribute to cognitive development (White et al., 2025). Students who learn slowly benefit from this approach because puzzle-based activities allow them to process information gradually, encourage repeated attempts, and reduce pressure associated with time-bound tasks.

During interviews, teachers who support slow learners share several challenges that these students experience during the learning process. Teachers report difficulties related to maintaining attention, understanding abstract instructions, and sustaining motivation over extended learning periods. These insights highlight the need for structured, visually guided, and repetitive learning media that align with students' cognitive pace and emotional readiness.

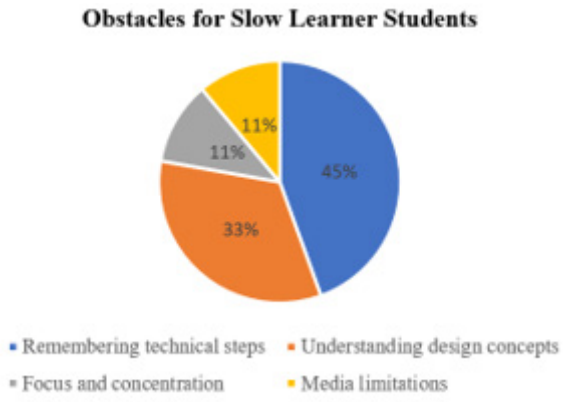

Figure 5 Obstacles for Slow Learner Students

Obstacles faced by slow learners at SMK Negeri 9 Surakarta are illustrated in the pie chart shown in Figure 5. The highest percentage, 45%, relates to difficulties in remembering the technical stages of design creation, which indicates challenges in procedural sequencing. The second most common obstacle, 33%, involves understanding design concepts, while an additional 11% relates to limitations in focus and concentration, as well as difficulties in understanding media constraints. Based on interviews with teachers who work with slow learners, the primary challenge for these students does not lie in creativity but rather resides in technical and conceptual aspects of learning. Teachers note that (1) slow learners often forget the sequence of technical steps when using design software such as CorelDRAW or Photoshop, (2) they struggle to understand abstract design concepts, including visual hierarchy and color theory, (3) they experience focus problems and are easily distracted when instructional materials are presented in a monotonous manner, and (4) existing learning media, such as video tutorials and printed modules, lack interactivity and do not provide direct feedback, leaving students uncertain about their mistakes.

Based on these interview findings, the initial design concept focuses on addressing attention and concentration challenges by developing game-based asset designs that engage slow learners in the DKV program at SMK Negeri 9 Surakarta and motivate them to use GBL to better comprehend course content. At the ideation stage, the researcher applies the Ideate phase to generate innovative game concepts that respond to the specific needs of slow-learning students in the DKV program. Logo design serves as the primary productive subject in the DKV curriculum at vocational high schools; consequently, the GBL developed in this research takes the form of a visual representation focused on learning logo design. Several game concepts emerge from the brainstorming process, including an interactive adventure model in which students are encouraged to embark on structured learning journeys to complete tasks aligned with course objectives and design competencies.

This GBL process for creating a logo design comprises three structured levels, as illustrated in Figure 6, which are designed to guide learners progressively through core design elements. Level 1 focuses on information and feedback related to color, helping students understand color selection, contrast, and basic color harmony in logo design. Level 2 addresses information and feedback on shape, emphasizing form recognition, symbol simplicity, and visual balance as essential components of effective logos. Level 3 concentrates on information and feedback related to typography, supporting learners in recognizing readable fonts, letterform consistency, and typographic suitability for brand identity. Logo creation serves as the final stage, allowing students to integrate color, shape, and typography knowledge into a complete logo design through guided and scaffolded gameplay.

Figure 6 GBL Level Layout Design

Figure 7 Final Level Layout Design

Then, at the final level, a slide appears, as illustrated in Figure 7, prompting students with slower learning abilities to create a logo that follows the core visual elements used in logo design. The logo creation process integrates the visual elements of color, shape, and typography, encouraging students to apply knowledge gained from previous levels in a coherent manner. Upon successful completion,

a reward is provided through an asset display that visually represents achievement, reinforces positive learning outcomes, and motivates students to continue engaging with the learning process.

Figure 8 GBL Reward Asset Design

The rewards for completing questions at each level appear in the slide show illustrated in Figure 8 and function as visual indicators of achievement. These rewards aim to help slower learners feel valued and acknowledged each time they successfully complete a question, reinforcing a sense of accomplishment. This positive reinforcement motivates students to maintain engagement, build confidence, and continue progressing to subsequent levels within the GBL environment.

Figure 9 Final Design

When slow-learner students complete all questions and tasks in the game related to logo creation, a visual reward slide appears, as illustrated in Figure 9. This slide features happy emoticons displayed inside a box frame that resembles a monitor screen, creating a familiar and encouraging visual context. The typography is large and functions as a dominant visual element that draws attention and reinforces achievement. During the prototype stage, the researchers design interactive elements for slow learners using Articulate Storyline to enhance usability. The primary goal is to boost learner engagement and facilitate easier navigation and understanding throughout the game. The interface design includes simple and clear navigation icons that support intuitive interaction. These icons are brief, straightforward, and sufficiently large to minimize confusion during gameplay. As students provide responses, the navigation icons indicate whether the answer is correct or incorrect through immediate visual feedback. The User Interface (UI) employs clear and simple visual components to support comprehension, reduce cognitive load, and maintain learner focus during the learning process.

Figure 10 GBL Navigation Design

Navigation icons are created in a simple cartoon or comic style, as illustrated in Figure 10, to attract attention and reduce visual complexity. This visual style engages slow-learning students and encourages them to focus more effectively on navigation commands during gameplay. The next step in the prototyping phase involves designing diverse interaction types that support active learning. These interactions include drag-and-drop activities, image selection tasks, image–description matching, and guided design creation, which are integrated throughout the learning and feedback stages. The difficulty levels are adjusted according to the cognitive skills and learning pace of slow learners, ensuring that tasks remain achievable without causing frustration. The interaction design aims to improve conceptual understanding by allowing students to learn through action and repetition. Relevant audio cues support comprehension in the GBL program for slow learners at SMK Negeri 9 Surakarta by reinforcing instructions and feedback. When students press navigation buttons, appropriate sound effects play, providing immediate confirmation of their actions. Basic animations are included to assist students in understanding moderately complex concepts, helping translate abstract ideas into clearer visual representations.

The drag-and-drop activity in the GBL module for slow learner students, as illustrated in Figure 11, requires learners to move selected answers into visual elements that correspond to the written instructions

provided. This interaction is designed to reinforce comprehension by directly linking textual cues with visual representations, thereby supporting multimodal learning processes. The questions presented in this task are carefully aligned with the instructional material and explanations introduced on the previous slide to ensure continuity and cognitive coherence. By maintaining consistency between content presentation and assessment, the activity reduces extraneous cognitive load and supports schema formation. Additionally, the drag-and-drop mechanism encourages active engagement and repeated practice, allowing slow learners to progress at their own pace while receiving immediate feedback on their responses.

Figure 11 Drag-and-Drop GBL Interaction Design

Figure 12 Selecting Models at GBL Interaction Design

Meanwhile, the feedback component of the GBL model for slow learner students employs an answer-selection method, as illustrated in Figure 12. In this model, students are prompted to select the correct response by clicking on one of the available answer choices, enabling direct and intuitive interaction with the learning content. This approach provides immediate feedback on learners' responses, helping them recognize errors and reinforce correct understanding in real time. By offering clear response options and instant confirmation, the model supports confidence-building and sustains learner engagement throughout the activity. Additionally, the simplicity of the selection mechanism minimizes cognitive load, making the feedback process accessible and effective for slow learners.

Figure 13 Matching models at

For matching models in GBL for slow learner students, the final design slide shown in Figure 13 serves as the primary reference. This matching model is developed through a straightforward and guided analysis of a logo's visual elements, allowing learners to focus on one design aspect at a time. The activity requires students to match visual components based on clearly defined criteria, supporting structured thinking and reducing cognitive overload. The logo is designed to reflect the product's character and align with the visual preferences of the target audience, helping students understand the relationship between design elements, brand identity, and audience perception.

Figure 14 Creating models

Furthermore, for the last model in GBL for slow learner students, the researchers create creation-based models. These models visually display commands and require students to analyze, select, and create design outputs, as illustrated in Figure 14. This model encourages higher-order thinking while remaining

structured and guided to suit the cognitive pace of slow learners.

The fifth and final stage in the design thinking method is testing. This stage collects input on how to improve the current solution and the overall GBL design. Usability testing assesses how effective and accessible the approach is for users. An approach is considered usable if it benefits users, reduces errors, and supports task completion efficiently. Meetings and surveys serve as two primary methods for conducting usability testing. In addition, the Single Ease Question (SEQ) matrix functions as a key evaluation tool (Robi'in et al., 2025). SEQ provides detailed insights into individual experience aspects (Zamri & Tan, 2022), helping researchers evaluate how easily users understand and navigate the prototype.

Testing begins with users or testers navigating the prototype independently without guidance. This process measures perceived difficulty on a scale ranging from 1 (hardest) to 7 (easiest). A value of 1 indicates "very difficult," meaning the user feels the task is very difficult and requires extensive assistance. A value of 2 indicates "difficult," where the user can complete only a small part of the task. A value of 3 reflects "somewhat difficult," indicating partial task completion. A value of 4 represents a neutral experience, where some parts feel easy and others difficult. A value of 5 indicates "somewhat easy," with minor challenges present. A value of 6 represents "easy," where most questions can be completed comfortably. Finally, a value of 7 indicates "very easy," meaning the user experiences no difficulty at all. The second round of testing is structured around four scenarios. The first scenario focuses on understanding Level 1 material, the second examines comprehension of Level 2 material, the third assesses understanding of Level 3 material, and the fourth tests the ability to complete the final level.

The SEQ results show a clear change in perceived ease of use of learning media before and after GBL implementation for two slow-learning students. Student 1's initial SEQ score is 2.4, indicating a low level of perceived ease of use before GBL implementation. After using GBL, the SEQ score increases to 6.1, representing a 3.7-point improvement. This increase serves as a strong indicator of GBL's potential to create a more welcoming, structured, and followable learning experience. Student 2 demonstrates a similar pattern. The pre-GBL SEQ score is 2.3, reflecting an initial perception of learning tasks as very difficult. After GBL implementation, the SEQ score rises to 6.2, showing a 3.9-point improvement. These findings demonstrate that educational game use effectively improves ease of use for learning tasks that require focus and procedural understanding.

Although the number of participants in this research remains limited, the consistent improvement in both students' SEQ scores suggests that GBL offers a more accessible and supportive learning experience than previous instructional approaches. Further research with larger samples is necessary to examine whether similar patterns of SEQ improvement occur across broader slow-learning populations. Nevertheless, these preliminary findings indicate that GBL enhances perceived usability and supports learning ease when students interact with structured instructional content.

This research aims to design and evaluate the effectiveness of GBL media developed through a design thinking approach. The primary goal is to improve understanding and skill development among slow learner students in a DKV program. The main findings demonstrate that well-designed GBL significantly increases student engagement and positively influences conceptual understanding and practical skill retention. This section interprets these findings, connects them to previous research, and discusses their theoretical and practical implications for inclusive vocational education.

One key finding of this research is the effectiveness of the design thinking approach as a development framework. The design thinking process, particularly the Empathy and Trial stages, successfully addresses the needs of slow learner students and guides the development of appropriate learning technology solutions. Unlike traditional instructional development models, which are often linear and content-focused, design thinking begins with students' lived experiences and learning challenges. The Empathy stage helps identify specific barriers, such as difficulty understanding multi-step instructions and abstract concepts, which are frequently overlooked in conventional learning media. This finding supports the views of Ningrum et al. (2022), who argue that a user-centered approach is essential for creating functional and relevant innovations. This research extends that argument within the context of inclusive vocational education, where learner characteristics vary widely and require adaptive instructional strategies.

The results indicate that GBL elements such as instant feedback, varied repetition, and reward systems effectively address the cognitive challenges faced by slow learners. Immediate feedback allows students to recognize and correct errors independently, which builds confidence and reduces learning anxiety. Repetition delivered through multiple formats proves more effective for long-term memory retention than traditional memorization-based approaches. These findings align with research by Maxwell Hartt (Tim et al., 2025) and Nathalie Barz (Barz et al., 2024), who demonstrate that GBL promotes deeper learning through a "try–fail–succeed" cycle. The uniqueness of this research lies in its application of GBL to vocational competencies in DKV. This result shows that game mechanics support not only conceptual understanding but also the development of procedural skills, such as operating and mastering design software.

Practical and theoretical implications emerge clearly from these findings. Practically, this research offers a replicable model for educators and educational technology developers seeking to design learning media for other special needs populations. For vocational high school teachers, GBL functions

as a supplementary instructional tool that adapts to students' individual learning pace and cognitive capacity. For curriculum developers, the findings encourage the adoption of more empathetic and iterative design processes. Theoretically, this research provides empirical evidence of the relationship between design thinking methodology and GBL pedagogy in supporting inclusive education. It also contributes to the UDL literature by demonstrating how UDL principles can be operationalized through the design thinking cycle to produce accessible, motivating learning materials.

CONCLUSIONS

This research addresses the learning challenges faced by slow learners in vocational education by achieving its two main goals. First, it designs an inclusive GBL model specifically tailored to the needs of slow learners, including structured repetition, concrete visualization, and immediate feedback mechanisms. Second, it develops a functional interactive learning media prototype based on this model, which is validated against user needs and demonstrates practical usability in a vocational learning context.

The design thinking process proves highly effective in achieving these goals. The user-centered approach ensures that every element and game mechanic in the prototype, ranging from the level system and step-by-step instructions to the reward elements, is intentionally designed to address cognitive barriers and enhance student motivation. As a result, this research produces a learning media model that directly responds to the real needs of slow learners. The outcome is an inclusive, adaptive, and supportive interactive GBL prototype that strengthens student motivation, encourages sustained engagement, and supports independent learning progression.

In this respect, the contribution of this investigation is significant in filling a gap in the literature on designing GBL for slow learners, a marginalized population in instructional design research. By positioning the learner rather than the content as the focal point of design, this research demonstrates that GBL must be tailored to specific learning needs to be effective. Moreover, this research extends existing literature by illustrating the real-world application of GBL within vocational education, a setting that demands complex visual and procedural skills yet receives relatively limited scholarly attention. From a technical perspective, Articulate Storyline proves capable of supporting the systematic implementation of UDL principles, thereby serving as an inclusive and replicable model for developing learning media across other vocational fields.

In conclusion, the combination of the design thinking approach and the GBL model offers a clear and effective solution for creating a more inclusive learning environment in vocational schools. The model developed in this research is recommended for implementation and further refinement as an adaptive teaching tool that enables each student to maximize their learning potential at their own pace. The prototype demonstrates strong potential to help slow learners gradually and enjoyably understand instructional material while providing a learning experience comparable to that of regular students. Therefore, this research contributes not only to the advancement of inclusive learning theory and practice but also introduces an innovative and adaptable model that can be implemented in other vocational education settings.

This research has several limitations that should be acknowledged. First, the case study is conducted within a limited scope, focusing on a single DKV program at one vocational school. As a result, generalizing the findings to other vocational fields, such as mechanical engineering or hospitality, requires further investigation. Second, the evaluation of GBL effectiveness primarily focuses on short-term engagement and comprehension outcomes. Longitudinal research is needed to assess sustained impacts on graduate competencies and job readiness. Therefore, future research is recommended to: (1) test this development model across diverse vocational programs; (2) compare media developed through design thinking with media produced using other instructional approaches; and (3) examine the impact of GBL on soft skill development. Despite these limitations, this research addresses the gaps identified in the introduction by presenting one of the first GBL models specifically designed for slow learners in vocational education. Previous studies tend to focus on general learner populations and overlook the cognitive and emotional needs of slow learners, such as limited working memory, high distractibility, and a strong need for repetition. By explicitly centering slow learners as the primary target group, this research contributes to the literature by demonstrating how GBL can be adapted to better support diverse learning needs.

This contribution is further strengthened by the vocational context of Visual Communication Design (DKV), a discipline that demands visual-procedural skills that slow learners often find challenging to acquire. Consequently, this research advances knowledge on the application of GBL within creative vocational fields that remain underexplored in global scholarship. Additionally, the study offers methodological value through its technical implementation using Articulate Storyline, which enables modular, customizable, and UDL-compliant game development. The platform's flexibility in visual design, ease of use, and immediate feedback mechanisms play a critical role in supporting effective learning experiences for slow learners. For these reasons, this work fills an important theoretical gap at the intersection of GBL, UDL, and cognitive theory and offers a practical model of inclusive learning media for broader application in vocational education.

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