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Implementing Javanese Culture-Based Geometry Puzzles through Ignatian Pedagogy for Growth Mindset

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Abstract

Students with intellectual disabilities often struggle to grasp abstract geometry and can benefit from concrete and visually accessible learning. This study examined the implementation of PUSAKA JAWA, a Javanese culture-based geometry puzzle integrated with Ignatian Pedagogy, and described changes in students' growth mindset. Five students with mild intellectual disabilities participated in six activity sessions. Data were collected through a 14-item Visual Growth Mindset Questionnaire, observations, visual reflections, teacher interviews, and supporting observations of geometry performance. Quantitative data were analyzed descriptively and integrated with qualitative findings. The mean growth mindset score increased from 26.4 at the pre-test to 38.2 at the post-test, with all students moving from the moderate to high category. Qualitative findings also indicated greater persistence, willingness to retry, use of assistance, and awareness of learning progress. These findings provide preliminary evidence that PUSAKA JAWA can support growth-oriented responses within an accessible, contextual, and reflective geometry learning environment.

Keywords: *growth mindset, PUSAKA JAWA, Ignatian Pedagogy, intellectual disability, geometry learning*

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INTRODUCTION

Article 31 of the 1945 Constitution of the Republic of Indonesia guarantees every citizen the right to education. This constitutional guarantee also applies to students with intellectual disabilities, who are entitled to equitable access to quality education. UNESCO (2020) emphasizes the importance of recognizing learner diversity. However, students with special needs remain vulnerable to marginalization due to ability-based discrimination. In mathematics learning, particularly geometry, students with intellectual disabilities require concrete, visual, step-by-step representations that are closely connected to daily

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experiences. Safera et al. (2024) indicate that visual learning strategies potentially support mathematics learning for students with intellectual disabilities. Hord (2023) also highlights the importance of manipulatives, diagrams, gestures, and connecting new material with familiar experiences to enhance accessibility to mathematics for students with mild intellectual disability.

Beyond the accessibility of representations, learning mathematics also depends on how students interpret difficulty and effort, especially in geometry, where errors and repeated attempts are common. Dweck (2006) distinguishes between growth and fixed mindsets within a conceptual framework of beliefs about the malleability of ability. A fixed mindset refers to the belief that ability is relatively stable and cannot be substantially changed, whereas a growth mindset reflects the belief that ability can be developed through effort, effective strategies, support, and learning opportunities. de Carvalho & Skipper (2020) reported moderate evidence that a growth mindset intervention increased the endorsement of growth mindset among young people with special educational needs and/or disabilities (SEND). However, further research involving follow-up assessments is needed to determine whether the changes observed following such interventions can be sustained over time. These findings indicate that growth mindset is a plausible target for students with special needs, but for students with intellectual disabilities it may be experienced more meaningfully when embedded in concrete learning tasks rather than delivered as a separate psychological intervention. This calls for a pedagogical framework that intentionally organizes challenge, support, and reflection within the learning process.

Ignatian Pedagogy serves as a relevant process framework by structuring learning through the stages of context, experience, reflection, action, and evaluation. Pratini & Prasetyo (2025) demonstrate the role of experience and reflection within reflective pedagogy, while Agustin & Santoso (2025) illustrate the application of the five stages of Ignatian Pedagogy in mathematics learning. Kurniyawati et al. (2022) further highlights the contribution of the reflective pedagogy paradigm to student character development. In this study, reflection is adapted using simple responses and visual media to make it more accessible to students with intellectual disabilities.

The use of concrete media receives empirical support in mathematics education for students with disabilities. A meta-analysis by Peltier et al. (2020) supports the use of mathematical manipulatives for students who are at risk or have disabilities. To ensure concrete experiences are also contextual, local culture can serve as a source of mathematical representation; studies by Utami et al. (2024) as well as Ilmianita & Ambarawati (2025) demonstrate the potential of ethnomathematics in connecting mathematical concepts with cultural practices and artifacts. Tran & Castro Schepers (2023) reinforce that leveraging cultural artifacts, experiences, and multiple representations makes mathematics more relevant for students with learning difficulties. In the Javanese cultural context, Kuling et al. (2025) identified mathematical activities embedded in the Ramayana Ballet at Prambanan, illustrating how local cultural practices can provide meaningful contexts for exploring mathematical concepts. Although manipulatives and growth mindset have each received attention, studies that examine them together remain scarce. Boaler (2016) proposes that visual and multi-representational approaches can help learners see mistakes and struggle as a normal part of learning mathematics, and Sisk et al. (2018) report that mindset interventions tend to show larger benefits for students facing academic risk. However, to the authors' knowledge, no previous study has examined how concrete, culturally contextualized geometry learning relates to the growth mindset of students with intellectual disabilities, which is the gap addressed in the present study.

Based on these foundations, this study implements PUSAKA JAWA (Puzzle Asyik Geometri Berbasis Kearifan Jawa/Fun Geometry Puzzle Based on Javanese Wisdom) as a

learning intervention that integrates concrete geometry manipulatives, Javanese cultural context, and Ignatian Pedagogy. In this study, growth mindset is positioned as the primary outcome examined, while Ignatian Pedagogy provides the process framework through which PUSAKA JAWA is delivered; growth mindset is therefore not treated as a separate instructional component but as the change expected to result from students' engagement with the intervention. The learning process is designed to foster joyful, meaningful, and mindful experiences. Ramadhan (2025) and Nasyir et al. (2025) describe these three orientations as learning that emphasizes joy and engagement, connection to personal experience, and self-awareness/reflection in the learning process. Within PUSAKA JAWA, these three dimensions are operationalized through observation indicators and student visual reflections.

Research on the individual components used in PUSAKA JAWA has developed significantly, yet these areas generally remain fragmented across separate research tracks. Growth mindset interventions for students with special educational needs and/or disabilities (SEND) remain relatively limited; de Carvalho & Skipper (2020) show that growth mindset interventions are feasible for the SEND population, but their effects do not consistently persist in follow-up evaluations. In mathematics education for students with disabilities, concrete manipulatives and visual representations are empirically supported (Hord, 2023; Peltier et al., 2020). Meanwhile, culturally responsive mathematics approaches emphasize connecting concepts with students' experiences and cultural artifacts (Tran & Castro Schepers, 2023), and a meta-analysis in Indonesia shows that ethnomathematics instruction tends to correlate positively with mathematics achievement and learning attitudes (Hartoyo et al., 2025). Ignatian Pedagogy has also been applied in mathematics through the context, experience, reflection, action, and evaluation cycle (Agustin & Santoso, 2025). The research gap emerging from these lines of inquiry is the limited evidence on how these elements function together. The distinctive contribution of PUSAKA JAWA therefore lies not in any single component, but in integrating concrete geometric media rooted in Javanese culture, the Ignatian Pedagogy approach, and attention to the growth mindset of students with intellectual disabilities. What remains substantively unknown is how growth-mindset-related responses develop when students with intellectual disabilities engage with culturally grounded, concrete geometry tasks structured through a reflective pedagogical cycle, and how such development is expressed in daily learning behavior rather than only in questionnaire scores.

In light of this research gap, the objective of this study is to describe changes in the growth mindsets of students with intellectual disabilities following the implementation of PUSAKA JAWA within the Ignatian Pedagogy framework relates to during geometry lessons, and to identify the learning processes, expressed in students' actions and reflections, that accompany these changes. Theoretically, this study is expected to enrich the literature on inclusive mathematics education by combining media, local wisdom, Ignatian Pedagogy, and the growth mindset concept. Practically, PUSAKA JAWA could become a hands-on, locally contextualized geometry learning tool for students with intellectual disabilities and support teachers in building a learning space that is joyful, meaningful, and mindful. Given the small sample size, purposive sampling, absence of a comparison group, and limited duration of observation and follow-up data, the findings are intended to provide contextual insights into individual changes and patterns appearing during the intervention.

Accordingly, this study addresses the following research questions (RQ): RQ1. How does the growth mindset of students with mild intellectual disabilities change following the implementation of PUSAKA JAWA within the Ignatian Pedagogy framework in geometry learning? RQ2. How do students with mild intellectual disabilities

experience geometry learning using PUSAKA JAWA in fostering growth mindset through joyful, meaningful, and mindful learning? RQ3. What factors support and hinder the implementation of PUSAKA JAWA in fostering the growth mindset of students with mild intellectual disabilities?

METHODS

The study used a descriptive multiple case study design with an explanatory sequential mixed-methods component. Each of the five students was treated as an individual case. Quantitative data from the visual growth mindset questionnaire and observation sheets were analyzed descriptively at the individual and group levels to document change in growth mindset. Qualitative data from visual reflections, teacher interviews, observation notes, and documentation were used to capture the learning process and contextualize the observed changes. Because only five students participated, the numerical data were not subjected to inferential statistical analysis, and no claim of statistical power or population level generalization was made. A multiple case study design allows cases to be examined in depth within their real-life context (Creswell & Poth, 2018; Yin, 2018). Purposive sampling is appropriate when cases are selected based on characteristic relevant to the phenomenon and research context under investigation (Palinkas et al., 2015; Patton, 2015).

In this study, quantitative and qualitative data were collected from the same cases and integrated during interpretation to examine convergence, complementarity, and divergence across data sources (Creswell & Plano Clark, 2018; Fetters et al., 2013). The research procedure involves preparing the media and the instruments, carrying out a baseline measurement, holding six intervention sessions, observing the process, conducting a post-intervention measurement, carrying out visual reflection, interviewing the teachers, carrying out separate analyses of the quantitative and qualitative data, and then integrating the findings. On this basis, the study is not regarded as a causal experiment but rather as an implementation study that includes both pre-test and post-test measurements as well as data triangulation.

The research subjects involved five students with mild intellectual disabilities who were selected purposively based on their ability to follow simple instructions and to do simple mathematical activities. Purposive sampling is appropriate when cases are selected based on characteristics that are relevant to the phenomenon and research context under investigation (Palinkas et al., 2015; Patton, 2015). Given the small number of cases, each student was treated as an individual case within the descriptive multiple case study design. The students had individual differences in their learning abilities and needs during the intervention. These differences were considered when interpreting the students' responses and learning experiences. Therefore, the findings are interpreted within the specific characteristics and learning contexts of the five cases and are not intended to represent all students with mild intellectual disabilities. To protect their identities, the subject were designated as S1 through S5.

The study was carried out in six sessions in a partner special school (SLB), with each session lasting approximately 35–45 minutes. The duration of each activity was adapted to the students' attention, fatigue and individual needs. Visual responses, brief questions, adequate wait time and graduated assistance were implemented to reduce verbal demand. "PUSAKA JAWA" was used as a concrete, manipulative, visual and contextual learning medium. The six-session intervention included: (1) recognition of squares and rectangles; (2) recognition of triangles and circles; (3) recognition of kites and trapezoids; (4) classification of geometric shapes; (5) construction of patterns and (6) consolidation and final evaluation. Each session consisted of the five stages of Ignatian Pedagogy: context

(relating the shapes to the surrounding objects or elements of Javanese culture); experience (activities such as holding, selecting, matching, and assembling puzzles); reflection (identifying what was liked, easy, difficult, or not yet mastered); action (using previously acquired knowledge); and evaluation (reinforcing the effort and documenting the students' progress).

The study's primary focus was growth mindset, operationalized across six dimensions synthesized from the growth mindset literature and adapted to the learning context of students with mild intellectual disabilities: belief in the capacity for growth, willingness to accept challenges, persistence during difficulties, use of strategies and assistance, response to errors, and orientation toward personal progress (Dweck, 2006; Boaler, 2016). These dimensions were used by the researchers to develop the Visual Growth Mindset Questionnaire and the corresponding observation indicators. The instruments were then reviewed by experts for content relevance and clarity. Joyful, meaningful, and mindful experiences, along with the implementation of Ignatian Pedagogy, were observed and recorded as process data. Geometric performance is used as supporting data, rather than as the primary outcome of the study.

Figure 1. PUSAKA JAWA Geometry Puzzle and Learning Cards

Table 1. Operationalization of the Research Focus and PUSAKA JAWA Instrument

Focus/data	Instrument	Scale/Indicator	Functions in Analysis
Growth mindset (primary)	Visual Growth Mindset Questionnaire; Growth Mindset Observation Sheet	Questionnaire: 14 items, scores 1–3, range 14–42. Observation: 12 indicators, scores 1–4.	Describing pre-post changes and behavioral development during the intervention.
Ignatian Pedagogy	PI Implementation Observation Sheet	Context, experience, reflection, action, evaluation; score 1-4.	Assessing the feasibility of the intervention framework.
Joyful-Meaningful-Mindful	JMM Observation Sheet; Visual Reflection	12 indicators: 4 joyful, 4 meaningful, 4 mindful; observation score 1–4.	Describes the quality of the learning experience and student awareness.
Geometric performance (supporting)	Geometry Performance Observation Sheet	The ability to point, distinguish, match, group, arrange patterns, and correct arrangements.	Provides context for the development of geometric activities; it is not a primary test of learning outcomes.
Supporting/ inhibiting factors	Semi-structured teacher interviews; documentation/process notes	Media, support, student conditions, environment, time, learning strategies.	Explaining the conditions influencing implementation and the observed changes.

Content validation was conducted separately for the learning materials and PUSAKA JAWA media and the research instruments. All validation assessments used a 1–5 rating scale covering conceptual accuracy, suitability for students with intellectual

disabilities, clarity and readability of instructions, appropriateness of illustrations, safety, and measurability of the intended indicators.

The learning materials and PUSAKA JAWA media were validated by two validators, coded as V1 and V2. V1 reviewed the learning materials and PUSAKA JAWA media, while V2 reviewed the learning materials, media, and learning implementation. The validation scores for the learning materials and media were analyzed using Aiken's V. The results showed Aiken's V values of 0.831 for the learning materials and 0.786 for the PUSAKA JAWA media, with a combined value of 0.807. Based on the percentage scores, the learning materials achieved 86.00%, the media 82.92%, and the learning implementation 78.57%. Taken together, these expert-validation results suggest that the media, learning materials and planned learning implementation were feasible to use, particularly with minor revisions.

The research instruments were validated independently from the learning materials and media. Instruments used were the Visual Growth Mindset Questionnaire as the main outcome instrument, Growth Mindset Observation Sheet, Ignatian Pedagogy Implementation Observation Sheet, Joyful-Meaningful-Mindful (JMM) Observation Sheet, Geometry Performance Observation Sheet, and protocols for visual reflection and interviews. These instruments were reviewed by V3, a lecturer with expertise in mathematics education. The review considered the suitability, clarity, accessibility, and relevance of the items or indicators in relation to the characteristics of students with intellectual disabilities and the constructs being measured.

Particular attention was placed on the primary outcome measure, the Visual Growth Mindset Questionnaire. The questionnaire is composed of 14 items that represent the six dimensions of a growth mindset: belief in the ability to grow, willingness to embrace challenges, perseverance through adversity, use of strategies and help, response to mistakes, and orientation toward progress. A process of validation was carried out to determine whether the items were clear enough, easy to understand, and could capture the intended dimensions.

The total percentage of the research instruments' validation was 81.11%. It meant that the instruments were feasible to be used to collect the data with some minor revisions. The validation results of the research instruments were reported in an overall percentage, not the Aiken's V value for each instrument. Thus, the 81.11% score is not specifically for the Visual Growth Mindset Questionnaire. The Aiken's V values from this study are therefore limited to the learning materials and PUSAKA JAWA media, and the validation score of 81.11% is the entire research instrument. Psychometric testing of the questionnaire (for example item validity, internal-consistency reliability, or factor structure) was not carried out because five participants are too few for such analyses to yield meaningful estimates. In line with the case-study design of this study, the questionnaire is therefore treated as an expert-reviewed instrument whose scores are interpreted descriptively, at the individual level, and only together with the qualitative data. The lack of reliability evidence is acknowledged as a limitation.

Based on the validation results, several updates were implemented, including the need for clear geometric definitions, the revision of previously ambiguous illustrations, the simplification of instructions, the refinement of assessment criteria, the use of color coding, the simplification of media layout, and enhancements to media specifications, safety information, and visual reflection cards. Regarding the research instruments, the modifications were made to improve the clarity and accessibility of the items of the questionnaire and the observation indicators, while preserving their appropriateness for students with intellectual disabilities.

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The research procedures also highlighted the necessity of safeguarding the participants as the research participants are students with special education needs. This study was approved by the Ahmad Dahlan University Research Ethics Committee under ethics approval number REC-UAD/01/02/07-2026/341, dated July 15, 2026. The ethical approval was valid for one year from the date of approval. Student identities have been anonymized as S1-S5. Parental/guardian consent and permission to conduct the study at the partner special school were sought prior to the research activities. Learning activities and methods of communication were adjusted to the capabilities of each participant, making sure they felt comfortable, safe, and engaged during the study.

The Visual Growth Mindset Questionnaire, which consists of 14 items each scored on a 1-3 scale, was used to measure changes in growth mindset, and the total score ranged from 14 to 42. Descriptive analyzes were performed at the individual and group level to compare pre-test and post-test scores. The analyzes at the individual level included pre-test scores, post-test scores, score differences (post-test − pre-test), percentage of maximum score and changes in growth mindset category. At the group level, the data were summarized using the minimum, maximum, and mean pre-test and post-test scores

The categorization of Visual Growth Mindset Questionnaire scores was performed based on the hypothetical mean and hypothetical standard deviation according to the categorization criteria of Azwar (2012). Based on the hypothetical minimum score of 14 and maximum score of 42, the hypothetical mean (μ) was 28, and the hypothetical standard deviation (σ) was 4.67. The score categories were determined based on the criteria $X < \mu - 1\sigma$ for the low category, $\mu - 1\sigma \leq X < \mu + 1\sigma$ for the moderate category, and $X \geq \mu + 1\sigma$ for the high category. Based on these calculations, the score categorization is presented in Table 2.

Table 2. Categorization of Visual Growth Mindset Questionnaire Scores

Category	Criteria	Score Range
Low	$X < \mu - 1\sigma$	14-23
Moderate	$\mu - 1\sigma \leq X < \mu + 1\sigma$	24-32
High	$X \geq \mu + 1\sigma$	33-42

Based on Table 2, scores of 14–23 are categorized as low growth mindset, 24–32 as moderate, and 33–42 as high. This categorization is subsequently used to describe changes in students' growth mindset categories from pre-test to post-test.

As the study involves five purposively selected subjects and aims to describe changes within the implementation context, inferential analysis is not used as the basis for drawing conclusions. Observational data on growth mindset and JMM are summarized by session using available data; missing scores are treated as missing data rather than being imputed as zero. The number of valid observations (n) for each session is reported alongside the mean values.

Data from teacher interviews, visual reflections, observation notes, and documentation were analyzed through transcription/data reduction, descriptive and interpretive coding, grouping codes into themes, and deriving meaning. Integration was conducted at two levels. First, we analyze individual joint displays (S1-S5) of pre-test and post-test growth mindset scores, observed growth mindset tendencies, and visual reflections for each student in an effort to evaluate convergence, complementarity, or divergence among the sources. Second, a group-level, cross-source synthesis linked quantitative patterns to themes in teacher interviews and aggregated JMM scores. Teacher interview data were not analyzed at the individual level because the transcripts did not

consistently assign all statements to particular students (S1-S5). Meta-inferences were drawn only when two or more sources of data offered mutually supportive or complementary evidence.

The trustworthiness of the qualitative analysis was addressed using the criteria of credibility, dependability, confirmability, and transferability (Lincoln & Guba, 1985). Credibility was supported through triangulation of four qualitative data sources: teacher interviews, students' visual reflections, observation notes, and documentation. The codes and themes derived from these sources were compared to identify consistent, complementary, or differing information across data sources. Dependability was supported by applying a consistent procedure of transcriptions in the collected data and by drawing meta-inferences only when at least two data sources provided mutually supportive or complementary evidence. Transferability was supported by providing descriptions of the subjects, research setting, intervention procedures, and learning context, allowing readers to assess the relevance of the findings to other context.

RESULTS AND DISCUSSION

Given the explanatory sequential mixed-methods design, in which qualitative data are used specifically to explain and elaborate the quantitative growth mindset findings, results and discussion are presented together by theme in this section rather than as fully separate sections; each subsection first reports the descriptive quantitative results and then discusses them in relation to the qualitative evidence and prior literature. PUSAKA JAWA was implemented within the Ignatian Pedagogy framework across six learning sessions involving five students with mild intellectual disabilities. Data were collected through the Visual Growth Mindset questionnaire, observations of growth mindset and geometry performance, Joyful-Meaningful-Mindful (JMM) observations, students' visual reflections, teacher interviews, and documentation. Quantitative results were analyzed descriptively and integrated with qualitative findings to provide a more comprehensive understanding of the changes that occurred and the ways students responded to challenges throughout the learning process. Since the participants were purposively selected and no comparison group was included, the findings are interpreted as descriptive patterns of change within the specific implementation context. Therefore, they should not be considered evidence of a causal relationship between the intervention and the observed changes.

Changes in Students' Growth Mindset

The main outcome examined in this study was students' growth mindset assessed using a Visual Growth Mindset questionnaire comprising 14 statements rated on a three-point scale. The possible total score ranges from 14 to 42, with scores of 24-32 indicating a moderate level and score of 33-42 representing a high level. At baseline, all five students were classified within the moderate category. After participating in six learning sessions using PUSAKA JAWA, all students reached the high category. Individual growth mindset scores increased by 9-14 points, and the mean group score improved from 26.4 in the pre-test to 38.2 in the post-test.

Individual results suggest that each student demonstrated positive change in their growth mindset, though the level of change varied across participants. The greatest increase was for students S3 and S4, both with an increase of 14 points. The lowest increase was for S5 with an increase of 9 points. Differences were also detected in the growth mindset levels obtained at the post-test stage. S3 scored the highest of 41 points, which corresponds to 97.6% of the maximum possible score, while S5 scored 33 points, which corresponds to 78.6%. These differences are important as they demonstrate that students had different

responses to the intervention and the development of the growth mindset occurred at different rates for the participants.

Table 3. Profile of Changes in Growth Mindset Scores

Student	Pre-test Score	Post-test Score	Score Difference	Post-test Category	Percentage of Maximum
S1	27	39	+12	High	92.9%
S2	29	39	+10	High	92.9%
S3	27	41	+14	High	97.6%
S4	25	39	+14	High	92.9%
S5	24	33	+9	High	78.6%
Mean	**26.4**	**38.2**	**+11.8**		**91.0%**

This overall improvement is consistent with Dweck's (2006) notion of growth mindset, which is the belief that one can develop abilities through effort, effective strategies, support, and learning experiences. In this study, the rise in questionnaire scores was mirrored by noticeable shifts in students' engagement with difficult mathematics tasks. Students were more willing to try tasks, more persistent with difficulties, used more strategies and help, were open to correction and had greater recognition of their own progress. These observed behaviors correspond to the dimensions used to define growth mindset in this study and provide qualitative support for the quantitative findings.

These findings are consistent with the study by de Carvalho & Skipper (2020), which indicates that growth mindset interventions can be implemented with young people with special educational needs and/or disabilities. Their study also emphasizes the need to consider whether changes in growth mindset are maintained over time. The present study conducted the post-test immediately after the intervention. Therefore, the results provide positive short term descriptive changes, but do not confirm if these improvements would be maintained without continued support. This is especially important for the development of growth mindset among students with intellectual disabilities because the development might require continuous reinforcement, repeated learning experiences, and constant guidance. Table 3 *shows* that every student obtained a higher post-test score than pre-test score. The consistency of this pattern across all five participants strengthens the descriptive interpretation of positive change, although it should not be interpreted as evidence of a causal effect because of the small purposive sample and absence of a comparison group.

Development of Growth Mindset During the Learning Process

The pre-test and post-test findings provide evidence of change before and after the intervention, while the observation data provide information about how growth mindset-related behaviors appeared throughout the six sessions. Growth mindset was observed using 12 indicators with a maximum score of 48 per student. The mean observation score increased from 27.4, or 57.1% of the maximum score, in the first session to 38.25, or 79.7%, in the sixth session. The highest mean score occurred in the fifth session, reaching 38.5, or 80.2%.

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Table 4. Summary of Students' Growth Mindset Observation Scores

Student	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
S1	33	35	-	36	-	39
S2	33	35	33	36	36	38
S3	28	35	39	39	43	41
S4	15	39	37	39	41	-
S5	28	-	26	25	34	35
Mean	**27.4**	**36.0**	**33.75**	**35.0**	**38.5**	**38.25**
Percentage	**57.1%**	**75.0%**	**70.3%**	**72.9%**	**80.2%**	**79.7%**

The results show that, overall, the observed growth mindset behaviors increased from the first to the sixth session, although this increase was not strictly linear. The average scores went down a little during the session and kept changing from one student to another. By the last session the scores were much higher than they were, at the beginning. This means that behaviors linked to a growth mindset can change based on the task, how focused the student's how tired they get, how well they remember things and how much help they need. Any missing information was not counted as zero. Instead it was treated as if it wasn't there. The averages only included the information that was actually collected for each session.

The phenomenon of behavior development observation results gains an important statement into the post-test finding. Through the intervention, students had received repetitive opportunities to propose on solving challenging geometry tasks that were finally being defeated by concrete manipulation and structured teacher scaffolding. When managing difficulties, students could retry tasks, ask for help, apply alternative methods, and rectify their work. Teachers consistently reported that, over the course of the intervention, student appeared more willing to participate, more confident in coming forward, and showed improvement in communication skills. Furthermore, some students somehow developed their own strategies, such as assembling puzzles outside the frame before they were placing them in the correct position, even reviewing their work before making corrections.

The findings are consistent with the conceptualization of growth mindset as a belief that abilities can be developed through effort, learning, and the use of effective strategies (Dweck, 2006). The observed behaviors also reflect the role of social support and scaffolding in helping learners engage with tasks that may initially be beyond their independent performance (Vygotsky, 1978; Wood et al., 1976). In the present study, students' attempts to retry tasks, seek help, modify strategies, and correct their work provided observable examples of how growth-oriented responses to difficulty were expressed during geometry learning. Thus, the behavioral observations complemented the questionnaire findings by providing contextual evidence of students' responses to challenges throughout the intervention.

Empowering Evidence by Geometry Performance

Although the primary outcome was not geometric performance, the changes in students' geometric activities provide additional context to the intervention. Students' geometric performance assessment was used to measure students' ability to point, identify, match, categorize, generate patterns and make corrections on the arrangement of geometric shapes. All five students showed gains from the pre-test to the post-test. The mean increase was 13.0 points. The group average increased from 30.6 to 43.6.

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Table 5. Pre-test and Post-test Results of Students' Geometry Skills

Student	Pre-test Score	Post-Test Score	Score Difference
S1	41	50	+9
S2	24	39	+15
S3	33	49	+16
S4	31	46	+15
S5	24	34	+10
Mean	**30.6**	**43.6**	**+13.0**

S3 had the biggest increase with 16 points and S1 had the smallest increase with 9 points. These results indicate that students' ability to do geometry activities increased after the intervention. However, because geometry performance was included as supporting data rather than a primary outcome, these changes should not be considered definitive evidence of the development of a growth mindset. Rather, they create an educational setting where students are constantly challenged and are engaged in problem solving.

The use of concrete geometric manipulatives aligns with previous findings regarding mathematics instruction for students with disabilities. Hord (2023) highlighted the significance of physical and visual representations for students with mild intellectual disabilities, whereas Peltier et al. (2020) discovered evidence in favor of the use of mathematical manipulatives for kids at risk of or identified with disabilities. Instead of depending just on abstract verbal or symbolic representations, PUSAKA JAVA allows students to engage with different shapes through hands-on manipulation of geometric parts. These manipulation exercises in this study also gave students the chance to make mistakes and correct them in a reasonably accessible learning setting. As Table 5 shows, the geometry performance of all participants improved. Although the study's main interpretation focuses on growth mindset and the learning process rather than just geometry achievement, this improvement offers supporting evidence that students become more involved in geometry exercises.

Joyful, Meaningful, and Mindful Learning in the Framework of Ignatian Pedagogy

The students' learning experiences were assessed using a composite observation instrument focusing on three dimensions: Joyful, Meaningful, and Mindful (JMM). The instrument consists of 12 indicators, with four indicators representing each dimension, resulting in a maximum possible score of 48. The mean composite JMM score increased from 39.0, equivalent to 81.2% of the maximum score, in the first session to 47.75, or 99.5%, in the sixth session.

Table 6. Combined Joyful, Meaningful, Mindful (JMM) Observation Score

Student	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
S1	45	45	-	47	-	48
S2	41	41	44	45	47	47
S3	45	44	46	47	48	48
S4	24	42	42	46	47	-
S5	40	-	44	46	47	48
Mean	**39**	**43**	**44**	**46.20**	**47.25**	**47.75**
Percentage	**81.2%**	**89.6%**	**91.7%**	**96.2%**	**98.4%**	**99.5%**

The consistently high an increasing composite JMM scores suggest that students generally experienced the learning activities positively. This is line with descriptions of

joyful learning as learning that emphasizes enjoyment and engagement (Nasyir et al., 2025; Ramadhan, 2025). Qualitative reflections further explain this finding. Students expressed positive responses to the activities, demonstrated an ability to identify geometric shapes that they had initially considered difficult, described how they responded to challenges, and recognized the skills they had acquired. Students S1 consistently expressed enjoyment and eventually no longer perceived particular geometric shapes as difficult. Similarly, S2, S3, and S4 initially experienced difficulties with specific shapes but no longer reported these difficulties in latter sessions. In contrast, S5 continued to depend more heavily on teacher assistance and frequently had difficulty recalling details related to certain geometric shapes. The reflection stage appears to have played a role here; giving students a simple way to name what was easy, difficult, or not yet mastered is a core feature of the reflective pedagogy paradigm (Kurniyawati et al., 2022; Pratini & Prasetyo, 2025), and it helped students recognized both difficulties and progress. The case of S5 also shows that a positive learning experience and secure mastery of shapes are different things: S5 obtained high JMM scores in the last sessions (46 to 48) while still relying on the teacher's help.

The JMM findings can be understood by looking at the Ignatian pedagogy cycle that was used in the intervention. In the context stage Ignatian Pedagogy linked ideas to everyday objects and cultural items. The experience stage let students touch objects and put together puzzles. After that the reflection stage asked students to notice and share what they felt and the challenges they faced. Then the application stage had students use the skill they learned. Finally, the evaluation stage praised their hard work and progress. This teaching order matches research that says experience and reflection are key parts of Ignatian Pedagogy and reflective teaching. The current study adds to that by using visual answers for reflection making the process easier and better, for students who have intellectual disabilities.

The overall JMM score should still be viewed with caution. Since the quantitative data provides a combined score instead of distinct scores for joyful, meaningful, and mindful learning, the study cannot confirm that each dimension has independently improved. However, the quantitative results indicate an enhancement in the overall quality of the learning experience, while the visual reflections offer qualitative insights that are especially pertinent to students' enjoyment, awareness of challenges, strategy application, and recognition of progress.

Students' Visual Reflections and Teacher Perspectives

Students' visual reflections provide a clear and easy way to learn about their educational experiences. Students were able to respond with symbols, gesturing, or succinct verbal responses according to their varying communication skills. According to the reflections, students were generally able to identify the challenges they faced and how to overcome them. S1 frequently expressed happy emotions and demonstrated growing self-assurance in identifying and organizing geometric shapes. With a number of geometric forms, S2, S3, and S4 showed a trend of progressively decreasing difficulty and reported techniques including trying again, asking the teacher, and accepting help. S5 still needed assistance and occasionally forgot forms that had been introduced earlier.

These reflections reinforce the interpretation of a "growth mindset," as they reveal how students respond to challenges from their own perspectives. Concrete signs of persistence, strategy employment, and a progress mindset are things like trying again, asking for help, receiving help, and noticing progress. At the same time the differences found among the students show that the development does not happen evenly. Student S5 case is particularly relevant, since the student had improved post-test scores, but visual reflections indicated continued challenges and dependence on help. A finding as this

implies that endorsing a growth mindset does not necessarily mean the end of all academic problems.

Interviews with teachers provide some context for these patterns. It was found before implementation that students' abilities to identify letters, numbers and geometric shapes were different. Students had difficulties in differentiating similar shapes, recalling the names of shapes and understanding abstract concepts. Teachers also noted differences in concentration, communication, emotional self-regulation, memory and independence. According to teachers, students responded positively to the new media, were interested in the puzzle pieces, engaged more, and were more willing to try tasks and communicate after implementation. Teacher also said students used their own strategies, checking their work and correcting mistakes.

Table 7. Summary of Students' Visual Reflection Results Over Six Sessions

Student	Patterns of Experience and Development	Response of Difficulty
S1	Consistently felt happy; recognized and named various shapes; at the end of the intervention no longer identified a shape as difficult; could group shapes and arrange patterns.	Tried again when experiencing difficulty.
S2	Initially experienced difficulty with rectangles, triangles, and trapezoids; by Sessions 5–6 no longer identified a shape as difficult.	Tried again and accepted gradual assistance from the teacher.
S3	Experienced difficulty with triangles and trapezoids during Sessions 2–4; no longer reported these difficulties in Sessions 5–6.	Tried again, asked the teacher, and accepted gradual assistance.
S4	Experienced difficulties with several shapes during the early and middle sessions; by Session 5 no longer identified a shape as difficult.	Asked the teacher, accepted help from the teacher or peers, and tried again.
S5	Felt happy and recognized several shapes but still forgot some shapes in Session 6; development was less consistent than that of the other students.	Continued to require teacher assistance.

These findings show that how well the instructional design works depends on more than the physical features of the puzzles. It also depends on how scaffolding is provided. Using materials can help students understand math ideas. Students with intellectual disabilities often need extra support. They may need repetition, more wait time, visual communication, support that grows as they learn and a learning pace that can change. Teachers said that challenges include trouble focusing, memory issues, the classroom environment and different levels of support needed. On the other hand, helpful things include using real objects, physical movement recognizing effort support that increases gradually and linking new tasks to things students already know.

This is consistent with the principle that support should be adjusted to the learner's current level and gradually withdrawn as competence grows (Wood et al., 1976; Vygotsky, 1978), and with evidence that manipulatives and visual representations support mathematics learning for students with disabilities (Hord, 2023; Peltier et al., 2020). Linking new tasks to familiar objects and cultural items also agrees with recommendations for culturally responsive practice for students with learning difficulties in mathematics (Tran & Castro Schepers, 2023).

Integration of Growth Mindset Findings through Joint Display

To integrate the quantitative and qualitative findings, a joint display was developed by placing the pre-test and post-test growth mindset scores alongside the observed growth mindset behaviors and students' visual reflections. This integration allows the changes in students' growth mindset to be examined together with the behaviors and experiences observed during the six-session implementation. The joint display also considers aggregated JMM observations and teacher perspectives at the group level. As specified in the research design, meta-inferences are drawn only when two or more data sources provide mutually supportive or complementary evidence.

The individual joint display shows an overall convergence between the quantitative and qualitative findings. All five students showed higher post-test growth mindset scores, with increases ranging from 9 to 14 points. These changes were accompanied by observable behaviors related to persistence, strategy use, help-seeking, acceptance of assistance, and responses to difficulty. S3 and S4 demonstrated the largest increases, while S5 showed the smallest increase and continued to require teacher assistance. Thus, the qualitative data do not simply repeat the quantitative results but provide additional information about how growth-mindset-related responses appeared during learning.

Table 8. Individual Joint Display of Growth Mindset Findings

Student	Pre-test→ Post-test	Growth Mindset Observation	Visual Reflection	Integrated Interpretation
S1	27→39 (+12)	33 (Session 1) → 39 (Session 6)	Consistently felt happy, recognized and named various shapes, and at the and no longer identified a shape as difficult. Tried again when experiencing difficulty.	Convergent: The increase in questionnaire score was accompanied by higher observed *growth-mindset* behavior and evidence of persistence in responding to difficulty.
S2	29→39 (+10)	33 (Session 1) → 38 (Session 6)	Initially experienced difficulty with rectangles, triangles, and trapezoids, but by Session 5-6 no longer identified a shape as difficult. Tried again and accepted gradual assistance.	Convergent: The quantitative increase was supported by decreasing perceived difficulty and greater willingness to retry and accept assistance.
S3	27→41 (+14)	28 (Session 1) → 41 (Session 6)	Experienced difficulty with triangles and trapezoids during Session 2-4, but no longer reported these difficulties in Sessions 5-6. Tried again, asked the teacher, and accepted gradual assistance.	Convergent: The largest questionnaire increase was accompanied by strong evidence of persistence, help-seeking, and reduced difficulty during later sessions.

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Student	Pre-test→ Post-test	Growth Mindset Observation	Visual Reflection	Integrated Interpretation
S4	25→39 (+14)	15 (Session 1) → 41 (Session 5)	Experienced difficulties with several shapes during early and middle sessions, and by session 5 no longer identified a shape as difficult. Asked the teacher, accepted help from teacher or peers, and tried again.	Convergent: The increase in score was supported by observable persistence and willingness to seek and accept assistance.
S5	24→33 (+9)	28 (Session 1) → 35 (Session 6)	Felt happy and recognized several shapes but still forgot some shapes in Session 6. Development was less consistent and the student continued to require teacher assistance.	Complementary: The post-test score increased, while qualitative evidence showed continuing difficulties and dependence on assistance.

Source: Visual Growth Mindset questionnaire, Growth Mindset Observation Sheet, and students' visual reflections.

Integration of Findings and Research Contribution

The convergence of quantitative and qualitative data gives a broader picture of changes occurring during the intervention. Pre-test and post-test results showed increases in growth mindset scores for all five students, and observational findings indicated the development of behaviors that are indicative of a growth mindset during learning activities. Visual reflections also further illustrate how students understood and responded to challenging tasks, while teacher interviews provided additional context regarding changes in participation, strategy use, and responses to feedback. The consistency across these sources suggests that the observed development included not only the students' reported perceptions of growth mindset but also changes in their learning behaviors.

These findings contribute to the existing literature by demonstrating that growth mindset development can be embedded in mathematics instruction for students with intellectual disabilities, rather than implemented as a stand-alone psychological intervention as in de Carvalho & Skipper (2020). Students were given manageable challenges repeatedly working with concrete materials, graduated support, correction of work and awareness of progress through PUSAKA JAWA. These experiences were re-enforced through the cycle of Ignatian Pedagogy where learning experiences were followed by reflection and translated into subsequent action (Agustin & Santoso, 2025; Pratini & Prasetyo, 2025). Therefore, the students' mathematical learning experiences appear to have provided occasions in which growth-oriented behaviors could be practiced.

The research contribution of this study does not lie in the individual use of concrete manipulatives, growth mindset principles, culturally responsive mathematics or Ignatian Pedagogy, as these approaches have been investigated in separate prior studies. Instead, its distinctive contribution is in combining these elements into one instructional design specifically designed for students with mild intellectual disabilities. The design integrates geometric puzzles based on the cultural context of Javanese people with the Context-Experience-Reflection-Action-Evaluation cycle while purposefully embedding manageable challenges, scaffolding, recognition of effort, and visual reflection. The

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integrated approach offers a possible model of mathematics instruction, which considers the accessibility to mathematical concepts and students' reactions to learning difficulties.

The cultural component also contributes to the contextual character of the intervention. Previous studies have emphasized the value of culturally responsive mathematics and ethnomathematics in connecting mathematical ideas with students' familiar experiences and cultural artifacts (Utami et al., 2024; Ilmianita & Ambarawati, 2025; Tran & Castro Schepers, 2023). In PUSAKA JAWA, Javanese cultural references were incorporated into the design and learning context so that geometry could be presented through familiar cultural representations. However, the present data do not directly demonstrate that students independently understood the cultural meanings embedded in every element of the media. Therefore, the contribution of the cultural component is best understood as a contextual and design feature that supports the meaningful presentation of geometry, rather than as an independently established causal factor.

An important finding of this study is that the development of a growth mindset among students with mild intellectual disabilities was observed alongside the use of accessible learning challenges. Presenting geometric tasks through manipulatives and gradual assistance coincided with continued student engagement when difficulties were encountered. In several instances, difficulty was not observed simply as an inability to complete a task, but as a situation in which students tried different strategies, asked for help, changed their approaches, and continued learning. These finding suggest that concrete materials and appropriate scaffolding may be relevant when applying growth mindset principles to students who require intensive instructional support. This is consistent with evidence that concrete and visual representations make mathematics more accessible for students with mild intellectual disability (Hord, 2023; Peltier et al., 2020) and that graduated support allows learners to succeed on tasks slighty beyond their independent level (Wood et al., 1976).

Results also indicate that development of growth mindset varies across individuals and learning contexts. While all students exhibited positive changes from pre-test to post-test, the observational and reflective data indicated varying developmental patterns. Overall, student S1-S4 reported that geometric shapes became easier as sessions progressed, whereas S5 continued to require assistance and demonstrated less consistent retention. Teachers should not expect all students to encounter the same challenges. Instead, they should vary repetition, scaffolding, communication, pacing, and opportunities for independent strategy use to meet individual needs. This heterogeneity is line with meta-analytic evidence that the benefits of mindset interventions differ across students and contexts (Sisk et al., 2018) and with the caution of de Carvalho & Skipper (2020) that changes should be monitored over time.

Overall, the application of PUSAKA JAWA through Ignatian Pedagogy is associated with descriptive positive changes in growth mindset. The mean score rose from 26.4 to 38.2 and all students moved from moderate to high. This improvement was demonstrated by observation of increased willingness to try tasks, persistence, strategy use, responsiveness to feedback and awareness of progress. High JMM composite scores and positive student reflections also suggested that the learning experience was joyful, meaningful, and mindful. These findings together suggest that learning mathematics in concrete, culturally contextualized, and reflective ways can provide a supportive context for promoting growth-oriented responses to challenges.

However, this finding should be interpreted with caution in light of several methodologic limitations. The study involved only five purposively selected students, lacked a comparison group, had some incomplete observational data, did not include follow-up assessments, and used a questionnaire and observation sheets that were expert-

reviewed but not tested psychometrically. Thus, the result cannot establish a causal effect of PUSAKA JAWA or be generalized broadly to students with intellectual disabilities. Rather, the study provides preliminary descriptive evidence of how an integrated instructional approach may support growth-mindset-related development in geometry learning. Future studies should involve larger samples, comparison group, longitudinal observations, and follow-up assessments to examine the sustainability and generalizability of these findings.

CONCLUSION AND SUGGESTIONS

The implementation of PUSAKA JAWA within the Ignatian Pedagogy framework over six sessions was accompanied by positive changes in the growth mindset of students with intellectual disabilities. In response to RQ1, all five students moved from the moderate to the high growth mindset category after participating in the six sessions. The mean Visual Growth Mindset Questionnaire score increased from 26.4 to 38.2, with individual increases ranging from 9 to 14 points. The observed changes were also reflected in students' willingness to try, persistence, use of strategies and support, openness to correction, and awareness of learning progress. However, these changes should not be interpreted as evidence of a causal effect because the study did not include a comparison group.

In response to RQ2, students experienced geometry learning through PUSAKA JAWA as joyful, meaningful, and mindful. Joyful learning was supported by hands-on manipulation of the puzzle pieces and physical interaction with the learning materials. Meaningful learning was developed through connections between geometric concepts, Javanese cultural contexts, and students' everyday experiences. Mindful learning was encouraged through visual reflection, recognition of difficulties, and opportunities to identify effort and progress. The composite JMM score increased from 81.2% to 99.5% of the maximum across the sessions. Visual reflections further showed that students could recognize challenging tasks and describe strategies such as trying again and asking for help. The learning experience was implemented through the five stages of Ignatian Pedagogy—context, experience, reflection, action, and evaluation—which provided a structure for connecting students' experiences with reflection and subsequent learning actions.

In response to RQ3, the implementation was supported by concrete learning media, physical activity, gradual scaffolding, recognition of effort, and connections with familiar contexts and Javanese culture. These factors helped make geometric tasks more accessible and provided opportunities for students to engage with challenges. The implementation was also hindered by variations in students' concentration and memory, differences in the need for individual assistance, and classroom conditions. The observation data also showed fluctuations when students encountered new geometric shapes and more demanding classification tasks, indicating that the implementation required adjustments in pace, repetition, scaffolding, and forms of support according to individual needs.

Overall, PUSAKA JAWA has the potential to support geometry learning that integrates concrete media, Javanese local wisdom, Ignatian Pedagogy, and a growth mindset. Nevertheless, the findings should be interpreted in light of the small purposive sample, absence of a comparison group, limitations in observation and follow-up data, and absence of psychometric testing of the Visual Growth Mindset Questionnaire.

Based on these limitations, future research should involve a larger and more diverse sample across several special schools to examine whether the observed patterns are consistent across different student characteristics and learning contexts. Replicated single-case designs, such as multiple-baseline designs, may also be considered when working with small numbers of students to provide stronger evidence while maintaining individualized intervention (Kazdin, 2011; Kratochwill et al., 2010).

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Future studies should also include a comparison condition to examine the contribution of different components of PUSAKA JAWA, particularly the integration of Javanese cultural contexts, reflective activities, and scaffolding. Follow-up assessments several weeks or months after the intervention are recommended to examine whether changes in growth mindset are maintained over time. More systematic observation procedures should also be established to minimize missing data and strengthen the documentation of students' learning experiences.

In addition, future research should report the joyful, meaningful, and mindful dimensions separately as well as in combination, allowing each dimension of the learning experience to be examined more clearly. Once a larger sample is available, the psychometric properties of the Visual Growth Mindset Questionnaire, including item validity, internal consistency, and factor structure, should be examined. Interobserver agreement should also be reported for observational measures to strengthen the reliability of the findings.

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