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Analysis of intellectual disability students' learning profiles on electron configuration material using individual education

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Abstract. This research is motivated by the need for effective learning strategies for students with intellectual disabilities, particularly those who experience cognitive barriers. This study aims to analyze the learning profiles and outcomes of students with intellectual disabilities in relation to electron configuration materials, utilizing individualized educational learning strategies. The learning media developed is the E-LAPD (Electronic-based Student Activity Sheet), integrated through the LiveWorksheet platform. This study employs a mixed-methods research approach, a method that combines quantitative and qualitative methods. The population of this study is three students with intellectual disabilities at SMAN 10 Surabaya. The sampling technique is a saturated sample (total sampling), where the entire population is used as a research sample. Data collection techniques through test and interview methods. The test results were analyzed quantitatively, while the interview results were analyzed qualitatively using the NVivo application. The results indicate that this study can enhance the learning outcomes of students with intellectual disabilities, as evidenced by the posttest scores, which are higher than the pretest scores. Thus, this research is important in helping students with intellectual disabilities and is expected to be the basis for developing more inclusive and adaptive learning media.

Introduction

Education is a fundamental right of every individual without exception, including children with special needs (ABK) who have significant differences in learning abilities compared to children in general. One of the groups that requires a special learning approach is children with intellectual disabilities, especially those who experience thinking barriers (slow learners). Students with intellectual disabilities typically have below-average cognitive abilities and limitations in adaptive skills, including communication, social skills, and basic academic abilities (Kustawan, 2021). According to Mardi Fitri (2021); Purnadewi & Widana (2023), a special approach is necessary for children to achieve maximum development.

Under ideal conditions, the learning process for students with intellectual disabilities in electron configuration materials should be implemented through an individualized educational approach

that fully accommodates each student's abilities, characteristics, and learning needs. Thus, learning focuses on achieving academic results and developing basic thinking skills, fostering independence, and enhancing student confidence through effective individualized educational strategies.

Based on the results of observations and interviews that have been conducted with one of the teachers on the social behavior and emotional management of students with intellectual disabilities at SMAN 10 Surabaya, it is found that some students with intellectual disabilities can be said to be less adaptive. This can be observed in the students' ability to interact with friends and teachers. Students are considered less responsive in their communication and tend to withdraw from the social environment, which is perceived as less adaptive.

In real conditions, the learning process for students with intellectual disabilities in electron configuration materials still does not fully apply the individualized educational approach. Still, it employs the same classical method for all students without making in-depth adjustments to the cognitive abilities of students with intellectual disabilities. This research examined learning strategies that can be used to reduce unwanted behavior. Good social behavior helps learners with intellectual disabilities build meaningful relationships, reduce social isolation, and improve the quality of learning.

To create adaptive social behavior in students with intellectual disabilities, an effective learning strategy is necessary (Widana et al., 2023). Han (2021) explained that learning strategies are a set of methods and techniques that educators consciously choose to maximize student involvement, understanding, and retention in the learning process. Zhang et al. (2024) suggest that diverse learning strategies have a positive and beneficial impact on student learning engagement, with the emotional involvement of teachers serving as a mediator. According to Riza and Barrulwalidin (2023), the selection of learning methods should consider the characteristics of students, the learning context, and the goals that students aim to achieve. Students who are slow learners often struggle to understand information and require more time to grasp the subject matter. This condition is characterized by a genetic factor that presents with mild to moderate intellectual barriers and requires individualized educational services.

According to Budyawati & Luh Putu Indah (2020), previous research has found that the development of Individual Learning Programs (ILPs) in inclusive schools in Jember effectively increases students' learning readiness and engagement in activities. Furthermore, research by Perdana (2020) developed an Individualized Learning Program (PPI) model for children with special needs in inclusive elementary schools, showing that the model is practical and effective in improving students' literacy and independent behavior skills. This aligns with the theory proposed by Rifqy Rabbani et al. (2025), which states that learning for slow learners needs to involve multisensory and visual approaches to increase student engagement and understanding.

Based on previous research, this study offers novelty in applying individualized educational learning strategies to analyze the profiles and learning outcomes of students with intellectual disabilities in the context of electron configuration material, an abstract chemistry topic. Unlike M Rifqy Rabbani et al. (2025), which focused on transforming the lecture method into a more interactive one for ABK students in general, this study focuses on mapping the learning style profile of each student through individual assessment. Novelty arises from a conceptual approach that places students at the center of learning, offering practical contributions in the form of adaptive learning media tailored to students with special needs.

The Individualized Learning Program (ILP) is derived from the term Individualized Educational Program (IEP), which was developed in the United States education system. According to Valentin in Sebrina & Sukirman, (2019) stated that "The Individualized Education Program (IEP) is a formal

document that explains the learning needs of students with special needs and the modification or change of the curriculum and the physical environment provided according to the needs of the student". According to UNESCO, it is revealed that "The Individualized Educational Program (IEP) curriculum is intended for students who do not allow using regular or modified curriculums". The level of service needs in particular is complex.

According to Quthni (2024), effective learning media for students with cognitive impairments include pictures, real objects, educational games, simple videos, and interactive tools. E-LAPD is one of the online learning media in the form of questions with elements of sound, images, and summaries of the material and instructions for implementing tasks that refer to basic competencies. E-LAPD aims to provide convenience for teachers and students. A teacher can help provide an understanding of the material. For E-LAPD students, it can serve as a learning experience that fosters an active, independent attitude and responsibility (Lathifah, 2021). Therefore, an alternative approach that can enhance the teaching and learning process is to utilize digital LAPD (E-LAPD), which makes learning activities more engaging and encourages students to be active during the learning process (Prastika & Masniladevi, 2021). In addition, research conducted by Alexandra (2020) on fun strategies to develop literacy through the liveworksheets platform.

One of the subjects that is considered quite difficult by students in MIPA Senior High School (SMA) is chemistry. The view that students find chemistry lessons difficult causes students' motivation to learn chemistry to not exist (Budiariawan, 2019). Electron configuration matters in other materials. Electron configuration matters is a fundamental concept in modern chemistry that describes the distribution of electrons in atoms under various energy states. The discussion of electron configuration is generally divided into two main approaches: based on atomic skin and by subshell. Without mastering the electron configuration material, students will struggle to understand the properties of elements or molecules and their order in the periodic table, so it is essential to find a simple way to grasp them.

Based on the literature review above, the formulation of the problem in this study is to profile students with intellectual disabilities in relation to electron configuration materials using individualized educational learning strategies, and to assess the learning outcomes of students with intellectual disabilities on electron configuration materials using individualized educational learning strategies. This study hypothesizes that the post-test score will be higher than the pretest score. This study aims to analyze the learning profiles and outcomes of students with intellectual disabilities in relation to electron configuration materials, utilizing individualized educational learning strategies.

Therefore, this study is important for analyzing the learning profiles of students with intellectual disabilities when studying electron configuration materials using individualized educational learning strategies. By understanding their learning profiles, teachers and education planners can design more targeted strategies, media, and assessments to maximize the learning outcomes obtained. The results of this study are expected to provide a practical contribution in the form of E-LAPD for teachers in implementing individualized educational learning strategies for abstract chemistry materials, as well as making a theoretical contribution to the development of an inclusive learning model in Indonesia centered on students with intellectual disabilities.

Method

The approach and method used in this study are a mixed-methods approach. Mixed research is oriented towards quantitative and qualitative approaches during the research implementation process (Suradika & Dirgantara, 2019). Furthermore, Sugiyono (2014) stated that the mixed

research method is a research approach that combines quantitative and qualitative methods to be used together or alternately in a study, thereby obtaining more valid, reliable, comprehensive, and objective data.

As a methodology, this joint research employs philosophical assumptions that inform the direction of data collection and analysis. It can process qualitative and quantitative approaches at each stage of the research process (Samsu, 2021). In the view of Parjaman and Akhmad (2019), mixed methods research is a systematic research model that combines concepts, perspectives, techniques, and quantitative and qualitative approaches in research. This type of research combines two quantitative and qualitative approaches integrated as new findings in the conclusion (Agus Subagyo, 2020).

The research method used in this study is the concurrent embedded design method. (Sugiyono, 2011) It combines quantitative and qualitative research methods simultaneously, but the weight of each method is not the same.

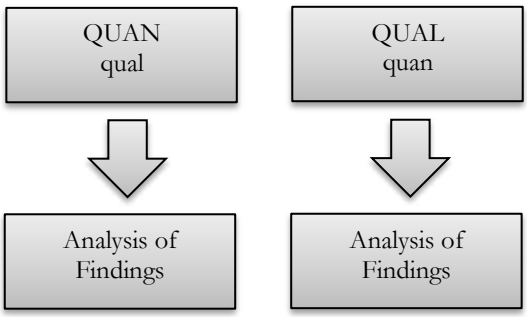

Image 1. Concurrent Embedded Design Research (Sugiyono, 2011)

Based on Image 1, there are two methods for merging models, with the primary method indicated by capital letters, while the secondary method is shown by lowercase letters. In the left-hand model, the primary method with a higher weight is quantitative, while in the right-hand model, the primary method is qualitative.

Qualitative Methods and Design

The method used in this study is a descriptive qualitative research design. The aim is to describe in depth the learning profile of students with intellectual disabilities in understanding electron configuration materials through individual educational learning strategies obtained from the results of interviews (Anisya, 2022).

Qualitative Data Analysis Techniques and Criteria

Qualitative data analysis was conducted using the N-Vivo application and the matrix coding query technique to analyze the interview results obtained. Qualitative data analysis is carried out through several stages.

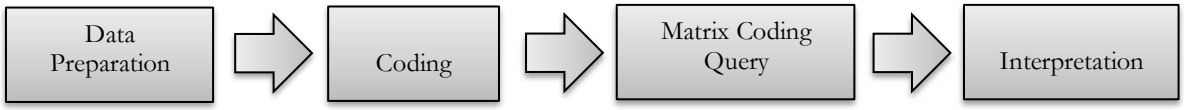

Image 2. N-Vivo Analysis Stage

The first stage is data preparation, where the transcribed interview results are entered into the NVivo application and classified based on students with intellectual disabilities. Furthermore, coding is performed by creating nodes according to the learners' learning styles, specifically visual, auditory, and kinesthetic, and then reclassified based on interview transcripts. The coding process is carried out openly (open coding) and continues with category grouping (axial coding). The next stage utilizes the Matrix Coding Query to display a diagram of the frequency of learning styles among students with intellectual disabilities, based on the number of coding reference counts. The results of the NVivo analysis were then interpreted to describe the tendency of learning styles among students with intellectual disabilities in relation to the applied learning strategies.

The data analysis criteria in the Matrix Coding Query in the N-Vivo application are determined based on the frequency of code occurrence (coding references count) in each category of learning styles, namely visual, auditory, and kinesthetic. Each category is interpreted based on the number of references that appear during the learning process using e-LAPD 1 and e-LAPD 2 (Sari et al., 2025). The determination of criteria is carried out by classification, as in Table 3.

Table 1. Matrix Coding Query Criteria

Dichotomy	Score
> 3	Height
1 ≤ 2	Medium
< 1	Low

Quantitative Methods and Design

The quantitative method uses a Quasi-Experimental Pretest-Posttest design. This design measures changes in students' knowledge, skills, or attitudes before and after an intervention or treatment (Kumala et al., 2022).

Quantitative Data Analysis Techniques and Criteria

The data analysis technique used in the quantitative method is the One-group Pretest-Posttest Design, where researchers can determine whether there is an influence on learning outcomes by comparing students' abilities before and after treatment.

Table 2. One-group Pretest-Posttest Design

O_1	X	O_2

(Sugiyono, 2011)

Information:
O1: the results of the student's pretest before being given treatment
X: treatment using E-LAPD media
O2: the results of the student's post-test after being given the treatment

Pretest and post-test results are also used to determine whether student learning outcomes increase or decrease. The N-Gain score (g) is calculated using the following formula:

$$g = \frac{Spost - Spre}{Smaks - Spre} \times 100\%$$

(Hake, 1998)

Description:
G : N-Gain Score

Spost : Posttest Score
Spre : Pretest Score
Smax : Maximum Score

The criteria for interpreting N-Gain scores are presented in the following table.

Table 3. N-Gain Criteria

Dichotomy	Score
$g > 0.7$	Height
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

(Hake, 1998)

Participants and Sampling Techniques

The subjects of this study were students with intellectual disabilities, including three students with thinking barriers (slow learners) who served as research respondents. The sampling technique used in this study was a saturated sample technique (total sampling), where the entire population was used as a sample to follow all stages of research activities.

Research Setup and Timeline

This research was carried out from July until it was completed. The research design stage was conducted at the State University of Surabaya in July, while the trial stage took place at SMA Negeri 10 Surabaya on August 7, 2025. Furthermore, the data analysis stage was carried out at the State University of Surabaya from August until it was completed.

Research Procedure

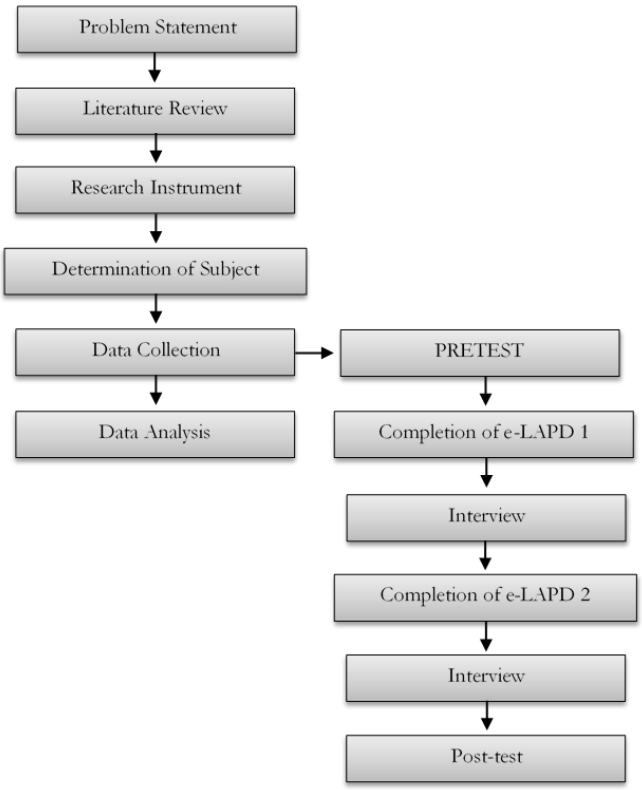

Image 3. Research Procedure

This research was carried out through six main stages. The first stage is problem formulation, which identifies the difficulties students with intellectual disabilities have in understanding the concept of electron configuration. In the second stage, a literature review is conducted to strengthen the theoretical foundation and clarify the research purpose. The third stage involves preparing research instruments in the form of pretests, posttests, and interview tests. Furthermore, the fourth stage involves determining research subjects using the saturated sample technique (total sampling), where the entire population serves as a sample to follow all stages of research activities. The fifth stage, data collection, involves the implementation of pretests, learning using e-LAPD 1 and e-LAPD 2, post-session interviews, and posttests. In the final stage, data analysis was conducted both quantitatively to compare the results of the pretest and posttest, and qualitatively using the NVivo application to analyze the interview results and identify students' learning styles.

Data Collection Techniques and Research Instruments

The data collection technique used in this study involved tests and interviews. The test obtains quantitative data in the form of pretest and post-test scores to determine students' learning outcomes on electron configuration material. The interview was conducted to obtain qualitative data on the learning experience to determine students' learning styles. The research instruments include pretest-posttest questions prepared based on the competency indicators of electron configuration material, as well as interview tests that focus on student responses and perceptions.

Instrument Validity and Reliability Test

The data collected were analyzed quantitatively and descriptively. The instruments used in this study were the E-LAPD validation sheet and the pretest-posttest. A summary of the instruments is presented in Table 4.

Table 4. Assesment Intruments and Indicators

Instrument	Purpose	Indicators	Example Iten	Scale
E-LAPD Validation Sheet	To assess the content validity and validity of the E-LAPD construct	Clarity and suitability	Visualization helps learners with intellectual disabilities	Likert 1-4
Pretest-Posttest	To find out the learning outcomes of students	Electron Configuration	Determine the electron configuration of the element Mg	0-100

Validators test the consistency of validity assessments using the Alpha Cronbach coefficient to ensure the reliability of evaluations. Evaluations with a coefficient of 0.70 or higher are considered reliable (Akpoghol et al., 2025). Pretest-posttest results are calculated using the N-Gain formula to measure the effectiveness of E-LAPD in improving student learning outcomes. The validation results were further analyzed using a qualitative descriptive method with a Likert scale, as shown in the following table.

Table 5. Licert Skale Criteria

Score	Category
4	Very Valid
3	Valid
2	Fairly Valid
1	Not Valid

Using a combined quantitative-qualitative research method, the researcher hopes to obtain appropriate analysis results regarding the influence of E-LAPD media on the learning style and learning outcomes of students with intellectual disabilities in learning the chemistry of electron configuration materials.

Results and Discussion

In accordance with the formulation of the problem, research objectives, and research methods, the discussion results were presented through qualitative analysis of the learning style of students with intellectual disabilities and quantitative analysis of the learning outcomes of students with intellectual disabilities on electron configuration materials using learning media in the form of E-LAPD.

Qualitative Learning Style Analysis

The mapping of learning styles in students with intellectual disabilities is based on three types of learning styles: visual, auditory, and kinesthetic, which are then analyzed qualitatively using the NVivo application. Based on the results of interviews conducted with three students with intellectual disabilities, the learning style of the first student, as identified by Avicenna (AV), is presented in Image 4 below.

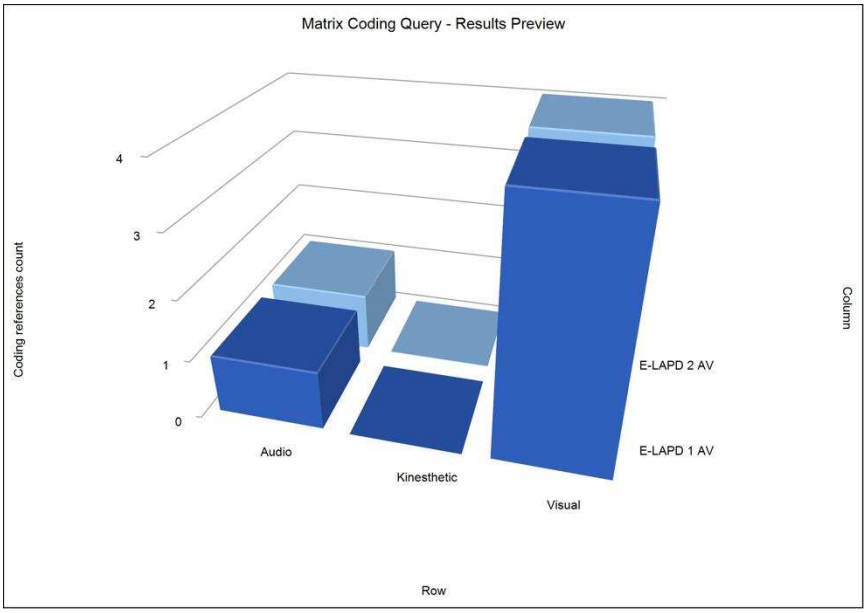

Image 4. AV Learning Style Frequency Diagram

Based on the results of data analysis displayed in the Matrix Coding Query table and diagram, the frequency of learning styles of AV students showed that the visual learning style occupied the highest position with a frequency of 4 in both types of material. This suggests that students can better understand abstract concepts, such as electron distribution, when presented with visual media, including diagrams, drawings, configuration tables, or animated illustrations. The audio learning style shows a relatively low frequency at number one. This means that the use of audio media cannot optimize the understanding of students with intellectual disabilities. The kinesthetic learning style shows zero frequency in both types of material. This condition confirms that for abstract material, such as electron configurations, learners need concrete media that can be visualized, rather than physical activity alone.

Furthermore, the second student, on behalf of Dandy (DA), obtained the learning style results, as seen in image 5 below.

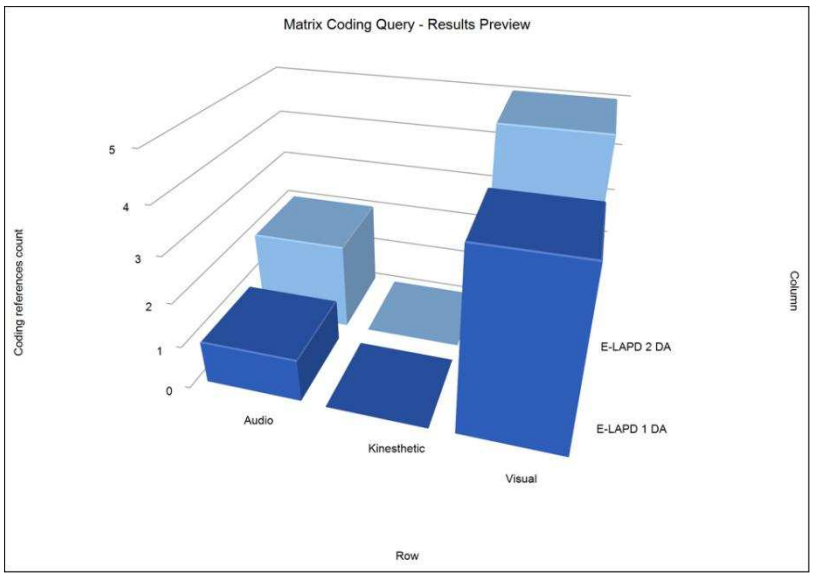

Image 5. DA Learning Style Frequency Diagram

Based on the results of data analysis displayed in the Matrix Coding Query table and diagram, it was found that the frequency of visual learning styles of DA students reached five in both materials. This shows that students are much easier to understand abstract concepts related to electron distribution when the material is presented through visual representations, such as electron shell diagrams, orbital models, or interactive animations. The audio learning style shows the frequency of numbers one and two, which indicates that students are still quite helped by verbal explanations of supporting audio, even though the effectiveness is not as strong as visual media. The kinesthetic learning style showed the lowest frequency, at zero, indicating that the physical activity-based approach is ineffective when learners learn abstract concepts such as electron configuration.

Furthermore, the third student, on behalf of Elfiana (EL), obtained the learning style results shown in image 6 below.

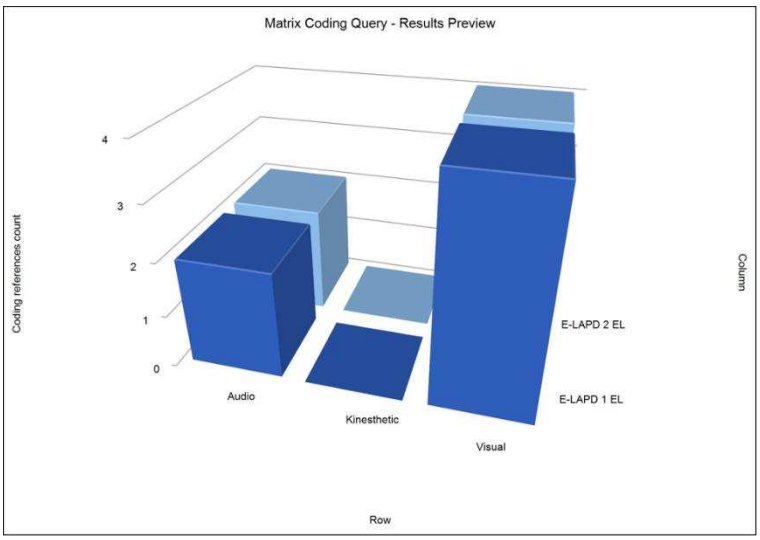

Image 6. EL Learning Style Frequency Diagram

Based on the results of data analysis displayed in the Matrix Coding Query table and diagram, it was found that the frequency of visual learning styles among EL students reached four, indicating that students understand abstract material more easily when presented in the form of diagrams, images, or animations. The audio learning style is shown at number two. This means that audio explanations play quite a role in strengthening understanding, although not as strongly as visual learning styles. On the other hand, kinesthetic learning styles show the lowest frequency, which is at zero. This suggests that physical activity or direct practice does not significantly contribute to understanding the concept of electron configuration, whether based on skin or subskin.

The three students with intellectual disabilities showed a consistent pattern, visual learning style being the most dominant, as shown by the frequency of coding references count in each student at >3 with a high score, followed by audio at a medium score, and kinesthetic at a low score. This indicates that visual learning remains the primary key, and the visual-audio combination is more effective for some students.

Quantitative Learning Outcome Analysis

Furthermore, the analysis of learning outcomes of students with intellectual disabilities was carried out using the One-group Pretest-Posttest Design technique, which was based on pretest and posttest scores. Based on the results of the tests that were carried out on 3 students with intellectual disabilities, the learning results of the students are obtained as shown in image 7 below.

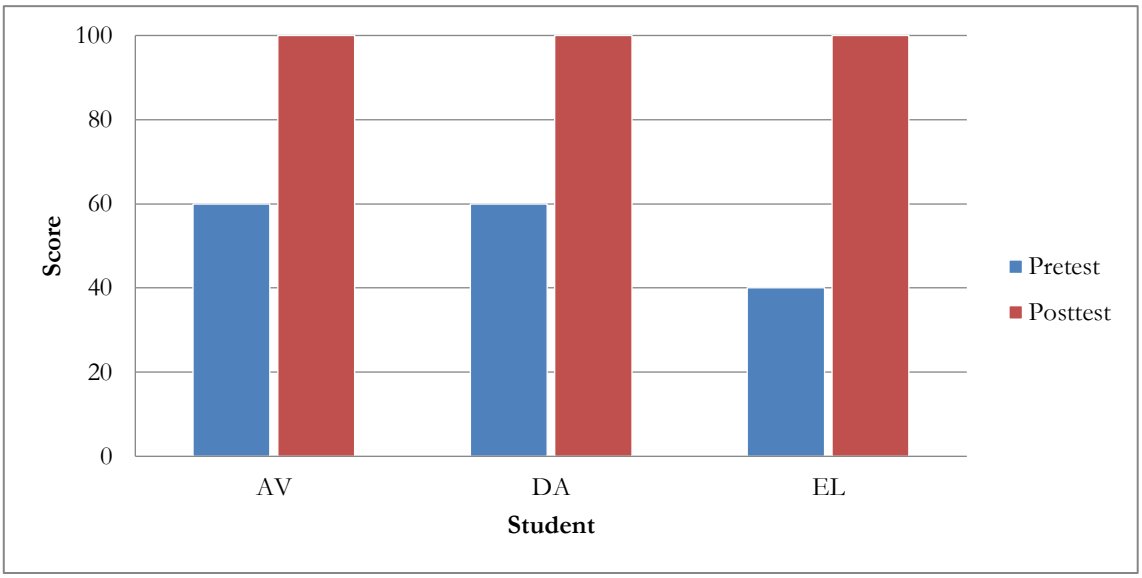

Image 7. Pretest-Posttest Result Diagram

The learning outcomes of students with intellectual disabilities on electron configuration materials showed a significant improvement after using E-LAPD-based learning media. This increase can be seen from the comparison of pretest and posttest scores obtained by three students, namely AV, DA, and EL, on two main topics: electron configuration based on skin (E-LAPD 1) and electron configuration based on subskin (E-LAPD 2).

Furthermore, the pretest-posttest results were re-analyzed based on the sub-material in each student. In the first student, AV, the comparison of pretest-posttest scores in E-LAPD 1 and E-LAPD 2 as shown in image 8 below.

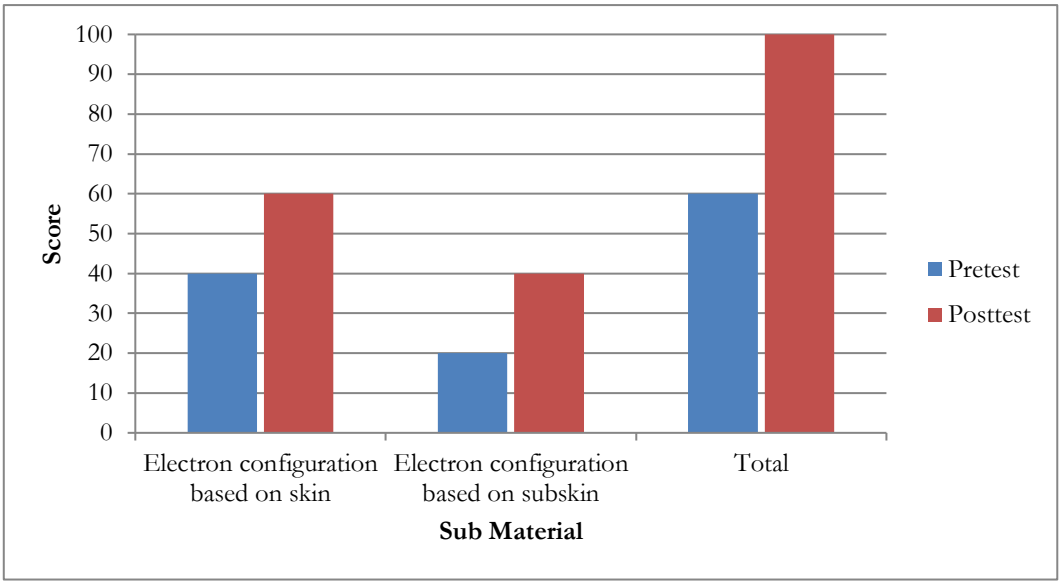

Image 8. AV Pretest-Posttest Result Diagram

Based on the table and comparison diagram of pretest and posttest scores of AV students, it shows an increase in learning outcomes after being treated through E-LAPD. In the electron configuration sub-material based on the skin, the students' pretest score was 40 while the posttest score increased to 60. In the electron configuration submaterial based on the subskin, the pretest score was 20 while the posttest score increased to 40. This increase is 20 points which indicates a better understanding after treatment. When viewed from the total overall score, the pretest score of AV students is 60, while the posttest score increases to 100. This means a total increase of 40 points from before to after treatment. Overall, these data show that E-LAPD media can strengthen concept understanding while providing clarity in the learning process that was previously considered difficult.

Furthermore, for DA students, a comparison of pretest-posttest scores in E-LAPD 1 and E-LAPD 2 was obtained as seen in image 9 below.

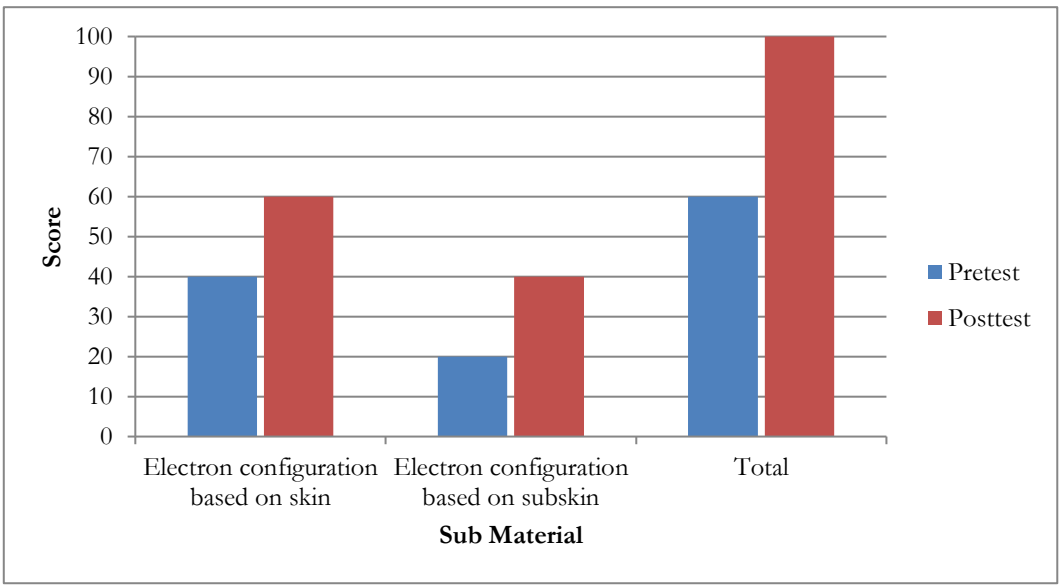

Image 9. DA Pretest-Posttest Result Diagram

Based on the table and comparison diagram of pretest and posttest scores of DA students, it can be identified that there is an increase in learning outcomes after using E-LAPD learning media. In the electron configuration submaterial based on skin, the pretest score obtained by students was 40, while the posttest score increased to 60. In the electron configuration submaterial based on the subskin, the pretest score obtained by the students was 20, then the posttest score increased to 40. When viewed from the total overall score, the pretest score of DA students is 60, while the posttest score increases to 100. Thus, there was a total increase of 40 points. This confirms that DA can better understand the material through the visual and interactive presentations offered by the E-LAPD.

Furthermore, in EL students, a comparison of pretest-posttest scores on E-LAPD 1 and E-LAPD 2 was obtained as seen in image 10 below.

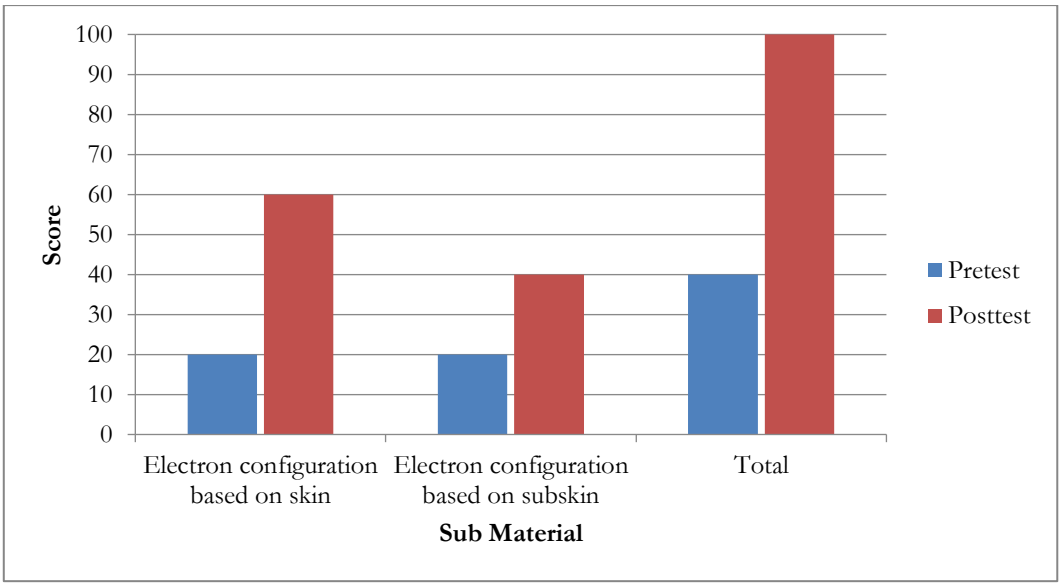

Image 10. EL Pretest-Posttest Result

Based on the table and comparison diagram of pretest and posttest scores of EL students, it can be concluded that there is an increase in learning outcomes after using E-LAPD learning media. In the electron configuration sub-material based on skin, the students' pretest score was 20, while the posttest score increased significantly to 60. In the sub-material of electron configuration based on subskin, students obtained a score of 20 at the pretest, then the posttest score increased to 40. When viewed from the total overall score, the pretest score of EL students is 40, while the posttest score reaches 100. Thus, there is an increase of 60 points. In general, this fact shows that E-LAPD media cannot only help students with moderate comprehension, but is also very effective for students with relatively low initial comprehension.

Analysis of improved learning outcomes using the N-Gain formula showed a high category of >0.70 in the three students, which achieved an N-Gain score of 1.00. To clarify the analysis results, pretest-posttest, and N-Gain data are presented in the form of the table 6 below.

Table 6. Analysis of Learning Outcomes Improvement

Student	Pretest	Posttest	N-Gain
AV	60	100	1.00
DA	60	100	1.00
EL	40	100	1.00

Overall, the three students achieved maximum scores after participating in E-LAPD-based learning. These findings show that using E-LAPD 1 and E-LAPD 2 media is very effective in improving understanding of the concept of electron configuration, both based on the skin and the subskin. The presentation of material in the form of visual, systematic, and interactive is able to change abstract concepts into more concrete and easy to understand for students with intellectual disabilities.

Validity of E-LAPD

The findings of this study show that E-LAPD with individualized educational learning strategies has a high level of validity. The validity of the E-LAPD was assessed by three validators, consisting of one extraordinary school lecturer (SLB), one chemistry teacher, and one Special Assistant Teacher (GPK) using a Likert scale ranging from 1 to 4. This scale includes three main criteria: (1) suitability of content with individual educational learning strategies, (2) clarity of images and videos regarding electron configuration material, and (3) clarity of E-LAPD language and design. The validation results showed that all aspects got a score of 4, which was categorized as "Very Valid". Content validity ensures that the material delivered is relevant to the targeted competencies. In contrast, construct validity confirms that the E-LAPD design can be used effectively to support the achievement of learning objectives. To clarify the validity of the E-LAPD, the validation results are presented in the form of a image 11 below.

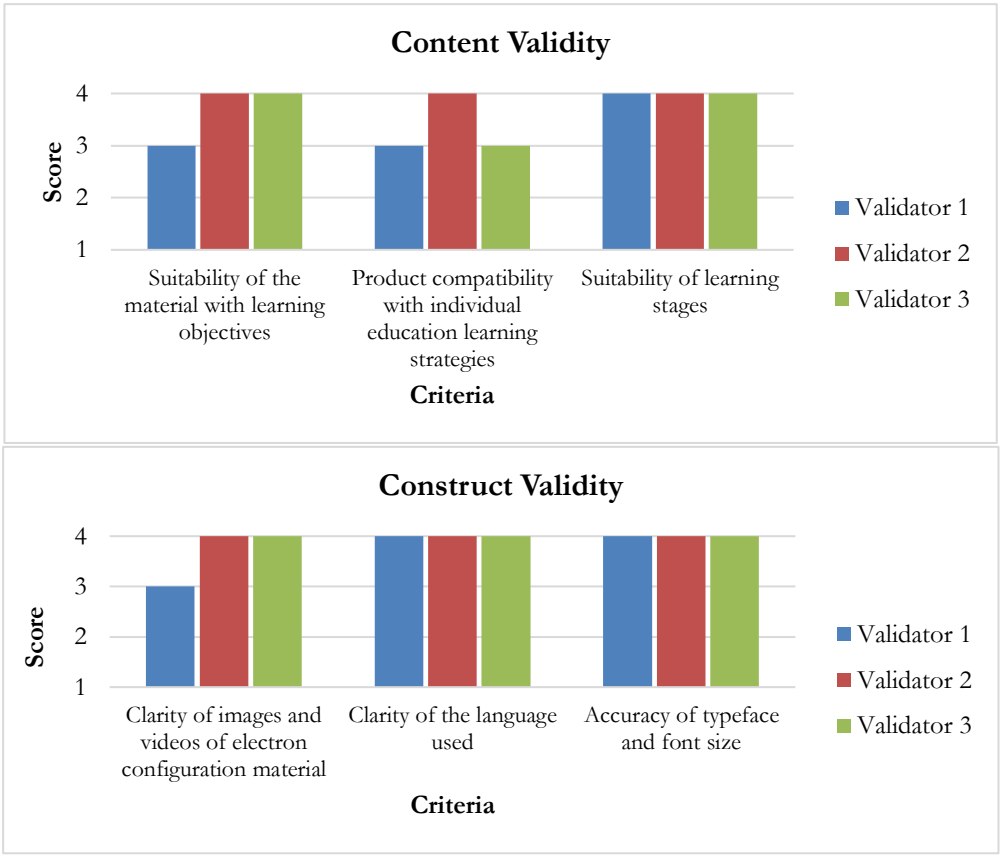

Image 11. Validity Diagram

This finding is in accordance with previous research submitted by (Budyawati & Luh Putu Indah, 2020) found that the development of Individual Learning Programs (PPI) in Jember inclusive schools effectively increases students' learning readiness and activities. Furthermore, research by Perdana (2020) developed an Individualized Learning Program (PPI) model for children with

special needs in inclusive elementary schools, showing that the model is practical and effective in improving students' literacy and independent behavior skills. This aligns with the theory proposed by Rifqy Rabbani et al. (2025) which states that learning for students with slow learners needs to involve multisensory and visual approaches to increase student engagement and understanding.

In addition to seeing the suitability with previous research, this study also has novelty in applying individualized educational learning strategies to analyze the profiles and learning outcomes of students with intellectual disabilities on electron configuration materials, which is an abstract topic in chemistry. Unlike Rifqy Rabbani et al. (2025) which focused on transforming the lecture method into a more interactive one for ABK students in general, this study focuses on mapping the learning style profile of each student through individual assessment. Novelty also appears in a conceptual approach that places students as the center of learning and practical contributions in the form of adaptive learning media for students with intellectual disabilities in the form of E-LAPD.

Thus, E-LAPD can be considered an inclusive and adaptive learning medium, which can provide equal learning opportunities for all students with intellectual disabilities to achieve maximum results. In addition, this study also shows that knowing the learning style profile of students with intellectual disabilities can facilitate the adjustment of individual education learning strategies to livework-based E-LAPD so that it can improve the learning outcomes of students with intellectual disabilities in electron configuration materials.

The findings of this study have theoretical and practical implications. Theoretically, the results strengthen the theory of quantitative-qualitative approaches (mixed method) by showing that combining the two approaches can produce more valid, reliable, comprehensive, and objective data. Practically, the E-LAPD based on the liveworksheets developed offers teachers a low-cost learning medium that students with intellectual disabilities can easily access. The significant improvement in learning outcomes shows that this medium is effective for some students and feasible for large-scale classroom applications. This impact highlights the potential of liveworksheet-based E-LAPD as a scalable solution to bridge students with intellectual disabilities in conducting adaptive learning in the classroom.

Despite the promising results, the study has some limitations that must be acknowledged. First, the trial was conducted on only three students with intellectual disabilities, which limited the generalization of the findings to a broader population of students with disabilities. Second, learning media is only applied to one material, namely electron configuration, so its effectiveness in other fields of chemistry is still uncertain. Third, this research was conducted in a relatively short period of time, meaning that the long-term impact on the motivation of students with intellectual disabilities cannot be fully assessed. Therefore, future studies should extend implementation to various inclusion schools and special schools (SLBs), cover a wider range of chemistry materials, and include long-term measurements to ensure the resilience and sustainability of learning outcomes.

Conclusion

The application of individual education learning strategies to learning media in the form of liveworksheet-based E-LAPD has been proven to analyze the learning style profile of students with intellectual disabilities and improve the learning outcomes of students with intellectual disabilities in electron configuration materials. The results of the study showed that the learning style of students with intellectual disabilities showed a consistent pattern, visual learning style was the most dominant as shown by the frequency of code occurrence (coding references count) in each student was at >3 with a high score, followed by audio at a medium score, and kinesthetic at a low score.

This confirms that visual representations in the form of diagrams, drawings, tables, and animations are more effective in helping students with intellectual disabilities understand abstract concepts such as electron configuration. Furthermore, the learning outcomes of students with intellectual disabilities showed a significant increase after learning using liveworksheet-based E-LAPD media, both in the sub-material of electron configuration based on skin and subskin. The three students experienced a very significant increase in pretest-posttest scores, with a final score of 100. Analysis of improved learning outcomes using the N-Gain formula showed a high category of >0.70 in the three students, which achieved an N-Gain score of 1.00. These findings prove that visual and interactive-based learning media are able to change abstract concepts into more concrete, as well as provide equal learning opportunities for students with intellectual disabilities. Thus, E-LAPD can be seen as an inclusive and adaptive learning medium that is effective in improving the understanding of complex science concepts. Further research is recommended to be able to expand the number of participants and cover a wider range of chemical materials. Thus, the results of this research are expected to be the basis for the development of more inclusive and adaptive learning media, in order to support the achievement of equal quality education for all students with intellectual disabilities.

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