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GENIALLY LEARNING MEDIA BASED ON POSNER'S THEORY TO REDUCE MISCONCEPTIONS IN LINEAR MOTION

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Abstract :
Misinterpretation of concepts or misconceptions often occurs in physics, especially in linear motion material. To overcome this problem, this study developed interactive learning media based on the Genially platform by applying Posner's Conceptual Change Theory. The research used the 4D development model (Define, Design, Develop, Disseminate) and involved 35 grade XI students at SMAN 5 Jambi City. The novelty of this research lies in the systematic integration of Posner's conceptual change approach and Genially's interactive features, which have not been effectively applied in the context of high school physics learning. The results showed that the developed media was able to significantly reduce the level of student misconceptions, with an average decrease from 10.48% to 5.24%. The Wilcoxon Signed-Rank Test statistical test yielded a significance value of 0.042 ($p < 0.05$), indicating a significant difference between the pre- and post-treatment values. The implication of this research is the availability of alternative digital learning media that are not only engaging and in line with the characteristics of the digital generation, but also effective in addressing student misconceptions in depth. This media can also serve as a model for developing other teaching materials on complex physics topics prone to misconceptions.

Keywords: Conceptual Change, Genially, Misconception

INTRODUCTION

In all aspects of human life, education plays a crucial role. This is because human development and all aspects of their personality are directly influenced by education. The entire process of education shapes our understanding and relationship with everything in life. Changes in the world of education must be implemented continuously to support future development, one of which is through teaching and learning activities (M. Rohmah et al., 2023; Suparno, 2013). Based on preliminary studies in research by Sutrisno (2019), students in grades X, XI, and XII amounted to 49.6% of students experiencing misconceptions. This percentage is relatively small when considering that they have learned about motion kinematics. There are even indications of misconceptions among students about the material. The percentage of students who indicated misconceptions was 26.7%. This shows that some students do not experience changes in concept understanding after learning.

According to Nasir (2020) and Hasan & Fitria (2021), almost all topics in Physics have misconceptions, as evidenced by approximately 700 studies that review misunderstandings in this field. Of these, 300 studies highlighted misconceptions in mechanics, 160 focused on electricity, 70 on heat and optics, 35 on Earth and space, and 10 on modern physics. Based on these findings, mechanical materials, including the kinematics of straight motion.

Misconceptions can occur due to concept processing errors between teachers and students. The meaning of concept processing errors is that there is a mismatch between the delivery of concepts by teachers and the acceptance of concepts by students (Negoro et al., 2018) . Misconceptions are seen as an important inhibiting factor for students and a reference for teachers in learning and teaching. The main factor in the occurrence of misconceptions is learning conditions that pay little attention to preconceptions or initial conceptions that students have (Halim et al., 2019) . Each student has a different initial conception. Therefore, teachers should pay attention to the initial conceptions that students bring into the classroom before providing new concepts or information so that the concepts provided can be readily accepted in the cognitive structure of students, and no misconceptions occur in students (M. Rohmah et al., 2023).

To overcome this problem, efforts need to be made to identify forms of misconceptions, understand their causes, and determine the correct method to reduce them. One of the learning models used in this study to help reduce misconceptions is the Conceptual Change learning model. The Conceptual Change learning model is a process of changing one's understanding from a less accurate or incorrect concept to a more precise and scientific concept. The conceptual change learning model is defined as a type of learning that alters students' initial conceptions, including their beliefs, ideas, or ways of thinking. In this learning, students not only collect new facts or skills, but also change their existing conceptions. This model encourages students to feel dissatisfied with their current conceptions and find new concepts that are more reasonable, understandable, and useful, as a step towards conceptual restructuring (Makhrus, 2019; Saputra et al., 2025).

According to Posner et al (1982) Conceptual Change has four conditions: dissatisfaction with the old concept, the new concept must be understandable, the new concept must be convincing, and the new concept must be consistent with the old concept. Thus, conceptual change is often necessary to understand more complex scientific concepts, especially when prior knowledge is insufficient to explain new data or phenomena. This model is often used in science education to address common misconceptions, such as an incorrect understanding of gravity or energy (Inayah A.M et al., 2023). With this method, teachers can identify misconceptions and help students gradually understand more accurate scientific concepts. Conceptual change learning involves two main stages: assimilation and accommodation. These two processes are governed by an internal mechanism called equilibration. Through assimilation and accommodation, students become more reliant on the thinking process rather than just observing, so their knowledge continues to grow, and misconceptions can be reduced (R. U. Rohmah & Fadly, 2021). The conceptual change learning model is considered quite effective in reducing student misconceptions. Because this learning model has a phase where it can develop inductive and deductive thinking skills (Nurafipah et al., 2022; R. U. Rohmah & Fadly, 2021).

Educational media is a means of conveying messages and information used in the classroom. This media is effectively designed to help students better understand the content or learning material. Apart from functioning as a tool for teachers, educational media also acts as a physical conveyor of information during the learning process. Each educational medium has its characteristics, advantages, and disadvantages, so learning media need to be well designed so that the delivery of material can run smoothly and be well received by students (Yolanda & Santa, 2023; Zahwa & Syafi'i, 2022).

Media is anything used as a tool to convey a message, stimulating students' thoughts, interests, feelings, and learning process, so that it can run efficiently and effectively as expected. Genially is one of the applications of website-based online learning media (Enstein, Bulu, et al., 2022; Enstein, Juliani, et al., 2022; Wadud & Lailiyah, 2024). Genially media encompasses various features, including presentations, animations, videos, infographics, electronic posters, quizzes, and games, that can provide interactive learning materials for students (Aisya & Wawan, 2024; Fatma & Ichsan, 2022). Genially can create an interesting and engaging learning experience for students, helping them to understand complex concepts better (Alza & Raharjo, 2024; Suspito et al., 2023; Tueno et al., 2024). It can be concluded that Genially is a learning medium that presents various features, such as interactive presentations, educational videos, digital posters, learning games, and various other forms of interactive teaching materials (Dewi Astuti et al., 2022; Khoirun Ni'mah et al., 2022; Nurjannah et al., 2025; Rindawati et al., 2024).

Strong conceptual understanding is essential for students to succeed in all academic disciplines. Understanding physics concepts is particularly important because it helps students connect knowledge, facilitates learning, and strengthens connections between concepts. However, many students struggle to understand complex physics concepts. Therefore, identifying misconceptions is important in designing effective learning strategies to improve student understanding (Salim Nahdi et al., 2018; Sengkey et al., 2023; Triani et al., 2025).

The novelty of this research lies in the integration of Genially interactive media with Posner's Conceptual Change Theory approach in the context of physics learning, particularly in the material of kinematics of straight motion. After an in-depth literature review, it can be concluded that there has been no previous research that explicitly and systematically combines these two elements in the context of kinematics learning. Although Genially has been widely utilized as a visual and interactive aid, and Posner's Conceptual Change Theory has proven effective in addressing student misconceptions, there has been no recorded effort to combine the strengths of each strategically. This research aims to fill that gap, demonstrating how the dynamic features of Genially can specifically support the stages of Posner's Conceptual Change Theory to facilitate students' conceptual change on the topic of kinematics, which is often rife with misconceptions. So far, the application of Posner's conceptual change theory in digital learning media remains limited, particularly in those designed systematically to address misconceptions. This research presents an innovation in the form of cognitive conflict-based media, structured with a logical flow, attractive visuals, and high interactivity through the Genially platform, which has not been widely applied in kinematics learning at the high school level. In addition, this research provides empirical contributions in the form of quantitative data, showing the effectiveness of the media in significantly reducing the level of misconceptions, as well as through expert validation, which demonstrates that this product is suitable for widespread use. Thus, this media not only offers a new approach to developing digital learning content but also addresses the challenges of learning abstract and complex physics concepts in a way that is easier to understand and more engaging for students. This research aims to analyze the causes of misconceptions among high school students and the factors contributing to these misconceptions. After analyzing the misconception problem, it can be a provision for educators, especially to identify students' misconceptions early, in order to avoid understanding the wrong concept.

RESEARCH METHOD

Research Design

The type of method used in this research is research and development (R&D). The R&D method is a research approach that produces a product in a specific field of expertise, accompanied by certain by-products, and has the effectiveness of a product. This research uses the 4D development model. This development model consists of 4 stages, namely defining, designing, developing, and disseminating (Bahosin Sihombing et al., 2024; Harjanto et al., 2023; Okpatrioka, 2023).

Research Target/Subject

The subjects of this study were Jambi City SMAN 5 students in Class XI of the 2024/2025 school year who had studied linear motion material. This research was conducted in April 2025.

Research Procedure

The procedure in this study involves creating genetically modified media based on Posner's conceptual change theory to reduce misconceptions in linear motion material, specifically in material selection. Where this material will be conveyed through learning media with a genially platform containing every sentence that will be conveyed on the media following the stages of Posner's conceptual change theory that has been previously analyzed, designing a storyboard, storyboard contains a layout or placement of components in the media, starting from the position of writing, explanatory texts, animations, or illustrations, and making media where interactive media is made using features such as navigation buttons, illustrations in the form of videos, to support students' conceptual understanding. Following the product design, research was conducted among students at SMAN 5 Jambi City. Product trial activities consist of pre-test activities, treatment, and post-test activities, all based on Posner's conceptual change theory and learning media.

Instruments, and Data Collection Techniques

The study utilizes both qualitative and quantitative data. Quantitative data from the analysis of expert validation sheets (material and media) were analyzed using a Likert scale, alongside the results of diagnostic tests adopted from Zahra (related to misconceptions in linear motion material. Meanwhile, qualitative data were obtained through descriptive explanation. Quantitative data sources include high school students who have studied linear motion material, as well as validators from material and media experts. The quantitative data analysis technique was carried out by reviewing and interpreting student misconceptions based on the results of the four-level diagnostic test. The results of the four-level diagnostic test were identified based on the respondents' answers at each level of the answer, both the first, second, third, and fourth levels, so that the average percentage of misconceptions experienced by respondents at each level of the answer, both the first, second, third and fourth levels, was known.

The qualitative data obtained in this research and development include comments and suggestions from validators. The qualitative data collection process involved two validators who acted as material experts and media experts. A qualitative descriptive analysis technique was used to analyze this data. The analysis was carried out by categorizing the data obtained, including criticisms, suggestions, responses, and recommendations for improvement from each validator. The results of the analysis were then used to improve the product.

Data Analysis Technique

The data obtained by researchers includes validation results from material expert validators and media expert validators, as well as the results of product trials conducted with students. Product trial activities consist of pre-test activities, treatment (learning media that have been developed), and post-test activities. Quantitative data analysis techniques are employed by reviewing and interpreting student misconceptions based on the results of a four-level diagnostic test. The following equation can determine the percentage of students' misconceptions

$$P = \frac{f}{n} x \ 100\%$$

With the percentage category of misconception level shown in Table 1, as follows:

Table 1. Misconception percentage categories

Percentage	Category
0 % - 30 %	Low
31 % - 60 %	Medium
61 % - 100 %	High

Source: (Mukhlisa, 2021)

The results of the validation questionnaire were analyzed quantitatively based on expert validation assessments, namely material experts and media experts, using a Likert scale. The following table shows the Likert scale assessment categories.

Table 2. Likert scale rating categories

Score	Description
Score 4	Very good
Score 3	Good
Score 2	Good enough
Score 1	Not good

Source: (Sukardi, 2021)

According to Sugiyono (2016) The formula used for Likert scale testing is as follows:

$$P = \frac{\Sigma R}{N} \times 100\%$$

After determining the feasibility percentage (P (%)) from each validator. Then the percentage results are matched with the validation criteria used in the validity of the material and media presented in the following table:

Table 3. Criteria for the validity of questionnaire data

No.	Achievement level (%)	Qualification
1	81-100%	Very good
2	61-80%	Good
3	41-60%	Good enough
4	21-40%	Not good

The Wilcoxon Test, or Wilcoxon Signed Rank Test, is a non-parametric method for testing significant differences between two conditions at different times with the same treatment (Alya Mukhbita et al., 2025; Anam et al., 2020; Windi et al., 2022). This test produces a Z-value and significance level of Asymp.Sig. (2-tailed).

- If the value is ≤ 0.05, then the difference is considered significant.
- If > 0.05, then it is not significant.

A qualitative descriptive analysis technique was employed to analyze the data. The analysis was conducted by categorizing the data obtained, including criticisms, suggestions, responses, and recommendations for improvement from each validator. The results of the analysis were then used to improve the product.

RESULTS AND DISCUSSION

The results of the research and development carried out are genially learning media based on Posner's conceptual change theory to reduce misconceptions in linear motion material. The presentation of learning media follows Posner's conceptual change theory components, consisting of (1) dissatisfaction, (2) clarity, (3) proof, and (4) usefulness. Learning media development is adjusted to the 4-D development model, which consists of several stages, including: (1) define; (2) design; (3) develop; (4) disseminate.

At the define stage, some initial analysis was carried out to understand the condition of students related to misconceptions in linear motion material. Based on the study (Sutrisno, 2019) As many as 49.6% of students still experience misconceptions, and approximately 26.7% demonstrate a completely incorrect understanding. This shows that previous learning has not been effective in changing students' understanding. Task analysis also reveals that students struggle to comprehend the concepts of velocity, acceleration, and motion graphs. Therefore, interactive media such as Genially is needed that supports Posner's four stages of concept change: dissatisfaction with the initial concept, clarity, proof, and usefulness of the new concept. The concept analysis identified various misconceptions, such as the assumption that lighter objects fall faster or that frictional force accelerates the fall the most. Therefore, this media was developed to facilitate students' concept change through visual and interactive simulations that guide students to understand physics concepts correctly and contextually.

The design stage was carried out to develop Genially learning media under Posner's conceptual change theory, aiming to overcome students' misconceptions about linear motion material. This process begins with the preparation of a benchmark reference test, which is based on the results of analyzing student misconceptions and preliminary studies. This test aims to measure students' understanding and direct media design skills. Furthermore, media selection was carried out by considering the characteristics of students and materials, then designed in a logical flow from introduction to evaluation, following the four stages of Posner's theory. The media format is adapted to the learning content through interactive visual design, the use of animations, images, and easy-to-understand text. The Genially platform was chosen because it supports user-friendly navigation, allowing students to learn independently. The initial design was then reviewed with the supervisor to gather input before proceeding to the next stage.

The process of making Genially learning media based on Posner's conceptual change theory to reduce misconceptions on linear motion material using the Genially platform is as follows:

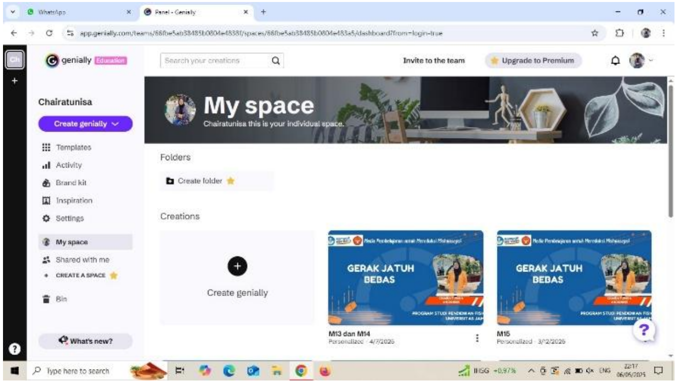

Figure 1. Genially display

After entering the Genially platform, a web-based tool used to create learning media, this study utilizes Genially to support students' conceptual changes, as outlined in Posner's theory. By presenting visual and interactive content, Genially helps reduce misconceptions, particularly in linear motion material.

Figure 2. Media Editing Through Genially

After the initial version of the learning media has been developed, the next step is to conduct validation by material experts and media experts. After undergoing the validation process, the revised media is then tested on a small scale in the field.

Product Validation

Media and material experts validated the learning media developed. The purpose of learning media validation is to see the feasibility of the products developed. Validation activities involved 2 Jambi University Physics Education lecturers. This validation was carried out 2 times. Collecting data on the validator's assessment of the product developed using a questionnaire with a Likert scale. The results of the validation of media experts at stage I are shown in Tables 4, respectively, as follows:

Table 4. Phase I media expert validation results

No.	Appraiser	Percentage	Category
1	Validator 1	66.07 %	Good
2	Validator 2	66.07 %	Good
Average		66.07 %	Good

The results of the validation of material experts at stage I are shown in Tables 5 respectively, as follows:

Table 5. Results of stage I material expert validation

No.	Appraiser	Percentage	Category
1	Validator 1	78.57%	Good
2	Validator 2	69.64%	Good
Average		74.11%	Good

After making revisions based on the suggestions of the validators, the researchers conducted phase II validation activities. The results of the validation of media experts and material experts in stage II are shown in Tables 6 respectively, as follows:

Table 6. Results of phase II media expert validation

No.	Appraiser	Percentage	Category
1	Validator 1	89.29%	Very Good
2	Validator 2	83.93%	Very Good
Average		86.61%	Very Good

The results of the validation of media experts and material experts in stage II are shown in Tables 7 respectively as follows:

Table 7. Results of phase II material expert validation

No.	Appraiser	Percentage	Category
1	Validator 1	92.86%	Very Good
2	Validator 2	80.36%	Very Good
Average		86.61%	Very Good

Based on the results of stage II validation, as shown in Tables 6 and 7, the validation process of the two learning media developed has been deemed very good (feasible) for use in research. After the initial results of the learning media were produced, they were validated by material experts and media experts. Then, the validated media was tested on a small scale in the field.

At the dissemination stage, product trials were conducted to assess the effectiveness of using Posner's conceptual change theory-based generative learning media in reducing students' misconceptions about linear motion material. The product trial activity involved 35 grade XI students (small group trial). The product trial used a one group pre-test post-test design. Students were asked to do pre-test questions and then given treatment. Furthermore, a post-test was conducted to assess the effect of the treatment administered.

The results of this study indicate that the use of Genially learning media based on Posner's Conceptual Change Theory is effective in reducing misconceptions in linear motion material. This can be seen from the increase in students' concept understanding, as indicated by the average N-gain value of 41.29, which falls into the medium to high category. Additionally, there was a decrease in the average student misconception from 10.48% to 5.24%, which reflects the success of the media in facilitating conceptual change, as posited by Posner's theory.

Specifically, the misconceptions that were significantly reduced were those related to indicators M13, M15, M16, M17, and M18. For example, in M13 (lighter objects move faster and arrive first), students tend to rely on everyday experiences involving air resistance, thinking that mass determines the speed at which objects fall. This concept was addressed through simulations in Genially media that showed that in a vacuum, mass does not affect the fall time. A decrease was also seen in M16 and M17, which relate to friction and the volume of objects in a vacuum.

Table 8. Data analysis of the percentage of misconceptions of students

Description of misconceptions	Percentage of misconceptions		% Mis	Description
	Pre-test	Post-test		
M13	14,29	2,86	11,43	Misconceptions Reduced
M14	5,71	8,57	-2,86	Misconceptions Increase
M15	11,43	8,57	2,86	Misconceptions Reduced
M16	8,57	2,86	5,71	Misconceptions Reduced
M17	17,14	8,57	8,57	Misconceptions Reduced
M18	5,71	0,00	5,71	Misconceptions Reduced
Average	10,48	5,24	5,24	Misconceptions Reduced

The decrease in students' misconceptions about linear motion (from 10.48% to 5.24%) after using Genially media is closely related to Posner's Theory of Conceptual Change. This media triggers students' dissatisfaction by showing that their initial understanding of free fall is incorrect, for example, through a vacuum simulation. Then, the correct concept is presented with 'clarity' through interactive visuals and animations. 'Evidence' is provided through convincing simulations to support the new scientific concept. Finally, this new concept proves to be 'useful' because students can apply the correct understanding, significantly reducing misconceptions across various indicators. This shows that the media is effective in transforming students' understanding from incorrect to scientifically accurate. In the pre-test, the level of misconceptions was relatively high. However, after learning, there was a significant reduction in misconceptions in the post-test, indicating that the applied method succeeded in improving students' understanding. There was an increase in misconceptions on question M14, whereas other misconceptions decreased. This suggests that the concept tested in M14 remains unclear to students. Based on the table above, the comparison of the percentage of misconceptions between the pre-test and post-test shows a significant change after learning. Misconceptions in most questions, such as in M13 (14.29% to 2.86%), M15 (11.43% to 8.57%), M16 (8.57% to 2.86%), M17 (17.14% to 8.57%), and M18 (5.71% to 0.00%) have decreased, which indicates that students' understanding of these concepts is getting better after learning. However, in question M14 (5.71% to 8.57%), there was an increase in misconceptions, indicating that some concepts were still confusing for students. Overall, the average percentage of misconceptions decreased from 10.48% in the pre-test to 5.24% in the post-test, representing a 5.24% decrease in misconceptions.

Table 9. Results of the wilcoxon signed rank test for student misconceptions

Test statistics[a]	
	Post-test misconceptions – Pre-test misconceptions
Z	-2.032[b]
Asymp. Sig. (2-tailed)	.042

The data was then tested using the Wilcoxon Signed Rank Test, resulting in the following data details: $z = -2.032$, $p = 0.042 < 0.05$ or Asymp.Sig. (2-tailed). Therefore, it can be concluded that the reduction in students' misconceptions from the pre-test to the post-test is significant. The unique integration of Posner's Conceptual Change Theory and Genially features significantly contributes to reducing student misconceptions. This media is innovative in presenting Posner's stages, as dissatisfaction is created through interactive simulations that directly challenge students' intuitions, a feature rarely found in traditional methods. The clarity of new concepts is enhanced by multimodal visualizations, such as animations and infographics, which are more dynamic than static diagrams. Evidence is presented through virtual experiments that allow students to manipulate variables and observe the results directly, a feature that surpasses the limitations of ordinary physical demonstrations. Finally, the usability of concepts is reinforced by presenting real-world applications in interactive scenarios. This innovation enhances the effectiveness of the conceptual change process and is a key factor behind the significant reduction in student misconceptions.

The results of this study indicate that the use of Genially learning media based on Posner's Conceptual Change Theory is effective in reducing misconceptions in linear motion material. This can be seen from the increase in students' concept understanding, as indicated by the average N-gain value of 41.29, which falls into the medium to high category. Additionally, there was a decrease in the average student misconception from 10.48% to 5.24%, which reflects the success of the media in facilitating conceptual change, as posited by Posner's theory. This finding aligns with previous research by Suparno (2013) and Sinaga (2017), which demonstrated that cognitive conflict-based media can enhance understanding and reduce student misconceptions in physics.

Overall, learning based on Posner's conceptual change theory is effective because it encourages students to reevaluate their initial understanding, replacing it with scientific concepts that are more reasonable and grounded in empirical explanations. Genially media supports this through integrated visual features and reflective animations, thus providing an enjoyable and meaningful learning experience. Thus, the results of this study not only corroborate previous findings but also contribute to innovative learning approaches that overcome misconceptions.

CONCLUSIONS

Based on the research, Genially learning media developed based on Posner's Conceptual Change Theory proved effective in reducing students' misconceptions about linear motion material. This effectiveness is evident in the results of the pre-test and post-test administered to 35 grade XI students, which showed a decrease in the average misconception from 10.48% to 5.24% after learning with the media. This decrease reflects an increase in student understanding. It supports the principle of conceptual change, as outlined in Posner's theory, which emphasizes the importance of cognitive conflict in transforming erroneous understanding into a more scientific one. Statistical test results using the Wilcoxon Signed Rank Test also showed a significance value (Asymp. Sig. 2-tailed) <0.05, indicating a significant difference between pre-test and post-test results. In the development process, this media is created using the 4D model (Define, Design, Develop, Disseminate) and has undergone validation by media experts and material experts, yielding results of 92% and 94%, respectively. This demonstrates that the media is not only feasible and valid, but also capable of capturing students' attention and aligning with the needs of physics learning. Interactive features, such as videos, visual illustrations, and logical cognitive conflict-based learning, make Genially an effective medium for helping students understand complex physics concepts more deeply, precisely, and interestingly.

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