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The didactical knowledge of generative artificial intelligence tools: The case of writing mathematics lessons

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Abstract

Generative artificial intelligence (GenAI) is attracting the attention of educators for its potential in the classroom, including the mathematics classroom. Investigating these potentialities for the student and the teacher is needed to support the teacher in his/her decisions concerning integrating this new technology into his/her classroom. The present study intends to study the potentialities of GenAI bots (ChatGPT, Gemini, Claude, and Perplexity) in writing mathematical lessons and in awareness of the teaching means (method, strategy and technique) in the lessons. We collected the data through prompts given to the bots. We analyzed the data using deductive and inductive reasoning. The research results indicated that the four bots succeeded in writing a mathematics lesson on the linear function topic. They showed awareness of the teaching means used in the lesson, but they differed regarding what they considered a teaching method and a teaching strategy. Future research is requested to study other aspects of the didactical knowledge of GenAI bots.

Keywords: AI bots, didactical knowledge, lesson planning, generative artificial intelligence, mathematics lesson

INTRODUCTION

Educational technology has turned out to be part of our educational practices, whether for students' learning (Daher, 2015) or for teachers' practices (Hamdan et al., 2021). Generative artificial intelligence (GenAI) tools have recently succeeded in becoming an integrative part of our life, including our educational practices. Many GenAI tools have emerged that serve teachers and students in their educational practices. These include bots like ChatGPT, Gemini, Claude, and Perplexity. Educational researchers and educators found that these GenAI tools could be used in educational settings for various purposes, where these purposes are related to the teacher, to the student, and to the text. In the present research, we are interested in the ability of GenAI tools to support the teacher in building lessons, specifically mathematical lessons. We investigated this ability for four GenAI tools: ChatGPT, Gemini, Claude, and Perplexity. These tools have attracted lately the attention of researchers as tools in educational settings (Ali et al., 2023; Pan et al., 2023; Ram et al., 2023), but little research has been done to investigate their didactical ability, here in planning and writing mathematics lessons, what the present research attempts to do.

Artificial Intelligence in Education

A growing number of teachers and students are turning to artificial intelligence (AI)-powered conversational bots to bolster and facilitate learning and teaching (Chen et al., 2023).

The acceptance and adoption of GenAI in educational settings have been a topic of interest for educators and researchers (Baytak, 2023; Göktepe Yıldız & Göktepe Körpeoğlu, 2025; Gouia-Zarrad & Gunn, 2024; Korkmaz Guler et al., 2024; Opesemowo & Adewuyi, 2024; Owan et al., 2023; Rosen, 2025; Udias et al., 2024; Ukala et al., 2025; Wardat et al., 2023). The potential of AI to improve learning outcomes for students is highlighted in different studies (e.g., Alfehaid & Hammami, 2023; Chen et al., 2023; Zhan et al., 2022). Alfehaid and Hammami

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Contribution to the literature

- The present study focuses on the didactical knowledge of AI bots. This issue was addressed little in the literature that examined the use of AI in the classroom.
- The present study examines the potentialities of GenAI bots (ChatGPT, Gemini, Claude, and Perplexity) in writing mathematical lessons according to specific theoretical frameworks.
- The present study examines the awareness of different AI bots to the teaching means (method, strategy, and technique) in mathematical lessons provided by these bots.

(2023) report that conversational bots can support students' learning, which can enhance their engagement in learning. Labadze et al. (2023) found that using AI-powered chatbots can significantly benefit students in three main areas: homework and study assistance, personalized learning experiences, and the development of different skills. Moreover, this use can benefit educators in the areas: time-saving assistance and improved pedagogy. Daher and Abu Thabet (2025) found that the literature indicates the contribution of AI tools to various types of students' motivation. Hmoud et al. (2024) reported that the GenAI bots contributes to higher education students' task motivation. Daher and Hussein (2024) found that students' AI knowledge significantly affected three aspects of learning (efficiency, interaction, and affect) of higher education students, where the level AI-knowledge influenced directly the level of the three aspects of learning. Moreover, the AI tools are designed to support various pedagogical models, including flipped classrooms and team-based learning, and to address the challenges of learning through massive open online courses and hybrid models by providing support and answering students' questions (Kamalov et al., 2023).

Researchers also found that there are still doubts regarding the use of large language models in education (Baytak, 2023). Researchers found that GenAI tools have the ability to answer content questions in the various disciplines, but they sometimes give inaccurate or partially accurate answers (Daher et al., 2023). Labadze et al. (2023) emphasize the importance of educators addressing several challenges and critical factors, such as reliability, accuracy, and ethical considerations associated with AI applications. So, while there is a need for conversational agents in education, there may be concerns and challenges associated with their deployment (Allouch et al., 2021).

AI tools used in education include conversational bots, which are AI-powered conversational bots that could be used to bolster and facilitate learning and teaching, with a focus on improving the learning experience and student engagement (Muldner et al., 2020) , tutoring technology, which consists of intelligent orchestration systems, such as FACT, developed to make recommendations to teachers regarding the attention that they need to pay to specific students, in addition to describing questions that they can send to their students (Muldner et al., 2020) and game-based learning, where this AI-based games can improve student involvement and performance (Zhan et al., 2022).

The Learning Styles Theory

Several learning style models are known today, each offering a unique framework for understanding how individuals prefer to learn and process information. Some of the prominent learning style models include the following ones (Fatahi et al., 2016). First, Felder-Silverman learning style model: this model categorizes learners into four dimensions: active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Second, Myers-Briggs type indicator: based on Carl Jung's theory of psychological types, this model classifies individuals into different personality types, each with its own set of preferences for interacting with the world. Third, five factor model: also known as the big five personality traits, this model measures personality based on five broad domains: openness, conscientiousness, extraversion, agreeableness, and neuroticism. In addition, the experiential learning model of Kolb give four learning styles: diverging, assimilating, converging and accommodating. The models described above, as well as many others, provide valuable insights into the way individuals approach learning, and they can also help teachers to accommodate diverse learning styles more effectively.

Kolb's Model of Learning Styles

Kolb's model of experiential learning, as outlined in his experiential learning cycle, consists of four cyclic stages (Ganira & Odundo, 2023; Morris, 2019): concrete experience (involves active participation and exposure to novel experiences, which are situated in a specific place and time), reflective observation (requires critical reflection as a mediator of meaningful learning), abstract conceptualization (involves the development of contextual-specific abstract concepts through model-building, reading, and analogies), and active experimentation (encourages pragmatic testing of new implications for actions, creating new experiences for learners).

A systematic literature review proposed a revision to Kolb's model, emphasizing the need for contextually rich concrete experience, critical reflective observation,

contextual-specific abstract conceptualization, and pragmatic active experimentation (Morris, 2019).

Kolb's learning style inventory is commonly used to assess learning styles based on his experiential learning model. The four fundamental learning styles that result from the experiential learning process are (Johnson et al., 2020): diverging (emphasizes concrete experience and reflective observation, assimilating (focused on reflective observation and abstract conceptualization), converging (involves abstract conceptualization and active experimentation) and accommodating (prioritizes concrete experience and active experimentation).

Despite the popularity of Kolb's model, the theoretical underpinnings have been questioned. However, quantitative studies have shown a significant association between the use of Kolb's cyclical transformation learning techniques and cognitive achievement increases (Johnson et al., 2020).

One special issue of education with AI is teachers' use of AI tools in the classroom. Teachers can integrate AI into their lesson plans through various approaches, such as teaching and learning with AI, where AI can be used to assess and support various aspects of students' learning and other educational outcomes. For instance, AI, machine learning, and data mining techniques can be leveraged to personalize learning and provide adaptive educational systems (Adair, 2023). In addition, co-design workshops with K-12 teachers have been organized to create lesson plans using AI tools and embedding AI concepts into various core subjects. This approach helps in integrating AI into core curriculum to leverage learners' interests and provides entry points for teaching AI in non-computing subjects (Van Brummelen & Lin, 2020). **Appendix A** shows an example of a lesson plan.

Teaching Strategies, Teaching Methods, Teaching Styles, and Teaching Techniques

The terms teaching strategy, teaching method, teaching style, and teaching technique refer to different aspects of the teaching process. We attempt to define them below.

A teaching method refers to the presentation of content in the classroom, whereas teaching strategy refers to the achievement of some objectives by using any method of teaching, which means that teaching strategy is a combination of several teaching methods that emphasize teaching as an art (Roy, 2022). Roy (2022) mentions two broad teaching strategies and related teaching methods: teacher-centered strategy and student-centered strategy. The author puts the following teaching methods under the teacher-centered strategy: story telling method, textbook method, lecture method, demonstration method, and tutorial method. In addition, the author puts the following teaching methods under the student-centered strategy: question-answer method, discussion method, heuristic method, discovery method, project method, role playing method, and brainstorming method.

Not all researchers agree with the previous approach to teaching strategies and methods. For example, Kuamr (2022) exchanges the previous notions, making student-centered as a method. Kuamr (2022) names the following as teaching strategies: brainstorming, group discussion, demonstration, games and independent study. Hasanova et al. (2021) attempted to differentiate between teaching approaches, methods, procedures, techniques, styles, and strategies. For them, the teaching approach provides a philosophy to the whole, alongside methods and techniques, which are just parts of an approach. They gave teacher-centered and student-centered examples on the teaching approach. Moreover, they gave the lecture and whole group discussion as examples on methods related to the teacher-centered approach. They gave small group discussions, simulations, and projects as examples on methods related to the student-centered approach. Moreover, for them, a method is a well-planned procedure to achieve certain instructional goals, including the support of students' learning. It takes into consideration students' abilities and needs. Furthermore, Hasanova et al. (2021) consider a teaching strategy as a plan of action designed to achieve a specific goal or series of goals. It includes the planned activities designed to achieve that goal. In addition, the teacher's technique is the way in which he or she goes about carrying out specific steps in the teaching process that is part of the teaching method. The authors argue that an individual teacher's unique teaching technique is the way in which he or she applies a strategy to accomplish a particular task in teaching and learning. Thus, a technique is one's own unique way of dealing with a specific problem.

Research Rationale, Goals, and Question

GenAI tools are new to the educational scene, so investigating their ability to support teachers and students is required, which would help teachers, as subjects that are part of the educational process to plan their use of the GenAI tools in their teaching and learning. In addition, it would enrich those interested in the didactic field, especially teacher educators, take decisions whether and how to utilize them in professional development workshops. The present research intends to investigate one didactical issue, specifically the ability of GenAI tools to write lessons, in this case mathematical lessons, in general and based on a learning-styles framework, specifically that of Kolb.

The issue of teaching strategies, teaching methods and teaching techniques is of special importance when writing a lesson. So, it is interesting whether the GenAI tools are aware pf these teaching means. The present research intends to investigate the awareness of GenAI bots of the teaching strategies, methods and techniques applied in writing lessons.

Table 1. Characteristics of data analysis for each RQ

RQ	Characteristics of analysis	Themes
First and third	Order of presentation and lesson parts, covered aspects of the topic, the subjects addressed	Order and lesson parts: title, objects, introduction, etc. Covered aspects for mathematical topics: representations, concepts, and relations The addressed subject: the teacher, the students, and the parent
Second	The values of each teaching means: strategy, method, and technique	Method: direct instruction, cooperative learning, and inquiry based learning Strategy: introducing a concept through storytelling, dividing students into groups for discussion, or using simulations to practice skills Technique: asking open-ended questions, using visual aids, providing manipulatives for hands-on exploration, or assigning problem-solving tasks
Fourth	The components of the learning styles model	The model components according to the literature review.

Research Questions

1. What is the ability of GenAI bots to write a mathematics lesson on the topic of the linear function, for the middle school?
2. What is the knowledge of GenAI bots of learning styles models?
3. What is the ability of GenAI bots to write a mathematics lesson, that is based on a model of learning styles, on the topic of the linear function, for the middle school?
4. What is the awareness of GenAI bots of the teaching strategies, teaching methods, and teaching techniques utilized in the written lessons, whether general based on a model of learning styles?

METHODOLOGY

Research Context and Participants

The research is confined to the context of educational didactics. Chevallard (2007), in his anthropological theory of didactics defines didactics as "the scientific study (and the knowledge resulting thereof) of the innumerable actions taken to cause (or impede) the diffusion of such and such a body of knowledge in such and such an institution" (p. 133). Lesson writing and planning belong to the didactic processes. A didactic planning process is an important teaching activity that institutions ought to have, according to Hernández-Carrasco et al. (2022), and didactic planning is the step prior to didactic action. In order to develop the evaluation processes, it is necessary to determine the learning objectives, design the experiences, select the activities, and select the resources. In the present research, we want to investigate the ability of different GenAI tools to write lessons, here is a mathematics lesson, in general and for students of different learning styles in particular.

In the present research, we were interested in four GenAI tools: ChatGPT, Gemini, Claude, and Perplexity. All the four tools have attracted the attention of researchers lately, which explains why we chose them.

Data Collection

We collected the research data by giving each of the four bots prompt related to the research questions (RQs). Thus, the following prompts were given to each bot:

1. Please write a mathematics lesson on the topic of the linear function for the middle school.
2. What are the parts of the lesson that you wrote above?
3. What are the teaching strategies, teaching methods, and teaching techniques that you used in the lesson, and where did you use each? Please talk at each one of them individually.
4. Please describe Kolb's model.
5. Please write a mathematics lesson, that is based on Kolb's model of learning styles, on the topic of the linear function for the middle school.
6. What are the teaching strategies, teaching methods, and teaching techniques that you used in the lesson, and where did you use each? please talk at each one of them individually.

Data Analysis

The data analysis was done through deductive and inductive content analysis. **Table 1** describes the characteristics of analysis of the data to answer each RQ, where these characteristics, besides their themes, helped perform the deductive reasoning. The values of themes were arrived at through inductive reasoning.

FINDINGS

Reporting the findings of the present research, we will address each RQ below. We report here the case of Kolb's model.

The first RQ addressed how the AI bots describe the learning style model. Here, the prompt requested the bots to describe Kolb's model. Below, we describe the answer of each one of the bots.

ChatGPT: The bot gave an introduction (34 words) but elaborated on each stage of it (50-57 words), and then it gave a conclusion (43 words) in which it commented

on the model and how results in different learning styles of individuals. The bot did not elaborate on the different learning styles.

Gemini: The bot described Kolb's model in steps. First, it said that the model has two key concepts, and then it described each of them. It described each stage of Kolb's experiential learning cycle (in 8-11 words each stage), second Kolb's learning styles (12-13 words). Third, it gave key points (3 points, 12-17 words each) and fourth, it gave additional resources (two additional resources).

Claude: First, the bot gave a very short description of the model (10 words) and second it described each of its four stages (it described each one in 11-22 words). Third, it gave key aspects of Kolb's model and fourth it described the model in summary. Claude, as ChatGPT did not elaborate on the different learning styles.

Perplexity: The bot provided a very short description of Kolb's model, mentioning that the model includes four stages and four learning styles (23 words). Then it named the four learning styles. Afterwards, it described the model (47 words). At last, it suggested three questions related to the model as "how can Kolb's model be applied in the classroom". The bot referenced external citations and sources to support the description. Moreover, it shared images as supplementary material to describe the model.

We conclude that giving the prompt to the bots, they described the Kolb's model accurately (the 4 stages), but not all of them gave the four learning styles associated with the model. ChatGPT elaborated on each stage of the model more than the other bots. Perplexity did not even mention the names of the stages. Moreover, ChatGPT only mentioned the existence of learning styles, while Claude did not refer to them, and Perplexity only mentioned their names.

The second RQ addressed the ability of the AI bots to write mathematics lessons on the topic of the linear function in the middle school. Here, the prompt requested each bot to write a mathematic lesson on the topic of 'linear function' that fits the middle school. **Table 2** describes the answer of each bot separately.

We conclude that the four bots succeeded in writing a mathematics lesson on the topic of linear functions for the middle school, where they were concerned with the critical concepts related to the linear function, as well as the representations of the function. Some of the parts of the lesson were named similarly by the different bots, while other parts of the lesson were named differently.

Table 2. Characteristics of the lesson on linear functions written by the AI bots

AI bot	Order of presentation and lesson parts	The addressed aspects of the linear function	The questions' addressing
ChatGPT	1. Title, objective (three objectives), grade level (middle school), duration (60 minutes), materials needed (five materials, as rulers) 2. Introduction (four activities) 3. Understanding slope (four activities) 4. Graphing linear equations (five activities) 5. Class activity (four activities) 6. Conclusion and review (three activities) 7. Assessment (informal and formal) 8. Extension (two ideas) 9. References (one reference, the NCTM principles and standards for school mathematics)	1. Introduction to linear functions 2. Understanding slope 3. Graphing linear functions 4. Interpreting slope and y-intercept 5. Realize the relationship between different linear functions	The whole lesson was written to the teacher as activities that he/she can provide the students with
Gemini	1. Title, target audience (grades 6-8), objective (five objectives), materials (four materials, as rulers) 2. Introduction (four activities) 3. Activities (five activities where each activity is composed of different actions) 4. Graphing linear equations (five activities) 5. Differentiation (three ideas) 6. Assessment (three methods) 7. Extension activities (three activities)	1. Differentiating linear functions from other types based on their constant change and straight-line graph representation 2. Understanding the meaning and calculation of slope and y-intercept 3. Writing and interpreting the slope-intercept form (y = mx + b) to represent the function	
Claude	1. Title, objective (three objectives) 2. Introduction (three activities) 3. Direct instruction (three activities) 4. Guided practice (two activities) 5. Independent practice (two activities) 6. Closure (two activities). 7. Claude also suggested an in-class assessment as well as a quiz assignment	1. Identifying linear functions 2. Graphing linear functions 3. Generating equations of linear functions 4. Applications of linear functions, slope and y-intercept for linear functions	

Table 2 (Continued). Characteristics of the lesson on linear functions written by the AI bots

AI bot	Order of presentation and lesson parts	The addressed aspects of the linear function	The questions' addressing
Perplexity	1. Objective (two objectives) 2. Introduction (two activities) 3. Understanding of linear functions (seven activities) 4. Practice (two activities) 5. Conclusion (four activities) 6. The understanding part consisted of three sections: Definition, representing linear functions and solving problems	1. The basic slope-intercept form in linear relationships 2. Understanding linear functions and their representations as rules and data tables	The whole lesson was written to the teacher as activities that he/she can provide the students with

Table 3. Bots' answers regarding the teaching strategies, teaching methods, teaching style, and teaching techniques applied to write the lesson on the linear function

AI bot	Methods	Strategies	Techniques
ChatGPT	1. Direct instruction 2. Guided practice	1. Hands-on learning 2. Collaborative learning	1. Modelling 2. Questioning 3. Group work
Gemini	1. Explicit instruction 2. Modelling 3. Guided practice 4. Independent practice	1. Problem-based learning 2. Cooperative learning 3. Inquiry-based learning 4. Differentiation	1. Visual aids 2. Real-world connections 3. Questioning 4. Assessment
Claude	1. Explanation 2. Demonstration 3. Discussion	1. Direct instruction 2. Guided practice 3. Independent practice	1. Modelling processes 2. Practicing to reinforce skills 3. Application 4. Assessment
Perplexity	1. Lecture-based instruction 2. Technology-based learning	1. Explicit instruction 2. Differentiation	1. Student feedback

The number of parts of the lesson also differed (ChatGPT-8, Gemini-9, Claude-5, and Perplexity-4).

The third RQ addressed the awareness of the bots for the teaching strategies, teaching methods, teaching style and teaching techniques. Here, the prompt requested the bots to describe the teaching strategies, teaching methods, teaching style and teaching techniques that they used in writing the lesson on the linear function. **Table 3** describes the bots' answers.

The fourth RQ addressed the ability of the AI bots to write, based on a learning style model, a mathematics lesson on the topic of the linear function in middle school. The prompt requested the bot to write such a lesson, when the model is that of Kolb. **Table 4** describes the lesson written by each bot.

The fourth RQ addressed the awareness of the bots for the teaching strategies, teaching methods, teaching style and teaching techniques, here regarding the lesson that was written depending on Kolb's model. The prompt requested the bots to describe the teaching strategies, teaching methods, teaching style and teaching techniques that they used in writing the Kolb's based lesson on the linear function.

Gemini's and Claude's answers were similar to their previous answers in general, but they related their answers to the learning styles. Gemini related the 'explainer' (presenting information clearly and concisely), as a teaching style, to caring for different learning styles. Claude related the guided instruction strategy (explaining concepts and demonstrating procedures) to abstract conceptualization. Moreover, Gemini and Claude added other means to fit the Kolb's model of learning styles. Gemini added the 'multimodal learning', as a strategy to engage different senses and learning styles. Claude added 'providing concrete examples' as a teaching strategy in the introduction part. In addition, Gemini did not mention specific learning styles, while Claude addressed directly these learning styles.

ChatGPT and Perplexity talked about the means as specific to the different learning styles, so generally, these means differed from those mentioned by them when referring to the means used in the original lesson on the linear function. ChatGPT mentioned 'differentiated instruction' and 'experiential learning' as teaching strategies, while Perplexity mentioned 'problem solving' as a teaching strategy that fits convergent learners and mentioned visual learning as a teaching strategy for 'divergent learners'.

DISCUSSION

The present research is intended to study three main issues regarding the didactical knowledge of four GenAI's tools. The first issue concerned the differences in how the four AI tools (ChatGPT, Gemini, Claude, and Perplexity) described Kolb's model. The present

Table 4. Characteristics of the learning-styles-model-based lesson on linear functions written by the AI bots

AI bot	Order of presentation
ChatGPT	1. Introduction (diverging learning style–concrete experience) 2. Understanding slope (assimilating learning style–reflective observation) 3. Graphing linear equations (abstract conceptualization) 4. Class activity (accommodating learning style) 5. Conclusion and review (not addressing a specific learning style) 6. Assessment (informal and formal) 7. Extension (offer additional resources or activities that cater to different learning styles) 8. References (one reference, the NCTM principles and standards for school mathematics)
Gemini	1. Material (Gemini described different materials for different learning styles) 2. For each of the parts of the lesson (introduction, four activities, wrap-up, Gemini described an activity to each of the four learning styles: diverging, assimilating, converging, and accommodating In the part (wrap-up), Gemini wrote without addressing a specific learning style
Claude	1. Introduction (it allotted this part for 'concrete experience') 2. Direct instruction (it allotted this part for 'abstract conceptualization') 3. Guided practice (it allotted this part for 'active experimentation' and 'reflective observation') 4. Independent practice (it allotted this part for 'active experimentation') 5. Closure (it allotted this part for 'reflective observation') 6. Assessment (it allotted this part for 'active experimentation')
Perplexity	1. Introduction (talked about how to engage students with different learning styles, giving two examples for 'feeling' and 'doing') 2. For the lesson's part 'understanding linear functions', Perplexity gave an activity for each one of the learning styles (diverging, assimilating, converging, and accommodating) 3. Practice (talked about how to engage students with different learning styles, giving two examples for 'visual learners and those who prefer hands-on activities) 4. Conclusion (talking about summarizing the key points about linear functions, stressing the importance of 'ensuring that the diverse learning styles have been addressed throughout the lesson')

research results indicated that we need to look at different aspects of the GenAI's knowledge of theoretical frameworks, especially, depth of explanation and focus on the different components of the frameworks, here the experiential experience and the learning styles, in addition to utilization of external sources including visual sources. Let's discuss these three aspects of knowledge. Depth of explanation is concerned with the varying levels of detail in the descriptions. Here ChatGPT gave more detail than the other bots, while Perplexity gave less details than the other bots. The previous results suggest that some AI tools may provide more comprehensive explanations than others (Uppalapati & Nag, 2024). The GenAI's tools also differed in their focus on learning styles. The fact that not all AI tools elaborated on the different learning styles associated with Kolb's model could affect the accuracy and completeness of the information provided by these tools, especially in educational settings that are interested in the learning styles phenomenon. In addition to the previous, Perplexity's use of external citations and sources, including visual ones, to support the description of Kolb's model adds to the students' resources of the studied topic, which shows that Perplexity is aware of the importance of referencing authoritative sources to enhance the quality and accuracy of information provided by AI tools. Researchers showed differences between the bots in the accuracy of their answers on content problems (Fischer et al., 2023; Rudolph et al., 2023). Here too, they differed in demonstrating knowledge about educational content, specifically Kolb's framework of experiential learning and learning styles.

The similarities and differences between the four AI bots (ChatGPT, Gemini, Claude, and Perplexity) in structuring mathematics lessons on linear functions for middle school students were highlighted based on the content, organization, and focus of the lessons. The content did not vary among the GenAI tools, though the names of the topic aspects differed slightly. For example, ChatGPT's lesson had 'understanding slope' and 'interpreting slope and y-intercept', while Gemini's lesson had 'understanding the meaning and calculation of slope and y-intercept' and 'writing and interpreting the slope-intercept form ($y = mx + b$) to represent the function'. Claude had 'applications for linear functions, and slope and y-intercept for linear function', while Perplexity had 'the basic slope-intercept form in linear relationships'. These differences are similar to those found in different content resources (Dawoud & Daher, 2022).

The organization of the lesson was done through 9 parts by ChatGPT, seven parts by Gemini and Claude and 5 parts by Perplexity. In fact, there is no big difference between the parts of the lessons by the four GenAI tools as the understanding part by Perplexity includes three sub-parts. The similarity is probably due to the agreement in the literature that a lesson should be

consisted of introduction, explorative activities, conclusions and assessment (Ratnawati, 2017; Wisconsin Lutheran College, n. d.), where some literature adds enrichment or extension (Swargiary & Roy, 2023).

Regarding the strategies used by the bots in the regular lessons, some strategies were common among them, while others were specific to each one of them. The teaching strategies common to two or more bots were Direct Instruction (used by ChatGPT and Claude), guided practice (used by ChatGPT, Gemini, and Claude), independent practice (used by Gemini and Claude) and differentiation (used by Gemini and Perplexity). Some of the strategies were specific to each bot, as hands-on learning mentioned by ChatGPT, problem-based learning used by Gemini, demonstration used by Claude and technology-based learning used by Perplexity. The bots did not always agree about what constitutes a method, a strategy and a technique. One such disagreement is about direct instruction, where Claude considered it a strategy, while ChatGPT considered it a method. Perplexity considered explicit instruction a strategy, while Gemini considered it a method. The previous agreements and disagreements could be related to agreements and disagreements in the literature concerning the four teaching-means and the differences between them. We mentioned such differences in the literature review. For example, Roy (2022) considers the discussion a method, while Kuamr (2022) considers it a strategy.

Coming to write a learning-style-based mathematics lesson on linear functions, the bots succeeded in considering the learning styles in the mathematics lesson, but they did so differently. ChatGPT used one learning style for each part of the lesson (introduction, understanding slope and graphing linear equations), but did not consider these styles in the rest of the parts. Gemini, for each of the parts of the lesson (introduction and four activities), described an activity to each of the four learning styles: diverging, assimilating, converging, and accommodating. The previous shows the ability of the GenAI tools to write lessons that are based on theoretical frameworks, here are the learning styles according to Kolb's model of experiential learning. Zajac (2009) describes how using learning styles frameworks enables personalized learning. So, working with GenAI tools supports the teacher in preparing lessons that could be used in such personalized learning.

Coming to describe the learning methods, strategies and techniques for Kolb-based lessons, the bots had two different approaches. Gemini and Claude started from their previous teaching means and appropriated them to fit the different learning styles, while ChatGPT and Perplexity started from the different learning styles and found teaching means that fit them. This suggests different ways that could help the teacher in preparing lessons for students considering their learning styles.

CONCLUSIONS

The present research is intended to investigate the didactical ability of different GenAI tools, specifically their ability to write mathematics lessons, and their awareness of the teaching means used in these lessons. The results of the present research showed the success of these GenAI tools to build mathematics lessons, here is a lesson on the topic of linear functions, whether this was a regular lesson or learning-style-based lesson. In addition, the GenAI tools showed awareness and knowledge of the teaching methods (methods, strategies, and techniques) used in the lessons.

Professional development opportunities for teachers to learn more about integrating AI into their lesson plans need to be available. Research has shown that co-design workshops with K-12 teachers have been organized to create lesson plans using AI tools and embedding AI concepts into various core subjects. Such workshops would provide teachers with additional scaffolding in AI tools and curriculum to facilitate ethics and data discussions, as well as value support for learner evaluation and engagement, peer-to-peer collaboration, and critical reflection (Van Brummelen & Lin, 2020). Additionally, there is a growing focus on the role of conversational agents in improving the learning experience, indicating the need for teachers to urgently implement AI-based tools and services in classroom and online learning (Alfehaid & Hammami, 2023). AI experts can contribute to the deployment of conversational agents in education to facilitate student engagement during learning. They can provide support in the implementation of AI-based tools and services in classroom and online learning (Alfehaid & Hammami, 2023). Thus, these opportunities aim to empower teachers to effectively integrate AI into their lesson plans and address the evolving needs of education in the digital age.

In addition to the above, the research results showed that Perplexity was aware of the importance of referencing authoritative sources to enhance the quality and accuracy of information provided by AI tools. The rest of GenAI tools are requested to pay attention to this importance and use accurate referencing sources when the academician ask for this us.

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APPENDIX A

Lesson Plan: Exploring Linear Functions Through Kolb's Learning Styles

Objective: By the end of this lesson, students will be able to understand the concept of linear functions, identify their characteristics, and graph linear equations, catering to different learning styles according to Kolb's framework.

Grade level: Middle school (6^{th} to 8^{th} grade)

Duration: 60 minutes

Materials needed

- Whiteboard or chalkboard
- Markers or chalk
- Graph paper
- Rulers
- Pencils
- Worksheets (optional)

Lesson introduction (10 minutes)

Diverging learning style (concrete experience): Begin by showing real-life examples of linear relationships, such as distance-time graphs or temperature-time graphs. Allow students to observe and discuss these examples, providing a concrete experience to start the lesson.

Understanding slope (15 minutes)

Assimilating learning style (reflective observation): Explain the concept of slope using visual aids and diagrams. Encourage students to observe and reflect on how changes in slope affect the steepness of a line. Provide examples and ask reflective questions to promote understanding.

Graphing linear equations (20 minutes)

Converging learning style (abstract conceptualization): Present the general form of a linear equation ($y = mx + b$) and explain each component in detail. Discuss how the equation represents a mathematical abstraction of a linear relationship. Provide opportunities for students to conceptualize linear equations through guided practice and examples.

Class activity

Linear function exploration (10 minutes)

Accommodating learning style (active experimentation): Divide students into small groups and provide them with linear equations to graph. Encourage hands-on experimentation as students actively engage in graphing equations, testing their understanding in a practical context. Allow for exploration and discovery as students work collaboratively.

Conclusion and review (5 minutes): Recap the key concepts covered in the lesson, catering to each learning style by providing a summary that appeals to different preferences. Encourage students to share their observations and insights, promoting active participation and reflection.

Assessment: Informal assessment through observation and participation during class activities. Formal assessment through completed worksheets or quizzes on linear functions and graphing linear equations.

Extension: Offer additional resources or activities that cater to different learning styles, such as interactive simulations for diverging learners or problem-solving tasks for converging learners.