

## AI in the Math Classroom: Can Flexi Foster Student-Centered Learning and Reduce Teacher Load?

الذكاء الاصطناعي في صفوف الرياضيات: هل يستطيع "فلكسي" تعزيز التعلّم المرتكز على الطالب وتقليل عبء المعلم؟

سيرج معلوف (\*) Serge Maalouf

تاريخ القبول: 2025-8-31

تاريخ الإرسال: 2025-8-22



### ABSTRACT:

*This classroom-based case study explores the use of Flexi, an AI-powered assistant in the CK-12 platform, in a Grade 10 mathematics class in Umm Al Quwain, UAE. The study examined Flexi's role in supporting student-centered learning through scaffolded problem-solving, challenges, and real-time feedback. Data included classroom observations, a student survey, and post-lesson reflections. Findings showed increased motivation, independence, and conceptual understanding, while Flexi also enabled differentiated learning and reduced teacher workload. Challenges included internet disruptions, digital fluency gaps, and some students' preference for teacher explanations. Overall, results suggest that purposeful integration of AI tools like Flexi can enhance personalized learning and improve classroom management in modern math education.*

**Keywords:** AI in Education, Student-Centered Learning, Flexi, CK-12, Intelligent Tutoring Systems

### الملخص

تستعرض هذه الدراسة الصفية حالة بحثية عن استخدام فلكسي (Flexi)، وهو مساعد تدريس مدعوم بالذكاء الاصطناعي ضمن منصة CK-12، في صف رياضيات للصف العاشر بمدرسة حكومية في أم القيوين، الإمارات. ركز البحث على دور فلكسي في دعم التعلّم المرتكز على الطالب من خلال المسارات المتدرجة لحلّ المشكلات، التحديات،

\* طالب ماستر في الجامعة اللبنانية - بيروت - لبنان - كلية التربية - قسم تعليم الرياضيات.

Master's student at the Lebanese University - Beirut - Lebanon - Faculty of Education - Department of Mathematics Education.  
Email: serge.maalouf@hotmail.com

وتفضيل بعض الطلاب للشرح المباشر. وتشير النتائج إلى أن دمج أدوات الذكاء الاصطناعي بوعي يمكن أن يعزز التعلم المخصص، وفعالية إدارة الصفوف في تدريس الرياضيات.

**الكلمات المفتاحية:** الذكاء الاصطناعي في التعليم، التعلم المرتكز على الطالب، فلكسي، ck-12، أنظمة التدريس الذكية.

## Chapter 1: Research Framework

### 1.1 – Introduction

Artificial intelligence (AI) is quickly becoming part of everyday education, changing the way students learn and how teachers plan their lessons. In math classes especially, AI tools are starting to offer instant help, tailored feedback, and learning activities that adjust to each student's needs. These capabilities address a long-standing challenge in education: the difficulty of differentiating instruction for every learner in real time. While traditional methods often struggle to meet diverse student needs, AI offers scalable pathways to deliver individualized support (Luckin et al., 2016).

This trend is highly visible in the United Arab Emirates (UAE), where sweeping educational reforms are embedding AI across all grade levels. In 2024, the UAE Ministry of Education announced a mandate requiring AI classes in all public

والتغذية الراجعة الفورية. جمعت البيانات من ملاحظات صفية، استبانة للطلاب، وانعكاسات بعد الحصة. أظهرت النتائج ارتفاع الدافعية والاستقلالية وتحسناً في الفهم المفاهيمي، وساعد فلكسي على التعلم المتميز وتقليل عبء التكرار على المعلم. برزت تحديات مثل انقطاع الإنترنت، تفاوت المهارات الرقمية،

schools from kindergarten onward, placing the nation at the forefront of future-oriented curriculum design (Unite.AI, 2024). The initiative goes beyond basic AI literacy, emphasizing active engagement with intelligent systems to build a digitally fluent generation (Digital Bricks, 2024).

One of the biggest changes in recent years is the rise of Large Language Models (LLMs), powerful AI systems that can respond in ways that sound natural across many different topics. Tools like ChatGPT and Claude are now being tested more often as helpers in teaching and learning. However, because their answers are not always structured, they can be less effective in classrooms where clear, step-by-step teaching is important. This has encouraged the creation of domain-specific AI tools designed with explicit instructional frameworks. MathDial, for example, uses interactive dialogue to support mathematics learning (Rori et al., 2023).

Flexi, created by the CK-12 Foundation, is one example of an AI tool designed specifically for education. Based on the principles of Intelligent Tutoring Systems (ITS), it is aimed at middle and high school students and seeks to offer the kind of support found in one-on-one tutoring. Unlike general-purpose LLMs that provide immediate answers, Flexi uses scaffolded questioning, step-by-step guidance, and mastery checks to deepen conceptual understanding. It also offers rephrased explanations, analogies, and targeted hints that respond dynamically to student input, strategies shown to encourage reflection and metacognition.

A key advantage of Flexi is that it is free and openly accessible, making it available to any school or student without cost barriers. Its easy-to-use design encourages students to work through math problems on their own, whether they are solving equations, converting units, or understanding geometry, by typing questions or uploading pictures of problems. All responses come from CK-12's curated digital library, ensuring the material matches the curriculum and avoids unreliable online sources.

Flexi can be applied in multiple educational contexts:

- Homework Support: Providing

step-by-step guidance when students encounter difficulties.

- Exam Preparation: Offering targeted practice questions and review materials.
- Concept Reinforcement: Extending and clarifying lessons taught in class.
- Self-Paced Learning: Allowing students to progress according to individual needs.

Its design supports a student-centered learning (SCL) approach, fostering independence and inquiry while enabling teachers to shift from repetitive explanation toward targeted intervention. A typical interaction screen is shown in Figure 1.

Flexi's interface encourages student inquiry by allowing them to ask questions or upload problem images, supporting diverse math topics in a student-friendly format. A typical interaction screen is shown in Figure 1.



Figure 1 Flexi's interface invites students to ask questions

## 1.2 – Research Problem

While interest in using AI in classrooms is increasing, only a few

tools are built to fit smoothly into formal curricula and support step-by-step learning with clear checks for mastery (Jaramillo, 2024). Moreover, although Flexi appears promising as a digital teaching assistant, little empirical evidence exists on how it functions in real classroom environments.

This leads to the central research question of this study:

How effectively does Flexi function as a classroom assistant in promoting student-centered learning and reducing teacher workload in mathematics education?

### 1.3 – Research Importance

This research is important because it examines Flexi within the context of the UAE's educational reforms, which prioritize the integration of AI in all schools. It investigates how AI can contribute to student-centered learning (SCL), an approach that emphasizes independence, inquiry, and active participation.

Equally important, the study addresses the teacher's perspective. By evaluating Flexi's potential to reduce repetitive explanations and initial support demands, the research highlights how AI can free teachers to focus on higher-order misconceptions and small-group interventions. Thus, the study contributes both locally to

the UAE context and globally to the field of mathematics education.

### 1.4– Research Hypothesis

The study is guided by the hypothesis that:

*Integrating Flexi into mathematics classrooms will enhance student-centered learning by providing scaffolded problem-solving, adaptive hints, and real-time feedback, while also reducing teacher workload through minimizing repetitive explanations and routine support tasks.*

### 1.5- Research Objectives

This study aims to:

- Explore how Flexi supports independent and student-centered learning.
- Evaluate its impact on student motivation, engagement, and confidence.
- Analyze its role in reducing teacher workload and repetitive tasks.
- Identify challenges and limitations in integrating Flexi into classroom practice.

### 1.6- Previous Studies

Several prior studies provide the foundation for this research. Luckin et al. (2016) highlighted the potential of AI to deliver personalized learning at scale. Rori et al. (2023) introduced



MathDial, a dialogue-based tutoring system designed for mathematics. Tang (2023) emphasized the importance of balancing curriculum goals with student independence in student-centered approaches. Dada, Laseinde, and Tartibu (2022) showed that digital tools in SCL environments can increase motivation, persistence, and learner autonomy. Jaramillo (2024) pointed out that many AI tools remain disconnected from curricula, limiting their usefulness in formal classrooms.

Together, these studies demonstrate the promise of AI but also highlight the need for classroom-based case studies that investigate real implementation, such as the present research on Flexi.

### 1.7 – Research Methodology

This study adopts a mixed-methods, classroom-based case study design. It was conducted in a Grade 10 mathematics class in a UAE public secondary school during the academic year 2024–2025. Twenty-five female students participated, representing varied academic profiles.

The intervention involved the integration of Flexi, the AI-powered teaching assistant embedded in the CK-12 platform, into mathematics lessons. Data sources included classroom observations, student work

samples, survey responses, and short post-lesson reflections. Quantitative data were drawn from a Likert-scale survey, while qualitative data were analyzed using Braun and Clarke's (2006) thematic analysis framework.

Ethical standards were followed throughout the research: participation was voluntary, all data were anonymized, and no personal information was recorded.

## Chapter 2: Context and Participants

This study was conducted in a government secondary school in the United Arab Emirates (UAE) that follows the national curriculum and emphasizes STEM and digital learning. Although the school is well-resourced with high-speed Wi-Fi and student tablets, large class sizes and curriculum coverage make individualized instruction challenging. These conditions created an opportunity to test AI-powered tools like Flexi for personalized learning.

### 2.1 -Participants and Setting

The participants were 25 Grade 10 female students with varied academic profiles, ranging from high achievers to learners needing reinforcement. Flexi was introduced as part of the mathematics program to promote self-reliance, engagement, and tailored

feedback, aligning with recent pedagogical recommendations on adaptive digital learning (Dada et al., 2022; Tang, 2023).

### 1.2-Pre-Implementation Training

Before classroom integration, students received a short orientation using a step-by-step tutorial. This guide covered how to access explanations, use rephrasing and analogy options, and attempt mastery challenges. The aim was to ensure digital fluency so students could focus on learning rather than technical barriers. One student reflected: “It was easy to use and helped me learn on my own. I liked using it before asking the teacher.” (Figure 2 shows a sample tutorial screenshot.)



Figure 2 Screenshot from the tutorial showing how a student asks Flexi, “What is DMS in angles?” and uses the Rephrase feature if the explanation was unclear.

### 2.3 -Instructional Platform and Daily Use

Flexi was embedded in daily lessons through the Classkick platform, where students completed tasks, uploaded screenshots of Flexi explanations, and received live teacher feedback. This setup allowed the teacher to monitor progress in real time and differentiate support as needed. Flexi’s role varied across lessons, introducing new concepts, supporting practice, or serving as a recap, but always encouraged self-paced, inquiry-based learning.

### 2.4- Instructional Approach within a Student-Centered Framework

Flexi functioned as a learning partner for both classwork and homework, supporting a constructivist, student-centered approach. Students posed their own questions, explored structured explanations, and attempted mastery challenges before turning to the teacher. This process fostered independence, persistence, and metacognition.

The approach aligns closely with student-centered learning (SCL) principles, which emphasize self-regulation and active inquiry. By encouraging learners to engage with Flexi first, the intervention promoted autonomy and resilience, consistent with research on digital tools in SCL

environments (Dada et al., 2022; Tang, 2023).

## 2.5- Research Design and Ethics

The study followed a mixed-methods, classroom-based case study design during the 2024–2025 academic year. Data sources included classroom observations, student work samples, survey responses, and short post-lesson reflections. Quantitative data came from a Likert-scale survey, while qualitative data were analysed using Braun and Clarke's (2006) thematic framework. Ethical standards were strictly observed: participation was voluntary, responses anonymized, and no personal information was collected.

## Chapter 3: Implementation and Classroom Use

This chapter describes how Flexi

was embedded into daily mathematics instruction and how it shaped both student and teacher experiences. The analysis considers two perspectives: (1) the student experience, including engagement, independence, and reflection, and (2) the teacher experience, focusing on instructional efficiency and feedback.

### 3.1 Learners' Interaction with Flexi

Students actively used Flexi to guide problem-solving and inquiry. For example, when asked about excluded values in a rational expression, Flexi provided a step-by-step explanation with examples (Figure 3). Students then attempted related challenge tasks, receiving targeted feedback that prompted corrections, as shown in Figure 4.

what are the excluded or undefined values of rational expression ? and how to find its domain ?

AI-GENERATED Other sources ^

AI-GENERATED CK-12 LIBRARY CK-12 LIBRARY

In a rational expression, the excluded or undefined values are those that make the denominator equal to zero. To find these values, set the denominator equal to zero and solve for the variable.

Steps to find the domain:

1. **Identify the Denominator:** Look at the rational expression and identify the denominator.
2. **Set Denominator to Zero:** Set the denominator equal to zero and solve for the variable.
3. **Solve for the Variable:** Find the values of the variable that make the denominator zero. These are the excluded values.
4. **Write the Domain:** The domain includes all real numbers except the excluded values.

**Example:**  
For the rational expression  $\frac{1}{x-3}$ :

1. **Denominator:**  $x - 3$
2. **Set to Zero:**  $x - 3 = 0$
3. **Solve:**  $x = 3$
4. **Domain:** All real numbers except  $x = 3$ .

So, the domain is  $x \neq 3$ .

**Excluded value:**  $x = 3$

*Handwritten annotation: excluded value*

Figure 3 Prompt to Flexi with step-by-step guidance and teacher's annotation on student work.

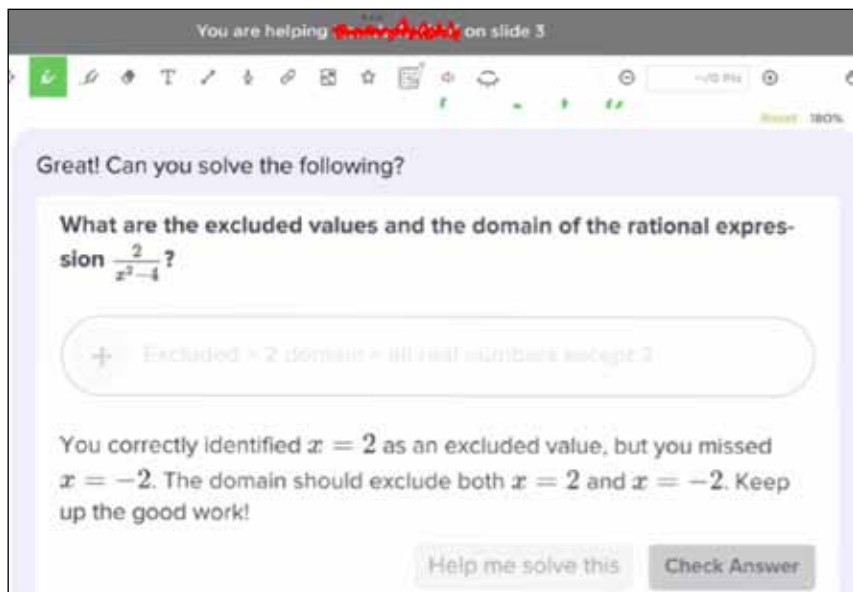


Figure 4 Flexi's challenge task and personalized feedback following the student's response.

Flexi also offered analogies linked to student interests, such as a music-based analogy for domain restrictions (Figure 6).

Scroll to answer

Q1 Analogy Regenerate

DO YOU LIKE MUSIC ANALOGIES? Yes | No

Think of a rational expression like a music concert. The denominator is the stage where the band performs. If something goes wrong with the stage, like it collapses, the concert can't happen. Similarly, if the denominator equals zero, the expression is undefined.

**Steps to find the domain (Concert Analogy):**

- Identify the Stage:** Look at the rational expression and identify the denominator, just like checking the stage setup.
- Set Stage to Collapse:** Set the denominator equal to zero, imagining what would cause the stage to collapse.
- Solve for the Collapse Point:** Find the values of the variable that make the denominator zero, like identifying the weak spot in the stage.
- Write the Domain:** The domain includes all real numbers except the collapse point, just like the concert can go on as long as the stage is stable.

**Example:**  
For the rational expression  $\frac{1}{x-3}$ :

- Stage:  $x - 3$
- Set to Collapse:  $x - 3 = 0$
- Collapse Point:  $x = 3$
- Domain: All real numbers except  $x = 3$ .

So, the domain is  $x \neq 3$ .

**Excluded value:**  $x = 3$ , like the weak spot that would cause the stage to collapse, preventing the concert from happening.

Figure 5 Flexi's music-based analogy to explain the concept of domain in rational expressions.

Some students prepared presentations showing how Flexi’s “Challenge Me” feature supported deeper learning (Figure 6). Their reflections demonstrated a shift from supported practice to independent problem-solving (Figure 7).

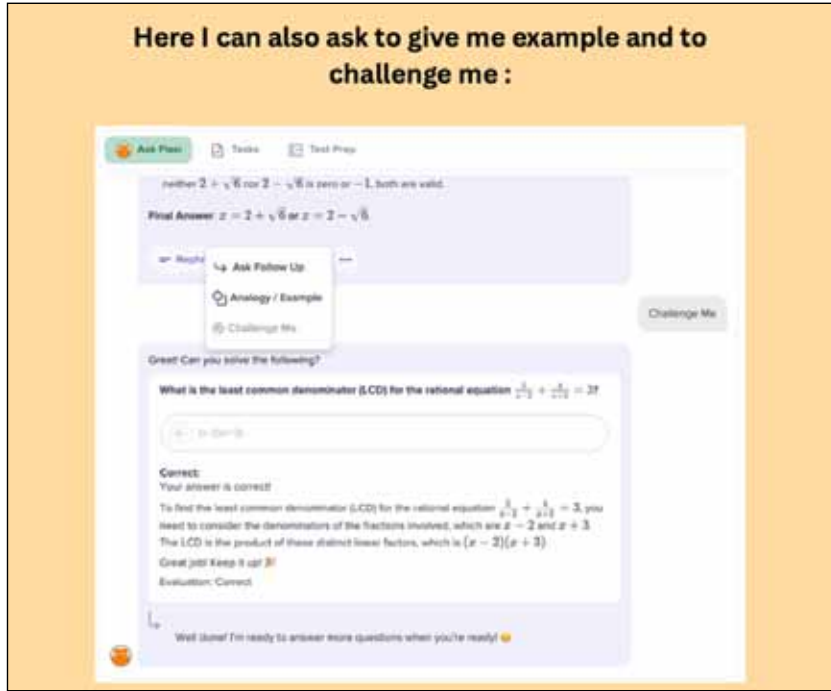


Figure 6 Student demonstrating Flexi’s “Challenge Me” feature and its instructional feedback

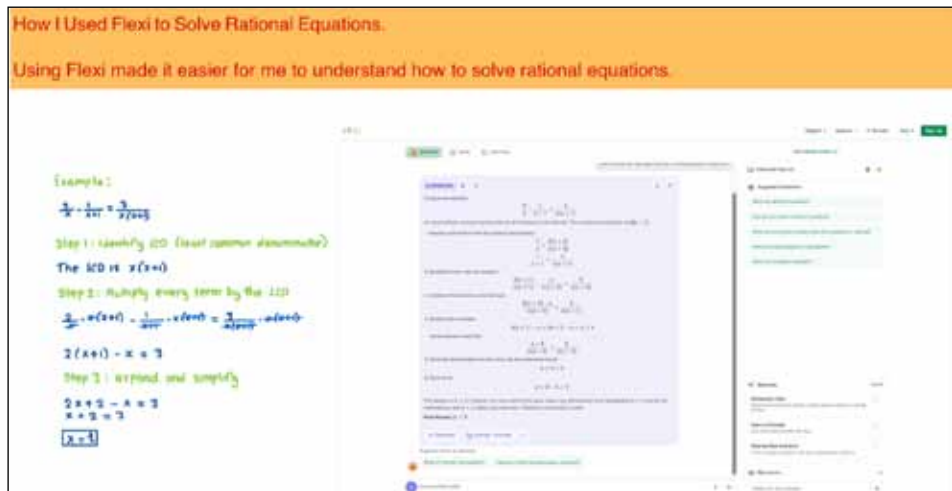


Figure 7 student’s presentation slide demonstrating how she used Flexi to solve rational equations.

These moments illustrate how Flexi encouraged persistence, inquiry, and ownership, core principles of student-centered learning.

### 3.2 Teacher Experience

For teachers, Flexi acted as both a support system and an informal formative assessment tool. The CK-12 dashboard displayed data on problem

attempts, accuracy, and misconceptions (Figure 8). Although the analytics were used informally, they helped the teacher identify struggling students and adjust instruction in real-time.

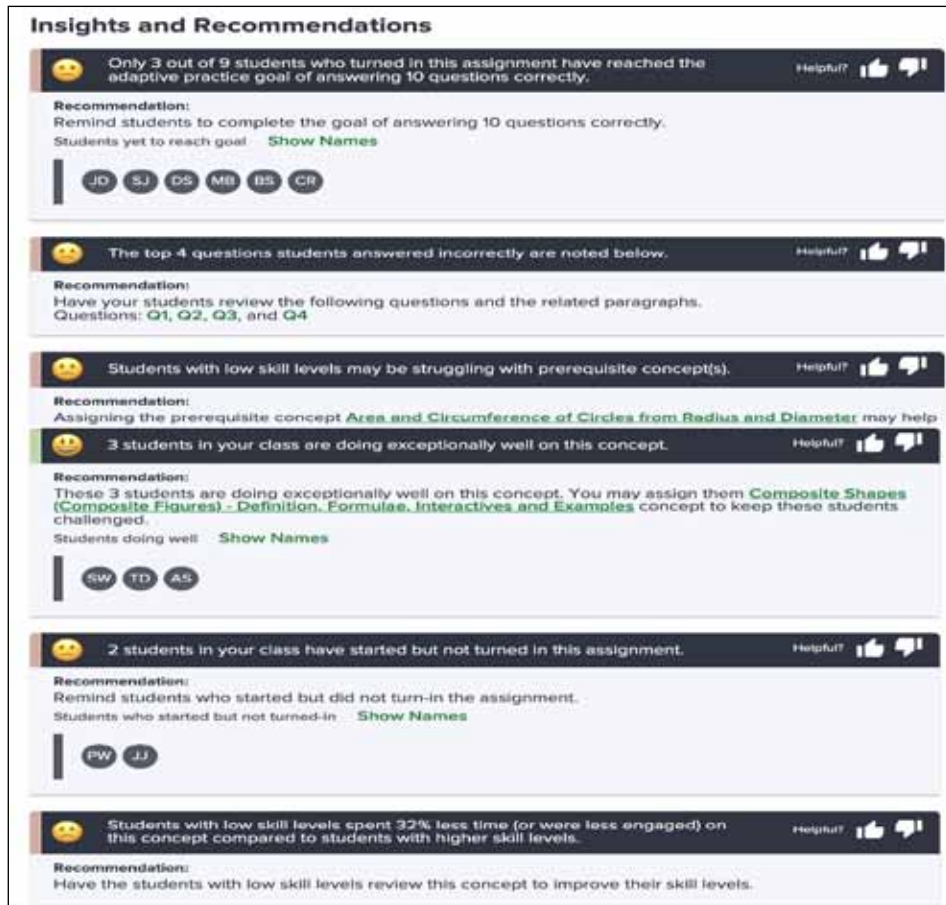


Figure 8 Dashboard from CK-12 showing Flexi-generated insights and personalized recommendations based on student performance.

Flexi also reduced repetitive explanations, allowing the teacher to spend more time in small-group work and on higher-order misconceptions. This hybrid model strikes a balance between independence and targeted teacher guidance.

## Chapter 4 : Benefits and Observations

Building upon the instructional strategies and classroom implementation



described in Chapter 3, this chapter presents the observed benefits of using Flexi from both student and teacher perspectives. Drawing on classroom artifacts, student feedback, and the teacher's reflective journal, the following sections highlight how Flexi supported independent learning, improved motivation, and enabled differentiated instruction in a student-centered learning environment.

#### 4.1 Increased Student Engagement

During lessons with Flexi, students appeared more engaged, particularly those who were usually reluctant to participate. They valued the independence the tool provided and the safe environment it created for repeated practice without embarrassment. One student said, "It's like having a tutor just for me, I can ask as many questions as I want." Another shared, "I like how Flexi doesn't make me feel bad when I get it wrong; it just helps me try again." A third added, "I'm enjoying Flexi, it looks like a cartoon! I feel like I'm playing while learning."

These reflections show how Flexi encouraged experimentation, persistence, and active inquiry. The rise in time-on-task and completion of work also indicated stronger

focus and investment in learning. Such outcomes align with findings by Dada, Laseinde, and Tartibu (2022), who noted that digital tools in student-centered environments promote autonomy, critical thinking, and motivation.

#### 4.2 Personalized Learning and Targeted Feedback

Flexi's ability to tailor responses to individual student errors contributed significantly to personalized learning and supported the broader goal of student-centered instruction. For example, when a student incorrectly identified excluded values in a rational expression by focusing on the numerator instead of the denominator, Flexi responded with a context-specific prompt:

"A rational expression is undefined only when the denominator is zero."

In one example, a student was able to identify the correct denominator but got stuck on the factoring step. Flexi stepped in with guided prompts, breaking the problem down into smaller steps and encouraging the student to find which values should be excluded from the domain. This immediate feedback helped the student rethink their approach and take more ownership of their solution.



These adaptive moments reflect the principles of student-centered teaching, where learners work independently, receive support tailored to their needs, and build skills step by step. As Dada et al. (2022) note, tools that enable self-paced exploration with instant feedback can strengthen understanding and promote critical thinking. Tang (2023) adds that when teachers use technology effectively, responsive digital environments can help students feel more confident managing their learning.

Acting like a tutor that is always available, Flexi helped students reach deeper understanding without always relying on the teacher, a key balance for classrooms aiming to blend technology with student-centered practices.

#### 4.3 Increased Teacher Efficiency

From the teacher's point of view, Flexi reduced the need to repeat the same explanations to the whole class. Students were encouraged to turn to Flexi first for step-by-step help, alternative explanations, and analogies before seeking the teacher's assistance. This approach made classroom management smoother, allowing the teacher to focus on tackling more complex misunderstandings and working closely with small groups.

#### 4.4 Student Perceptions Based on Survey Results

To complement classroom observations and teacher reflections, a student survey was administered at the end of the instructional unit on rational equations. The survey captured students' perceptions of Flexi's usefulness, motivation, confidence-building, tool preference, and reliance on teacher explanations. Twenty-five students completed the survey, which included five Likert-scale items rated from 1 (Strongly Disagree) to 5 (Strongly Agree).

Results highlighted strong motivation ( $M = 4.76$ ), with 80% of students giving the maximum score, and improved confidence ( $M = 4.48$ ), with over 90% rating 4 or 5. More than 90% also reported a preference for Flexi over other classroom tools ( $M = 4.28$ ). However, some students still preferred teacher explanations ( $M = 3.68$ ), reflecting the continued importance of human interaction. Finally, Flexi was rated as a reliable source of support when students were confused ( $M = 4.32$ ), with nearly half assigning the highest rating.

*Figure 9* presents student ratings on motivation, confidence, and tool preference.

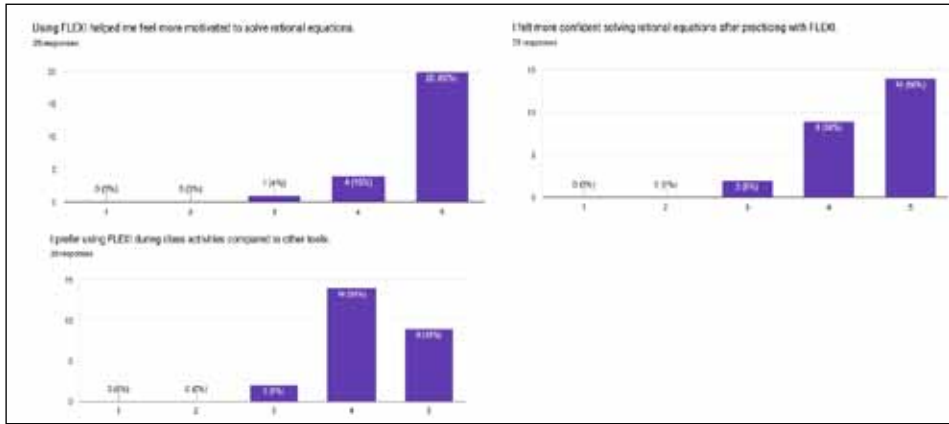


Figure 9 student ratings on motivation, confidence, and tool preference.

**Figure 10** shows results for teacher support versus Flexi, along with perceptions of Flexi's reliability when students were stuck.

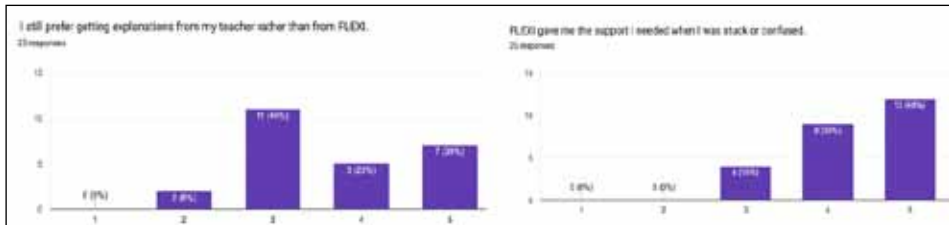


Figure 10

Overall, the survey confirmed that Flexi enhanced motivation, confidence, and independence while reinforcing its role as a complement to, not a replacement for, teacher explanations.

#### 4.5 Fostering Classroom

##### Independence

Over the course of the academic year, students exhibited increased independence in their learning behaviors. Many began relying on Flexi for both procedural queries

(e.g., solving rational equations) and conceptual understanding (e.g., domain restrictions), often choosing to complete challenge problems and request feedback without prompting.

This increasing independence aligns with the core aims of student-centered learning, which focus on self-regulation, inquiry, and active participation in building knowledge. Several students mentioned they continued using Flexi at home, showing that it encouraged ongoing engagement

and a sense of ownership over their learning. This mirrors the findings of Dada et al. (2022), who note that digital tools supporting learner autonomy can have a strong motivational effect in STEM education.

#### 4.6 Summary of Observed Benefits

The classroom implementation of Flexi revealed several key pedagogical benefits supported by both survey data and classroom observations:

**Increased motivation and confidence:** Students showed strong agreement that Flexi enhanced their motivation ( $M = 4.76$ ) and confidence ( $M = 4.48$ ) when solving rational equations. These affective gains were reinforced by persistence with challenge questions and willingness to engage independently.

**Support during confusion:** Nearly half of students rated Flexi's just-in-time guidance 55/, underscoring its role in providing timely hints and explanations before they sought teacher help.

**Positive tool preference:** Over 90% of students reported that they preferred using Flexi compared to other classroom tools, confirming its usability and relevance.

**Instructional efficiency:** Flexi reduced repetitive explanations, enabling the teacher to focus on small-

group interventions and higher-order misconceptions.

Further reflections on how students experienced these benefits in practice, including self-reliance, responsiveness to feedback, and the continuing role of teacher support, are presented in Section 4.7.

#### 4.7 Thematic Insights from Student Reflections and Observations

While the preceding section consolidated the main outcomes, it is equally important to understand how students experienced these benefits in practice. A thematic synthesis of classroom observations, student presentation slides, and post-lesson reflections highlights three central themes.

##### Theme 1:

##### Self-Reliance and Initiative

Many students began turning to Flexi before approaching the teacher, especially during problem-solving tasks. They made increasing use of features like "Challenge Me," rephrased explanations, and analogies. As one student explained during her presentation, *"I used Flexi to try another example before asking the teacher. It was helpful because I could repeat the steps."*

This shift illustrates Flexi's role in encouraging independent problem-

solving, a key outcome of student-centered learning.

### Theme 2:

#### Responsiveness to Feedback

Students valued Flexi's immediate feedback. Instead of giving up after errors, they often adjusted their work based on the AI's prompts. For instance, as shown in Figure 5, one learner corrected a mistake after Flexi highlighted a missing domain exclusion. These low-stakes feedback cycles supported persistence and deeper reflection, reinforcing the importance of formative assessment in SCL environments.

### Theme 3:

#### Continued Role of Teacher Support

Despite Flexi's popularity, some students still preferred teacher explanations, especially when reassurance was needed. This was reflected in survey data (average score of 3.68 for preferring teacher support) and echoed in reflections. Emotional reassurance and clarity from the teacher remained essential, confirming that AI should complement rather than replace human instruction.

Together, these themes demonstrate that Flexi functioned not only as a digital tutor but also as a catalyst for inquiry, persistence, and self-regulation. At the

same time, the findings highlight the irreplaceable value of teacher presence, suggesting that successful integration of AI requires positioning such tools as learning companions within a balanced instructional model.

## Chapter 5: Challenges and Limitations for Student-Centered Integration

### 5.1 -Student Preference for

#### Teacher Interaction

Although many students valued Flexi's instant feedback and step-by-step support, a noticeable group still preferred asking the teacher first. For them, this was less about habit and more about trust and reassurance. One student shared, "I feel better when the teacher explains, I'm not sure if I'm doing it right with Flexi." Another added, "Flexi is very good, but I still like asking Mister because he knows what I mean."

Survey data supported this view: the statement "I prefer getting explanations from my teacher rather than from Flexi" had the lowest mean score ( $M = 3.68$ ), though still slightly positive. This indicates that while Flexi engaged students, human explanations offered emotional comfort and clarity that AI could not fully replace.

These findings highlight that integrating AI in classrooms is not

only about its technical capabilities but also about shaping learning culture. To build student trust, teachers need to model Flexi's reliability and frame it as a complementary support rather than a substitute. As Tang (2023) notes, the success of student-centered learning depends as much on emotional safety and teacher presence as on effective tools.

## 5.2 Dependence on Internet

### Access and Digital Literacy

Flexi's availability depends on a stable internet connection. Although students in this school had high-speed Wi-Fi and personal tablets, occasional disruptions interrupted lessons, requiring a temporary return to teacher-led explanations or textbook work.

Another challenge was digital fluency. While some students quickly navigated Flexi, others needed coaching on how to access hints, interpret feedback, or use features like analogies. During the first weeks, the teacher's role included supporting these skills alongside teaching mathematics.

This echoes Dada et al. (2022), who stress that technical readiness is critical for technology-supported classrooms, and Tang (2023), who emphasizes the importance of teacher and student digital fluency. Once students moved

past this learning curve, Flexi became a reliable partner in their learning, though initial guidance and patience were essential.

## 5.3 Limited Use of Teacher

### Analytics

Flexi's teacher dashboard provides valuable insights on hint usage, error types, and performance trends. In this study, the data was only reviewed informally, such as spotting students who repeatedly struggled with domain restriction questions but not systematically used for lesson planning or grouping.

Beyond error tracking, the dashboard suggests prerequisite reviews for struggling learners and enrichment tasks for advanced students. Fully leveraging these features could transform Flexi into a real-time diagnostic tool, aligning with student-centered learning by enabling targeted remediation and extension.

Future use should include teacher training on interpreting and applying analytics, embedding feedback loops into planning to make AI integration more strategic. Ultimately, Flexi's potential highlights a broader point: technology alone is insufficient without careful planning, digital fluency, and balance with human interaction.

## Chapter 6: Discussion, Pedagogical Implications, and Final Recommendations

Artificial intelligence (AI) is becoming central in education, with strong potential to support student-centered learning (SCL) and reduce classroom challenges. In mathematics, where large class sizes and fast curricula limit personalization, tools like Flexi offer meaningful support.

This study set out to answer one central question:

*How effectively does Flexi function as a classroom assistant in promoting student-centered learning and reducing teacher workload in mathematics education?*

Findings, drawn from observations, student reflections, teacher notes, and a survey, point to two main themes: supporting SCL and reducing teacher workload, followed by recommendations and implications.

### 6.1 Supporting Student-Centered Learning

Flexi consistently fostered SCL by allowing students to engage independently, ask unlimited questions in a judgment-free space, and select explanation formats (step-by-step, rephrased, or analogies). Mastery challenges and real-time feedback encouraged persistence and reflection.

These supports align with SCL principles of autonomy and metacognition (Dada et al., 2022; Tang, 2023). Quieter students especially benefited, often using Flexi independently or outside class. Survey results confirmed high motivation, confidence, and growing independence.

### 6.2 Reducing Teacher Workload

Flexi reduced repetitive explanations by offering scaffolding and alternative explanations, freeing teachers to focus on small groups and higher-order misconceptions. This hybrid model, AI for independence, teacher for guidance, was especially valuable in large classes

### 6.3 Recommendations for Classroom Implementation

To maximize Flexi's potential, schools should:

- Provide pre-training tutorials to build digital fluency.
- Position AI tools as first-line support before teacher intervention.
- Train teachers to interpret AI-generated learning data.
- Integrate AI within SCL and inquiry-based approaches.
- Build student trust by modeling Flexi's reliability and showing it complements, not replaces, teacher support.

These steps echo findings by Dada et al. (2022) and Tang (2023), emphasizing pedagogy and readiness alongside technology.

#### 6.4 Future Platform Enhancements

Flexi could be strengthened with:

- Curriculum alignment features that link content to local standards.
- Offline accessibility to reduce dependence on connectivity.

Such improvements would expand adaptability and equity in diverse contexts.

#### 6.5 -Broader Educational Implications

By 2025, Flexi supports multiple subjects beyond math. Although it cannot replace teachers' emotional understanding, this study shows

its value in large or mixed-ability classrooms. Flexi reduced bottlenecks, promoted exploration, and provided adaptive feedback, creating learning that is:

- More inclusive, meeting varied learner needs.
- More scalable, easing teacher pressure.
- More aligned with 21st-century pedagogy, fostering student agency.

While based on a single classroom, these results provide practical lessons for wider AI adoption. Future research could explore long-term effects, use of analytics in planning, and cultural factors shaping trust in AI.

In sum, AI's strength lies in partnership, not replacement. Tools like Flexi can enhance teacher capacity and empower students to take greater ownership of their learning.

#### Reference

1. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
2. CK-12 Foundation. (2025). Flexi by CK-12: Interactive AI tutor and teaching assistant. Retrieved from <https://www.ck12.org/flexi>
3. Dada, D., Laseinde, O. T., & Tartibu, L. (2023). Student-centered learning tool for cognitive enhancement in the learning environment. *Procedia Computer Science*, 224, 1611–1618. <https://doi.org/10.1016/j.procs.2023.02.182>
4. Digital Bricks. (2024). UAE mandates AI curriculum in schools. Retrieved from <https://digitalbricks.ai/news/uae-ai-mandate>
5. Jaramillo, J. J. (2024). The AI-driven classroom: A review of 21st-century practices in artificial intelligence and curriculum integration. *Prospects*. Advance online publication. <https://doi.org/10.1007/s11125-024-09704-w>
6. Rori, J., Vujosevic, M., & Murad, A. (2023). MathDial: Dialogue-based tutoring using mathematical reasoning. In *Proceedings of the 24th International Conference on Artificial Intelligence in Education (AIED 2023)* (pp. 443–455). Springer. [https://doi.org/10.1007/978-3-031-36336-8\\_37](https://doi.org/10.1007/978-3-031-36336-8_37)
7. Tang, K. H. D. (2023). Student-centered approach in teaching and learning: What does it really mean? *Acta Pedagogica Asiana*, 2(2), 72–83. <https://doi.org/10.53623/apga.v2i2.218>
8. Unite.AI. (2024). UAE makes AI classes mandatory from kindergarten: The world needs to follow. Retrieved from <https://www.unite.ai/uae-makes-ai-classes-mandatory-from-kindergarten>