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Comprehensive Analysis on Impact of AI Tutor System, Among High School Students in Learning Maths and Science

Jeevapriya B.[1]; Theju S.[2]; S. Aruna[3]; Santhanalakshmi V.[4]; Dr. Sivasakti Balan D. P.[5]; R. J. Thayumanaswamy[6]

[1;2][11B]; [3;4][Mentor]; [5][Principal]; [6][CEO]

[1;2;3;4;5;6]K. R. M. Public School

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Abstract: This study examines the influence of Artificial Intelligence (AI) on students when they use AI-based tutoring systems to learn mathematics and science. The primary objective is to determine whether AI tutoring enhances students' academic performance and to understand their preference between AI-assisted learning and traditional classroom instruction.To conduct this investigation, students' performance is evaluated both before and after using the AI tutor system. Initial test scores serve as a baseline, showing how students perform under regular or traditional teaching methods. They then engage with the AI tutor for a set duration, during which they experience adaptive learning modules, instant feedback, detailed explanations, and personalized practice tasks. After this period, they take a similar assessment to measure their progress. HYPOTHESIS"Students who use AI tutors will demonstrate improved retention of science and mathematics concepts."

Keywords: *AI Tutor System Traditional Learning System Maths Science.*

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I. INTRODUCTION

Most students prefer learning through AI tutor systems because these platforms help them grasp mathematical and scientific concepts more clearly and efficiently. The study shows a noticeable difference between traditional classroom learning and AI-assisted learning. Many students often experience difficulties or doubts while reading and writing in both subjects, and they find it much easier to resolve these doubts using AI tools. Unlike traditional settings—where students may feel shy, hesitant, or unable to ask questions—AI tutors provide a comfortable, judgment-free environment where learners can ask unlimited questions at their own pace.

Students also show enthusiasm for AI-supported learning because it uses engaging multimedia elements such as videos, audio explanations, interactive apps, and educational websites. These features make the learning experience more interactive and enjoyable. Additionally, AI tutor systems offer diverse practice formats, including quizzes, chapter tests, mock exams, and step-by-step problem-solving exercises. The ability to practice repeatedly and receive instant explanations helps students strengthen their understanding, improve accuracy, and develop better time-management skills.

One of the major advantages highlighted by students is the convenience of 24/7 doubt-clarification. AI tutor systems allow learners to seek explanations whenever they need them—something traditional classrooms often cannot provide. Students can also track their progress and receive personalized feedback through AI tools, which supports continuous improvement and makes independent learning at home more effective.

Overall, the use of AI tutor systems not only increases student motivation but also enhances their confidence and academic performance by offering personalized, flexible, and engaging learning opportunities.

By comparing pre- and post-learning results, the study aims to identify:

- The extent to which students' understanding of mathematics and science improves

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- How much of the improvement is directly linked to the AI tutor system
- Which learner groups—such as fast, slow, or average learners—benefit the most

Beyond academic performance, the study also explores students' perceptions and experiences. Students share how they feel about using the AI tutor in comparison to traditional learning, addressing questions like:

- Is the AI tutor easier to understand than a classroom teacher?
- Does AI make learning quicker or more engaging?
- Do students feel more confident after practicing with AI?
- Which method do they prefer—AI-based learning or teacher-led instruction?

Additionally, the research evaluates whether students consider AI learning to be:

- Superior to traditional learning
- Equal to traditional learning
- Less effective than traditional learning

In summary, this study provides a comprehensive view of the educational impact of AI tutoring systems by combining quantitative data (test scores) with qualitative insights (student preferences and experiences). This helps educators decide whether integrating AI tools into classrooms can effectively enhance learning outcomes in mathematics and science.

II. METHODOLOGY

Primary data collection refers to the process of gathering first-hand information directly from individuals, observations, or experiments specifically for a research study, rather than relying on previously recorded data. It involves collecting original insights that are tailored to the researcher's objectives, making the data highly relevant, timely, and reliable for analysis. Common approaches include surveys, interviews, questionnaires, observations, and experimental methods, all of which allow researchers to obtain accurate details directly from the source. Because this type of data is collected purposefully for a specific investigation, it often provides deeper and more precise understanding compared to secondary data.

The descriptive analysis is used to understand all types of study patterns of students through this AI tutor system. It also evaluates the performance of students before and after using the AI tutor system. Furthermore, it observes where students struggle in tests and provides feedback on how to correct their mistakes.

The quantitative method is used to assess the overall performance of students in mathematics and science through the AI tutor system. It also involves collecting test scores and the time taken to complete them. This method shows the improvement of students and includes practice quizzes and tests that have been conducted. Finally, it presents the percentages and graphs of students' performance based on the collected information.

The tools used for this study include survey questions designed to understand and gather feedback from students about their learning experience with the AI tutor system. Both close-ended and open-ended survey questions are used to evaluate students' performance through their responses.

Data was collected from 80 students of age between 15 to 17 and the data was analysed based on the previous research papers.

III. LITERATURE REVIEW

Quantitative findings, in line with Black and Wiliam's (2009) and Carless's (2015) theories on the benefits of in-class formative assessment, specifically Assessment for Learning (AFL) activities, showed a 27.2% increase in retention rates among students participating in these activities compared to a control group. Qualitative insights from interviews reveal that AFL practices foster self-regulation and collaborative learning, with students noting enhanced responsibility, motivation, and peer connections. The AFL framework supports students' transition from surface learning to deep engagement with material, leading to improved academic performance.

The study investigated a number of study strategies, such as elaborative encoding, retrieval practice, and spaced repetition, to ascertain how well they enhanced performance and retention. Results showed that students who used active learning strategies, including concept mapping and self-testing, performed better academically and had higher retention rates than those who used passive tactics, such underlining and rereading. Furthermore, the association between study habits and memory retention was found to be significantly moderated by stress levels and sleep patterns.

- Studies, such as the one published by ISAR, show that AI tutor systems can improve academic outcomes compared to traditional teaching methods.
- Across subjects and levels: A major meta-analysis synthesized controlled evaluations of AI tutor systems (Journals).
- K–12 Mathematics: A meta-analysis reports 26 out of 34 independent samples on AI tutor systems for K–12 math learning.
- 2011–2022 Experimental AI Tutor System Studies (Mixed subjects, multiple steps): A recent systematic review analysed 40 qualified studies using social experimental designs (PMC).
- Research has found that AI tutors can lead to significant learning gains, sometimes outperforming traditional in-class active learning methods.
- Unlike human tutors, AI tutors offer flexible, round-the-clock assistance, which is especially beneficial for students who need help outside of regular school hours.

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➢ *Data Analysis:*

- 43% of students tells that Ai tutor system has improved their learning and 43% of students tells it does not show any improvements.
- 66% of students tells that Ai tutor system identifies their weakness in subjects
- 43% of students tells that they need 1 hour to practice by AI tutor system
- 73% of students tells that sometimes they will learn by AI tutor system.
- 55% of students tells that Ai tutor system is better than traditional learning.
- 51% of students tells that they use AI tutor system rarely for learning.
- 46% of students tells that they get distracted while using AI tutor system.
- 60% of students tells that they are neutrally satisified with AI tutor system
- 42% students gives their feedback about AI tutor system for learning.
- 47% of students tells that they feel no difficulties while using AI tutor system
- 63% of students tells that they feel easy to work out problems in AI tutor system.
- 51% of students tells that AI tutor system provide clear solutions for their doubts.
- 75% of students tells that their performance has improved after the use of AI tutor system.
- 42% of students tells that they feel both AI tutor system and traditional learning is not same as much and they understand in both learning systems.

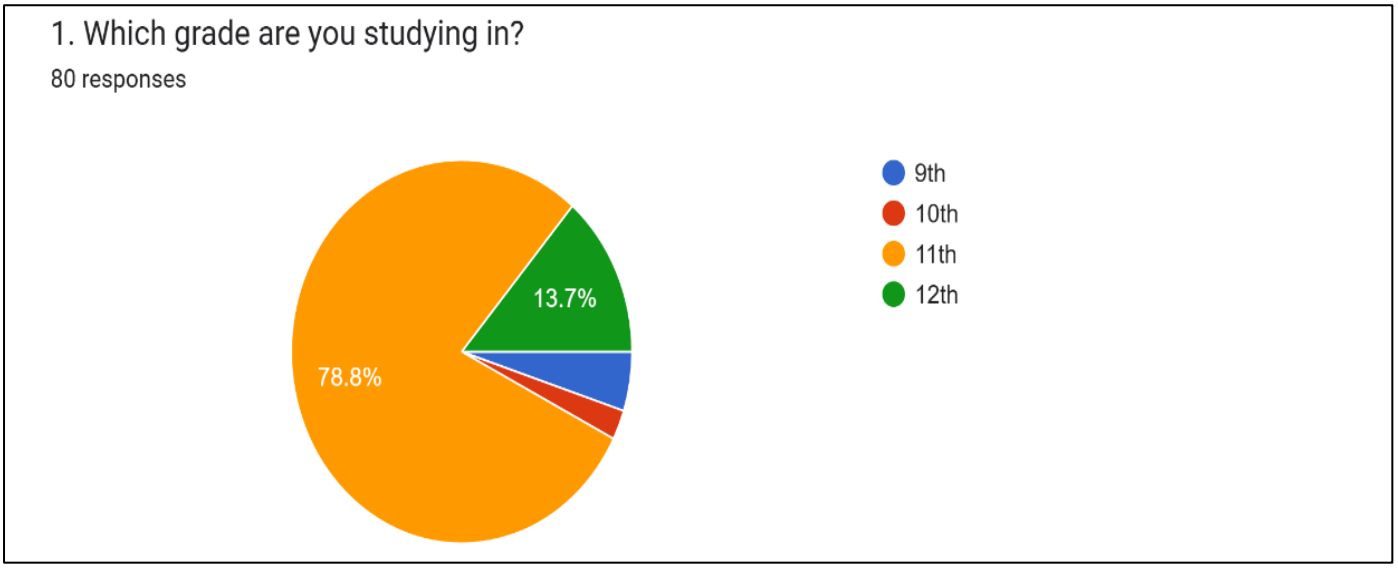

Fig 1 Class of Study

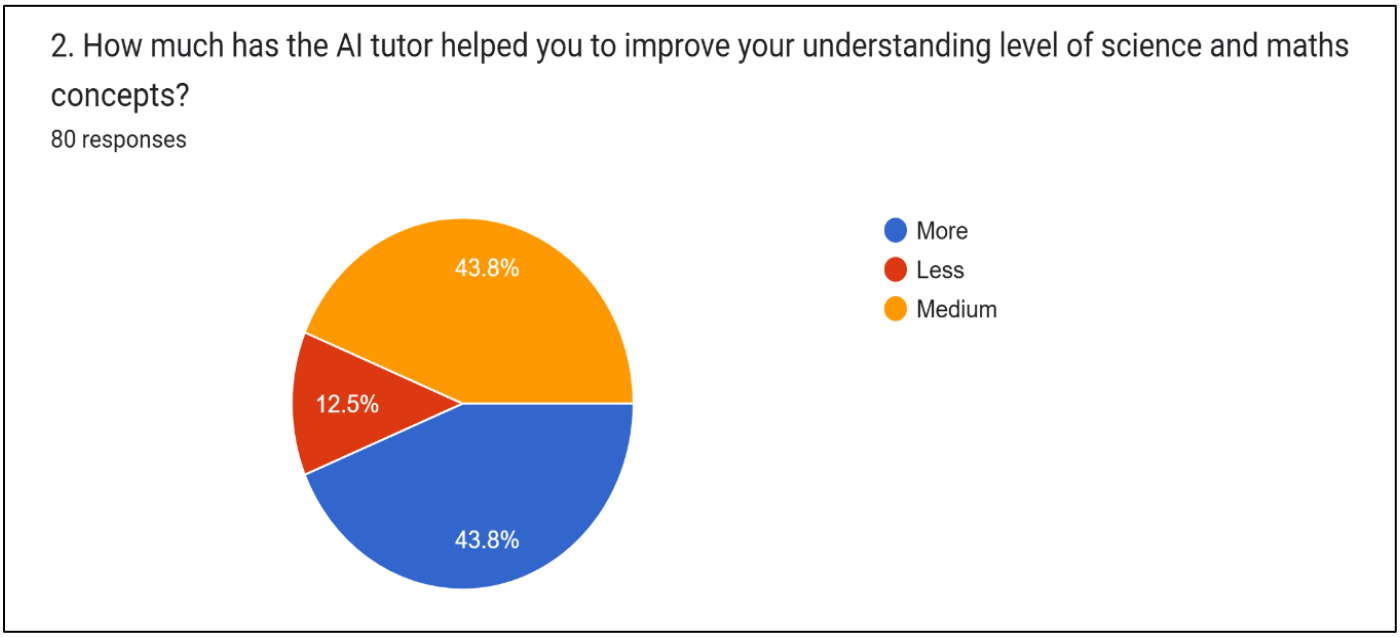

Fig 2 Improvement of Study in Two Subjects

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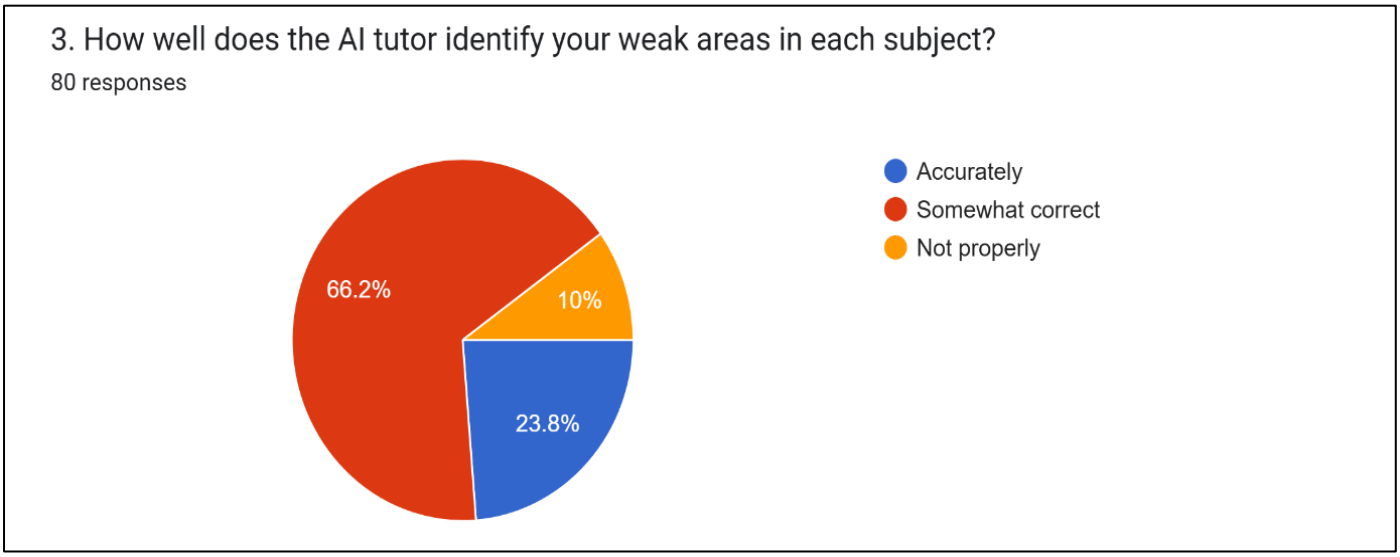

Fig 3 Identifying your Weakness in Subjects

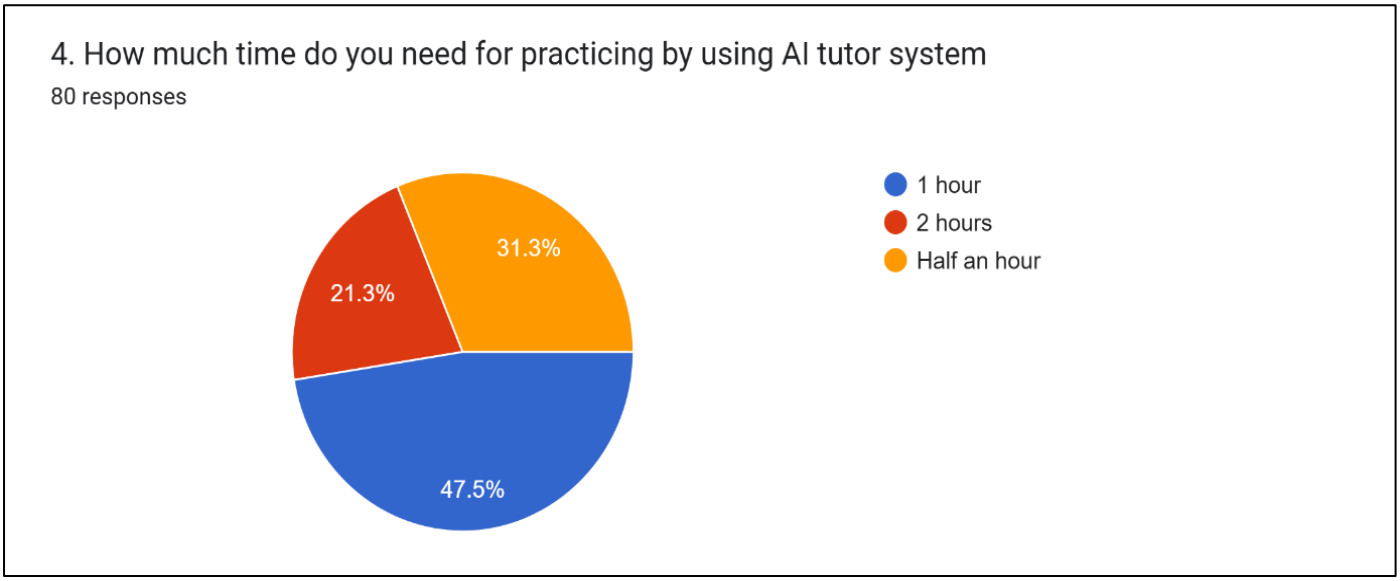

Fig 4 Time to Practice

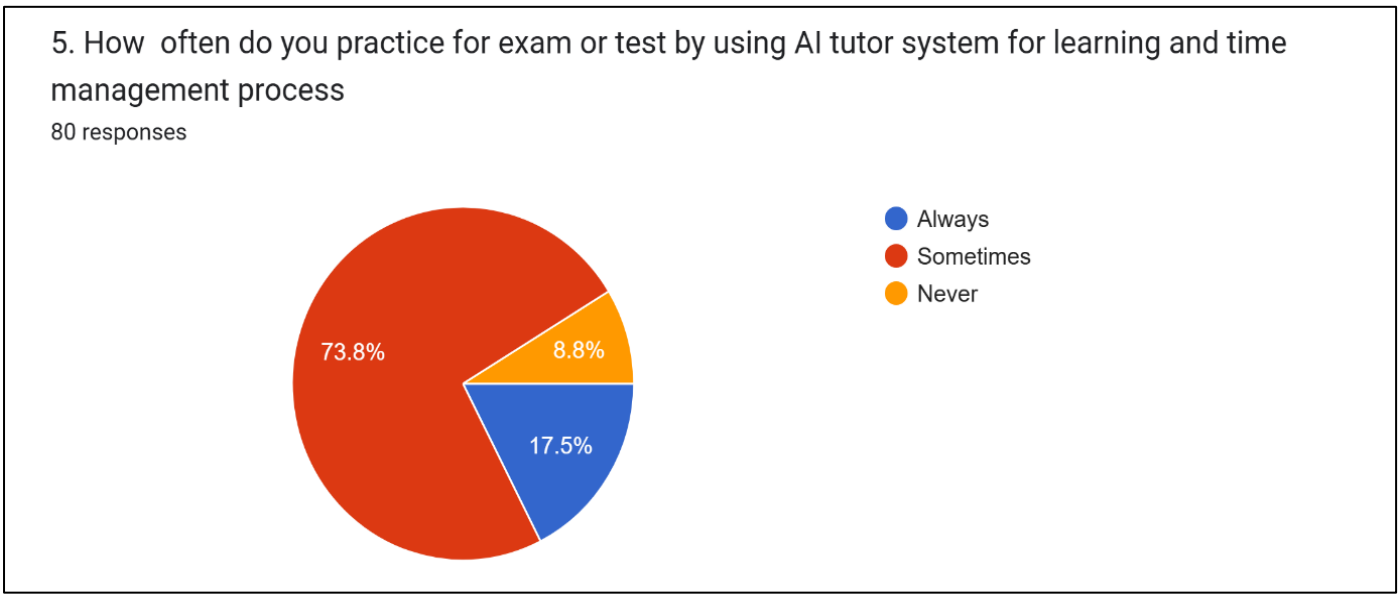

Fig 5 Time Management

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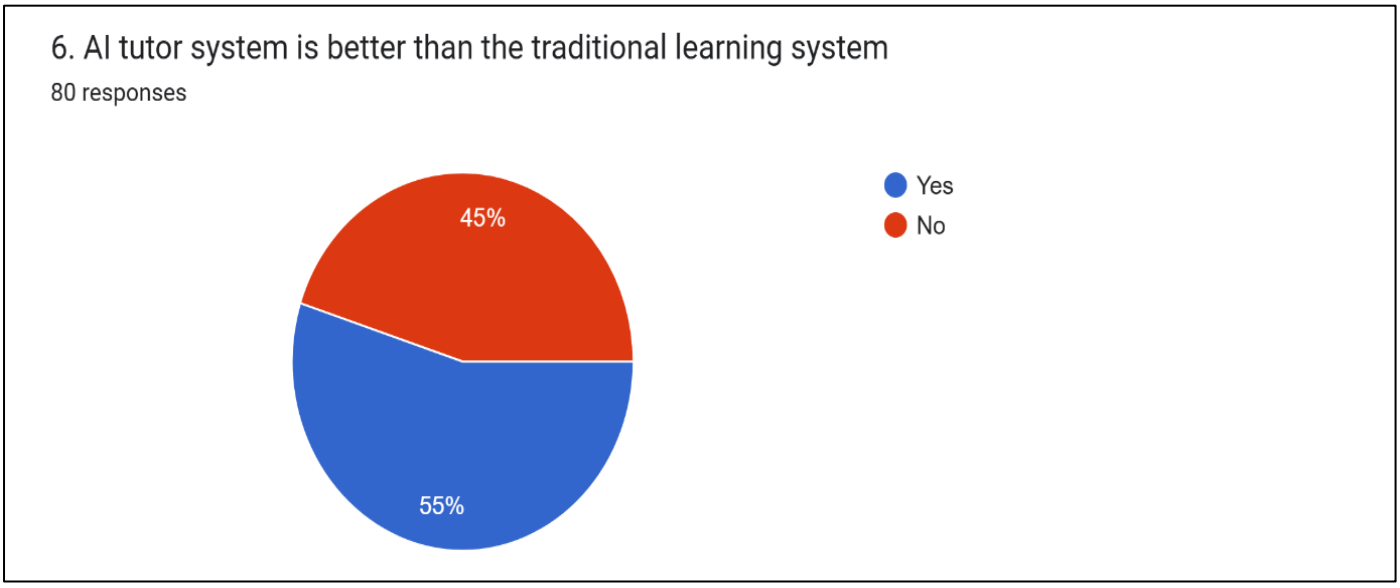

Fig 6 AI Tutor System vs Traditional Learning

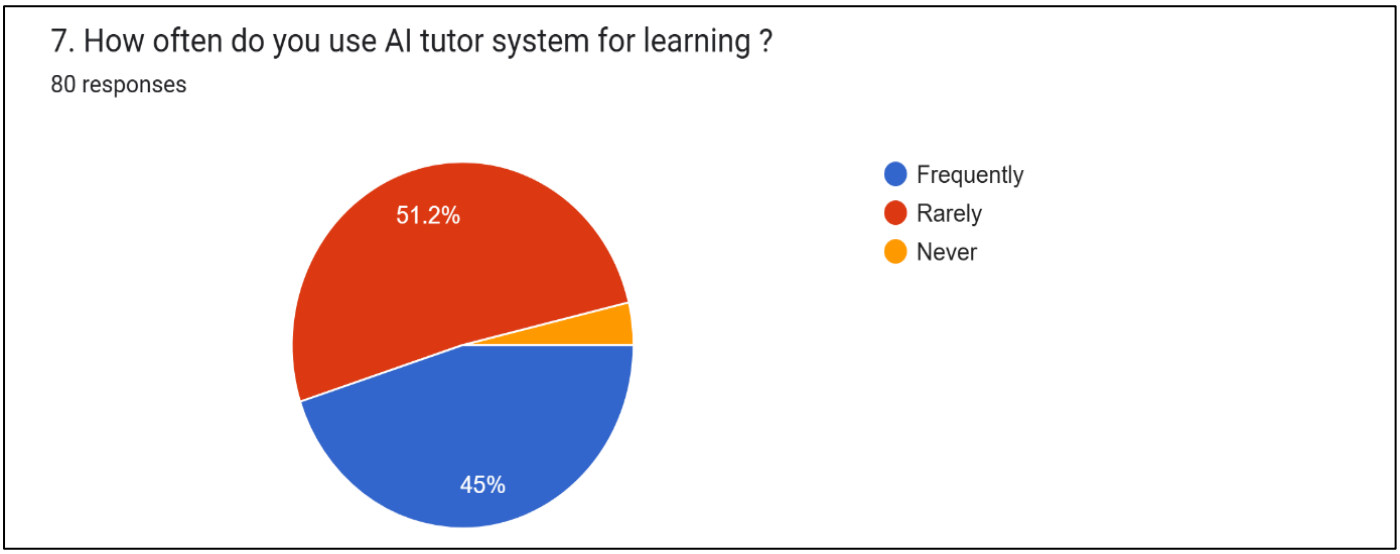

Fig 7 AI Tutor System for Learning

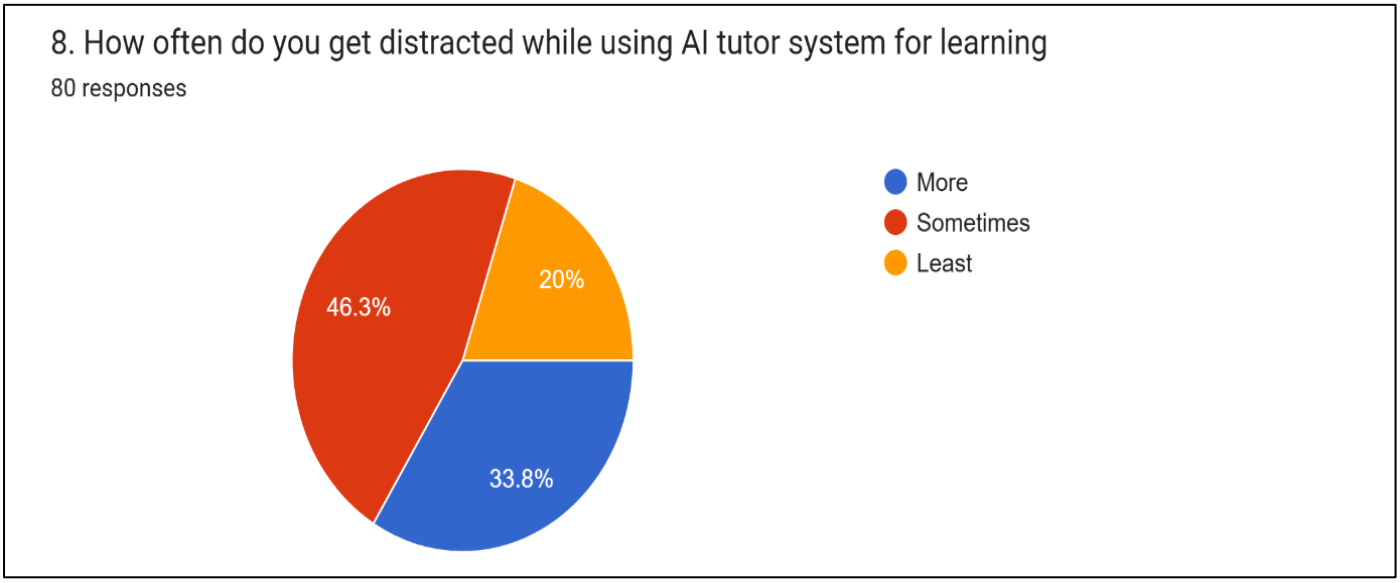

Fig 8 Distracted while Learning

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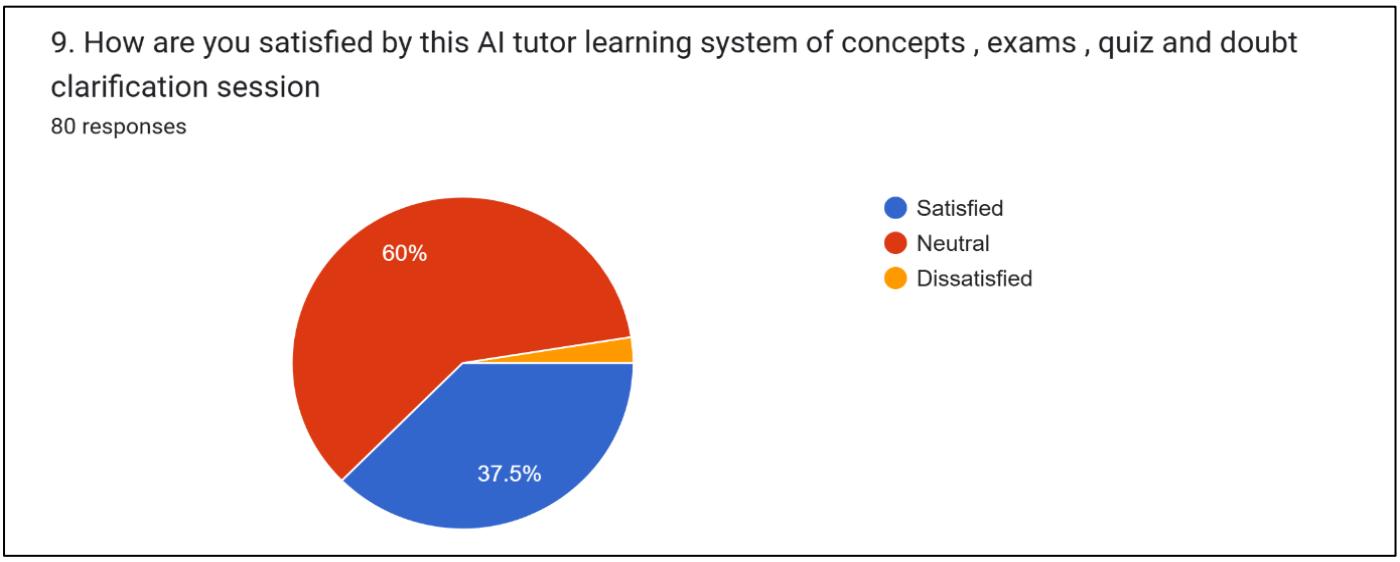

Fig 9 Clarification Session

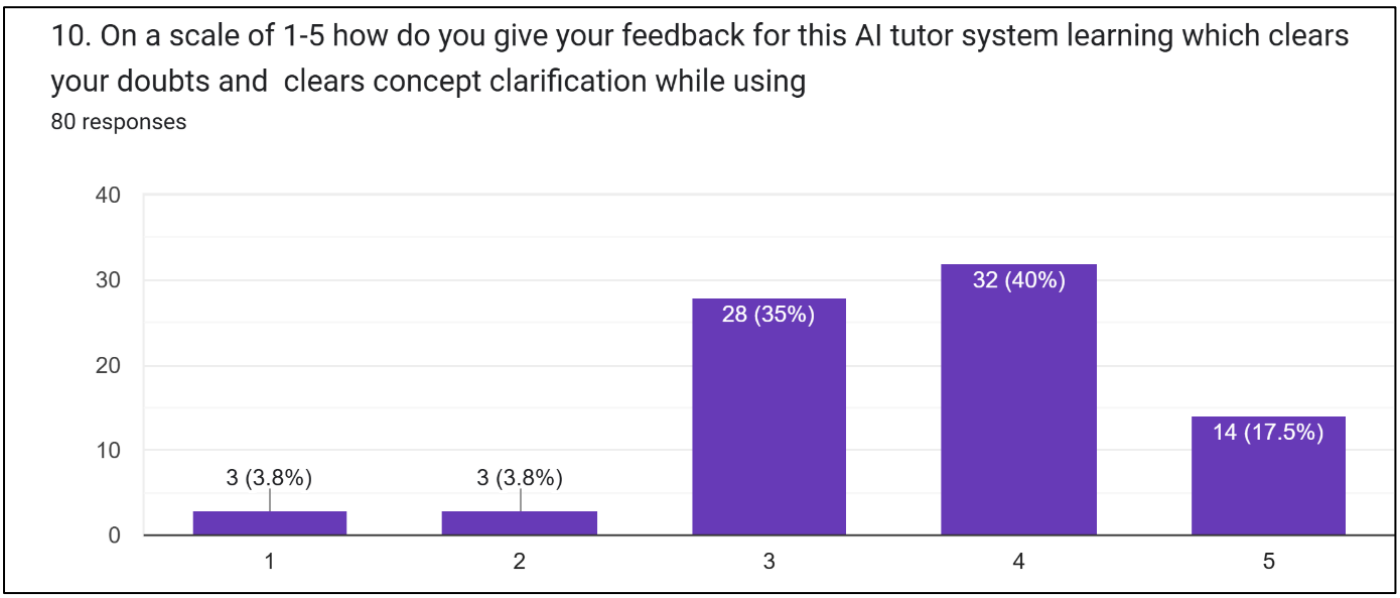

Fig 10 Feedback

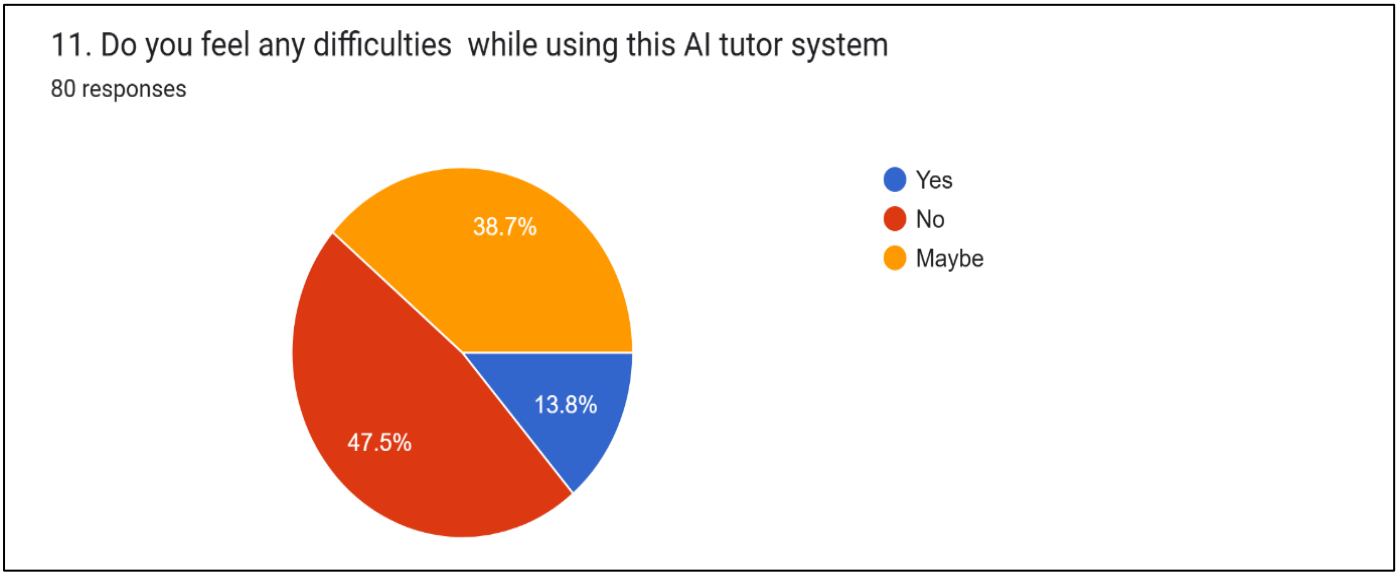

Fig 11 Difficulties Using AI Tutor System

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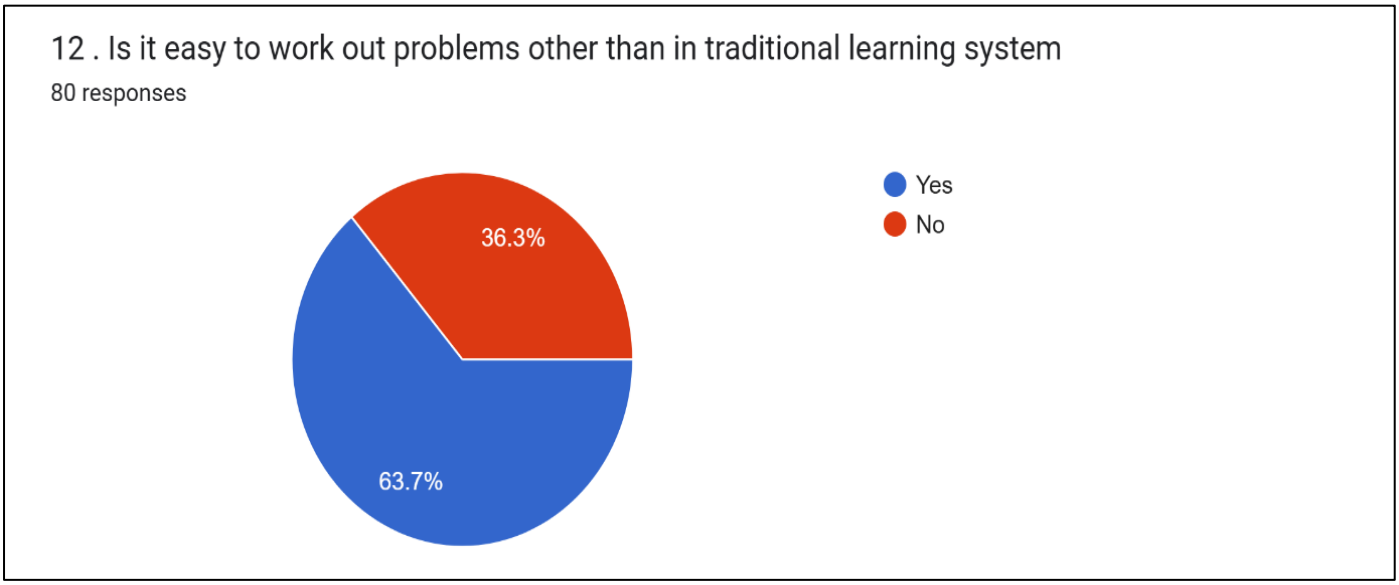

Fig 12 Easy or Difficult Using AI Tutor System

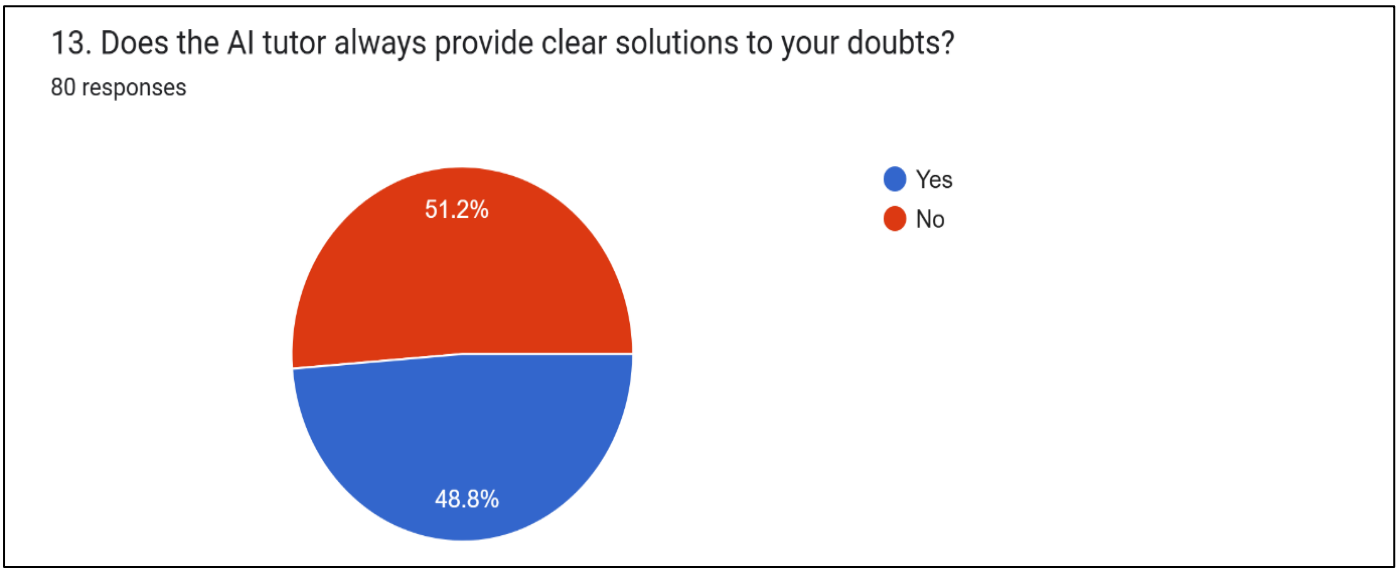

Fig 13 AI Tutor System Gives Clear Solution

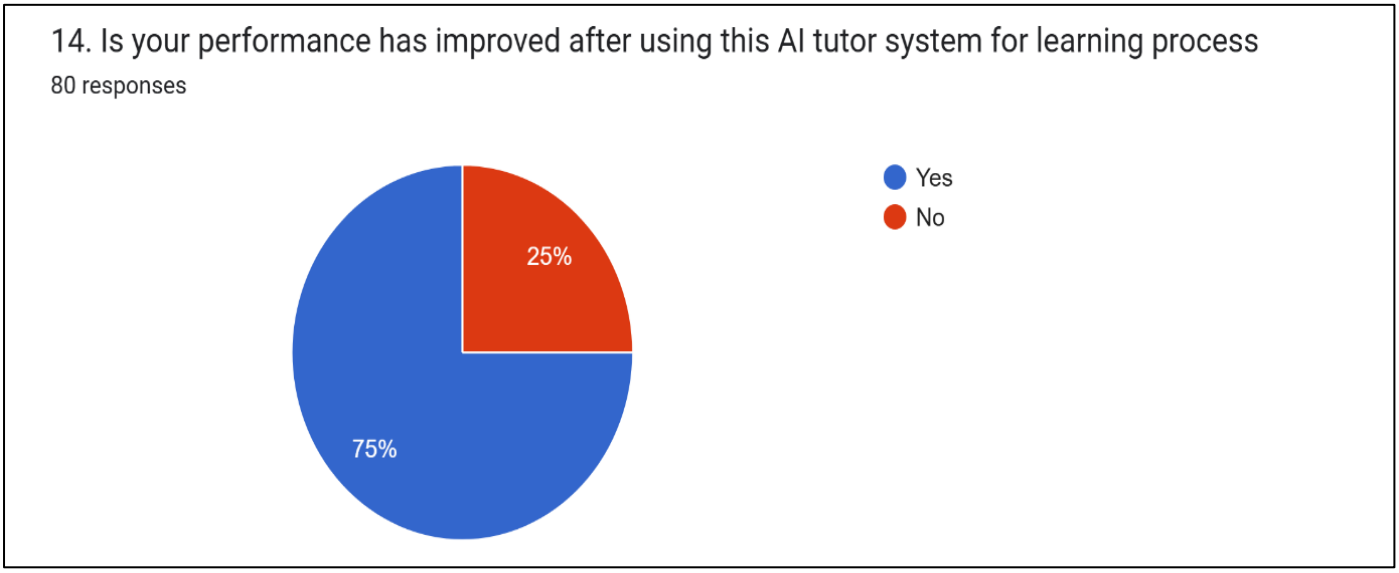

Fig 14 Performance has Improved or Not after the Usage

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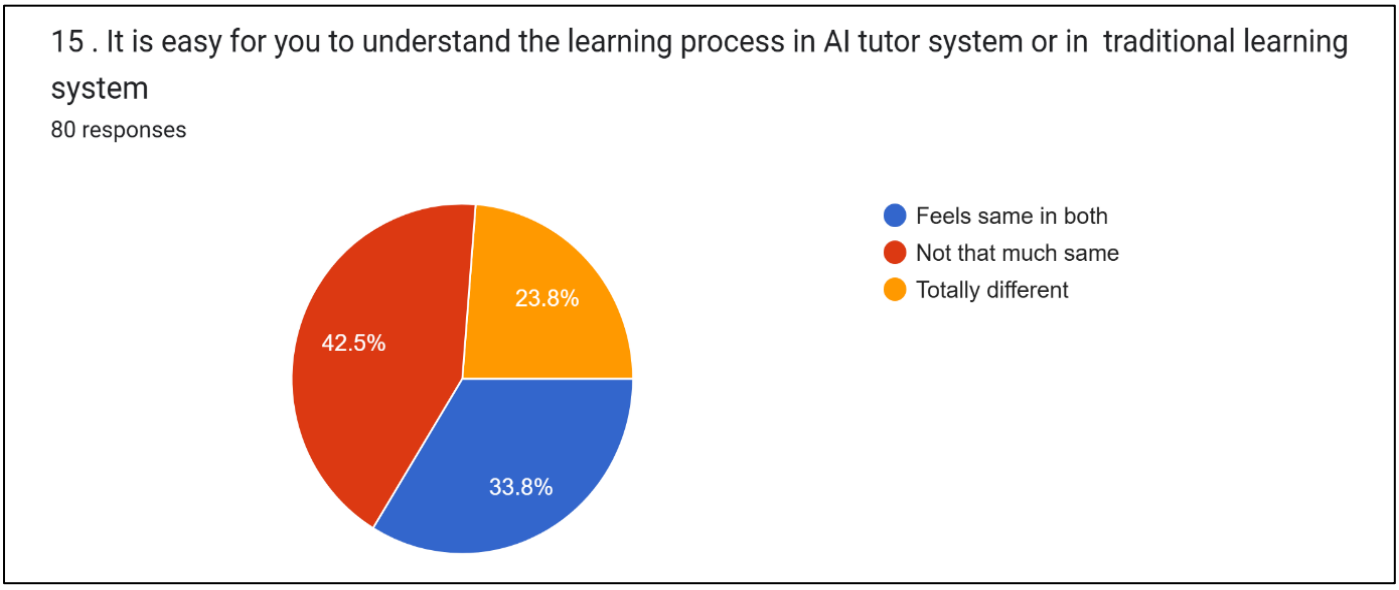

Fig 15 Learning Method AI Tutor System or Traditional Learning

IV. DATA INTERPRETATION

The AI tutor system helps improve students' understanding of mathematics and science. It correctly identifies each student's weaknesses. Most students need about one hour for practice or learning. Many of them use the AI tutor system only occasionally for their studies. Sometimes, students get distracted while using it. Most of them say that the AI tutor system is better than the traditional learning method. Some students are neutrally satisfied with the AI tutor system, while many feel no difficulties when using it. It is easier to solve problems with the AI tutor system than with traditional learning methods. Overall, it has improved students' performance. Most students feel that the AI tutor system and traditional learning system are different from each other.

V. CONCLUSION

In conclusion, we can say that the AI tutor system is more modern than traditional learning methods. It improves students' performance based on their practice and learning. It provides answers and explanations to clarify doubts. Most students prefer the AI tutor system for their learning process. It also offers numerous practice tests and opportunities to solve questions. This makes it helpful for all students to learn these subjects. Hence, it is considered better than the traditional learning system by 50% of students.

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