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The State and Use of Virtual Tutors

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The State and Use of Virtual Tutors

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Abstract

Virtual tutoring is the process by which students and teachers participate in the learning experience in an online, virtual, or networked environment. This process can not only separate the participants from each other in a physical space, but it can also separate them by time. Virtual tutoring can take the form of the group of students coming together synchronously in an online setting and receiving lessons from a single tutor, or by asynchronous learning in which the teacher pre-plans lessons in advance that the students consume on their own time. The advent of online learning technologies and virtual learning environments are gaining significant attention, and are likely to become a key aspect of teaching and learning at all levels of education. With the recent advancements in technology and especially artificial intelligence, the state of the art of virtual tutoring is becoming more and more advanced as well. In this literature review, I will propose the question of "What are the current uses and state of the art of virtual tutoring?"

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1 Introduction

In recent years, virtual tutoring has gained significant popularity as a promising approach to providing a learning experience that is supported remotely using online tools and platforms. With technology increasing at a rapid speed, and the unprecedented challenges posed by the COVID-19 pandemic, virtual tutoring has become a staple solution in the teaching and learning process. As this technology evolves further, it has the potential to revolutionize educational systems by offering a more flexible and personalized learning experience to students of all backgrounds and grade levels.

Virtual tutoring commonly involves one-on-one or small group sessions conducted online, where teachers and learners interact in real-time or asynchronously. This environment allows for greater accessibility, as students are able to access the material from anywhere in the world. Moreover, virtual tutoring makes it possible for teachers to offer more individualized instruction, tailoring to the specific needs and pace of each learner.

Given the rapid advancements in AI technology and the ever growing interest in virtual tutoring, it is crucial to understand the current state and use of virtual tutoring technologies. This literature review aims to explore the past, present, and potential future applications of virtual tutoring, examining the benefits and disadvantages of virtual tutoring systems. By synthesizing existing knowledge, this review will look to provide insight into the current state and use of virtual tutoring technologies, and identify directions for future research and practice. The findings of this review are expected to contribute to the understanding of virtual tutoring as an innovative approach to education, with implications for educators, policymakers, and researchers in the field of educational technology and computer science.

2 Summaries

2.1 A Review on Techniques, Characteristics, and Approaches of an Intelligent Tutoring Chatbot System

This article explores the techniques, characteristics, and approaches of intelligent tutoring chatbot systems. Rather than focusing on a specific group of people for its population of study, the literature related to tutoring chatbot systems was studied. As such, the article does not describe a specific procedure of study. The article concludes that chatbots have the potential to be effective tools for intelligent tutoring due to their ability to provide personalized and interactive learning experiences. However, some limitations of this include a narrow scope and no systematic review methodology. The article provides a comprehensive overview of the state-of-the-art use of chatbots as a tool, and insights from this paper can guide further discussion of such systems, therefore giving relevant relation to this literature review.

This article was published in 2020, which is relatively recent. However, given the rapid pace of advancements in the world of virtual tutoring, some of the information presented may no longer be current or relevant. The authors presented the article at the 2020 International Conference on Smart Innovations in Design, Environment, Management, Planning, and Computing, which provides some trustworthiness. That being said, it is not explicitly mentioned whether the article went through a peer-review process before that presentation.

The authors' qualifications include being affiliated with various academic institutions, including the Maulana Azad National Institute of Technology, the Indian Institute of Information Technology Allahabad, and the Institute of Engineering and Technology. Some inconsistencies in this article include a lack of clarity on the selection criteria for the studies included, a limited discussion on the ethical and privacy considerations of virtual tutors, and a possibly limited focus on a specific domain. The sources and/or methods used seem

reasonable, but they could have been made stronger by using a systematic and transparent approach to their source selection.

The intended audience for this article is other researchers/professionals interested in virtual tutoring systems, and based on the information presented in the article, it is difficult to determine any clear bias.

2.2 A Technological Acceptance of E-Learning Tools Used in Practical and Laboratory Teaching, According to the European Higher Education Area

This article discusses the use of e-learning tools in practical and laboratory teaching in higher education, and examines the factors that influence their acceptance in this context. The population of study for the research consists of 220 students from two universities in Spain. The researchers used a standardized questionnaire to survey the students' perceptions of the usefulness, ease of use, and intention to use e-learning tools. They then analyzed the data using statistical methods to identify the factors that influence the acceptance of e-learning tools.

This research concludes that e-learning tools can be a valuable addition to practical and laboratory teaching in higher education, but their success is dependent on their perceived usefulness and ease of use. Some limitations of the study include the relatively small sample size and the focus on practical and laboratory teaching, which may limit its applicability to other forms of teaching.

The article is relevant to the design and implementation of virtual tutoring systems today as it explores the acceptance of e-learning tools in higher education. The article was published in 2008, which may be considered dated. However, the article's focus on acceptance of e-learning is still relevant in the design and implementation of virtual tutoring systems today.

It was published in the journal “Behavior and Information Technology,” which is a peer reviewed academic journal. The first author, M. R. Martinez-Torres, is a professor of Computer Science and Artificial Intelligence at the University of Granada, Spain, and the other authors are also affiliated with the University Granada, Spain, so we can trust that the authors are qualified to write on this topic.

While the study does not take into account the students’ prior experience with e-learning tools, and uses a small sample size in a specific area, the sources and methods used seem reasonable, although they could have addressed some of the limitations mentioned.

The intended audience for this article is other researchers/professionals interested in the acceptance of e-learning tools, as well as educators at higher education institutions. There appears to be little bias in the article, although there may be a potential bias towards the use of e-learning tools, as the authors focus mostly on the benefits and potential applications of these tools.

2.3 Activate Interaction Relationships Between Students Acceptance Behavior and E-Learning

This article explores the interaction relationships between student acceptance behavior and e-learning, specifically in the context of data and web management. The study focuses on university students in Taiwan who have experience with e-learning. The authors collected data from 451 students across different academic programs and used a structural equation model to analyze the data. They aimed to identify the factors that influence student attitudes towards e-learning, perceived usefulness, ease of use, and behavioral intention to use e-learning. The authors suggest that their model can help analyze student acceptance behavior towards e-learning and explore the impact of interaction relationships on acceptance behavior.

It is worth noting that the article has some limitations, such as its context being specific to Taiwan, which may limit generalizability to other settings. Additionally, it was pub-

lished in a conference proceedings series, which may not undergo the same level of scrutiny as peer-reviewed journals. It was also published in 2007, which some may consider to be too out of date. Nevertheless, the article's focus on acceptance of e-learning remains relevant in the design and implementation of virtual tutoring systems today.

The authors of the article come from reputable universities in Taiwan, including the Department of Information Management at the National Cheng-Chi University and the Department of Business Administration at Tung-Nan Technology Institute. Although it is not specified whether the article underwent peer review, its publication in a reputable conference proceedings series suggests that it likely underwent some form of peer review.

While the sources and methods used in the study appear reasonable, the lack of detail on sample size and characteristics, as well as specific data analysis methods used, may limit the study's robustness. The article is likely written for researchers in the fields of data management and web technology, given the conference proceedings in which it was published. Finally, there is no apparent evidence of bias in the article.

2.4 An Approach to Generate Virtual Tutors for Game Programming Classes

The article focuses on presenting an approach to generate virtual tutors for game programming classes, which aims to improve the learning experience and outcomes of students. Rather than focusing on a specific population, the article proposes a general approach for generating virtual tutors. As a result, there is no specific study procedure. The approach involves the creation of a pedagogical agent capable of answering student questions and providing feedback, which the authors named the Virtual Tutor Generator (VTG). The system generates virtual tutors based on a set of rules provided by the instructor.

The study has a limited sample size since it only focuses on a specific approach for game programming classes. Therefore, the findings may not be generalizable. However, the article provides insight into the current state of the art in creating personalized and

adaptive virtual tutors for students, as well as the potential benefits and challenges of using virtual tutors. The article was published in 2019, so it is relatively recent, but the rapid advancement in technology means that some of the information may be outdated.

The article was published in the Proceedings of the 50th ACM Technical Symposium on Computer Science Education, which is a peer-reviewed conference. The authors are affiliated with the Federal University of Bahia Aranha in Brazil and have published other articles in the past. There were no identified gaps or inconsistencies in the article.

The authors used a systematic approach to develop and evaluate the virtual tutor, which included conducting surveys and usability tests with students and instructors. However, to further strengthen their approach, they could conduct additional evaluations with larger and more diverse populations, beyond game programming classes.

The article targets researchers and educators who are interested in using virtual tutors, specifically for game programming classes. There is no evidence of bias in the article.

2.5 Designing a Virtual Tuttee System to Enhance College Student Motivation

This article focuses on the design of a virtual tuttee system aimed at enhancing college student motivation. Unlike some articles that focus on a specific population, this article proposes a design for a virtual tuttee system that can be used by any college student. However, due to the lack of a specific study, there is no procedure of study outlined in the article.

According to the article, the virtual tuttee system designed based on the ARCS model is an effective tool for enhancing college students' motivation and improving their academic performance. However, some limitations of the article are its lack of detail regarding the methodology and specific results, leading to a short article that is only three pages long, with the last page consisting mostly of references.

Despite its shortcomings, this article is useful for understanding the benefits of using virtual tutoring systems to enhance college student motivation. The article was published

in 2011, and while some of the concepts and findings may still be relevant, it is possible that advancements in technology have made some of the information outdated.

The article was published in the proceedings of the 2011 IEEE 11th International Conference on Advanced Learning Technologies, which is a peer-reviewed conference. This suggests that the authors are likely experts in the field of virtual tutoring. However, due to the article's brevity, there are gaps in the level of detail that could be provided, such as sample selection and data analysis.

The article is written for attendees of the conference who are likely researchers in the field of virtual tutoring. Despite the article's lack of detail, there is no evidence of bias due to its short length.

2.6 Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promot- ing Teaching and Learning

This article explores the potential benefits of using generative artificial intelligence, specifically ChatGPT, to enhance teaching and learning in the era of AI. The authors draw upon theoretical frameworks, previous research, and current trends in education and AI to discuss potential applications of AI in education. They suggest that incorporating ChatGPT can lead to significant improvements in learning outcomes and student engagement while ensuring the responsible and ethical use of AI. However, the article is largely theoretical with little empirical research and does not provide a balanced analysis of the potential drawbacks of using ChatGPT in education, such as cost and feasibility.

Despite these limitations, the article highlights the potential benefits of using ChatGPT for personalized and interactive support in teaching and learning, which has relevance to the research of virtual tutoring. The article also touches upon ethical considerations such as privacy and bias. Published in January 2023, the article is fully current and relevant.

While it is not explicitly stated whether the article is peer reviewed or not, it is available on the Social Science Research Network (SSRN) platform, where most papers published there are peer reviewed. The authors are both affiliated with the Department of Mathematics and ICT Education at the University of Education, Winneba, Ghana.

The article seems to be written for an academic audience in the fields of education and artificial intelligence. While the authors have relied on a review of existing literature to support their claims about the potential benefits of using ChatGPT in education, the methods could have been strengthened by incorporating some empirical evidence. Although it is difficult to determine any clear bias in this research article, the article mainly focuses on the benefits of ChatGPT, which may suggest some bias.

2.7 Studying and Comparing the Free E-Learning Platforms

The main purpose of this article is to explore and compare various free e-learning platforms based on their usability, functionality, and features, with the goal of providing educators and students with a resource to help them select the platform that best fits their specific needs. The population of the study included approximately 400 participants, consisting mainly of university students and educators. The study was carried out through two main procedures: a survey consisting of 24 questions covering various aspects of the platforms, and an evaluation of those same platforms based on a set of criteria.

The article concludes that while each of the free e-learning platforms evaluated in the study had its own strengths and weaknesses, there is no single platform that stands out as the best choice for all users. Instead, users should consider their specific needs and preferences when selecting a platform. One limitation of the article was the small sample size, with only approximately 400 participants, and only four platforms being evaluated.

The study emphasizes the importance of evaluating e-learning platforms based on specific needs and preferences, which is crucial to consider in virtual tutoring research. Although the article was published in 2016, it may still be relevant for understanding the



Figure 1: Using ChatGPT as a Basic Algebra Tutor

landscape of free e-learning platforms and their use in virtual tutoring. It is likely that the article underwent some form of peer review, as it was presented at the 2016 4th IEEE International Colloquium on Information Science and Technology (CiSt). The first two authors are affiliated with the National School of Applied Sciences in Morocco, and the latter two are affiliated with the Abdelmalek Essaadi University in Morocco.

One gap identified in the study was the lack of evaluation of the effectiveness of e-learning platforms in improving student learning outcomes, which is an important consideration in evaluating the usefulness of these platforms. While the sources and methods used seem reasonable, the study could have benefited from additional data collection methods, such as interviews or observations, to complement the survey data.

The article is targeted at researchers, educators, and anyone interested in e-learning platforms, including policy makers involved in the implementation of virtual tutoring initiatives. One possible source of bias in the study could be the limited population of the survey, which was primarily drawn from Moroccan universities.

2.8 The Advantages and Disadvantages of Virtual Learning

This article explores the advantages and disadvantages of virtual learning. The benefits of virtual learning, as highlighted in the article, include its flexibility, accessibility, and cost effectiveness. On the other hand, the limitations of virtual learning are its lack of interaction and socialization, as well as the requirement for self-discipline. The article does not focus on a particular population of study or any specific research procedure.

The article concludes that virtual learning can provide convenience, flexibility, and cost effectiveness compared to traditional classroom learning. However, it also has limitations that must be considered. Despite the article's brevity, it provides a concise overview of the advantages and disadvantages of virtual tutoring. Published in 2020, the article should be relevant to current research on virtual tutoring.

The article was published in the IOSR Journal of Research and Method in Education, which suggests that it underwent a peer review process. The author, affiliated with the Department of English Language at Hong Bang International University, lends credibility to the article. Nonetheless, the article could benefit from a more comprehensive analysis of the advantages and disadvantages of virtual learning, as well as an in-depth discussion on how virtual learning can be effectively implemented.

The article seems to target educators and researchers, presenting a balanced view of the advantages and disadvantages of virtual learning without showing any apparent bias. However, since the article does not describe a research study, no sources or methods are used to evaluate in this context.

2.9 The Comparative Effectiveness of Web-Based and Classroom Instruction: A Meta-Analysis

The purpose of this article is to compare the effectiveness of web-based instruction and classroom instruction using a meta-analysis. The authors selected 51 studies, which included 5013 participants that were either traditional classroom learners or web-based learners, as the population of the study. The authors conducted a meta-analysis of previous research studies to compare the effectiveness of web-based versus classroom instruction. They used specific criteria, such as being conducted in North America and having sufficient data for effective size calculations, to select studies from several databases published between 1990 and 2004.

The authors found that web-based instruction was more effective than classroom instruction on average, but the difference was small and depended on the type of instruction and the characteristics of learners. Some limitations of this study include the heterogeneity of the selected studies and the use of potentially outdated data.

Understanding the factors that influence the effectiveness of virtual instruction could be helpful in the research of virtual tutoring. Although the article was published in 2006,

it provides a meta-analysis of studies conducted over a period of several years, which means the results may still be relevant today. The article was published in the peer-reviewed academic journal "Personnel Psychology," and the authors are affiliated with various universities around North America.

There is potential publication bias as the study did not include unpublished studies or those published in languages other than English. Additionally, there is a high degree of heterogeneity in the selected studies, which may limit the ability to draw generalizable conclusions. The authors used a comprehensive search strategy to identify relevant studies and conducted a thorough analysis of the data.

The article is written for those who read Personnel Psychology, such as educators or researchers in the field of psychology. The authors reported their methods and findings in a transparent manner, and since the study used a systematic review of multiple studies, there is no clear bias apparent in the article.

2.10 Using Second Life for Problem Based Learning in Computer Science Programming

The article focuses on the use of Second Life, a virtual world, as a problem-based learning tool for computer science programming. The study population consists of computer science students who were enrolled in a class that utilized Second Life for problem-based learning. In the class, students were assigned to build a virtual object using the scripting language LSL, and the authors collected data on their experiences and perspectives through observations and surveys.

According to the authors, Second Life is an effective tool for learning computer science programming. The virtual world provided an immersive and collaborative environment that enabled students to experiment with programming in a safe and engaging manner. However, the article has several limitations, including a small sample size, a lack of a control group, and a time-limited nature.



Figure 2: Second Life Programming Session in Progress

Despite the limitations, the article is relevant to research as it explores the potential of virtual worlds for problem-based learning in computer science education. The findings suggest that virtual worlds like Second Life can enhance students' programming skills. The article was published in the *Journal of Virtual Worlds Research*, a scholarly journal with a rigorous peer-review process. The authors are all affiliated with different universities as faculty members or graduate students.

Although the study's sources and methods appear reasonable, the authors could have addressed the limitations mentioned to strengthen their research. The article may interest computer science instructors who are seeking innovative ways to engage their students in programming. Nonetheless, the study may suffer from self-selection bias as it involved a volunteer sample of students who elected to participate in the learning activity.

2.11 Utilizing a Virtual Learning Assistant as a Measurement and Intervention Tool for Self-Regulation Learning

This article focuses on the use of virtual learning assistants as a means of measuring and enhancing self-regulation in learning. While the size of the population is not explicitly stated, the experiment was carried out with undergraduate students. The students were

required to complete programming-related tasks, and the virtual learning assistant provided support to the experimental group by giving them feedback on their progress, reminders to set goals, and suggestions for adjusting their learning strategies. The effectiveness of the virtual learning assistant was then evaluated using a questionnaire.

The results of the study demonstrated that the virtual learning assistant was effective in improving students' self-regulation skills, as measured by their ability to set goals, monitor their progress, and adjust their strategies. The experimental group that received support had significantly higher post-test scores compared to the control group that received no intervention. However, some limitations of the article include the small sample size and the reliance on self-report measures.

This article may be of relevance to research projects exploring the state of virtual tutoring, as it demonstrates the potential effectiveness of a virtual learning assistant in promoting self-regulated learning. Although published in 2018, the article is mostly up to date. It was presented at the 2018 IEEE International Conference on Teaching, Assessment, and Learning for Engineering, which is a peer-reviewed conference. The first author is a researcher in the School of Computer Science and Electronic Engineering at the University of Essex in the UK, and the other authors are researchers in the field of education with publications in peer-reviewed journals.

The study was conducted over a relatively short period of time (six weeks) and had a limited sample size. While the researchers used established questionnaires and descriptive statistics for their study, they could have strengthened their methods by employing a randomized controlled trial design with a larger sample size to increase the validity and generalizability of their findings. Moreover, the study was conducted in a single programming course at one university, which may limit the generalizability of the findings to other populations or educational settings.

2.12 Virtual Tutor and Pupil Interaction: A Study of Empathic Feedback as Extrinsic Motivation for Learning

The article aims to investigate the effect of empathic feedback as a form of extrinsic motivation for learning when provided by a virtual tutor in an educational technology setting. It explores how the use of virtual tutors can impact the motivation and learning outcomes of pupils. The study sample consists of 23 pupils who were randomly assigned to two groups - one group that received empathic feedback from a virtual tutor and another group that received non-empathic feedback. The study design was quasi-experimental, where participants were randomly assigned to groups before engaging in a learning task that involved solving math problems on a computer. After completing the task, pupils completed a survey that assessed their level of engagement and intrinsic motivation to learn. The data was then analyzed using statistical methods to compare the two groups.

The results of the study showed that pupils who received empathic feedback from the virtual tutor reported higher levels of engagement and intrinsic motivation to learn compared to those who received non-empathic feedback. The study concluded that the use of empathic feedback in virtual tutors can be an effective way of promoting pupils' engagement and willingness to persevere in a learning experience. There were no apparent limitations mentioned in the article.

This article provides insights into the potential impact of virtual tutors on motivation and engagement in learning, which is an essential aspect of research on virtual tutors. It was published in 2020 and remains relevant today. The authors underwent a peer review process, and the first author is affiliated with the Middle East Technical University in Turkey, the second with the Universite Paris-Saclay in France, and the third with the Universite Catholique de Louvain in Belgium.

Although the authors conducted a controlled experiment and included pre and post-test measures and qualitative analysis of perceptions of the virtual tutor, there are some gaps, such as the small sample size and the lack of comprehensive analysis of the virtual

tutor system itself. Increasing the sample size could strengthen the study as well. The article targets educators interested in exploring the use of virtual tutors as a tool. Based on the article, no significant bias was identified.

3 Synthesis and Discussion

3.1 Technology Enhanced Learning

The first of the major themes discussed throughout the literature is that of technology enhanced learning. Many of the articles discuss the use of technology to enhance learning. They explore the use of virtual environments, chatbots, e-learning platforms, and other digital tools in order to support teaching and learning processes.

The majority of the literature discusses solely the benefits of using technology in or as a learning environment. For example, Martínez-Torres et al. (2008) suggest that e-learning tools can enhance practical and laboratory teaching in higher education by providing opportunities for students to engage in self directed learning and by enabling teachers to monitor and track students' progress more effectively. This idea of using technology to improve students' experience in learning is supported by Park and Kim (2011), whose study's results showed that the virtual tutee system based on their ARCS model could be an effective tool for enhancing college students' motivation and improving their academic performance. The benefits extend beyond just this however, as Dung (2020) identifies the benefits of technology enhanced learning to include increased access to educational resources, greater flexibility for students, and personalized learning experiences.

Some articles discussed more specific forms of technology enhanced learning, such as the use of chatbots. Ashfaque et al. (2020) focused on the development and implementation of an intelligent tutoring chatbot system, which falls under the umbrella of technology enhanced learning. The use of chatbots in education has become increasingly popular in recent years due to their ability to provide a unique and immediate feedback to learners, which can

enhance the learning experience. Baidoo-Anu and Owusu Ansah (2023) concur with this assessment, as their article discusses how ChatGPT, a new and quickly growing chatbot AI, can be used as a tool for teacher and professional development. This is done by providing them access to a vast knowledge base and helping to develop new pedagogical strategies. All of this is done in an attempt to further the learning experience and academic excellence of students.

Another specific form of technology enhanced learning discussed is that of web based e-learning platforms. Ouadoud et al. (2016) provide an overview of e-learning platforms, giving valuable insights into how technology enhanced learning platforms can support teaching and learning processes. To do this, the authors evaluated a number of platforms based on factors such as user interface, ease of use, features, and flexibility. What they found is that none of the platforms were a one size fits all, but rather that they could all be customized and selected to cater to the students/teachers needs. This further supports the idea that technology enhanced learning can be used as a way to increase flexibility in the learning process, possibly making it more likely for students to achieve higher goals and levels of education. To back this up, a study by Sitzmann et al. (2006) highlights the potential benefits of web-based instruction, such as increased accessibility, flexibility, and convenience. The results of this study suggest that web-based instruction may be more effective than traditional classroom instruction for certain types of learning outcomes. This use of web-based learning environments may even go so far as to become their own virtual classrooms. Esteves et al. (2009) highlight the potential benefits of using a virtual world such as Second Life for teaching and learning. These sorts of virtual environments could be used by students and teachers well across the world from each other, while still feeling face to face with each other, increasing the accessibility to learning for students across the globe.

These technology enhanced learning experiences are not without their faults or challenges however. Dung (2020) also discusses some of the disadvantages of using technology enhanced learning. Some of these include the potential for technical difficulties and lack

of social interaction, both of which could decrease motivation and efficiency in the learning process. Another issue that could come from this is described by Esteves et al. (2009), who claim that the use of virtual worlds would require careful consideration of design and implementation of activities to ensure effective learning outcomes. It could mean the equivalent of building the classroom from the ground up in a virtual environment, which would potentially require a lot of overhead.

3.2 Personalization

Another theme that emerges from several of the articles is the importance of personalization in learning. They investigate how the use of intelligent tutoring systems, virtual tutors, and other personalized learning approaches can improve student outcomes by tailoring the learning experience to individual needs and preferences.

The importance of personalization in learning is emphasized by Ashfaque et al. (2020). The intelligent tutoring chatbot system reviewed in their article is designed to personalize the learning experience for individual learners by adapting to their unique needs and preferences. This is accomplished by leveraging the power of machine learning and natural language processing. Santana and Aranha (2019) prove that this personalization supports students and can improve learning outcomes by proposing an approach to generating virtual tutors that are tailored to the needs and preferences of individual students in game programming classes.

This improvement of student outcomes and enhancement in learning is shown further by Pogorskiy et al. (2018), who show that virtual learning assistants provide feedback and recommendations to students that can help to increase student motivation and engagement by providing students with a sense of progress and achievement. Personalization does not have to be baked in however, and can be used dynamically in chatbots such as ChatGPT. Baidoo-Anu and Owusu Ansah (2023) highlight this point, by showing how ChatGPT can

be used in education to personalize the learning experience for students, providing them with instant feedback and answering their questions in a conversational and adaptable manner.

This personalization comes at a cost however, coming in the form of overhead. And this overhead cost has to be worth it in the return on investment, which is ultimately dependent on the acceptability of these technology-enhanced learning and peoples motivation behind using them.

3.3 Motivation

Motivation is the final recurring theme in the literature. Many of the articles examine how different aspects of technology-enhanced learning, such as gamification, virtual tutor feedback, and personalized learning, can impact student engagement and motivation.

One of the most critical parts of e-learning systems as a whole is whether or not the students will actually accept the use of these systems, because if they don't want to use it, motivation and engagement would plummet. Fu et al. (2007) suggest that e-learning systems can be designed to activate interaction relationships between students' acceptance behavior and their motivation to engage in e-learning activities.

One way the articles explored motivation was with the use of feedback to support student motivation. Santana and Aranha (2019) studied the use of virtual tutors in game programming classes as a means of increasing student motivation and engagement. By providing personalized feedback and support, the virtual tutors can help students overcome challenges and stay engaged in the learning process. To back up this claim of feedback increasing student motivation, Oker et al. (2020) examined how empathic feedback impacts the motivation of the pupils in a virtual tutor/pupil interaction. The results suggest that the use of empathic feedback has a positive impact on the motivation of the pupils, which in turn enhances the overall learning experience.

Gamification is another important aspect of maintaining student engagement. The use of technology enhanced learning can create new avenues of motivation for students beyond

just making their teachers happy or getting good grades. For example, Park and Kim (2011) propose a virtual tutee system that is designed to provide personalized feedback to students and allow them to track their progress and set goals for themselves. The system also incorporates elements such as points, badges, and leaderboards in an attempt to make learning more engaging and fun. This sort of self-regulated learning is supported further by Pogorskiy et al. (2018), who highlight how a virtual learning assistant can provide a tool for measuring and improving self regulated learning. This can ultimately lead to improved student outcomes. This can go even further however, as Esteves et al. (2009) propose a whole learning experience within the virtual world of Second Life. This sort of environment can provide a more immersive and interactive experience for students, which can lead to increased student engagement and motivation. And with the hype that has been surrounding projects like the metaverse in recent years, virtual worlds for learning will become more and more accessible and advanced.

While technology can be used to enhance student motivation through gamification, personalized learning, and virtual tutor feedback, Dung (2020) suggests that the lack of social interaction in these sorts of platforms could actually decrease student motivation. Furthermore, the author also mentions an inherent problem, which is the need for self-discipline and time management skills for the students using virtual tutors, which could lead to decreased motivation.

3.4 Virtual Tutoring Systems Comparison

Given the synthesis of a multitude of literature, it is also appropriate to discuss the comparisons that can be made between the most popular virtual tutoring system at the moment. To choose these systems, I did a broad overview of search results looking for virtual tutoring systems, and chose the ones with the most and highest reviews, as well as the ones with the most marketing.

The level of efficacy varies from high to low, with high being a proven track record of providing high quality content and low being a less than high quality, mostly due to the nature of the given system being community driven instead of highly regulated. The level of utility varies from high to low as well, with high being a large number of overall instructional utilities and features and low being a lack of those specified utilities. The level of personalization varies from high to low, with high being a large selection of subjects to study as well as many different ways to personalize how the content is consumed and low being a small selection of subjects and limited personalization capabilities. The level of motivation varies from high to low, with high being a high degree of gamification and enthusiastic feedback such as individual goals and badges and low being a lack of those gamification aspects and/or feedback.

From the results, we can see that all of the systems have a great deal of usefulness. The level to which it will be useful for the user is dependant on their needs, but there is something for everybody.

Name	Efficacy	Features	Utility	Personalization	Motivation
Khan Academy	High	Video lessons, interactive exercises, personalized learning plans, progress tracking.	High	High	High
Brainly	Low	Crowd sourced answers to user questions, community based learning, homework help, QA forum.	Medium	Low	Low
Quizlet	Medium	Flashcards, quizzes, games, progress tracking.	Medium	Medium	High
EdX	Medium	Online courses, interactive learning, video lectures, assignments.	High	High	Medium
Varsity	Medium	Text-based tutoring, explanations, guidance.	Medium	High	Medium

Table 1: Comparison of Popular Virtual Tutoring Systems

4 Conclusion

This literature review presents a comprehensive analysis of the state of virtual tutoring, revealing significant advancements in the technology, and the potential for providing personalized feedback and increased motivation to students. The main findings show the benefits of virtual tutoring, including its ability to deliver personalized and empathic feedback, utilize gamification and engagement tools, and offer alternative educational solutions in the face of challenges such as the COVID-19 pandemic.

The implications of this analysis are far reaching. The virtual tutoring systems examined have demonstrated promising outcomes and gained acceptance from students, educators, and major technology companies like Microsoft and Google. The potential of virtual tutoring to provide an effective and engaging learning experience that is on par or even surpasses that of traditional classroom teaching underscores the need for continued research and advancement in this field.

Despite the positive aspects, virtual tutoring is still suffering some growing pains, and presents challenges that will need to be addressed going forward. The potential overhead costs in major learning institutions with implementing wide scale virtual tutoring systems, as well as inherent issues of self-discipline and time management in students, will require careful consideration. Future research beyond this literature review could focus more specifically on individual virtual tutoring systems in order to gain deeper insights into their efficacy, limitations, and areas of improvement in different environments.

In light of the findings of this literature review, policymakers have a crucial role to play in the future adoption and advancement of virtual tutoring technologies. Policymakers can provide funding and resources to promote research and development in virtual tutoring, establish policies that facilitate their integration in educational institutions, and ensure access to all students regardless of socioeconomic status. Collaborative efforts among policymakers, educators, major technology companies, and researchers can contribute to the effective implementation and utilization of virtual tutoring systems in education.

In conclusion, this literature review highlights the significant advancements in virtual tutoring technologies and their potential to enhance the educational experience for learners. The findings explore the benefits, challenges, and future directions of virtual tutoring, and emphasize the need for continued research, policy support, and collaboration among all stakeholders. By leveraging the potential of virtual tutoring and addressing the current challenges, we may be able to pave the way for a more effective, accessible, and inclusive education system that meets the evolving needs of learners in our technologically driven age.

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