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Application of Gaussian Minimization in AI-Based Three-Dimensional Computer Education for Stakeholders

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Abstract: The rapid advancement of technology has driven the incorporation of artificial intelligence (AI) into educational frameworks, fundamentally transforming conventional methods of learning. In addition to accepting the information supplied by the AI- education provider, educational stakeholders must also independently comprehend the underlying pedagogical qualities that drive AI based 3D education. The main goal is to enhance the immersive learning experience, promoting increased involvement and comprehension among students, instructors, and other stakeholders. This study employs a qualitative research methodology, the issues that these stakeholders have about AI's ethics in 3D education were identified with the use of interviews and participant observation as the primary techniques of data collection. This article intends to offer the curriculum along with teaching techniques of 3D printing that can be fruitfully used in public education courses, per the findings of this study. Education serves as a preparing measure for the future micro-manufacturing sector.

Keywords: *3D Education; AI; Technology; Stakeholders; Student; Teacher*

1. Introduction

Artificial intelligence (AI) is being used more and more in education to improve teaching methods and cater to individual learning requirements [1]. Significant efforts have been made in the area of artificial intelligence inside education (AIED) to develop systems that can match the quality of one-on-one tutoring provided by humans [4]. The Fourth Industrial Revolution has led to the emergence and implementation of several breakthrough technologies across different industries. At the school level, it is necessary to include 3D technology into the curriculum to develop the necessary competence. Hence, it is crucial and imperative to do study on including courses related to three dimensional (3D) printing into the next public school curriculum. Utilizing educational theories and principles to shape educational resources and curricula via educational policies is crucial for fostering students' capabilities. The ability to create three-dimensional artwork and effectively communicate ideas, thoughts, and information via such artwork is very advantageous in several domains, including education, industry, business, and other areas of life [3].

This study initiates and facilitates a debate by examining the ethical inferences of AI in 3D education. It focuses on the viewpoints of three main stakeholder groups: students, instructors, and educational institutions. The primary objective was to ascertain the ethical concerns that are central to learning with AI for various stakeholders. This would serve as a basis for future study and give insights for future implementation and practise. To evaluate topics of concern, used the framework presented by Holmes et al., (2023) which modified to include the viewpoints of the three stakeholder groups (see Figure 1). The framework also facilitated the identification of some supplementary potential concerns that were absent from the empirical data [6].

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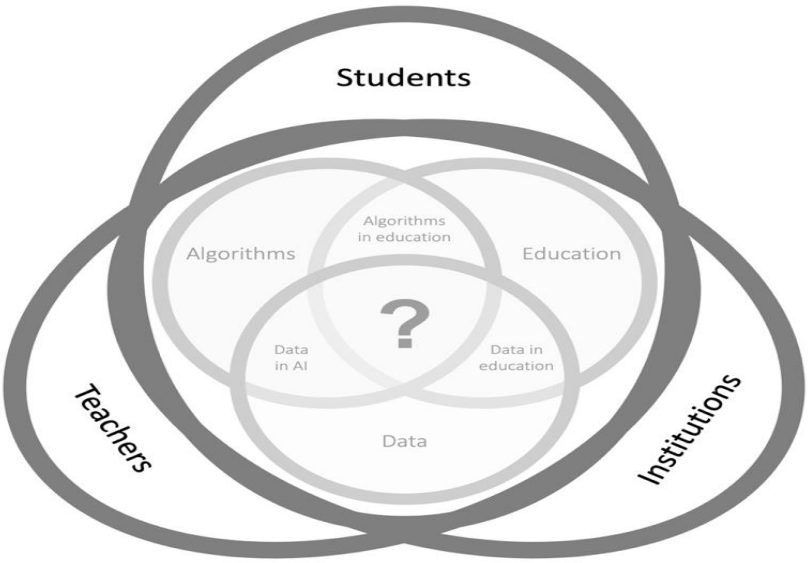

Fig 1: Viewpoints of the three stakeholder groups [6]

Furthermore, ethical concerns may emerge not just from the choice to utilise AI, but also from the selection of a certain AI methodology.

2. Literature Review

Author & Year	Research Contribution	Remark
Hoi, (2018) [5]	Created a diverse range of fusion materials for utilization in 3D printing, using an 8-bit microcontroller-based control board.	Provided specific functions through Arduino
Young and Eun, (2018) [4]	Showed the possibility that mathematics, along with art, along with 3D printing could be effectively utilised	Achieve the goals of education technology
Farnicka and Serrano Diaz., (2019) [3]	Author used 3D printing	Enhancing students' achievements might be achieved by constructing tangible prototypes based on their concepts.
Huang, (2021) [2]	Conducted an in-depth analysis of the influence of 3D printing on the development of creative skills in preschool-aged children.	3D visuals enabled youngsters to go from theoretical concepts to practical application and fostered considerable enhancement of their creativity.
Holmes and Tuomi, (2022) [1]	Conducted a comprehensive analysis on the beneficial effects of three-dimensional art, such as pictures and animations, on students' learning and creative abilities.	Determined that 3D art had the ability to enhance pupils' spatial vision abilities and was beneficial in all areas of education and professional work.

Research Gaps

The number of scientists has conducted research on the methods of 3D printing teaching. Nevertheless, there exists a constraint when it comes to effectively implementing 3D printing in education [4].

3. Methdology

This paper examines the prospective approach to teaching via the utilisation of AI based 3D technology. In order to perform this study, first theoretical investigation was undertaken in this work. The theoretical analysis examined the fundamental principles of 3D printing and its educational applications. This article subsequently examined the present state of 3D printing education in

developed nations. The analysis was conducted using a variety of sources, including papers, relevant books, and periodicals. Furthermore, besides consulting research sources, the paper's author personally visited an educational institution that offers 3D printing instruction. During the visit, the author conducted interviews with all three stakeholders. Ethnography is a qualitative research approach devised by James P. Spradley, an American cultural anthropologist. It involves the use of interviews and stakeholders' observation techniques. The process of stakeholder observation consists of six distinct stages. This paper examines AI's ethics in 3D education from three key stakeholder groups' perspectives: student, teacher and institution. Ultimately, this research forecasts the future trajectory of 3D printing education [8]. Author sought the perspectives of three stakeholder groups about the ethical implications of AI in 3D computer-based education. 3D printing technology enables the rapid production of goods by printing three-dimensional digital data in developed nations like the US along with Japan, high schools have implemented the use of 3D printers to educate students on the theoretical and practical aspects of 3D printing technology [9].

4. Result and Analysis

The study focused on STEAM education, which is an educational programme that integrates science, along with technology, along with engineering, art, along with mathematics (Figure 2). Its objective is to foster the development of innovative skills by considering the group of three stakeholders. In the future, with the advancement of AI, the significance of creative imagination surpasses that of academic understanding. Numerous educational institutions have a keen interest in STEAM education. Due to this rationale, several governments allocate significant resources towards STEAM education. The essence of STEAM education is in a curriculum that addresses real-world challenges via project-based learning. Also, students want to develop their problem-solving acumen by devising their own solutions, with the resolving practical issues. Students may exhibit a keen interest in learning when they independently tackle real-life difficulties. In addition, students need a diverse range of knowledge in order to effectively address practical challenges. Hence, pupils require a comprehensive education that mandates proficiency in several disciplines in order to effectively address and resolve challenges. Convergence education has significance in the realm of STEAM education [10]. Furthermore, a multitude of tools are utilised in STEAM teaching. These tools are crucial competencies in the future civilization. Commonly used technologies include coding, robotics, drones, virtual reality, and 3D printing.

Fig 2: STEAM Education for Stakeholders

There is a growing need for education including the use of 3D printing technology. Specifically, industrialized nations like the United Kingdom and Japan include 3D printing technology into their public-school curriculum for stakeholders. Proficiency in software for generating 3D data is crucial in the field of 3D printing. Currently, there are several 3D software applications designed specifically for the purpose of 3D printing. These programs include intricate programs designed for specialists and simple ones that may be readily grasped by primary school students. Common software applications include Rhino and SketchUp, these applications are extensively used in the fields of design and architecture. Lately, there has been extensive use of 3D software among primary school children. Hence, including 3D printing education should serve as a means to foster the capacity for generating innovative concepts throughout the production of goods [11].

The renowned computer-aided design (CAD) program designed for children's education is Tinkercad. Tinkercad is user-friendly, allowing learners to use the application online. Subsequently, the student utilizes the program to create the product. Users convert CAD files into 3D SDL files. Users now have the capability to produce physical objects from 3D SDL files using a 3D printer. Aside from Tinkercad, there is another distinct CAD program called SketchUp, which is very popular among architecture students. Therefore, learners have the option to choose the most suitable program based on their study objectives and the degree of difficulty of the program [9].

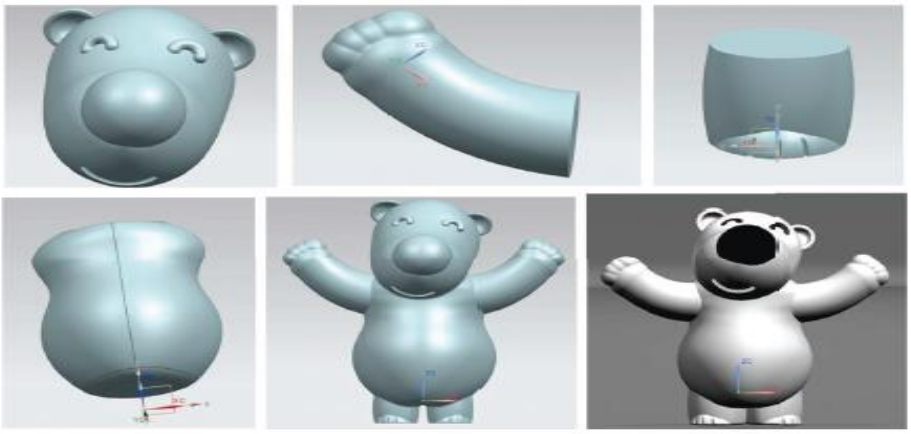

Figure 3: 3D printing through CAD software [5]

Education in 3D printing differs based on the three stakeholders' institution, instructors, and learning objectives. The purpose is to provide courses that have practical applications in public education, alongside other available courses [10]. The course may be segmented into many classes, as seen in (Figure 4).

- **First Class:** During the first session, instructors provide students with theoretical instruction on the subject of 3D printing. Theoretical seminars include a range of topics, including the attributes, historical background, and practical applications of 3D printing.
- **Second Class:** The second session is a theoretical course focused on Computer-Aided Design (CAD) software. Instructors educate students on the use of computer-aided design (CAD) software. Furthermore, educators demonstrate to pupils the outcomes of 3D printing by using a range of illustrative instances.
- **Third Class:** The third session effectively demonstrates the product design process using CAD software. Teachers create simple items, present them to students, and enable students to engage in the process of product creation. Students engage in repetitive practice as previously described.
- **Fourth Class:** During the fourth session, students engage in independent practical projects and actively seek out real-life challenges to solve. Initially, they raise issues with their peers, and subsequently, they create PowerPoint presentations and deliver them to illustrate problem scenarios. Subsequently, under the teacher's supervision, students propose a resolution to the issue.
- **Fifth Class:** During the fifth lesson, students convey precise concepts via the use of drawings. In addition, they evaluate several approaches and propose the optimal resolution. Currently, instructors have the ability to impart information to pupils about design components, such as colors and forms. In addition, students use computer-aided design (CAD) software, as per the instructions provided by their lecturers, to generate three-dimensional (3D) files from initial drawings.
- **Sixth Class:** During the sixth class, students use a 3D printer to directly accomplish their assignments.
- **Seventh Class:** During the seventh class, students showcase their finished projects in accordance with the instructions provided by the instructor. These presentations include the complete course of the task, starting with the planning stage and concluding with the conclusion. Students will actively engage and undergo the whole process of resolving a single issue.

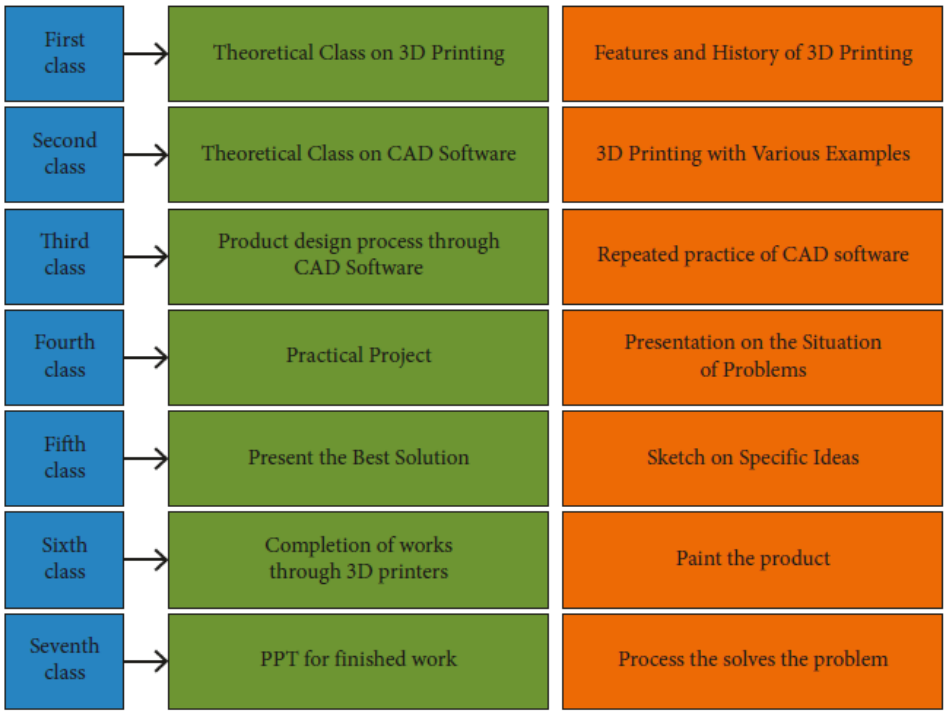

Fig 4: AI based 3D printing education for three stakeholders [5]

By engaging in this process, students can cultivate their creativity and boost their problem-solving abilities. Furthermore, these educational approaches are taught independently to learners. Additionally, this subject offers a convergence education that integrates the disciplines of art and engineering. Figure 3 displays the suggested arrangement and organization of courses and classes [5].

The issues are categorised based on the stakeholder framework for the ethical aspects of AI learning.

`A student viewpoint

Participants highlighted many issues that were particularly relevant to students, such as informed consent, along with data ownership, along with privacy, personalization, biases, along with societal effect. Initially, some participants contended that AI had the capability to enhance learning via the provision of tailored assistance, perhaps facilitated by individual lifelong learning partners, hence resulting in superior outcomes.

- Initially, the incorporation of AI based 3D computer education has the potential to enhance students' spatial sense. Education of this nature can exert a profound influence on pupils, similar to the impact of engineering education.
- Second, students have the opportunity to transform their own designs into tangible objects using 3D printers. This course primarily fosters student motivation more effectively than conventional learning.
- Third, this 3D printing program has the capacity to foster pupils' creativity. Within this course, students engage in critical thinking and independently devise solutions to the given topic. By engaging in this process, students have the opportunity to cultivate their problem-solving abilities and foster their creativity.

A Teacher Viewpoint

Participants highlighted many issues that were particularly relevant to teachers, such as data management, training and support, the balance between supporting and replacing instructors, optimising teacher time, and fostering meaningful human relationships. Many participants emphasised the use of data in facilitating teacher decision making, while also acknowledging that instructors often lack proficiency in efficiently using student data. This raises the second worry, which is the need for teacher education in AI—comprehending its nature and its potential applications in education, along with the many ramifications associated with these issues. Recently, there has been a significant focus on enhancing teachers' proficiency in digital skills and digital literacy. This emphasis should now be expanded to include AI and should be integrated into teacher training programmes. However, in the near future, problem-solving along with creativity will be prioritised above the acquisition of knowledge, in response to the evolving needs of society. Attaining this goal only via the instruction of the curriculum is challenging. In addition to other techniques and resources that increase students' creativity, including 3D printing education is a crucial feature that may enhance creativity and help students to develop problem-solving skills. AI has the potential to reduce the workload of teachers, enabling them to

dedicate more attention to other areas of student support. This argument in favour of educational technology has been proposed since the 1930s, but its practical implementation has not been widely observed [8].

An Institutional viewpoint

Participants highlighted many key concerns that were particularly pertinent to institutions, including data management, trustworthiness, the benefits of AI, and the difficulties associated with implementation. Participants recommended that universities prioritise the accuracy and security of data models as AI is more often used in educational assistance and assessment. This entails placing more focus on avoiding data breaches and fraud. Participants largely concurred that the utilisation of AI in 3D computer education is advantageous for schools. Numerous educational institutions, like Stanford University Graduate School of Design, have used the design thinking teaching style. In addition, this strategy has also served as the foundation for cultivating a multitude of entrepreneurs in Silicon Valley.

5. Conclusion

This study examined the viewpoints of important stakeholders involved in the ethics of using AI in distance-based higher education. The research revealed some ethical dilemmas in the field of education. This study used a qualitative research methodology, using interviews along with participant observation as the primary techniques of data collection. Participants largely concurred that the utilisation of AI in 3D computer education is advantageous for schools. AI has the potential to reduce the workload of teachers, enabling them to dedicate more attention to other areas of student support. Student may effortlessly create goods by using 3D software and can enhance their creativity via this process of product creation. This article intends to offer the curriculum along with teaching techniques of 3D printing that can be successfully used in public education courses, based on the findings of this study. AI based 3D computer education has the potential to enhance students' spatial sense.

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