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Artificial Intelligence and the Future of ICT Education: Developing Digital Learning and Computational Thinking in Secondary Schools an Exploratory Study among IGCSE and IB Students

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Abstract

Globally, educational systems are changing due to the introduction of technological innovations that use Artificial Intelligence (AI) to improve the processes of teaching and learning. AI technology also creates an opportunity for students to develop digital literacy, computational thinking, and problem-solving skills in their studies of Information and Communication Technology (ICT) within school education. This research project focusses on how AI has enhanced digital learning through computational thinking for secondary students enrolled in ICT classes following international curricula. This study was conducted using a descriptive survey research approach that included a conceptual analysis of data that was collected through a perceptual based survey. The survey sample consisted of secondary school students from Grades 8-10 who completed a structured survey (questionnaire) that contained 10 statements associated with learning supported by AI. The data was collected from 48 students and presented their perceptions related to the use of AI technologies in ICT education. The results of this research suggest that secondary school students perceived AI supported learning tools as having a substantial positive impact on these students; engagement, ability to problem-solve and improve their computational thinking skills. This study also indicated the importance of implementing concepts and ideas associated with AI into the school ICT curriculum in order for students to be better prepared for future careers that will be driven by technology. Additionally, AI supported learning environments will significantly enhance digital learning in secondary schools when they are appropriately supported by technology infrastructures and the methodologies and techniques utilized by teachers.

1. Introduction

Technology's rapid growth has dramatically changed the educational system throughout the world. Artificial intelligence (AI) is among these newly developed technologies that are utilized as a significant part of preparing for future careers. AI is starting to be utilized inside classrooms to enhance the way that teachers teach, improve how students learn, and increase the level of student engagement. Artificial intelligence is the term used to describe machine-based systems that can perform nearly all functions that require human intelligence - such as making decisions, recognizing patterns, and solving problems. Artificial intelligence is used in an educational environment for adaptative learning technology, intelligent tutoring systems, automated assessment tools and personalized learning applications. Artificial intelligence solutions provide opportunities for secondary school students to build computational thinking skills, particularly in ICT subjects. Computational thinking is an ability to systematically solve a problem using logical reasoning, algorithmic thinking, and by analyzing data. The IGCSE and IB international curriculum are examples of international curricular frameworks that emphasize digital competency development and technology-based problem-solving. Therefore, integrating AI concepts into ICT education will provide an opportunity for successful 21st-century workers in the fields of science, technology, engineering and data science. That purpose of this project is to investigate how AI can enhance the student's digital learning experience.

2. Research Gap

There is a considerable amount of literature regarding the use of Artificial Intelligence in higher education and teacher education programming. However, there is little research on the integration of AI Technology into secondary school ICT education within an internationally focused program such as the IGCSE and the International Baccalaureate program. There is primarily a focus in existing research on AI-Assisted Learning Environments within Higher Education rather than schools.

Furthermore, there is very little empirical data available to research how students in secondary schools view the use of Artificial Intelligence Tools during their ICT Learning experiences.

It is important to examine students' perceptions to inform how Artificial Intelligence Technologies can support Engagement, Computational Thinking and Digital Literacy Skills.

Thus, the purpose of this study is to investigate the role of AI in promoting Digital Learning and Computational Thinking for secondary school students who are studying ICT in an International School Context.

3. Objectives of the Study

In this research, there are several objectives.

- First, we will examine how AI can help improve digital learning experiences for students in ICT classes at the high school level.
- Second, we will investigate how the use of learning tools that are supported by artificial intelligence may enhance students' abilities to think through computational problems.
- Third, we will analyze student experiences and attitudes toward using AI technologies in their study of ICT.
- Fourth, we will identify several ways that students can benefit from using AI technologies in a secondary school classroom.
- Finally, we will provide suggestions on how to incorporate AI technology concepts into high school ICT classes.

4. Review of Related Literature

Earlier studies have indicated the increasing impact of AI in education. Holmes, Bialik, and Fadel (2019) report that AI technologies provide personalized learner experiences by modifying the quantity and content of educational materials according to the specific learner's requirements. These types of systems assist in increasing student motivation and improving student outcomes.

Luckin (2018) believes that AI can also help students with their problem-solving skills by creating interactive digital learning environments that support computational thinking and logical reasoning.

Research from Zawacki-Richter et al. (2019) has found that there are many AI applications currently being used in education, including adaptive learning environments, intelligent adult tutoring systems and automated assessments.

Selwyn (2019) states that using AI within the school education system can help students develop the digital literacy and technology skills they will need in future employment. The literature suggests that AI has great potential to enhance students' digital learning environments and support developing students' computational thinking abilities.

5. Artificial Intelligence in ICT Education

There are many different ways that Artificial Intelligence (AI) technologies can assist in advancing the field of ICT (Information and Communication Technology) education.

Personalized Learning

AI systems can review and assess student's learning styles and areas of growth to develop a personalized digital library for each individual.

Intelligent Learning Platforms

AI-enhanced learning platforms provide students with a way to interact with coding environments, simulations and digital labs.

Automated Assessment Systems

AI tools provide teachers with an efficient way to assess student work and/or code-related projects.

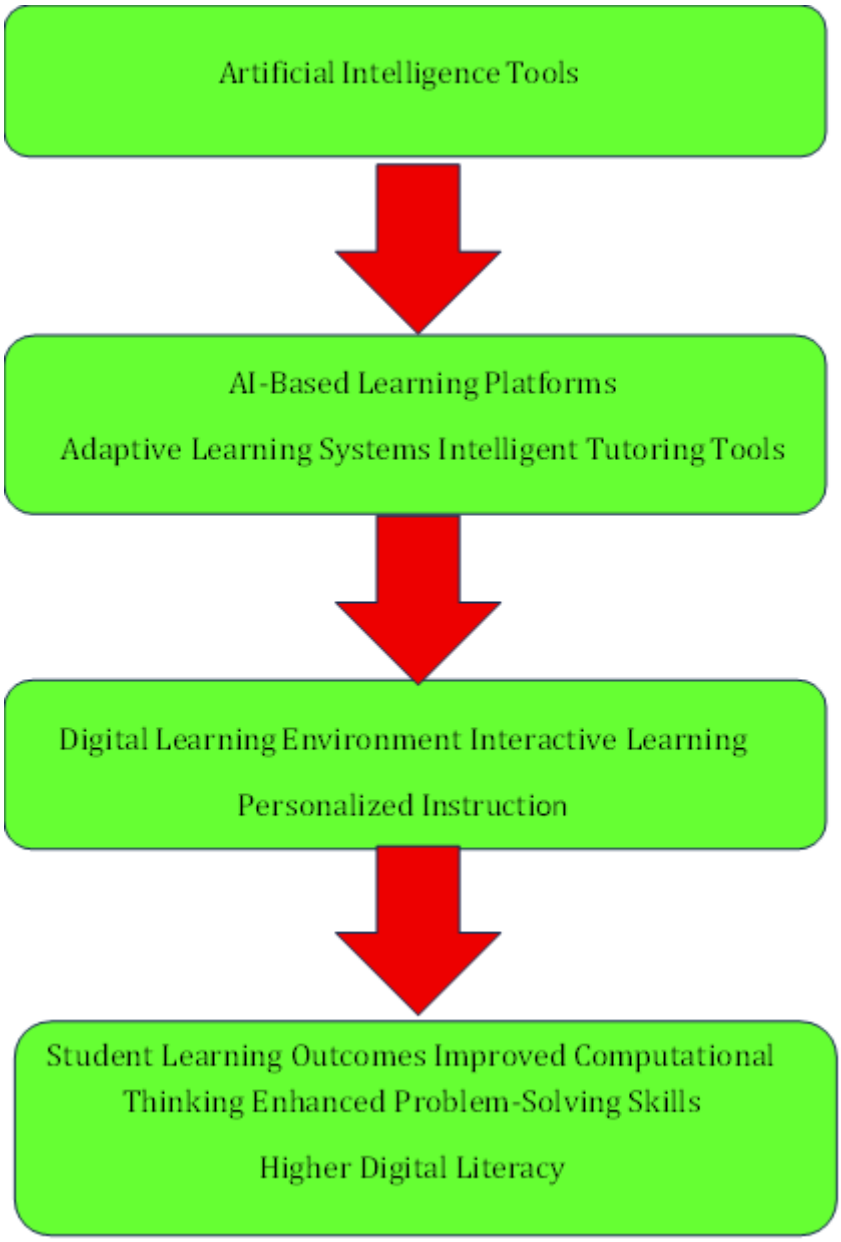
Interactive Learning Environments

AI technological advances create interactive and engaging environments for students to explore digital tools and complete problem-solving exercises.

6. Conceptual Framework of AI-Supported ICT Learning

The integration of Artificial Intelligence in ICT education can be understood through a conceptual framework that connects technological tools, learning processes, and educational outcomes. AI technologies act as enabling tools that support digital learning environments, which in turn enhance students' computational thinking and problem-solving abilities.

Conceptual Framework of AI Integration in ICT Education



7. Computational Thinking and Artificial Intelligence

Computational thinking is a critical competency of present-day learning. It includes finding a solution by using logical reasoning as well as using algorithms to solve problems.

Through Artificial Intelligence we can enable students to develop their computational thinking skills. Specifically, AI can assist students in the following areas:

- identifying data patterns
- designing algorithms
- creating basic machine learning systems
- creating problem-solving methods through digital means.

To this end, incorporating Artificial Intelligence ideas into ICT education will improve students' data analysis and IT skills.

8. Research Methodology

The study adopts a descriptive survey research design to examine students' perceptions regarding the integration of Artificial Intelligence in ICT education.

Sample

A total of 48 secondary school students studying ICT were selected for the study.

Table 1: Demographic Distribution of Students

Grade	Number of Students
Grade 8	16
Grade 9	17
Grade 10	15
Total	48

Participants were selected using convenience sampling.

Tool Used

A structured questionnaire consisting of 10 statements related to AI-based learning tools was used to collect students' responses.

Responses were recorded using a five-point Likert scale:

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

Survey Statements

1. AI tools make ICT learning more interesting.
2. AI-based platforms help students understand programming concepts better.
3. Artificial Intelligence improves problem-solving skills.
4. AI technologies enhance computational thinking.
5. AI tools support personalized digital learning.
6. AI increases engagement in ICT classes.
7. AI technologies help students analyze digital data effectively.
8. Learning about AI prepares students for future technology careers.
9. Schools should include AI topics in ICT curricula.
10. Artificial Intelligence improves overall digital learning experiences.

9. Findings of the Study

Table 2: Students' Perceptions of Artificial Intelligence in ICT Learning

Aspect of AI Integration	Agreement (%)
AI improves ICT learning engagement	85%
AI enhances computational thinking	81%
AI improves problem-solving ability	78%
AI supports digital learning environments	83%
AI should be included in ICT curriculum	90%

The findings indicate that most students perceive Artificial Intelligence as a valuable technological resource that enhances digital learning experiences. Students particularly recognized the role of AI tools in improving engagement and supporting computational thinking skills.

10. Educational Implications

The research findings have significant consequences for ICT teachers and the design of school curricula. Schools must prepare future students with the skills needed to use these technologies as artificial intelligence continues to change how digital technologies are used.

ICT education that integrates artificial intelligence concepts can foster students' development of computational thinking, critical-thinking and problem-solving skills as well as digital literacy. AI-enabled learning technologies and tools can create a personalized learning environment that is tailored to each student's unique learning style.

Teachers can employ educational technologies supported by AI to create interactive learning experiences (i.e., coding, analyzing data, and simulating problem-solving). Activities of this type will greatly increase the level of student involvement and promote the development of additional skills necessary for careers in technology.

For these reasons, schools should include artificial intelligence concepts in their curriculum before providing professional development opportunities for teachers to effectively integrate AI technology into their teaching.

11. Discussion

Study results suggest that the use of Artificial Intelligence technology to improve ICT learning experiences for secondary school students is substantial. Students agree

that researchers have created tools that promote an interactive and engaging environment, and that using AI in programming and problem-solving games creates more opportunities for students to learn and develop skills in these areas.

The findings also indicate that incorporating Artificial Intelligence concepts into ICT curriculum will prepare students for future careers in technology. International Schools and schools that offer IGCSE or IB programs can gain from adding AI based learning activities into their ICT classrooms.

These findings correlate with results from earlier studies that concluded the benefits of AI technology are providing innovative approaches, and improving student learning.

12. Recommendations

The recommendations for action based on the research findings include the following:

- Introduce curriculum topics about artificial intelligence into ICT.
- Encourage teachers to utilize AI-driven educational resources to improve digital learning.
- Provide students with opportunities to take part in programming and AI workshops through educational institutions.
- Invest in improving digital learning environments through technology.
- Provide teachers with professional development training using teaching strategies that utilize AI support.

13. Limitations of the Study

The study has certain limitations. First, the research sample consisted of students from a single educational institution. A larger sample including students from multiple schools would provide more comprehensive insights.
Second, the study relied on perception-based responses rather than direct measurement of students' computational thinking abilities. Future studies may incorporate experimental research designs to examine the impact of AI tools on student performance.

14. Future Prospects of AI in K-12 Education

It is projected that AI will play a significant role in the future of education. AI will be used to support intelligent tutoring systems, predictive learning analytics, and virtual learning environments.

As a result, schools should be aware of their opportunity to build Digital Learning Ecosystems that leverage human teaching expertise paired with intelligent technologies to improve student learning achievements.

15. Practical Applications of Artificial Intelligence in ICT Classrooms

There are a variety of digital learning platforms and/or tools that can be used in an ICT classroom using AI technologies, eg an AI powered coding platform allows the student to have a hands on experience of trying out algorithms and machine learning concepts. Also, there is the option of using intelligent tutoring systems giving students individualized feedback and comments while completing complex programming tasks.

In addition, Artificial Intelligence (AI) based web-based data analysis tools can be used by learners to identify patterns in datasets and will help to develop learners' analytical reasoning skills and computational thinking while providing them with feedback regarding their progress. Additionally, using AI enabled educational platforms can assist teachers in tracking students' progress and identifying areas where additional intervention may be required.

Utilizing such AI based learning technologies will enable teachers to create a more enjoyable, engaging and interactive learning experience for their learners by motivating their learners to explore new, flexible and innovative technologies.

16. Conclusion

AI is changing the landscape of K-12 education with innovative digital learning methods that will enhance students' engagement levels and support their future development of computational thinking. Research studies have shown that students view AI technology positively, and that they believe it can help improve their engagement with ICT learning, as well as equip them with skills for career success in the IT industry following the completion of their formal schooling.

By introducing AI into the curriculum of schools, students will gain the digital skills they need to thrive in the technology-centric modern world. All educational providers must implement innovative teaching methodologies based on AI technology, while providing the necessary supportive infrastructures for developing productive learning environments through AI.

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