

Generative Artificial Intelligence and Formative Assessment: Perspectives from Higher Education in South Africa

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Abstract: Artificial Intelligence (AI) advancements have increased computer capacity to generate knowledge. Since 1960, computer algorithms and statistical models have enabled machines to learn from data, make decisions, and improve performance in specific tasks. Various industries have benefited from the growth of AI, and tertiary education has been included, with applications such as personalised learning, automated grading, predictive analysis, intelligent tutoring, and plagiarism detection. The advent of generative AI applications threatens to change the scope of formative assessment in higher education. Students no longer apply maximum effort to resolving assessment tasks with the temptation to seek solutions from generative AI applications such as ChatGPT. The accessibility of generative AI applications by tertiary students calls for new strategies in planning formative assessment tasks to achieve the intended objectives. This study explores the impact of generative AI on Formative Assessment for Higher Education. Underpinned by the Interpretivism paradigm, the study adopted a qualitative research approach. The study collected data from students, lecturers, and experts in Educational Technologies. Lecturers and students from various departments at the University of Venda were selected for interviews using probability purposive sampling. The interviews captured respondents' experiences and perceptions of the use of generative AI by students on Formative Assessment tasks. The study applied Thematic Analysis using Atlas.ti software to analyse qualitative data. The study identified the role of formative assessment in HE. The study also established the perceptions of generative AI applications for Formative Assessment in HE and associated challenges. The study contributes to teaching and learning in higher education by establishing strategies for the best practices for using generative AI for formative assessment.

Keywords: Generative Artificial intelligence; AI applications; Computer programming; Teaching and learning; Formative assessment (FA) Higher Education (HE)

1. Introduction

Technological advancement in recent years has seen the development of Artificial Intelligence (AI), making intelligent devices and brilliant computer programmes that make computers understand human intelligence. AI computer systems emulate human intelligence in performing any intellectual work humans may achieve (Okulicz-Kozaryn, Korneliuk, Kupczyk, Kalamani, Jasinowski, Artyukhov, Artyukhova, Malovychko, & Volk, (2023). According to Karan-Romero, Salazar-Gamarra, and Leon-Rios, (2023), AI imitates human intelligence, created by science and engineering in the form of behaviour capable of thinking, learning, and making decisions expressed through technological artefacts. Machine learning is a form of artificial intelligence application that enables the automation of systems (Mohammad, 2020). Machine learning facilitates computers to acquire knowledge and skills without human intervention (Acemoglu & Restrepo, 2018).

AI debuted in the 1950s, as identified by the Dartmouth Conference. The expansion of volumes of data processing, improvement of algorithms, and increase in computer power and memory resulted in the prevalence of AI (Okulicz-Kozaryn et al., 2023). According to Pannu (2015), this century has been marked by vast improvements and applications of artificial intelligence in various industries. Some areas in which AI has dominated include Language and Understanding, Learning and Adaptiveness, Problem Solving, Perception Visualisation, Modelling, Robotics, and Gaming (Acemoglu & Restrepo, 2018). The beginning of this decade has also seen the emergence of generative AI applications, with the popular ChatGPT being one of these. Higher Education teaching and learning has also joined other industries in evaluating ways to leverage AI.

The advent of Generative AI applications has brought about new perspectives in Higher Education teaching and learning. According to Zhaier (2021), Kale, Roy, and Yuan (2020), teaching and learning components in HE includes Instruction, Curriculum Design, Assessment, Feedback, Mentorship, Classroom Management, and Technology Integration. The growing application of AI in higher education teaching and learning comes with the challenge of re-strategizing approaches to these components. This study aims to analyse Formative Assessment perspectives in Higher Education in this era of generative AI. Advancements in big data technologies have led to the increased use of software, such as Turnitin since the late 1990s to limit academic dishonesty on Assessment tasks. The early 2020s marked the availability of generative AI applications such as ChatGPT. These technologies

are a class of machine learning technologies that may generate new content such as text, images, music, or video by analysing patterns in existing data (Brynjolfsson, Li, & Raymond, 2023). Few studies have been conducted on the impact of artificial intelligence and formative assessment in higher education. This study aims to bridge the gap by researching Generative Artificial Intelligence and Formative Assessment: Perspectives from Higher Education in South Africa.

This study is motivated by the need to re-strategies Formative Assessment in Higher Education in South Africa in this era of generative AI. The study established the following objectives:

- Identifying the objectives of Formative Assessment in Higher Education.
- Confirming the relevance of generative AI as a tool for formative assessment for HE.
- Establish perspectives on using generative AI for Formative Assessment in HE.

The study significantly contributes to the ongoing scholarly discussions on the use of generative artificial intelligence in teaching and learning in higher education, underscoring the importance of this research in shaping the future of education.

2. Review of theoretical literature and Conceptual Background

This section reviewed the application of AI in teaching and learning and identified the role of formative assessment in higher education. Understanding the objectives of Formative Assessment in higher education will assist in determining the applicability of generative AI in Formative Assessment.

2.1 Applications of AI in Higher Education

According to Zawacki-Richter, Marín, Bond, and Gouverneur, (2019), the incorporation of AI techniques in education dates to the early 1970s. Recent scholarly research has focused on leveraging AI technologies and techniques to support personalised learning (Wong & Liem, 2022). Personalised learning would allow customising learning depending on the needs and performance of individual learners. Intelligent Tutoring has also benefitted from the incorporation of AI techniques. Knowledge-based tutoring systems, also known as adaptive tutoring systems, use AI techniques to determine what to teach, who to teach, and how to teach it (Zawacki-Richter et al., 2019). Other AI application areas in Higher Education teaching and learning are automated grading and adaptive assessment that facilitates the reception of timely feedback on assessment tasks by learners (Erickson, Botelho, McAteer, Varatharaj, & Heffernan, 2020). Some AI applications in teaching and learning are Learning analytics, content recommendation, Game-based learning, Natural Language processing, virtual learning, and teacher Support (Zhai, Xuesong, Chu, Xiaoyan, Chai, Ching, Jong, Morris, Istenic, Starcic, Andreja, Spector, Jonathan, Liu, Jia-Bao, Yuan, Jing, Li, & Yan, 2021). Figure 1 illustrates how AI systems enhance teaching and learning.

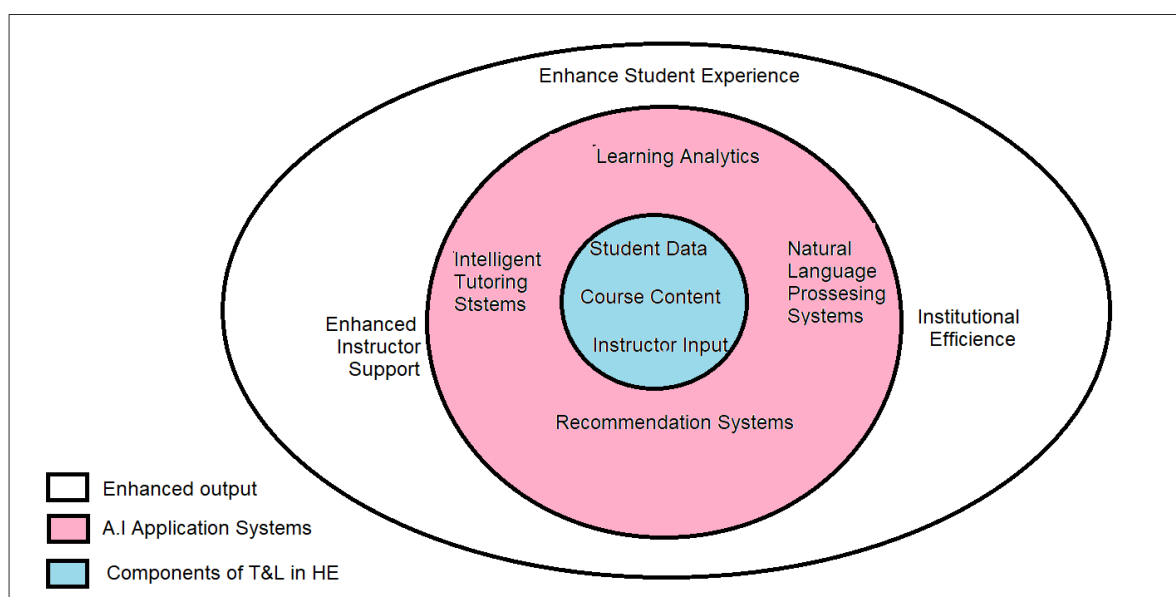


Figure 1: Application of AI in teaching and learning

Source: Fitria, (2021)

Considering the South African context, some institutions of Higher Learning still may not be able to afford some of the latest AI technologies to enhance teaching and learning (Opesemowo & Adekomaya, 2024). However, the recent availability of free generative AI applications has accelerated accessibility by most students, thereby potentially promoting student dishonesty during formative assessment.

2.2 Formative assessment in Higher education

Trumbull and Lash (2013) characterised formative assessment as an activity undertaken by teachers and students to provide feedback usable in modifying teaching and learning activities. Teachers use assessments as an integral part of the instructional process to identify individual learning difficulties and prescribe remediation procedures (Trumbull & Lash, 2013). Formative assessments may take various dimensions, determined by how the assessment activity is designed, executed, or scheduled.

2.3 The Role of Formative Assessment in Teaching and Learning and Prospects of AI

As a fundamental component of education, formative assessment represents an active and collaborative method of understanding and enhancing the learning process. These assessments give lecturers a valuable way to shape their teaching strategies through real-time feedback on student understanding.

2.3.1 Customized Learning

Customised learning, or personalised learning, is an educational approach that specifies the instruction to each student's needs, interests, and abilities. It departs from the traditional one-size-fits-all education model and aims to provide a more effective and engaging learning experience (Menéndez, Napa, Moreira, & Zambrano, 2019). AI captures the specific needs of students and gives feedback based on specific inputs. Engaging with AI also shapes the student's understanding of the task.

2.3.2 Enhancing Motivation and Confidence

Formative assessment serves not only as a powerful tool to assess students' understanding but also to boost students' motivation and confidence. Students receive recognition for their progress and achievements through formative assessment, which increases learning motivation and confidence (Leenknecht, Wijnia, Köhler, Fryer, Rikers, & Loyens, 2021).

2.3.3 Enhancing Communication Skills

Participating in discussions and joint activities related to common learning goals improves students' communication and interpersonal skills. Students learn to articulate thoughts, listen actively, and express ideas effectively in preparation for academic and professional success (Koka, Brēmane, & Koçe, 2023). Feedback from AI derives from the universal standards of the respective disciplines. Students' engagement with AI may enhance eloquence in engaging concepts within the discipline.

2.3.4 Student Engagement

Engagement is the quality of effort that students make cognitively in the educational activities that contribute directly to desired learning outcomes (Groen & Germain-Rutherford, 2021). Formative assessments assist students with student engagement, which leads to academic success (Wong & Liem, 2022). Enlightened students would not hesitate to share notes with fellow students regarding task findings from AI applications.

2.3.5 Sharing Learning Goals

A crucial role of formative assessment is to clarify and communicate to learners the learning intentions and success criteria that were initially the teacher's goals. When teachers share learning objectives transparently, students understand what is expected of them and why they engage in specific learning activities (Wong & Liem, 2022).

2.3.6 Enhancing Real-Time Feedback

Feedback is one of the strongest influences on learning and performance. AI technologies enable immediate and constructive feedback to students engaged in tasks. By using new automated assessment technologies such as natural language processing and machine learning, it is possible to provide automated feedback on students' short written answers (Wisniewski, Zierer, and Hattie, 2020). Advances in automated assessment technologies, facilitates timely feedback on students' work. Automated feedback based on multiple-choice answers is widely used in formative assessment because of its simplicity and convenience (Maier et al., 2016). Pedagogical research on the pedagogical implications of formative assessment using these new automated assessment technologies in real classrooms is just beginning.

2.4 Formative assessment tasks

Assessment tasks should be aligned with the teaching objectives to achieve the desired outcomes. Objectives are structured based on the level of the taught subject. Bloom's taxonomy of educational objectives is a framework for categorising teaching objectives and determining what students will have learned by the end of the teaching activities. Figure 2 illustrates Bloom's taxonomy and the possible general learning objectives.

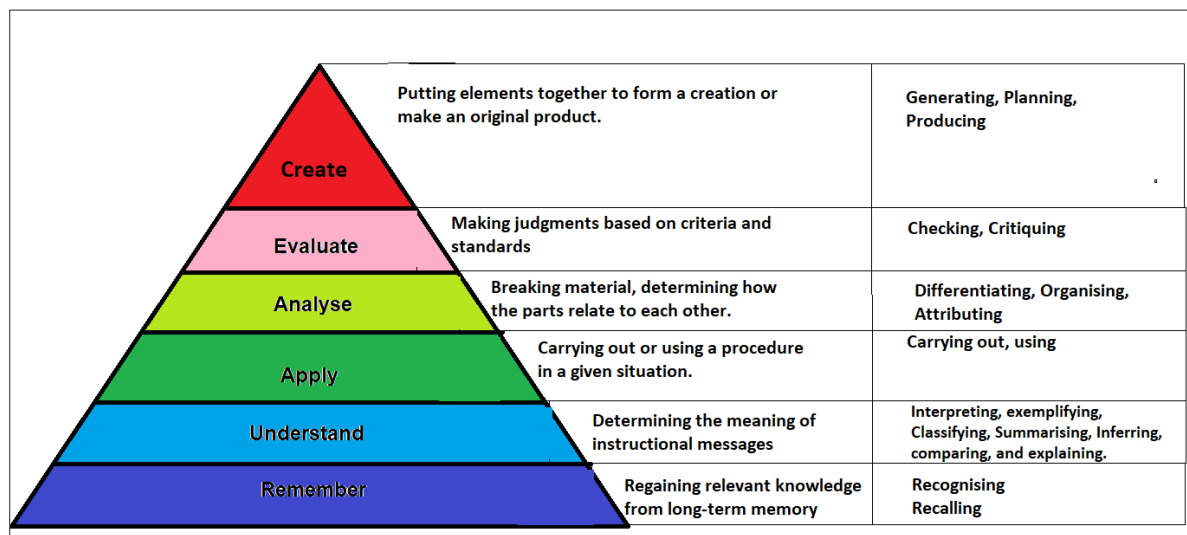


Figure 2: Bloom's taxonomy

Source: (Hwang, Challagundla, Alomair, Chen, and Choa, 2023).

2.5 Challenges of Generative AI in Formative Assessment in Higher Education

The following subsections discuss some of the identified challenges.

2.5.1 Overreliance on Technology

The sudden accessibility of generative AI tools to students in recent years came without warning to curriculum planners. Whilst AI applications are good tools for learners and teachers in their Formative Assessment tasks, lack of formal training on its use has resulted in overreliance. Some learners now turn to AI, even for basic assessment tasks that require individual input (Ivanov, 2022). Resorting to AI applications promotes laziness among students poorly prepared teachers may not identify student dishonesty.

2.5.2 Lack of understanding of AI

Many institutions have yet to establish meaningful support for using AI by students. Lack of proper training on using any technology might result in undesirable results. Proper training may equip learners and teachers with the relevant skills for engaging AI systems to guarantee better results (Velandar, Taiye, Otero, and Milrad, 2024)..

2.5.3 Output dependency on data quality

The output given by AI applications depends on the quality of data available for use by the system, which doesn't guarantee good quality at all times. Research has shown that AI systems' output is biased towards available data (Ntoutsis, Fafalios, Gadiraju, Iosifidis, Nejd, Vidal, Ruggieri, Turini, Papadopoulos, Krasanakis, and Kompatsiaris, 2020).

2.5.4 Ethical concerns

Plagiarism and academic dishonesty are some of the common issues encountered in Higher education. Akgun and Greenhow (2022) identified privacy, surveillance, autonomy, bias, and discrimination as ethical issues arising from using AI in education. Proper training of users is required to appraise the AI users in HE on the ethical implications involved with the use of AI.

2.6 Summary

With the established application of AI in teaching and learning in section 2.1 and the prospects of AI in Formative Assessment discussed in section 2.3, the availability of generative AI applications will reshape the approach to Formative Assessment in higher education. An analysis of the various dimensions of Formative Assessment

shows that some conventional dimensions will become ineffective in this era of generative AI. The methodology of the study is explained below.

3. Methodology

Underpinned by interpretivism, this study adopted a qualitative approach to interrogate the perspectives of Formative Assessment in the advent of generative AI within the Higher Education context in South Africa. Qualitative research tools such as interviews, document analysis and observation were employed. The study focused on understanding students' and lecturers' subjective experiences using generative AI applications for formative assessment in Higher Education. According to Alam (2021), qualitative researchers are inclined to illustrate and explore social issues rather than social structures, and qualitative research is more suitable for understanding the actual behaviour of human interactions, meanings, and procedures that establish actual organisational surroundings.

Based on the survey design, the study sampled students and lecturers from various departments at the University of Venda. Probability purposive sampling was applied to select students and lecturers from various departments for interviews. The purposive sampling method allows the researcher to select the most appropriate objects based on their knowledge and ability to reply to the study queries (Alam, 2021).

The study conducted semi-structured interviews to gain an in-depth understanding of generative AI perspectives from the interviewed sample of students and lecturers. The researchers prepared questions and themes based on the studied phenomena. The study also interviewed specialists in the field of educational technologies. Open-ended questions allowed the specialists to avoid the potential for biased responses (Velandar et al., 2024). The researchers transcribed the interview audio recordings and used the software ATLAS.ti to analyse the data.

4. Findings

The study identified three groups of participants in the survey. As shown in Table 1, twenty students and ten Lecturers from different university departments at the University of Venda were selected and interviewed. Students were tested on the awareness of generative AI applications to qualify for selection. Probing questions were used to identify lecturers who could share more information regarding the discussion topics. The last participants were the Experts in Technology in Education, and two experts participated.

Table 2: Participants

Participants	Number
Students	20
Lecturers	10
Experts in Technology in Education	2

Source: Author, (2024)

Data from the participants was analysed using the framework thematic analysis. Thematic analysis is a process of recognising, analysing, and reporting themes from data, and it is characterised by its flexibility (Alam, 2021). All the information extracted from the interviews was transcribed and imported to ATLAS.ti. Four themes were identified for discussion from the interview data. These include the objectives of Formative Assessment in Higher Education, the relevance of generative AI in formative Assessment in HE, the challenges of using generative AI applications by students for FA tasks, and possible strategies to facilitate the positive use of generative AI for Formative Assessment in HE. The themes were derived from the coding process using ATLAS.ti, and codes were analysed by relating to the findings from the literature review.

4.1 The Objectives of Formative Assessment in Higher Education

Section 2.3 discusses the role of formative assessment as revealed by the literature. Empirical evidence from the interviews confirmed the findings from the literature. Both students and lecturers attested to the relevance of Formative Assessment in teaching and learning in higher education.

4.1.1 Customised Learning

Formative Assessment allows the lecturer to give customised feedback to individual students, which helps address individual student challenges (Mahabeer and Akoo, 2021). The interviewed students expressed satisfaction with the personalised examples of improving their performance. The lecturers also confessed how Formative Assessment allows them to address individual student challenges and appraise and encourage performing students individually. As part of the response to the interview question, "What is your opinion on

the role of Formative Assessment in your teaching and learning activities?" the following extracts were captured from students' and lecturers' responses.

"It gives me a chance to demonstrate my understanding of the content to the lecturer, which I can't do in a lecture, and the lecturer gives me personalised advice on improving". Student 3. Quote 2.

"Engaging students through their submissions for assessment tasks allows you to understand individual students and their strengths and weaknesses. This is difficult to achieve during lectures where some students never engage you as the lecturer". Lecturer 4. Quote 5.

4.1.2 Enhancing Motivation and Confidence

Leenknecht et al. (2021) alluded to the role of formative assessment in motivating students. Lecturers' feedback can change how students perceive their competence in a particular module and encourage them to improve. This view has also been captured from the interviews with students and lecturers, as quoted below:

"There are modules I only got encouraged after receiving feedback on an assessment task, and I realised I can do better". Student 11. Quote 3.

"You may notice some change in the attitude of some students to the module after giving them feedback on tasks. Some will only start taking the module more seriously than before." Lecturer 3. Quote 2.

4.1.3 Enhancing Communication Skills

Fundamentally, Formative Assessment enhances high-quality communication, relationships, and subject knowledge (Morris, Perry, and Wardle, 2021). In large classes, a few students can engage directly during lectures. Assessment tasks allow students to communicate themselves in the context of the subject matter, which, in turn, will enhance their communication skills. Students and lecturers confirmed that, as captured in some of the quotes.

"Assessment tasks have made me realise that, at times, I think I know, but I just fail to express what I know in the correct language. Feedback from lecturers has always helped me improve before sitting for my final exam," Student 13. Quote 4.

"Some students struggle to express themselves and only improve after a few assessment tasks." Lecturer 9. quote 3.

4.1.4 Enhancing Real-Time Feedback

Feedback is the most important aspect of formative assessment, which may be important in teaching and learning in real-time. Students then reflect and improve before forgetting the content (Wisniewski et al., 2020; Morris et al., 2021). Below are some of the quotes from student lecturer interviews that confirmed this.

"The formative assessment task allows me to reflect on the content taught soon after the lectures. The feedback also improves my understanding of recent lecture content." Student 17. Quote 4

"Formative assessment allows an immediate follow-up to evaluate class objectives and to give remedial action before students forget about the subject content of the class" Lecturer 8. Quote 3.

The students and lecturers interviewed confirmed the established role of Formative Assessment in higher education. Some students were unfamiliar with the term, but once the interviewer revealed what it constitutes, they could identify it and comment accordingly.

4.2 The relevance of generative AI in formative Assessment in Higher education

One of the objectives of this study was to establish the relevance of generative AI in formative assessment in higher Education. Section 2.1 discusses the application of AI in Education in general. An analysis of the role of Formative Assessment in Education also reveals how generative AI may contribute to Formative Assessment. The literature review revealed that generative AI enhances real-time feedback (Thomas, Gatz, Gupta, Lin, Tipper, and Koedinger, 2024), provides motivation and confidence to students (Cao & Dede, 2023), enhances communication skills (Yan, Nakajima, and Sawada, 2024), promotes customised learning (Guo, Yi, and Liu, 2024), and promote student engagement. The interviews with students and lecturers confirmed the above; the following quotes allude to that.

"When using Chat GPT, you can get immediate assistance on tasks anytime and with any quarries. The submitted work is immediately graded, and feedback will be given soon after the submission." Student 10. Quote 4.

“In some cases, lecturers use AI to generate assessment tasks particularly targeting certain students based on their performance.” Student 13. Quote 4.

“As lecturers, it’s easier to use AI to generate and deploy many assessment tasks that will all be graded, and feedback given on time. The tasks might target different student competencies, and the different tasks will encourage students to engage each other without one student having to do the task and allow others to copy.” Lecturer 5. Quote 3.

The empirical evidence of extracts from students' and lecturers' interviews confirms the relevance of generative AI in teaching and learning. Students and lecturers appreciate the use of generative AI in teaching and learning.

4.3 Challenges of using generative AI Applications by students for FA Tasks

These challenges are classified under the following: Over-reliance on technology, ethical concerns, poor quality of output, and lack of support. The following quotes from students and lecturers confirm the above:

“As students, we sometimes don’t try to understand the tasks given. We rush to Google for answers from the internet. We also copy what comes up, paste it, and then submit it to the lecturer without engaging it. This means the search will be poorly done if one does not understand the task” Student 19. Quote 4.

“I have had problems with lecturers marking me wrong when I have used the internet (Chat GPT) to research answers to certain tasks. One lecturer confused me by saying that not everything online is correct.” Student 13. Quote 5.

“Students no longer put effort into tasks. They forwarded the task to Chat GPT and copied what came from there. In most cases, we as lecturers fail to detect plagiarised work due to lack of expertise, and students get away with it.” Lecturer 7. Quote 5.

“Institutions are not up to standard with acquiring tools to monitor abuse of generative AI by students who appear to be more resourceful than the lecturers. The lecturers also get lazy and resort to overuse AI to generate and grade assessment tasks.” Lecturer 3. Quote3.

The above quotes reveal challenges such as ethical issues, academic dishonesty, overreliance on technology, plagiarism, inadequate data, and lack of support. This calls for an improved strategy to facilitate the effective use of generative AI for formative assessment tasks.

4.4 Strategies to facilitate the positive use of generative AI for FA in Higher education

The study contributed to the effective use of generative AI by considering possible solutions to the challenges proposed by lecturers and students. Interviews with experts in Educational Technologies gave hints on how best to strategise for the excellent use of generative AI for Formative Assessment in higher education (Dwivedi et al., 2023).

Table 3: Strategies to facilitate Generative AI in Higher Educatio

Challenge	Possible solutions
Overreliance on technology	Students should be advised only to use technology as scaffolding and not entirely depend on it for solutions.
	Use monitoring tools to check plagiarism on student solutions
Lack of understanding of AI	Train students and lecturers on the usage of Generative AI tools
	Lecturers should further engage students to test originality when they suspect fraud.
Output dependency on data quality	Lecturers should know the capacity of AI tools in every task they give.
	The lecturer should devise counter-engagements to improve solutions to tasks further.
Ethical concerns	Licensed tools should be used in the institution to counter academic dishonesty and plagiarism, and lecturers should always be knowledgeable about these tools.

Source: Author, (2024)

5. Discussions

The results suggested that the Objectives of Formative Assessment in Higher Education included customised learning, enhancing motivation and confidence, enhancing communication skills and enhancing real-time feedback. The findings agree with the studies of Mahabeer and Akoo (2021), whose findings indicated that students sometimes ignore feedback. Complimenting the above results is the work by Leenknecht et al. (2021), whose findings suggested that effective feedback positively influences students' actions, involves a dialogue between lecturer and student, and is cyclical, so it must be meaningful and correctly understood before students can correctly implement it.

The findings also demonstrated the significance of generative AI in formative assessment in higher education. This includes the use of Chat GPT, which provides prompt support for assignments and inquiries at any time. By utilising AI, educators may enhance the frequency of assigning work since the process of task creation and generation becomes automated. The findings of Thomas, Gatz, Gupta, Lin, Tipper, and Koedinger (2024) align with the outcomes obtained in this study. Their research indicated that in the Giving Effective Praise lesson, tutors practice reacting to students by offering praise and then getting prompt and standardised feedback provided by LLMs (Cao and Dede, 2023).

The outcomes demonstrated the difficulties encountered by students while utilising generative AI applications for FA tasks, which encompass ethical concerns, academic dishonesty, excessive dependence on technology, plagiarism, insufficient data, and absence of assistance. The investigations conducted by Guo et al. (2024) support the aforementioned conclusions. Their research highlighted the importance of Ethical Considerations and Bias in AI Algorithms, Addressing Privacy and Data Security Concerns, and Empowering Educators to utilise AI effectively. Research conducted by Yan et al. (2024) supports the previous conclusion since it revealed that there are challenges in collaborating with Gen AI in complex learning tasks and considering the differences among students.

Finally, the findings suggested utilising monitoring technologies to detect plagiarism in student responses and develop strategies to enhance task solutions in order to promote the responsible use of generative AI for formative assessment in higher education. The study conducted by Gupta et al. (2024) supports the aforementioned findings. It acknowledges the need to adapt to the fast-evolving educational practices and integrate these changes into our existing educational praxis. Supporting the aforementioned discovery, Dwivedi et al. (2023) conducted research that indicated incorporating generative AI tools into the classroom and instructing students on their constructive and secure usage might equip them with the skills needed to succeed in a work environment dominated by AI after completing their education.

6. Conclusion

The study concluded that the Objectives of Formative Assessment in Higher Education included customised learning, enhancing motivation and confidence, enhancing communication skills and enhancing real-time feedback.

With reference to the significance of generative AI in formative assessment in higher education. The study concluded that the use of Chat GPT provides prompt support for assignments and inquiries at any time. By utilising AI, educators may enhance the frequency of assigning work since the process of task creation and generation becomes automated.

The other conclusion was that both students and lecturers attested to the relevance of Formative Assessment in teaching and learning in higher education. Students and lecturers appreciate the use of generative AI in teaching and learning.

The study also concluded that the difficulties encountered by students while utilising generative AI applications for FA tasks encompass ethical concerns, academic dishonesty, excessive dependence on technology, plagiarism, insufficient data, and absence of assistance.

Lastly utilising monitoring technologies to detect plagiarism in student responses and develop strategies to enhance task solutions in order to promote the responsible use of generative AI for formative assessment in higher education.

7. Contribution and implications

The study contributes to policymakers and education practitioners' assessment policies in higher education institutions. The study also contributes to curriculum development by monitoring technology use in assessment.

In relation to practical implications, policy makers, researchers, educators, and technology experts should work together to start. Conversations on how these evolving generative AI tools could be used safely and constructively to improve education and support students' learning.

8. Research limitations and suggestions for further research

Future research will focus on evaluating the use of generative AI tools in formative assessment tasks to establish the accomplishment of teaching and learning outcomes. This would guide the design of Formative Assessment tasks that eradicate students' abusive tool usage. Assessment tasks should be well-planned to eradicate academic dishonesty. Tools to test plagiarism should be tested to isolate all weaknesses that might be taken advantage of by dishonest students.

References

- Acemoglu, D. and Restrepo, P. (2018) Artificial intelligence, automation, and work. In *The economics of artificial intelligence: An agenda* pp. 197-236. University of Chicago Press.
- Akgun, S. and Greenhow, C. (2022) Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics*, Vol 2, No.3, pp431-440.
- Alam, M.K. (2021) 'A systematic qualitative case study: questions, data collection, NVivo analysis and saturation', *Qualitative Research in Organizations and Management: An International Journal*, Vol 16 No.1, pp1–31. Available at: <https://doi.org/10.1108/QROM-09-2019-1825>.
- Baidoo-Anu, D. and Owusu Ansah, L. (2023) 'Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning', *Journal of AI*, Vol 17, No.1, pp 52–62. Available at: <https://doi.org/10.61969/jai.1337500>.
- Brynjolfsson, E., Li, D. and Raymond, L. (2023) 'Generative Ai at Work', *SSRN Electronic Journal* [Preprint]. Available at: <https://doi.org/10.2139/ssrn.4426942>.
- Cao, L. and Dede, C. (2023) Navigating a world of generative AI: Suggestions for educators. *The next level lab at harvard graduate school of education*, Vol 5 No. 2.
- Chen, L., Chen, P. and Lin, Z. (2020) 'Artificial Intelligence in Education: A Review', *IEEE Access*, Vol 8, pp 75264–75278. Available at: <https://doi.org/10.1109/ACCESS.2020.2988510>.
- Dwivedi, Y.K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A. and Galanos, V. (2021) Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International journal of information management*, Vol, 57, pp 101994.
- Erickson, J.A., Botelho, A.F., McAteer, S., Varatharaj, A. and Heffernan, N.T. (2020) March. The automated grading of student open responses in mathematics. In *Proceedings of the tenth international conference on learning analytics & knowledge* pp. 615-624
- Fitria, T.N. (2021) 'Artificial Intelligence (AI) in Education: Using AI Tools for Teaching and Learning Process', *Prosiding Seminar Nasional & Call for Paper STIE AAS*, Vol 4, No. 1, pp 134–147. Available at: <https://prosiding.stie-aas.ac.id/index.php/prosenas/article/view/106>.
- Gupta, R.P.(2024) On Dark Matter and Dark Energy in CCC+ TL Cosmology. *Universe* Vol, 10,pp 266.
- Guo, H., Yi, W. and Liu, K. (2024) 'Enhancing Constructivist Learning: The Role of Generative AI in Personalised Learning Experiences', Vol 1, pp 767–770. Available at: <https://doi.org/10.5220/0012688700003690>.
- Groen, J. and Germain-Rutherford, A. (2021) 'Number1 6 7 » Fall 2 0 2 1 » Student Engagement: Perspectives Within a Canadian University'. Available at: www.wiley.com/go/citizenship.
- Hwang, K., Challagundla, S., Alomair, M., Chen, L.K. and Choa, F.S. (2023) Towards AI-assisted multiple-choice question generation and quality evaluation at scale: Aligning with Bloom's Taxonomy. In *Workshop on Generative AI for Education*
- Ivanov, S.H., (2022). AI2AI marketing: Foundations and research agenda. *ROBONOMICS: The Journal of the Automated Economy*, Vol, 3, pp 26.
- Karan-Romero, M., Salazar-Gamarra, R.E. and Leon-Rios, X.A. (2023) Evaluation of attitudes and perceptions in students about the use of artificial intelligence in dentistry. *Dentistry Journal*, Vol 11, No.5, pp 125.
- Koka, R., Brêmane, A.J. and Koçe, T. (2023) Formative assessment in higher education: From theory to practice. *European Journal of Social Science Education and Research*, Vol 10 No.4, pp.79-89.
- Leenknecht, M. et al. (2021) 'Formative assessment as practice: the role of students' motivation', *Assessment and Evaluation in Higher Education*, Vol 46, No. 2, pp 236–255. Available at: <https://doi.org/10.1080/02602938.2020.1765228>.
- Li, K.C. and Wong, B.T.M. (2023) 'Artificial intelligence in personalised learning: a bibliometric analysis', *Interactive Technology and Smart Education*, Vol 20, No. 3, pp 422–445. Available at: <https://doi.org/10.1108/ITSE-01-2023-0007>.
- Mahabeer, P. and Akoo, F.F. (2021) 'Connecting assessment and feedback: A customised and personalised experience for knowledge-building', *Journal of Education (South Africa)*, Vol 83, pp 87–110. Available at: <https://doi.org/10.17159/2520-9868/i83a05>.
- Maier, S.B., Jussupow, E. and Heinzl, A., 2019. Good, bad, or both? Measurement of physician's ambivalent attitudes towards A

- Menéndez, I.Y.C., Napa, M.A.C., Moreira, M.L.M. and Zambrano, G.G.V.(2019) 'The importance of formative assessment in the learning teaching process', *International journal of social sciences and humanities*, Vol 3, No. 2, pp 238–249. Available at: <https://doi.org/10.29332/ijssh.v3n2.322>.
- Mohammad, S.J., Hamad, A.K., Borgi, H., Thu, P.A., Sial, M.S. and Alhadidi, A.A. (2020) How artificial intelligence changes the future of accounting industry. *International Journal of Economics and Business Administration*, Vol 8, No.3, pp.478-488.
- Morris, R., Perry, T. and Wardle, L. (2021) 'Formative assessment and feedback for learning in higher education: A systematic review', *Review of Education*, Vol 9, No. 3, pp 1–26. Available at: <https://doi.org/10.1002/rev3.3292>.
- Mulliner, E. and Tucker, M. (2017) Feedback on feedback practice: perceptions of students and academics. *Assessment & Evaluation in Higher Education*, Vol 42, No2, pp266-288.
- Ntoutsis, E., Fafalios, P., Gadiraju, U., Iosifidis, V., Nejdil, W., Vidal, M.E., Ruggieri, S., Turini, F., Papadopoulos, S., Krasanakis, E. and Kompatsiaris, I. (2020) 'Bias in data-driven artificial intelligence systems-An introductory survey', *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, Vol 10, No. 3, pp 1–14. Available at: <https://doi.org/10.1002/widm.1356>.
- Opesemowo, O.A.G. and Adekomaya, V. (2024) 'Harnessing Artificial Intelligence for Advancing Sustainable Development Goals in South Africa's Higher Education System: A Qualitative Study', *International Journal of Learning, Teaching and Educational Research*, Vol 23, No. 3, pp 67–86. Available at: <https://doi.org/10.26803/ijlter.23.3.4>.
- Okulicz-Kozaryn, W., Korneliuk, B., Kupczyk, T., Kalaman, O., Jasinowski, A., Artyukhov, A., Artyukhova, N., Malovychko, A. and Volk, I. (2023) Threat of Artificial Intelligence to the higher education services: statistical analyses in selected Eastern European countries. *Nowoczesne Systemy Zarządzania. Modern Management Systems*, Vol 4, pp 89-104.
- Pannu, A. (2015) 'Artificial Intelligence and its Application in Different Areas', *International Journal of Engineering and Innovative Technology (IJEIT)*, Vol 4, No. 10, pp 79–84.
- Thomas, D.R., Gatz, E., Gupta, S., Lin, J., Tipper, C. and Koedinger, K. (2024) 'Using Generative AI to Provide Feedback to Adult Tutors in Training and Assess Real-life Performance', *Files.Osf.io*, pp 1–12. Available at: <https://files.osf.io/v1/resources/n9w4b/providers/osfstorage/662919b0f49cdf1556d25371?action=download&direct&version=1>.
- Trumbull, E. and Lash, A., (2013) *Understanding formative assessment. Insights form learning theory and measurement theory*. San Francisco: West Ed, Vol 1, pp 20.
- Velander, J., Taiye, M.A., Otero, N. and Milrad, M.(2024) 'Artificial Intelligence in K-12 Education: eliciting and reflecting on Swedish teachers' understanding of AI and its implications for teaching & learning', *Education and Information Technologies*, Vol 29, No. 4, pp 4085–4105. Available at: <https://doi.org/10.1007/s10639-023-11990-4>.
- Vermesan, O., Bröring, A., Tragos, E., Serrano, M., Bacciu, D., Chessa, S., Gallicchio, C., Micheli, A., Dragone, M., Saffiotti, A. and Simoens, P. (2022) Internet of robotic things—converging sensing/actuating, hyperconnectivity, artificial intelligence and IoT platforms. In *Cognitive hyperconnected digital transformation*, pp. 97-155, River Publishers.
- Wisniewski, B., Zierer, K. and Hattie, J. (2020) 'The Power of Feedback Revisited: A Meta-Analysis of Educational Feedback Research', *Frontiers in Psychology*, Vol 10, pp 1–14. Available at: <https://doi.org/10.3389/fpsyg.2019.03087>.
- Wong, Z.Y. and Liem, G.A.D. (2022) Student engagement: Current state of the construct, conceptual refinement, and future research directions. *Educational Psychology Review*, Vol, No.34,1, pp107-138.
- Yan, W., Nakajima, T. and Sawada, R. (2024) 'Benefits and Challenges of Collaboration between Students and Conversational Generative Artificial Intelligence in Programming Learning: An Empirical Case Study', *Education Sciences*, Vol 14, No. 4. Available at: <https://doi.org/10.3390/educsci14040433>.
- Zawacki-Richter, O., Marín, V.I., Bond, M. and Gouverneur, F. (2019) 'Systematic review of research on artificial intelligence applications in higher education – where are the educators?', *International Journal of Educational Technology in Higher Education*, Vol 16, No. 1. Available at: <https://doi.org/10.1186/s41239-019-0171-0>.
- Zhaier, X., Chu, X. and Chai, C.S. (2021) 'Una revisión de la Inteligencia Artificial (IA) en la educación de 2010 a 2020', *Boletín das ciencias, Hindawi -Complexity*, Vol 34, No. 93, pp 73–74
- Zhai, X., Chu, X., Chai, C.S., Jong, M.S.Y., Istenic, A., Spector, M., Liu, J.B., Yuan, J. and Li, Y. (2021) A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, 2021(1), p.8812542