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Usage and Perceptions of ChatGPT as a Pedagogical Resource among Secondary School Science Teachers: A Survey-Based Study

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Usage and Perceptions of ChatGPT as a Pedagogical Resource among Secondary School Science Teachers: A Survey-Based Study

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Dissertation submitted in partial fulfilment of the award of

Professional Master of Education in Post-Primary

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Abstract

This study explores the attitudes of Irish secondary school science teachers towards adopting and applying ChatGPT in education. Adopting a quantitative research approach with randomised sampling, questionnaires were administered to post-primary school teachers. The findings reveal positive perceptions towards the use of ChatGPT but highlight concerns about cheating and dependency on artificial intelligence. Additionally, this study addresses the need for comprehensive teacher training on such tools and the establishment of ethical practices. Recommendations include policy development and regulation, extensive teacher training surrounding ChatGPT, and future research on the long-term impact of ChatGPT on teaching and learning practices.

Acknowledgements

I would like to dedicate this dissertation to my supervisor, my parents, and my two sisters who have supported me throughout this process

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List of Acronyms and Abbreviations

AI	Artificial intelligence
AIEd	Artificial intelligence in education
CBA	Classroom-based assessment
CPD	Continued professional development
DEIS	Delivery Equality of Opportunity in Schools
DOE	Department of Education
EU	European Union
GDPR	General Data Protection Regulation
ICT	Information and communications technology
LLM	Large language models
NLP	Natural language processing
SEN	Special educational needs
TAM	Technology acceptance model
USA	United States of America

Chapter 1: Introduction

'Technology will never replace great teachers, but technology in the hands of great teachers can be transformational.' - George Courols

1.1 Origin of the Dissertation

The quote mentioned above shows that technology and teaching are interdependent and cannot be separated from one another. Artificial Intelligence (AI) has been described as the ability of technology to learn new scenarios, reason, solve problems, answer questions, solve queries, and other tasks that require a certain level of intelligence normally associated with human beings (Coppin, 2004, p. 4). In recent years, there have been forms of generative AI called Large Language Models (LLM), which can generate human-like language (OpenAI, 2023). In an educational setting, AI has been incorporated into administration, teaching, and learning (Chassignol et al., 2018). Nevertheless, Celik (2023) noted that educators have not optimally incorporated AI in learning environments. This thesis will explore the use of ChatGPT, one such AI LLM (Fauzi et al., 2023), in a post-primary school science class from the perspective of the teacher.

1.2 Background to Study

When the researcher posed the question 'Is ChatGPT useful in a science secondary school classroom in 50 words?' to ChatGPT, the AI LLM responded with the below text:

'ChatGPT holds potential as a valuable resource in science secondary school classrooms, supporting interactive and engaging learning experiences. Its incorporation may enhance student engagement, facilitate conceptual understanding, and provide opportunities for personalised and adaptive instruction. However, further research is needed to fully explore its effectiveness and ethical considerations.' (OpenAI, 2023).

The use of ChatGPT in educational settings has had significant impacts, including fostering student curiosity, improving questioning skills, creating educational resources like flashcards and lesson plans, and introducing new teaching and learning methodologies (Kasneci et al.,

2023). However, some ethical concerns have been raised surrounding the use of ChatGPT, including copyright issues, bias and fairness, overreliance on the models by learners and teachers, and challenges in distinguishing between student and model-generated responses (ibid.).

Notably, a European Union (EU) law titled 'The Artificial Intelligence Act' was provisionally passed on 6 June 2023, which outlines the guidelines for the use of AI in education (European Parliament, 2023). Article 9 of the law emphasises the importance of mitigating risks associated with high-risk AI systems, their intended purposes, and reasonably foreseeable instances of misuse (European Parliament, 2023, p. 48). The need for control measures, information provision, and training of users is also highlighted (ibid.). Other factors that need to be taken into account include technical knowledge, experience, education, and the context in which the AI system is to be deployed (ibid.).

1.3 Rationale

Several countries have added and implemented ChatGPT to their school curriculum, though this list of countries does not include Ireland (UNESCO., 2022). One of the aims of this research is to identify whether or not teachers think the LLM, ChatGPT, should be more visible in the science class. Furthermore, considering the EU AI Act (2023), this research aims to know whether teachers would be willing to have financial and time resources devoted to their training in LLMs.

Presently, teachers hold diverse opinions as to whether AI should be adopted in educational settings or not (Baidoo-Anu and Owusu Ansah, 2023). Advocates regard ChatGPT and generative as the future bedrock of education that will guide teaching, learning, and research. Contrastingly, many of the sceptics see it as a future threat to traditional education, fostering passivity and eroding analytical abilities, not just in teachers but also in students (ibid.). Thus, this study aims to understand the viewpoints of Irish science teachers regarding the implementation of AI LLMs in their classrooms.

This research also aims to fill the gap in the present understanding of teachers' perceptions and usage of ChatGPT in Irish science classrooms. A further study aim is to provide invaluable insights into how ChatGPT can improve student attainment and guide teachers into its optimal use.

1.4 Dissertation Layout

This dissertation has six chapters, each attempting to serve the specified objective within the research. Chapter One serves as an introduction to the aims of the study being carried out. It also provides a succinct background to the research and outlines. Chapter Two describes in detail and reviews the history, current use, and potential use of LLMs like ChatGPT as pedagogical tools, barriers in adopting them into the classroom, and what integrating AI tools into educational settings entails. The results of this literature review formulated the research questions used in the experimental part of the study. Chapter Three lists the methodologies that have been applied, and it holds an extensive review of the quantitative approach. This chapter explains the reasons why the researcher chose that approach, how the participants were selected, and how the survey questionnaire was prepared and expounded on, but also highlights limitations regarding data collection. Chapter Four talks about the results obtained from the research, and Chapter Five engages in critical analysis and highlights the findings. Chapter Six summarises the findings on the main overarching research question and discusses their implications for practice. Furthermore, it provides recommendations for further research and proposes improvements in this study.

1.5 Conclusion

In conclusion, this chapter has described the complex interaction between AI technology, namely ChatGPT, and the possible usefulness of its integration in post-primary science instruction, along with raising awareness on how AI is currently being implemented in learning institutions, the strengths of using AI, and challenges that come with its implementation. This research proposal brings to the foreground, the failure of ChatGPT to be implemented in schools in Ireland and aims at identifying the perception of these

teachers towards the integration of this technology into their classroom. In this chapter, the reader is introduced to the topics that will be covered in the literature review in Chapter Two, which will explain the history and development of AI language models, their current and future applications, and the challenges faced in implementing their use in education. It also presents the basis for the research questions and methodological approach of the current study.

Chapter 2: Literature Review

2.1 Introduction

The present literature review will focus on various themes that have arisen regarding the integration and perception of AI technologies, more particularly ChatGPT, within educational contexts. In section 2.2, the discussion surrounds the transformative power of AI and technology within education, with its promise to influence positive learning and teaching experiences. The nuanced understanding of the potential and limitations of using high technology in education, particularly AI, will also be looked into in this section. In section 2.3, the adoption of ChatGPT by students will be examined, along with its potential to bring about change in traditional pedagogy, prompting educators to adopt AI technologies into their teaching methods gradually. This will then be followed by a discussion on the possible applications of ChatGPT in a science classroom, with particular emphasis on considering its capabilities, benefits, and specific instances in which it may enhance the learning experience for a secondary-level education setting. Finally, this section examines challenges that are associated with the use of ChatGPT in education, ranging from concerns related to accuracy and reliability to approaches to learning, how chatbots can be used efficiently for assignment generation and student evaluation, and what can be done in the face of such challenges. Section 2.4 evaluates the training of teachers and learners on ChatGPT to tackle the challenges offered by ChatGPT in an educational context. Section 2.5 focuses on investigating teachers' perceptions and adoptions of ChatGPT in classrooms. Finally, the conclusion summarises key themes from the literature review in anticipation of the upcoming study. The research questions naturally emerge from and conclude the review.

2.2 AI and its Implications in Education

The educational landscape of the twenty-first century has been hugely reshaped by fast-paced technological advancements, prominently exemplified by AI (Baidoo-Anu and Owusu Ansah, 2023). Huang, Spector and Yang (2019, p. 14) note that educational technology is a domain with a comprehensive range of practices put forward by utilising and implementing

several technologies, tools, methodologies, resources, and processes. Indeed, AI is anticipated to play a vital role in the classroom benefitting both students and teachers (Sharma et al., 2021). AI technologies can act as personalised tutors, create customised learning experiences, give feedback to students, automate administrative work, enable teachers to act more as facilitators of education, and create virtual lectures, to name a few (ibid). Furthermore, the Department of Education (DOE) is working on comprehensive guidelines regarding the proper use of AI in Irish schools in terms of safety, effectiveness, and compliance with ethical standards (DOE, 2024). These guidelines will be based on the opportunities, risks, and factors that should be taken into account for the integration of AI, which will be evaluated and revised with the help of Oide and in cooperation with the EU and other member states (ibid.).

AI in education (AIEd) is the application of AI technologies into learning environments (Luckin and Holmes, 2016). However, despite its potential, the field has limitations (ibid.). Seo et al., (2021) commented on a gap in knowledge of its impact on both the dynamics of student-instructor interactions and prevailing norms. Moreover, achieving favourable educational outcomes goes beyond simply deploying advanced infrastructures of AI and advanced computing tools (Castañeda and Selwyn, 2018). However, very few studies have explored the explicit multifaceted roles of AIEd, how these link to established theories in education, and whether these AI technologies define learning and instruction (Hwang et al., 2020). Indeed, a recent paper by Campbell (2022) expresses a need for an AI-empowered learner-as-leader approach to be recognised and integrated into the academic literature in the AIEd field. Building on learner agency, a theme identified in Bandura's conceptualisation (2006), this approach places the learner at the heart of AIEd (Campbell, 2022). Learners are expected, under this framework, to use AI techniques in a way that will empower their cognitive abilities (Campbell, 2022). This seems to indicate a need for more research to achieve complete clarity on the best use of AI technologies within classrooms.

2.3 ChatGPT in the Classroom and its Limitations

2.3.1 Student Adoption of ChatGPT

LLMs, like ChatGPT, have had substantial improvements in the field of Natural Language Processing (NLP) (Kasneci et al., 2023). With training on extensive text data, these models produce human-like text, can answer questions, and competently perform language-based tasks (ibid.), and may facilitate the integration of AIEd (Lo, 2023). OpenAI launched ChatGPT in November 2022, and within a mere two months, it had achieved over 100 million active users, showing how quickly the tool became popular (Hu, 2023). Indeed, a survey by Studyclix (2023) found that one in five Irish students has used ChatGPT for school-related tasks. This student usage number is even higher in The United States of America (USA), where 42% of 1002 students surveyed had used ChatGPT for schoolwork as of July 2023 (Impact Research, 2023). The vast user base of students using ChatGPT hints at a potentially changing norm in conventional learning approaches, which may influence a new set of learning dynamics and compel educators to adapt alongside the infusion of AI technologies like ChatGPT.

2.3.2 Potential Use of ChatGPT in the Science Classroom

Despite the limited research on the integration of chatbots into secondary-level schools (Bitzenbauer, 2023), ChatGPT exhibits a versatile range of capabilities. It can be used for language translation, summarising text, answering questions, generating test questions, carrying out immediate grading, creative writing, providing conversational answers, and explaining complex topics or ideas in simpler terms (Adiguzel et al., 2023; Farrokhnia et al., 2023). Additionally, Farrokhnia et al., (2023) highlight ChatGPT's potential to reduce teacher workloads when used as a feedback tool for tasks, essays, and assignments. Furthermore, according to Atlas (2023), it can generate comprehensive lesson plans, engaging presentations, and educational resources. This extra support likely makes it easier for teachers to use materials for various learning needs, potentially allowing for more innovative teaching techniques and activities (Grassini, 2023). Once teachers' routine tasks are streamlined, they will have more opportunities to reflect, innovate, and develop new

teaching methodologies (ibid.). While the conventional role of a teacher may not be entirely replaced by AI, the continued evolution of LLMs and other AI-driven digital tools holds significant promise for enhancing the experiences of both students and teachers (Cope et al., 2021).

Notably, emerging research on integrating chatbots in educational settings, particularly in secondary schools, is nascent (Bitzenbauer, 2023). Despite this, the physics education domain is poised to explore the potential and functionalities of AI systems like ChatGPT (Wang, 2023). Additionally, a study conducted by Bitzenbauer (2023) on two twelfth-grade physics classes in a German high school has shown that ChatGPT may be adopted as a pedagogical tool to improve critical-thinking skills, this being a key skill in the Irish Leaving Certificate programme (National Council for Curriculum and Assessment, 2009). Inspired by the think-pair-share method, teachers can also facilitate text generation, critical analysis, revision, and discussion amongst the students (Bitzenbauer, 2023). In this process, the students compare with existing knowledge, revise using multiple sources, and assess the accuracy of information (ibid.). The use of reasoning generation by ChatGPT further facilitates comprehensive, engaged discussion, even those not conforming to some viewpoints (ibid.). Furthermore, a study by AlAfnan et al., (2023) suggested that teachers could support using ChatGPT in formal and informal learning environments, primarily to search for definitions, insights, or explanations of terms. Nevertheless, the study discourages its use for tasks requiring written assessments or official submissions (ibid.). However, the scale of this study was limited to the college level; thus, it underlines how little there is of such kind of research on the general applicability of chatbots and ChatGPT, in particular for use in secondary schools.

2.3.3 Challenges of ChatGPT for Learners and Teachers

Despite its promise, ChatGPT presents challenges to many sectors of education (Sallam, 2023). In particular, it has potential shortcomings related to inaccuracy and unreliability that result from several factors. (AlAfnan et al., 2023; Bitzenbauer, 2023; Lo, 2023; Ray, 2023). The extensive data body that ChatGPT generates is tainted with biases (Farrokhnia et al., 2023; Lo, 2023) such as gender, racial, or cultural biases, novelty and recency biases, and

confirmation and false consensus biases, among others (Ray, 2023). Worryingly facts produced by ChatGPT could be false or fabricated, creating even more challenges for learners (Lo, 2023) and the current absence of updates post-2021 further decreases relevance, academic weight (Baidoo-Anu and Owusu Ansah, 2023), and ability to provide accurate responses (Lo, 2023). Additionally, the model's inability to assess the reliability of its training data(Lecler et al., 2023) weakens its accuracy assessment (Sallam, 2023). To address this, Bitzenbauer (2023) encourages learners to critically assess the quality and coherence of ChatGPT's outputs. Furthermore, researchers advise that using ChatGPT could oversimplify learning and decrease student motivation for independent research, as noted by Farrokhnia et al. (2023). This echoes research by AlAfnan et al., (2023) who argued that dependence on ChatGPT for assignments could harm academic development, promote student reliance on AI, and further reduce student motivation.

The potential for using ChatGPT to generate assignments is a major concern for students and teachers (AlAfnan et al., 2023). Students may find it convenient to rely on AI-generated content, which may pose a problem for the instructors to grade 'robotic' responses (ibid.). Additionally, this phenomenon poses questions about the evaluation of course learning outcomes by teachers and students (AlAfnan et al., 2023; Grassini, 2023). Grassini (2023) highlights that the use of ChatGPT by students creates a challenge for teachers in masking learning deficiencies from them, which makes it difficult for the teachers to provide accurate feedback to the students and develop the necessary intervention strategies. To address this challenge AlAfnan et al., (2023) recommend that instructors can change their assessment approach by offering clear instructions and including aspects that require students to provide background information. Alternatively, Rudolph, Tan and Tan (2023) recommend adopting flipped learning approaches, where students engage with pre-class materials to allow for interactive learning during the lesson Furthermore, instructors can consider approaches like incorporating digital-free elements like the oral presentations to evaluate the students' real-time and face-to-face knowledge and skills (Rudolph et al., 2023; Tlili et al., 2023).

Educators are also being confronted with the difficult role of handling student plagiarism, which can be a significant barrier to assessing a pupil equitably (Lo, 2023). Furthermore, results from research by Bašić et al., (2023) also show that students who use ChatGPT are more prone to copying than their non-using colleagues. Importantly however, the study by Bašić et al., (2023) focused only on fifty, third-level students. In a somewhat contradictory fashion, Grassini (2023) also adds that some students see AI tools as support for learning which can help them hone their skills in essay writing rather than simply being used to detect plagiarism. This was also found to be true by Knight (2021), who stated the need to educate students on the effective use of LLMSs in collaborative writing and discuss its contextual relevance. However, to implement this approach, clear policies must be developed at the program and institution level (Perkins, 2023). These protocols should contain clear academic regulations and common standards for maintaining academic integrity (ibid.).

2.4 ChatGPT training

The Technology Acceptance Model (TAM) developed by Davis (1989) is particularly useful to appreciate the determinants behind technology acceptance among teachers. There are two variables which enhance the level of technology acceptance which according to TAM are perceived usefulness and perceived ease of use (ibid.) Both Farrokhnia et al., (2023) and Kasneci et al., (2023) advocate for teachers to learn how to best utilise ChatGPT for lesson design and assessment. Likewise, García-Peñalvo (2023) argues that the implications of ChatGPT can be managed by training teachers and raising students' awareness in this regard.

Consequently, training teachers to identify whether ChatGPT is employed in student essays through AI exams is necessary (Grassini, 2023) although the recognition of AI-generated content may eventually no longer be feasible as AI improves its ability to generate text closer to human-like writing (Lo, 2023). As such, Grassini (2023) expresses concerns that mitigation strategies may rapidly become obsolete, which resonates with the sentiment Ray (2023) has in this regard. Ray (2023) Ray (2023) questions the increasing challenge of differentiating between writings generated by AI due to the improvement in AI

sophistication, thereby generating concerns regarding academic integrity. Given these concerns, teachers are advised to assist students with a more authoritative source of information, such as reference books, which are able to confirm, and review the information provided by ChatGPT as precise and accurate (Kasneci et al., 2023). Grassini (2023) indicates teacher-student dialogues on ChatGPT as a solution to instil the importance of ethical behaviour and academic integrity. In order to achieve this effectively, instructors are encouraged to openly talk about ChatGPT and their curriculum, thus, stressing the importance of academic honesty as well (Lo, 2023).

2.5 Current Teacher Perceptions and Adoption of ChatGPT in the Classroom

Understanding how people use and perceive AI is of particular importance as this helps determine the successful adoption and integration of AI into educational technologies (Yilmaz et al., 2023). The integration of advanced technological tools and equipment helps modern students learn better as they benefit from increased interactivity using such tools (Raja and Nagasubramani, 2018). This technology-driven method not only enhances engagement but also creates a more interesting and interactive educational setting (ibid.). These findings underscore the need to investigate how teachers currently perceive ChatGPT and how frequently they are using it.

The Diffusion of Innovations theory by Rogers provides a framework for understanding the adoption of new technologies like ChatGPT (Sahin, 2006). This theory states that the rate of adoption follows a normal distribution, with innovators and early adopters being at the forefront, followed by the majority and laggards (ibid.). Interestingly, a survey conducted by the Walton Foundation (2023) found that 63% of the 1000 teachers surveyed in the USA reported having used ChatGPT for their job. The same survey found that teachers have immensely optimistic views on ChatGPT, with 61% believing the tool to have valid educational applications compared with a modest 23% who opine that its primary utility will be for students to cheat (ibid.).

The concern about students cheating is also highlighted in a study conducted by Iqbal, Ahmed and Azhar (2022). In this study, teachers who were interviewed expressed the belief

that students would use ChatGPT 'primarily for cheating' and that it was not possible to 'prevent cheating with ChatGPT' (ibid.). Interestingly, this study also revealed that teachers generally held a pessimistic view about integrating ChatGPT into teaching with some citing that ChatGPT was a 'waste of time' and other teachers saying it was merely 'distracting for both students and teachers' (ibid.). However, this research paper only included twenty, third-level teachers in Pakistan, therefore potential cultural differences to the adoption of ChatGPT should be taken into account. Alternatively, this may indicate that teachers at the secondary level are more optimistic about its potential than their counterparts at the tertiary level. Teacher perception of ChatGPT, as demonstrated by the research presented, is unfortunately limited to non-Irish educational settings and presents contrasting views regarding teacher optimism around ChatGPT adoption. Given these varying perspectives, there arises a clear need for additional research in this domain at a local and global level.

2.6 Conclusion

From reviewing the literature, AI has the potential to bring about a revolution in education. While it claims to enhance learning experience, it is faced with issues like biases, accuracy and how best to incorporate it into teaching. The research discussed showed that ChatGPT is used by students to a great extent, which indicates the need to adjust the educational processes. Teacher training is highly recommended to foster the proper use of AI, as well as raise awareness of AI-created content and plagiarism to uphold academic standards. Understanding the acceptability and attitudes of Irish secondary-level science teachers toward ChatGPT might help to identify the advantages and risks of using it in the Irish educational context. Moreover, findings at the local level may prevent the over-generalisation of teachers' perceptions of ChatGPT.

The research questions emerging from this review are:

1. What are the challenges and opportunities associated with the practical implementation of ChatGPT in Irish secondary-level science classrooms?
2. How do Irish secondary-level science teachers perceive the integration of ChatGPT in their classrooms?

3. To what extent do Irish secondary-level science teachers believe they are adequately prepared and trained to address ethical considerations and effectively integrate ChatGPT into their teaching practices?

These questions are crucial as the use of AI technologies in learning environments increases. The findings of the current study, which focuses on teachers' perceptions and adoption of ChatGPT, will be analysed using quantitative research methods described in the third chapter.

Chapter 3: Methodology

3.1 Introduction

This chapter gives a clear account of the methods employed in this study with emphasis on the systematic approach used in this study. This study used the positivism research philosophy and administered quantitative questionnaires to forty-four secondary school science teachers. A quantitative approach was considered suitable because it allows for having a large number of participants with objective answers.

This chapter provides the rationale for selecting the research paradigm; the author has chosen positivism because of its reliability and scientific approach. It explains how the questionnaire was constructed and distributed, as well as the process of pre-testing to check the validity and reliability of the instrument. In addition, the chapter also covers the sampling procedures applied in the research, the data collection and the analysis of the findings. The ethical considerations and measures that would be taken to enhance the credibility of the study are also discussed to give a clear understanding of the research process.

3.2 Research Paradigm

Methodologies employed in social and educational research processes are shaped by underlying philosophical assumptions (Humphrey, 2013), referred to as paradigms (Guba and Lincoln, 1994). It has been proposed that the choice of a research paradigm is more fundamental than the selection of specific research methods (Saunders, Lewis and Thornhill, 2009). A paradigm can be described as the underlying belief system or worldview that not only influences methodological choices but also shapes the research in fundamentally ontological and epistemological ways (Saunders, Lewis and Thornhill, 2009, p. 106). Saunders, Lewis and Thornhill, (2009) identify four principal research philosophies: Positivism, Pragmatism, Interpretivism, and Realism.

Positivism assumes a single, tangible reality that can be understood, measured, and predicted in a causal framework, emphasising objectivity and dismissing the importance of subjective experiences (Park, Konge and Artine, 2020). Researchers must remain objective and avoid interaction with participants during data collection (ibid.).

Pragmatism as a research paradigm avoids metaphysical debates on truth and reality, accepting multiple realities open to empirical inquiry (Kaushik and Walsh, 2019). It emphasises practical problem-solving, viewing reality as what works, and knowledge as socially constructed (ibid.). Additionally, pragmatism allows researchers to combine qualitative and quantitative methods, focusing on the utility and outcomes of the research rather than adhering to a single philosophical stance (Hall, 2013).

Interpretivism critiques positivism by emphasising subjective perspectives and context-specific variables (Alharahsheh and Pius, 2020). It acknowledges cultural and circumstantial differences shaping social realities, focusing on understanding individual meanings and experiences and preferring qualitative data for deep insights (ibid.).

Realism supports the notion that facts about the world are discoverable through investigation, independent of human perception (ibid.). Sobh and Perry (2006) note that while reality is 'real,' it is imperfectly so; thus, research should aim to dismantle preconceived perceptions during data collection.

3.3 Methodology

This research adopts a positivist approach. Positivism in research involves systematic methods and empirical observation to identify patterns, make predictions, and test hypotheses (Michell, 2003). This approach relies on statistical tools and experiments to gather quantitative data, ensuring that findings are objective, generalisable and replicable across different contexts (ibid.).

3.4 Approach

For this dissertation, the author has chosen a positivist approach, which is rooted in the philosophy of objectivity and empirical measurement (Michell, 2003). Quantitative positivist approaches offer significant advantages in research by enabling the collection of large, representative samples and facilitating the objective measurement of variables (Rahman, 2020). According to Rahmen (2020), research under this paradigm is structured and systematic, using tools such as surveys to collect data that can be statistically analysed. Correctly applied, it provides a structured and reliable way to quantify social phenomena (ibid.). Employing a questionnaire is a widely adopted deductive approach for gathering quantitative data, as noted by Almalki (2016).

3.5 Research Methods

This study adopted a positivist approach, using structured questionnaires to gather quantitative data. The decision to employ questionnaires was informed by a literature review highlighting a gap in knowledge regarding Irish science post-primary school teachers' perspectives on the integration of ChatGPT in educational settings. Given ChatGPT's relative novelty, surveys were deemed more appropriate for capturing a broad range of perspectives from a larger sample size (Wu et al., 2023).

The questionnaire was carefully designed to ensure it covered all relevant aspects of the research topic. Initially, a pilot survey was conducted with three experienced teachers to test the effectiveness and clarity of the questions. This pilot phase was crucial for identifying any ambiguities or issues with the questionnaire format. Feedback from these teachers was invaluable in refining the survey, ensuring that the final version was both comprehensive and user-friendly.

The questionnaire included both short, open-ended questions and closed-ended questions with a five-point Likert scale to quantify teachers' attitudes, experiences, and perceptions regarding the use of ChatGPT in their classrooms (Likert, 1932). This format allowed for efficient data collection and facilitated statistical analysis. Questions were developed based

on key themes identified in the literature review, ensuring that they were relevant and targeted. The structured nature of the questionnaire aligned with the positivist paradigm, enabling the collection of objective, measurable data (Rahman, 2020).

By adopting this approach, the research aimed to provide robust, generalisable findings that could contribute to evidence-based decision-making in educational practices and policy. The structured questionnaire not only streamlined the data collection process but also ensured that the responses could be systematically analysed to uncover patterns and correlations, ultimately enhancing the comprehension of ChatGPT's influence on education.

3.6 Sample and Participants

This study investigated the views of secondary school science teachers on AI-Language Models, specifically ChatGPT, and their application in the classroom. The participants were drawn from the author's placement schools along with other surrounding schools, ensuring a mix of urban and rural settings. However, the study excluded teachers from Delivering Equality of Opportunity in Schools (DEIS) and fee-paying schools, which may limit the generalisability of the results to these groups. Thus, the study does not represent the views of teachers working in DEIS and private schools, who may face different challenges and opportunities.

Additionally, the study employed a single quantitative methodology which was solely based on structured questionnaires as a data collection tool. The absence of methodological triangulation in this study implied that it did not involve qualitative methods, such as interviews and focus groups, which could have offered a more robust dataset and highlighted the contextual and nuanced experiences of the participants. The lack of these nuanced dimensions may restrict the depth of understanding that would allow for the exploration of the multifaceted factors behind teachers' attitudes and perceptions towards ChatGPT.

As data collection was carried out using self-reports through questionnaires, there is a possibility of response bias. Participants may have provided socially desirable answers or

misinterpreted questions, affecting the authenticity of the collected data. While a pilot survey was conducted to improve the questionnaire, these intrinsic problems of self-reported data cannot be fully eliminated. Additionally, ChatGPT's novelty means participants' experience with the tool may be limited, which could impact their responses.

3.7 Data Analysis

Data collection involved using Google Forms, which offers tools for data analysis. Excel generated charts and graphs were created for responses from the forty-four secondary school science teachers, providing bar charts and pie charts, for easy data comparison.

Closed-ended questions involved a five-point Likert scale, and the quantitative data were analysed by determining the frequency of responses to each option. This helped identify overall patterns in teachers' attitudes and perceptions towards using ChatGPT. Additionally, open-ended questions with a maximum word count of 20 words provided additional context and depth to the statistical findings.

Results were analysed quantitatively and automated graphical representations simplified the data analysis process, making it more accurate and consistent. This laid a strong foundation for interpretation and discussions in subsequent chapters.

3.8 Rigour

To ensure the research's accuracy and quality, several steps were taken to maintain objectivity, validity, and reliability. Recognising that personal bias is inevitable, the author involved colleagues and mentors in the peer review process to reduce bias. The principle of bracketing was used, critically scrutinising and disregarding personal biases and prejudices during the research process to achieve the highest level of objectivity.

Data collection instrument reliability and validity have been ensured through the pilot test of the survey that was performed on a small group (N=3) of senior teachers. This phase of the pilot testing was pivotal for examining the appropriateness of the survey questions in terms of their clarity and neutrality. This group was the source of feedback that guided us to

make some changes to the questionnaire, and as a result, the final survey was both comprehensive and unbiased.

Procedures were standardised during the administration of the survey to all participants, and this was followed strictly to maintain consistency in the process of data collection. This standardisation involved uniform guidelines in the way the survey was to be filled and the conditions under which it was to be completed. This eliminated variations and sources of bias.

Although the small sample size (N=44) reduces the generalisability of the findings, rigorous methodological steps increased the research's credibility and reliability. Establishing mechanisms to eliminate biases, ensuring uniform data collection, and validating the survey instrument through pilot testing helped achieve the required degree of rigour in quantitative research.

3.9 Ethical Considerations

Ethical approval was obtained from the Hibernia College Ethics Committee ahead of the start of the research. The researcher took into account the Ethical Guidelines for Educational Research (BERA, 2018) as a basis for the ethical standards that were set and adhered to throughout the research process.

Participants received full information about the study via soft copy before consenting. The online questionnaire described the research ethics, particularly confidentiality and anonymity. Participants were informed their participation was voluntary, and that they could withdraw at any time without consequences.

To comply with BERA (2018) guidelines, an information sheet and consent form were sent via soft copy to school principals to ensure voluntary informed consent. These soft copy forms were then sent to participants to ensure they fully understood the purpose of the research, the nature of their involvement, and their rights. The guarantee of confidentiality and anonymity was crucial in encouraging honest and reliable responses, thereby enhancing the study's validity and reliability.

Following Kang and Hwang (2023), measures ensured participants' information did not reveal their identities. The names of participating schools and respondents were omitted from all data records, including questionnaire responses and subsequent analysis. Data protection and General Data Protection Regulation (GDPR) compliance were considered, with data securely stored for three years before permanent deletion to ensure privacy and confidentiality. These ethical rules, based on respect, integrity, and responsibility, were observed throughout the research study.

3.10 Conclusion

In conclusion, this chapter has outlined the systematic approach used in the study on the integration of ChatGPT in post-primary education. Using positivism as the theoretical orientation and structured questionnaires, the study ensured that only quantitative data that was accurate and credible was collected from teachers who were selected through a random sampling technique. The development of the questionnaire and its pilot testing, as well as the ethical concerns, played a major role in ensuring the credibility of the study.

The results of the implemented methodologies are presented and discussed in the subsequent chapter, where the quantitative data is displayed using charts. These findings are analysed in conjunction with insights from the literature review conducted in Chapter Two. However, it is important to note that this study relies on a single data source, and thus does not achieve triangulation. Future research should consider employing mixed methods to provide a more robust validation of findings through multiple data sources.

Chapter 4: Findings

4.1 Introduction

This chapter presents the findings of the study that aimed at identifying the impact of AI technologies with an emphasis on ChatGPT on teachers in post-primary schools in Ireland. In the first section of the chapter, the authors present details about the experience level of the teachers. This then progresses to examine the current trends in the application of Information and Communications Technology (ICT) in teaching and learning in order to identify the level of integration of these technologies in learning practices.

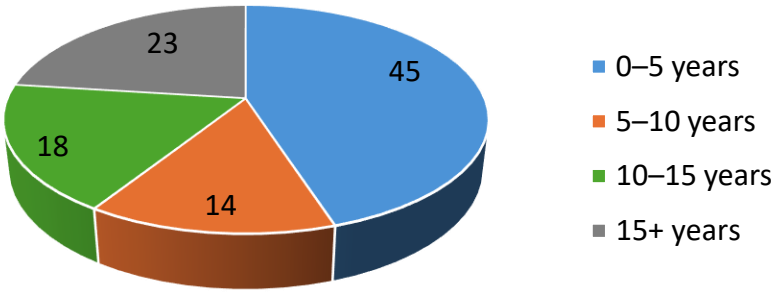
The next sections present the participants' views on ChatGPT, their self-efficacy concerning the tool, perceived benefits and drawbacks, and ethical concerns. The chapter also outlines the issues that may arise when using ChatGPT such as resource constraints and training. Finally, the findings respond to the research question by outlining the key themes and offering a summary of the current developments and future potential of AI applications in education.

4.2 Results

4.2.1 Participants

Overall, the survey was used to gather responses from forty-four qualified Irish teachers. Participants were asked how many years of experience they had as a qualified teacher. Overall, nearly half had the fewest years of qualified teaching experience (45% with 0−5 years), while 14% had 5−10 years, 18% had 10−15 years and 23% had 15+ years of experience (Figure 1).

Figure 1: Duration of Post-Primary Teaching

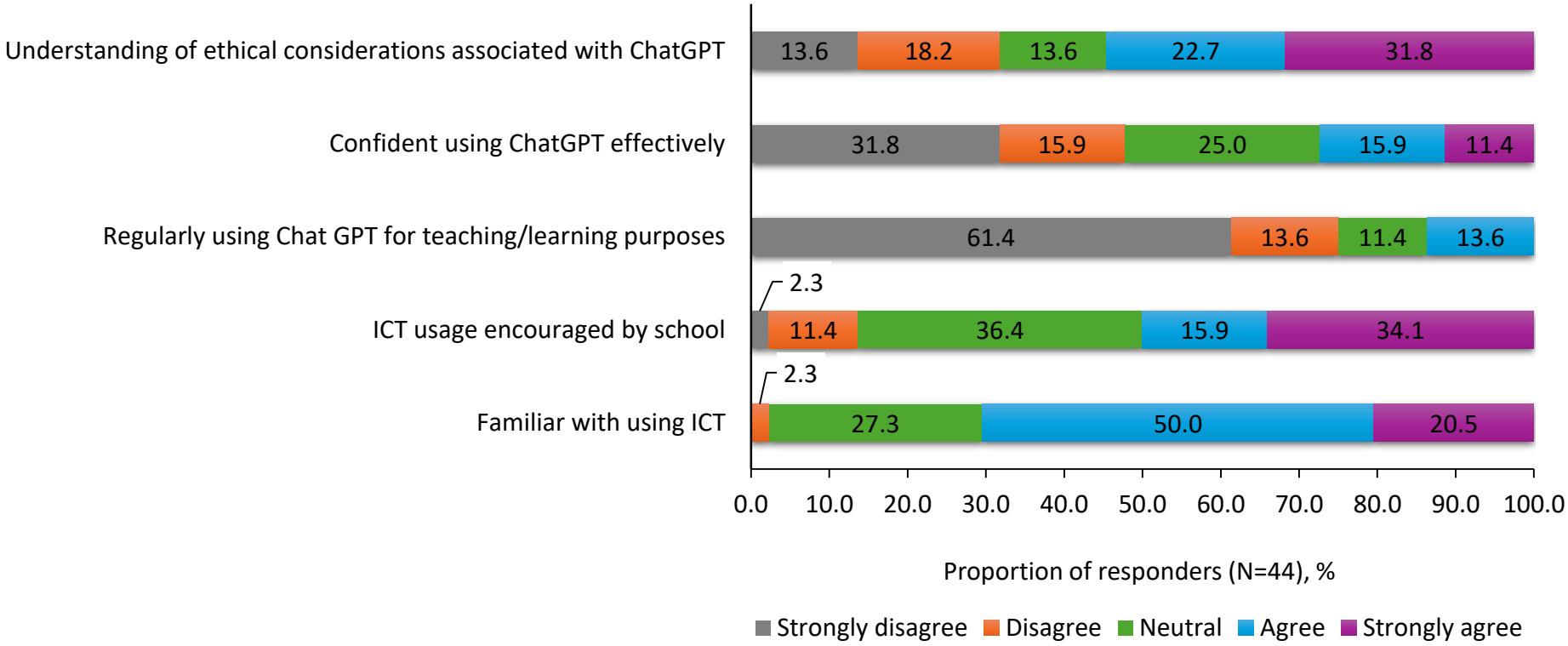


Proportion of responders (N=44), %

4.2.2 Trends in Current ICT Usage

The survey asked participants how many hours per week they incorporate ICT into the Junior or Senior cycle biology, chemistry, physics or agricultural science classroom teaching. Based on responses, twenty participants incorporate ICT for 0–5 hours per week, nine incorporate it for 5–10 hours, five incorporate it for 10–15 hours, five incorporate it for 15–20 hours, and three incorporate it for ≥20 hours.

Figure 2: Attitudes Towards Current ICT Usage



Participants were asked whether they agreed or disagreed with statements relating to current attitudes towards ICT use in the classroom including their familiarity with using ICT, whether ICT use is encouraged by their school, their confidence in using ChatGPT effectively, whether they use ChatGPT regularly, and whether they understand the ethical considerations surrounding ChatGPT. Based on the data presented in Figure 2, 34.1% and 15.9%, respectively, strongly agreed and agreed with the statement that ICT use is encouraged by their school, compared with 2.3% and 11.4%, respectively, who strongly disagreed or disagreed, and 36.4% who were neutral. Most respondents agreed with the statement that they are familiar with using ICT (20.5% and 50.0% strongly agreed and agreed, respectively) versus 2.3% who disagreed and 27.3% who were neutral.

In terms of ChatGPT specifically, more participants disagreed (61.4% and 13.6%, respectively, strongly disagree and disagree) with the statement that they regularly use ChatGPT for teaching and learning compared with those who agreed to use it regularly (13.6% agree). No respondent strongly agreed to using ChatGPT regularly and 11.4% were neutral to the statement. Additionally, 47.7% (31.8% strongly disagree and 15.9% disagree) disagreed with the statement that they were confident using ChatGPT effectively compared with 27.3% (11.4% strongly agree and 15.9% agree) who agreed, while a quarter of respondents were neutral (25.0%).

When asked whether they agree or disagree with a statement related to understanding the ethical considerations of ChatGPT, most participants (31.8% strongly agree and 22.7% agree) claimed to understand compared with 13.6% and 18.2% who strongly disagreed and disagreed, respectively.

4.2.3 ChatGPT-Related Training

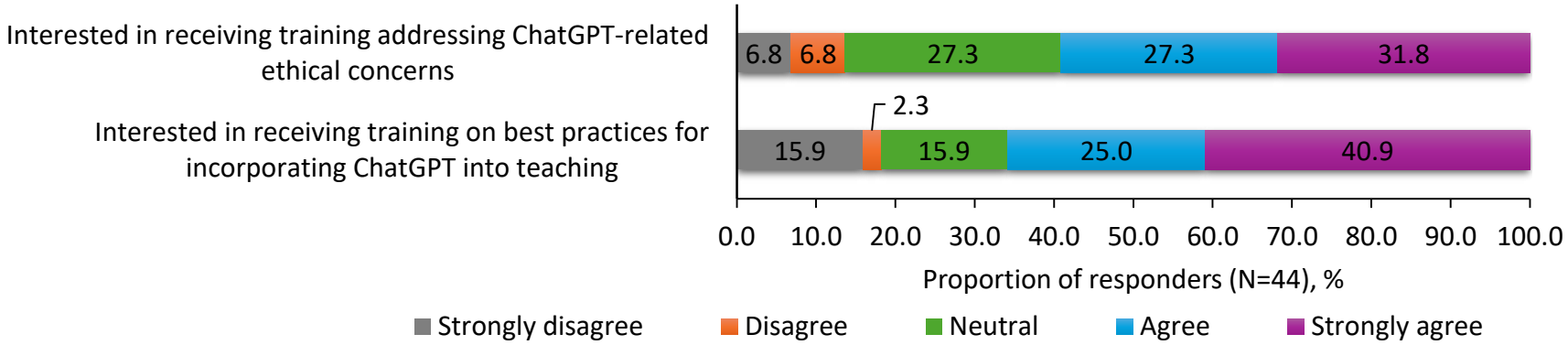
In response to statements indicative of interest in ChatGPT-related training (Figure 3A), 59.1% (31.8% strongly agree and 27.3% agree) agreed with the statement that they would be interested in training about the ethical considerations of ChatGPT, while 27.3% remained neutral and 13.6% disagreed (6.8% strongly disagree and 6.7% disagree). In terms of training on best practices for incorporating ChatGPT into teaching, 65.9% (40.9% strongly agree and

25.0% agree) responded that they would be interested in training, 15.9% were neutral, and 18.2% disagreed (15.9% strongly disagree and 2.3% disagree).

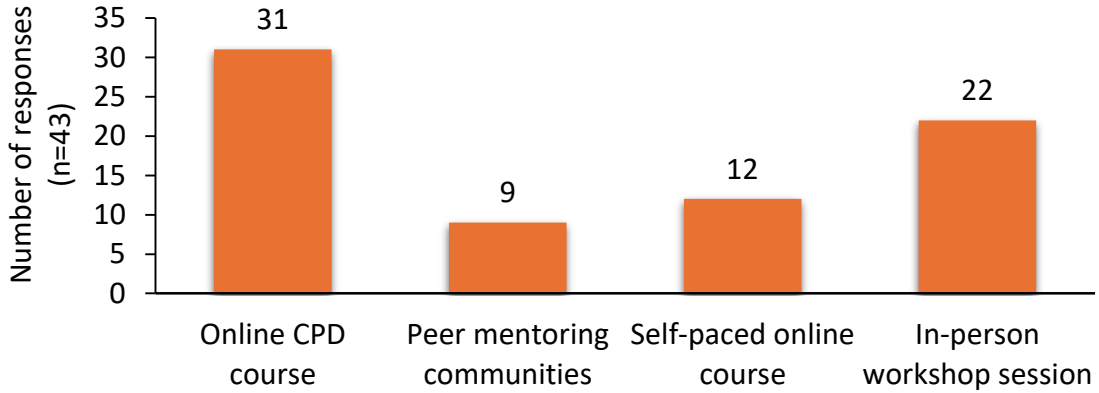
The survey also included a question for participants to choose their preferred format to receive training, whereby participants could choose multiple formats. The most frequently chosen training format was an online Continued Professional Development (CPD) course (Figure 3B), chosen by thirty-one responses, followed by an in-person workshop session (twenty-two responses), a self-paced online course (twelve responses), and peer mentoring committee (nine responses).

A

Figure 3: (A) Interest in ChatGPT-Related Training and (B) Preferred Training Format



B



4.2.4 Attitudes Surrounding the Potential of ChatGPT

When presented with optimistic statements about the potential of ChatGPT in teaching and learning (Figure 4), results were varied whether participants thought that ChatGPT would be helpful to improve students' understanding of scientific concepts with approximately two-fifths of participants disagreeing with the statement, two-fifths agreeing, and one-fifth neutral (38.6% strongly disagree and disagree, 18.2% neutral, 43.2% strongly agree and agree). More participants agreed (20.5% strongly agree and 22.7% agree) versus disagreed (9.1% strongly disagree and 18.2% disagree) with the statement that ChatGPT could positively impact overall teaching workload; nearly a third of participants were neutral for this statement (29.5%).

The survey included a question for participants to choose how ChatGPT could be used in the classroom, whereby multiple options could be chosen. Based on the data presented in Figure 5, the most frequently chosen option was for creating worksheets (thirty-five responses) followed by creating assessments (twenty-nine responses), lesson planning (twenty-seven responses), student feedback and reports (nine responses), and homework (eight responses). Other options each chosen once included "none of the above", "won't use it or promote it", "very little", "planning documents" and "note-making".

Participants were asked whether they agreed or disagreed with statements relating to concerns about how students' use of ChatGPT may influence schoolwork, the findings of which are presented in Figure 6. Based on responses, most participants agreed or strongly agreed with the statements that ChatGPT may be used to complete assessments, impact authenticity and introduce biases. Overall, 72.7% (59.1% strongly agree and 13.6% agree) agreed with the statement that ChatGPT may impact authenticity of work compared with 9% (4.5% strongly disagree and 4.5% disagree) who disagreed, while 70.4% (54.5% strongly agree and 15.9% agree) agreed with the statement that ChatGPT could introduce biases that may affect students' research compared with 11.3% (4.5% strongly disagree and 6.8% disagree) who disagreed. In terms of assessments and homework, 45.5% of participants strongly agreed and 13.6% agreed with the statement that ChatGPT may be used to complete Classroom-Based Assessments (CBA), while 45.5% and 15.9% strongly agreed and

agreed, respectively, with the statement that it may be used to complete homework. In contrast, 11.3% (6.8% strongly disagree and 4.5% disagree) and 13.6% (6.8% strongly disagree and 6.8% disagree) disagreed, while 29.5% and 20.5% remained neutral to both statements, respectively.

Figure 4: Positive Attitudes Towards ChatGPT in the Classroom

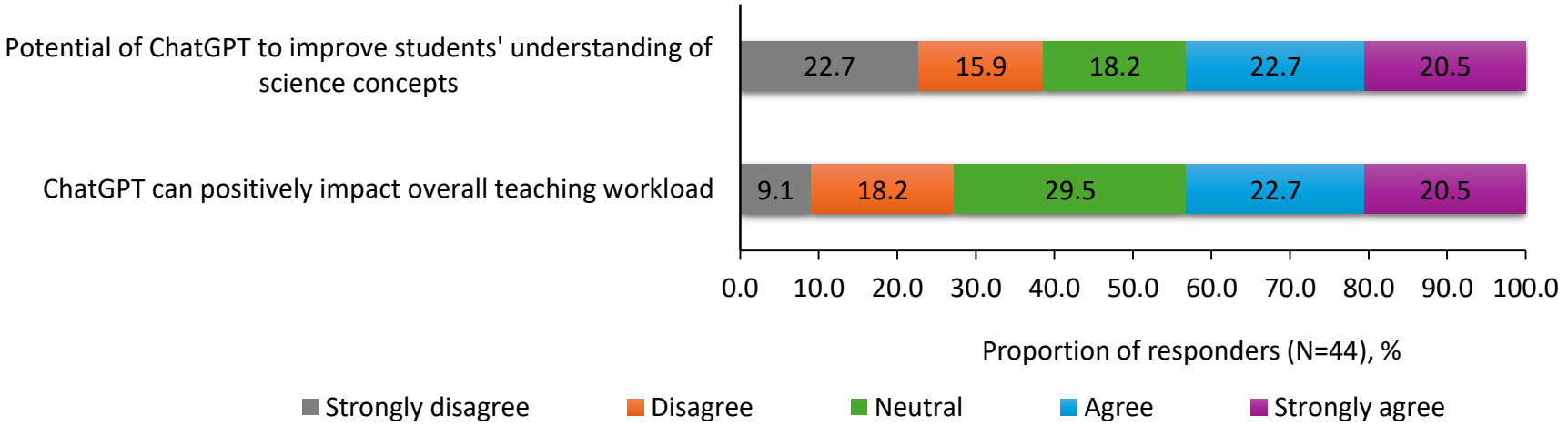


Figure 5: How ChatGPT Could Be Used in Teaching and Learning

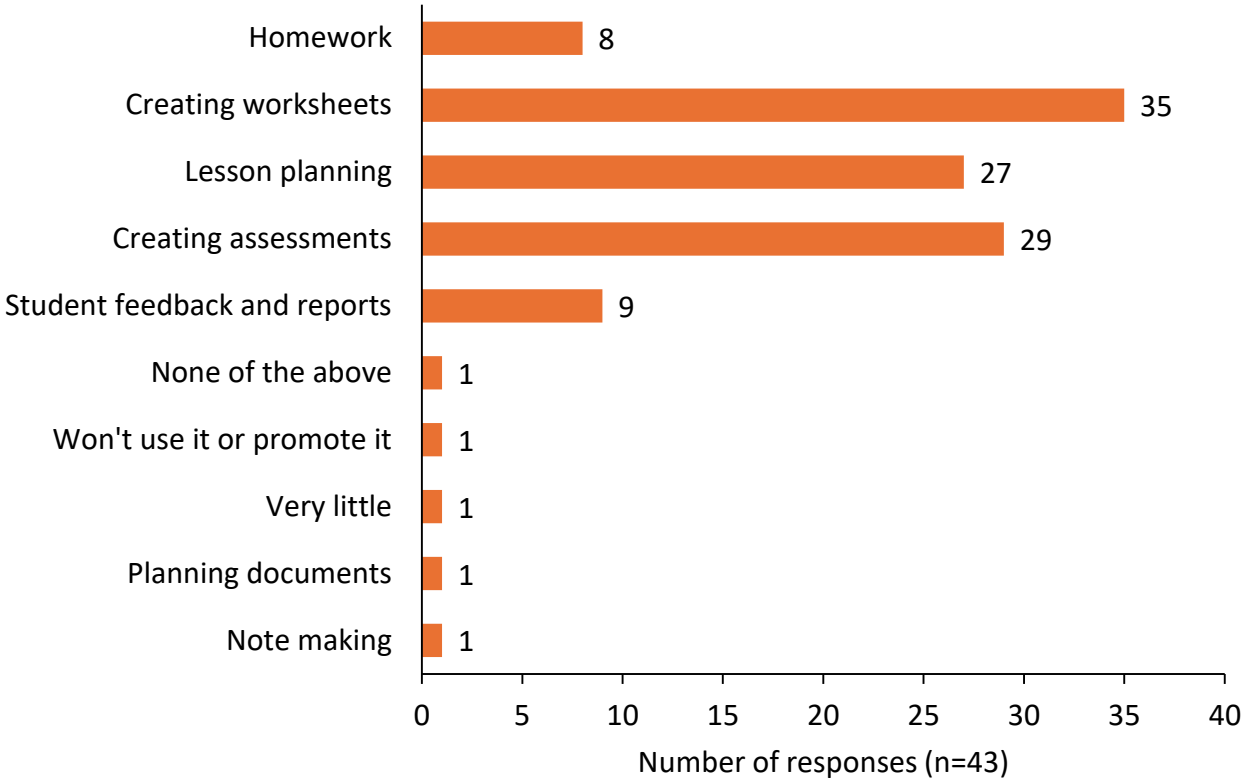
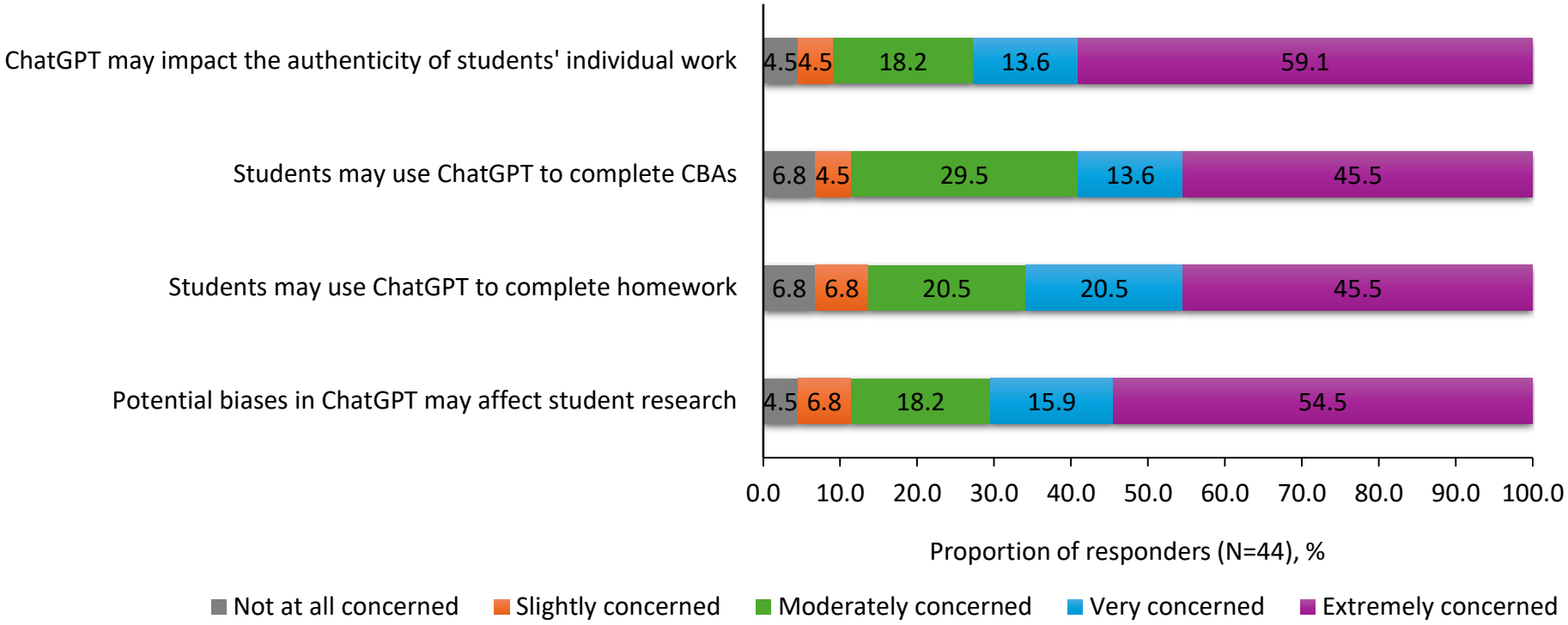


Figure 6: Concerns Related to ChatGPT in the Classroom



4.2.5 Ethical Concerns Surrounding ChatGPT

Participants were allowed twenty words to describe the ethical concerns they anticipate relating to the integration of ChatGPT in the classroom. Overall, there were four reoccurring themes identified from their responses, which are detailed below:

Impact on Student Learning

Of thirty-seven responses, nineteen mentioned the potential negative impacts of ChatGPT on students' learning, including how students will not learn to research effectively and may not attempt to understand the information they've gathered, becoming overly reliant on AI. Respondents also commented on how ChatGPT could prevent individual innovation and limit learning critical thinking and problem-solving skills.

Impact on Teaching

In terms of the impact on teachers, two respondents mentioned that it could cause teachers to be lax in their profession and reduce innovation and creativity.

Quality of Work

The impact of ChatGPT on the quality of work was mentioned by sixteen respondents. They noted the issue of reliability regarding information obtained from ChatGPT, whereby sources may not be accurate, verified, or reputable and are regularly not cited, potentially leading to misinformation.

Several respondents mentioned the issue of bias within AI programs such as ChatGPT and how this may result in impartial information being provided.

Plagiarism

In terms of plagiarism, ten respondents expressed concerns that this would become an issue should ChatGPT be integrated into the classroom, whereby students would simply "copy and paste" answers directly from ChatGPT.

4.2.6 Potential Barriers to ChatGPT Implementation

Participants were asked to comment on potential barriers to implementing ChatGPT in the classroom. Based on thirty-four responses, nineteen mentioned issues with resources, five mentioned finance and/or time constraints, and ten mentioned barriers relating to expertise in and understanding of ChatGPT.

Resources

Several respondents mentioned how access to technology is limited in their schools, including a lack of school devices such as laptops, strict policies on mobile phone use, and limited or unreliable access to internet/Wi-Fi. Additionally, respondents commented on how they would be able to monitor the use of devices should they be allowed in the classroom.

Finance and/or Time Constraints

Within all responses, finance was mentioned as a barrier to adopting ChatGPT in the classroom by one respondent and time constraints to correctly integrate ChatGPT into teaching and learning was mentioned four times.

Expertise and Understanding

A common theme from respondents related to the current lack of adequate training for teachers on how to successfully integrate AI programs into the classroom and how to educate students on how to use it effectively. Within this, two respondents also mentioned that some teachers may not be willing to adapt to using ChatGPT.

In addition to the reoccurring themes mentioned previously, one respondent cited the negative press surrounding ChatGPT and bias against technology in schools as a barrier to implementation, another mentioned how the prompt engineering in ChatGPT can dramatically impact the answer received, and another stated concerns that some subjects will be impacted more than others (e.g. English). Plagiarism was also mentioned as a barrier by two respondents, who emphasised the need for plagiarism checkers to prevent cheating.

4.2.7 How ChatGPT Can Influence Homework

When asked how ChatGPT could influence homework assigned, there were thirty-five responses provided, of which seven related to the type of homework and seven related to homework output format.

Homework Type

A common theme from the answers was about how the type of homework assigned would need to be adapted should ChatGPT be integrated into the classroom, including making questions/assessments more complex and problem-based whereby they require critical thinking and creative answers. Two respondents also mentioned assigning individual independent research to avoid students having the same answers, and three respondents suggested that homework should be made more interactive and mentally stimulating to promote students' interest.

Homework Format

Five respondents mentioned focusing homework output style on more creative and exciting documents such as posters and leaflets rather than text-only paragraphs to avoid a direct "copy and paste" from ChatGPT. Another respondent suggested assigning students to develop personal opinions and debate preparation as homework. One respondent suggested including a section within the homework to show all workings and describe methods used for information collection.

Six respondents stated that they do not anticipate ChatGPT to have any impact on the homework they assign, and eight respondents claimed that they would not encourage using ChatGPT for homework or they don't give homework.

4.3 Conclusion

This chapter presents findings from a survey conducted among forty-four Irish secondary school science teachers, specifically in terms of their perception and use of ChatGPT in their teaching practice. These survey findings reveal diverse responses, with the majority of the

teachers understanding that ChatGPT could help, it is possible to make learning personalised and engaging. Important concerns were also raised including ethical concerns such as plagiarism, reliability of the content produced by AI, and the reliance of students on AI.

The findings presented also indicate the necessity of training the teachers sufficiently on how to use ChatGPT effectively and responsibly indicative by responses from several teachers who pointed out a lack of proficiency and confidence in how they can use ChatGPT in their teaching. Furthermore, several factors hampering the use of ChatGPT in learning institutions were identified such as logistical issues, time constraints, and lack of resources.

Overall, these findings provide initial data on teachers' attitudes and real-world considerations regarding the implementation of ChatGPT in Irish secondary-level science classes. These findings will be further discussed in the next chapter, where the emphasis will be made on the discussion of the results and how they align with the existing literature.

Chapter 5: Discussion

5.1 Introduction

In this chapter, the findings presented in Chapter Four will be critically analysed and described in a contextualised manner, with peer-reviewed literature used as supporting evidence. The data obtained in this study will be explained and related logically to current literature in this chapter, while the next chapter will detail the limitations of the study, concluding remarks, and recommendations.

The purpose of this research was to explore the impact, both present and future, of ChatGPT on science teachers in post-primary education in Ireland. Some of the issues that have been highlighted in the course of the dissertation include the shift in the role of the teacher due to the integration of AI, the impact of AI on motivation and student engagement, the advantages of AI in the context of differentiated instruction, and the disadvantages such as the ethical issues, lack of resources, and the need for professional development. The findings contribute to the answer to the research questions posed in Chapter Two by presenting both the advantages and the disadvantages of the application of ChatGPT in education, the integration of ChatGPT into the classroom, and teacher training on ChatGPT.

5.2 Critical Interpretation of Findings

5.2.1 Recurring Themes

One of the more significant trends that can be derived from the data presented is a perception that ChatGPT has the potential to enhance teaching and learning activities. Many teachers like it for its ability to make engaging content, assist with personalisation, and address administrative tasks. This is in agreement with the work of Chassignol et al., (2018) who noted that there are several positive uses of AI in education. Teachers noted that ChatGPT could be helpful as a tool used for learning, planning lessons, and creating content for lessons, which can reduce the overall burden of work experienced by teachers, allowing

them to devote more time to students and freedom for generating creativity and innovation in their teaching styles.

This optimism about what AI can bring is not without its issues, as noted in this study. The results reveal that there are critical concerns regarding the ethical questions and possibilities of using the AI applications like ChatGPT in the classroom. Teachers had concerns about plagiarism, the reliability of the information obtained from ChatGPT, and the potential of students to become overly reliant on AI in their schoolwork, thus limiting the opportunity to learn valuable knowledge and skills in preparation for their futures. These are not mere assumptions without substance, as Farrokhnia et al., (2023) and Ray (2023) have observed that AI models can contain biases and inaccurate information, thereby promoting misinformation. As noted by Zawacki-Richter et al., (2019), there is a lack of critical educational and ethical discussions about AI in education, and a lack of research on how AI can be used ethically and effectively, ultimately preventing the development of tangible solutions to AIEd barriers.

Importantly, the study shows that a significant number of teachers are not actively using ChatGPT at present, which may be associated with inadequate training available for teachers on how to use it effectively. This association is highlighted by literature, with García-Peñalvo (2023) stressing the necessity of extensive teacher training to fully unlock the possibilities of AI tools and achieve optimal benefits. The current disparity between the use and potential of AI in learning environments means that professional development will be vital for the effective implementation of AI in the classroom.

5.2.2 Exceptional Points

Several interesting observations were identified within the findings of this study regarding the use of ChatGPT in the classroom. For example, although most teachers acknowledge the potential benefits of ChatGPT, there is an obvious split in their confidence in the tool's ability to enhance students' comprehension of scientific concepts, with roughly 40% agreeing that it would be useful compared with 40% who disagree. It may be that different levels of exposure to AI technology are impacting teachers' confidence with the tool. The

literature reveals that, while some educators have embraced AI as a tool that will revolutionise education, others have some level of concern regarding the long-term effects of AI on conventional education delivery and students' performance (Baidoo-Anu and Owusu Ansah, 2023).

The data presented also indicate a high level of interest in professional development related to ChatGPT. Most teachers reported a need for professional development such as online CPD courses and in-person workshops, whereby the former provides a flexible option for training while the latter could provide an opportunity for engaging in discussion on the topic. This concurs with the findings of other studies that have pointed to the need for teachers to engage in continuous professional development to enable them to evolve along with emerging technologies and incorporate them into their teaching (Kasneci et al., 2023). The alignment of the data obtained in this study with the literature is encouraging as it potentially speaks to the accuracy of the study.

5.2.3 Policy and Practice

The implications of the findings are far-reaching in terms of educational policy and practice. The EU's Artificial Intelligence Act (2023) focuses on the need to address risks that stem from the use of AI systems, especially in education. This research has provided evidence of the need for proper policies and laws that can guide the use of AI in classrooms in an ethical manner. It is necessary to determine the policies regarding the training of teachers, the introduction of AI literacy in the curriculum, and the protection against misuse. From this study, we showed that teachers would like to use ChatGPT for themselves but are concerned about students' possible misuse of the tool. This further emphasises the critical need for professional development for both teachers and students on the ethical use of AI and also highlights an urgent need for adequate strategies and/or programs that prevent or identify cheating.

Another element identified from the study relates to the availability of resources and access to technology. It is very evident from the findings in this study that schools lack the appropriate resources to successfully integrate the use of AI applications like ChatGPT, thus

requiring significant investment to overcome this barrier. A further limitation noted was the lack of access to technology that some students face. These are essential elements to be addressed by policymakers to ensure the successful integration of AI within the school setting, and, as such, it is vital that all schools are equally provided with adequate technological tools. While governments have recently begun taking an actively aggressive role in funding new technologies and structures in education, in many cases, they embark on large-scale investment before a clear vision of how such investment can be optimally utilised is developed. This can lead to a redundancy in the technology, where technology resources are present, but educators and institutions do not know how to apply the technology in teaching (Smeyers and Depaepe, 2016, p. 13).

5.2.4 Points of Contrast

It is relevant to note that the findings of this study are contrary to some previous studies examining the application of AI in learning. Baidoo-Anu and Owusu Ansah (2023) revealed that the majority of educators are of the view that AI will be integrated into education in the future, while in this study, there was no unanimous consensus on this across teachers. There may be elements to consider when attempting to explain this difference, such as different educational backgrounds, access to training and resources, or prior exposure to AI applications. Ultimately, the level of current AI usage and the perceived relevance of AI in teaching and learning may vary from one teacher to another based on their backgrounds, thus, influencing results.

Another point of contrast relates to the level of concern over the ethical implications of AI. According to Bitzenbauer (2023), there is a potential that AI will enhance students' critical thinking and problem-solving skills; however, in this study, there was an evident concern from teachers about plagiarism and cheating and the credibility of the content generated by AI negatively impacting the ability of students to think critically and gain valuable problem-solving skills needed for the future. The disparity between the findings of this study and previous literature highlights the need for open and thorough discourse in Ireland surrounding ethical issues relating to the application of AI in education. This is particularly relevant since Bašić et al., (2023) showed a high risk of plagiarism when students employ

ChatGPT. Thus, there is an urgent need to increase awareness among tutors and students on the appropriate use of AI.

5.2.5 Theoretical Perspectives

To understand the findings presented in this study, it is useful to describe some theoretical notions. According to the Technology Acceptance Model (TAM), perceived usefulness and user-friendliness are two key factors that influence the level of technology acceptance (Davis, 1989). This study reveals that while teachers can understand how ChatGPT can be useful to them, there are several barriers that prevent the use of the tool, including its capabilities and its ethical implications. This is in line with Alharahsheh and Pius (2020), who noted that the level of perception that teachers have towards the use of technology depends on the self-efficacy of the teachers and the amount of support that is available to them.

Another theory that relates to this study is the 'Diffusion of Innovations' theory developed by Rogers, which states that the adoption rate of new technologies follows a normal distribution, with innovators and early adopters leading the way, followed by the majority and late adopters (Sahin, 2006). This division in the teachers' attitudes toward ChatGPT identified in this study could be reflective of different human personalities. Some teachers are typically innovative and eager to introduce new technologies into the teaching/learning process, while others are traditional and either opposed to the use of new technologies or are not well informed about the technologies or the issues of ethicality (ibid.).

Additionally, this study highlights the importance of establishing a strong ethical framework for the use of AI in learning environments, particularly in relation to data protection and AI-generated results, considering that many teachers had concerns over AI-introduced biases and misinformation, which is reflected in the literature (Ray, 2023). This is in concordance with the assertion made by Zawacki-Richter et al., (2019) who urged scholars to be more mindful of the ethical use of AI in learning.

5.2.6 Themes Requiring Further Research

Several themes identified in this study require further research. One such theme is the effects of AI on the teaching-learning process and students' achievement in the long run. Despite some optimism regarding the potential benefits of AI, there is little research available on its long-term impact. Future research should consider longitudinal analysis to understand the dynamics of integrating AI and how it unfolds in educational contexts over time. Another research question that could be of interest in the future would be to better understand why individual teachers do not maximise the capabilities of AI tools despite encouragement from schools for them to do so, a disparity that was evident in this study between school encouragement and actual ICT usage.

From the literature and from this study, it is evident that the creation of effective training programs for teachers is vital. However, while this study raises the need for professional development, it does not provide details on what these programs should be. Further studies should focus on identifying the best strategies for preparing teachers for AI integration into education processes, taking various contexts into account, along with levels of technology adoption. With ethical concerns in mind, training should be established in formats that people find most engaging, which, according to the data presented here, are online CPDs or in-person workshops. Ideally, a combination of both would be useful as the online CPD is convenient and flexible, while face-to-face workshops enable critical discussions.

Research by Šabić, Baranović, and Rogošić (2022) on gender differences in attitudes and usage of ChatGPT was not considered in this paper's initial literature review but is important to the current study's context. They found that males spend more time using AI than females, despite teaching being a profession primarily dominated by females (ibid.). This may cause a disparity in the implementation of AI in educational practices as male teachers may be more inclined to incorporate new technologies (ibid.), although whether this is true remains unknown. Support and training for teachers of both sexes, though perhaps for females particularly, could be extremely beneficial in ensuring that there is equal distribution of AI in the teaching profession.

Finally, the ethical implications of AI in education are an important area to be pursued in greater depth. This could help to mitigate concerns surrounding biases, misinformation, and academic integrity, and redirect focus on developing detailed best practice guidelines and strategies for preventing risks. There should be particular emphasis on the development of frameworks intended for the ethical use of AI in education so that the use of AI tools in education can be made in a responsible way while maximising the opportunities AI can deliver.

5.3 Conclusion

In conclusion, the initial research question posed what were the challenges and opportunities that were offered by the integration of ChatGPT in the classroom. Based on the data obtained from this research, it can be concluded that the application of ChatGPT in teaching can be highly beneficial for teachers.

One of the most prominent themes that came out of the study was the issue of teacher training, which the participants stressed as an essential aspect of professional development in relation to ChatGPT. This is in line with previous studies where participants called for more practice to improve the application of the resources offered by ChatGPT. Additionally, all participants mentioned that they apply modern methodologies in their teaching because they understand that these methods make the learning process more effective and interesting for students. These findings imply that to improve the delivery of effective learning experiences, teachers may need professional learning to help them facilitate AI in learning environments.

Chapter 6: Conclusion

Among elements that can improve post-primary science education by optimising the process of teaching and learning is ChatGPT. In this study, teachers surveyed reported that ChatGPT is useful for creating interesting content, supporting learners, and saving time on administrative tasks. These findings are in concordance with the earlier studies that supported the use of AI in enhancing learning in education (Chassignol et al., 2018; Sharma et al., 2021). However, despite these benefits, several relevant questions remain. Some of the ethical concerns identified include plagiarism, misinformation, and overreliance on AI primarily by students, which echoes research findings by both Ray (2023) and Bašić et al., (2023). The participants of this study had concerns regarding the reliability and originality of the content produced by AI, along with hesitance in allowing students to control such technologies

6.1 Limitations of the Study

A number of limitations were identified during the research process. One such limitation was the relatively small and rather homogenous sample of the participants, who were all Irish-based science teachers. This may restrict the transferability of the study results to other educational settings and areas. Furthermore, the study was mainly quantitative in nature, and although the quantitative data helped in establishing trends, qualitative data would have provided a more detailed understanding of the teachers' experiences and perceptions. Future research should also include qualitative data collection techniques to gain a better understanding of the difficulties and possibilities of using ChatGPT in education (Almalki, 2016). One of the limitations is the significant difference between teachers' awareness of the benefits of ChatGPT and its application in classes. This gap is usually attributed to a lack of training and support, therefore, there is a need for professional development that meets the needs of educators (Kasneci et al., 2023). Additionally, the study did not consider the effects of ChatGPT on the learning outcomes of the students in the long run, which is an area of research that should be pursued. Furthermore, the study did not focus on the requirements of students with Special Educational Needs (SEN). Subsequent studies should examine how the use of AI, such as ChatGPT, can be optimized

for SEN students' learning needs and provide equal opportunities for learning.

6.2 Achieving Intended Outcomes

The purpose of this research was to identify the issues and prospects of implementing ChatGPT in science classes and to determine how this implementation impacts teachers. Despite the findings that were made in the research and the understanding of the teachers' perceptions and the benefits and concerns that were highlighted, the extent to which this research was able to achieve its intended objectives is somewhat limited by the aforementioned factors. However, the study adds to the existing literature on the use of AI in education and identifies the key factors that determine the effectiveness of AI implementation.

6.3 Recommendations

Based on the findings, the following recommendations are made to enhance the effectiveness of using ChatGPT in education and to overcome the challenges that may be encountered.

6.3.1 Policy-based Recommendations:

This is why policymakers should establish guidelines and ethical frameworks for the use of AI in education. These should include data protection, the reliability of the content that is produced by the AI, and ways of detecting and preventing cheating (European Parliament, 2023). The formulation of such guidelines will help in establishing a safe learning environment in which the learners can benefit from AI in learning without suffering harm.

6.3.2 Practical Recommendations for Educators:

Schools should ensure that they implement professional development programs that would assist them in the adoption of the use of AI tools like ChatGPT. These should be online and

face-to-face training sessions in order to meet the needs of the different learning modalities and the time of the people. It should contain not only the technical information about AI but also the ethical way of thinking about AI and how to implement it in the learning-teaching process (García-Peñalvo, 2023).

6.3.3 Methodological Recommendations for Future Research:

Future studies should use both qualitative and quantitative research to establish a better understanding of the impact of AI on learning. The use of both quantitative and qualitative data will assist in a better understanding of the benefits and drawbacks of the use of AI tools such as ChatGPT (Alharahsheh and Pius, 2020).

In conclusion, the proposed use of ChatGPT in post-primary science classrooms is likely to yield many advantages to the learning process. However, it is also necessary to pay attention to the ethical aspects and the feasibility of this strategy in order to achieve success. In conclusion, it can be stated that AI has the potential to become a valuable asset in the sphere of education, but only if the specialists and the government invest in the proper training of AI and establish strict ethical guidelines. By emphasising the importance of teacher preparedness and ethical issues when it comes to the use of new technologies in learning, this paper offers practical suggestions for the current discourse on AI in education.

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Appendices

Appendix 1 – Principal's Letter

Dear [Principal's Name],

Subject: Request for Permission to Conduct Research Study at [School Name]

My name is Kevin Towell, and I am writing to you in relation to a research study I will be undertaking in fulfilment of my Professional Masters in Education degree. I would like to provide you with information about my study and seek your consent to conduct the research with members of your teaching staff. The purpose of this study is to explore the integration of ChatGPT in science classrooms, specifically focusing on the perspectives of teachers.

The research aims to investigate the role of ChatGPT in post-primary school science classrooms, with a particular interest in understanding its impact how teachers perceive and utilise ChatGPT or other AI language models as pedagogical tools. The study intends to contribute valuable insights to the field of education regarding the benefits and challenges associated with adopting artificial intelligence tools like ChatGPT.

The primary method of data collection for this research is a quantitative online survey. The survey is designed to gather opinions and experiences of science teachers in the school regarding the use of ChatGPT in the classroom.

I am seeking participation from science teachers at [School Name] who are currently involved in teaching at the post-primary level. Their perspectives and experiences will be instrumental in shaping the outcomes of this study.

I assure you that all data collected will be treated with the utmost confidentiality. The survey is anonymous, and no personally identifiable information will be disclosed in any publications or presentations resulting from this research. If you or any of the participating teachers have any questions or concerns, please feel free to contact me at XXXX.

I am committed to ensuring minimal disruption to the school routine during the research process as this survey can be completed outside of school hours.

I appreciate your time and consideration of this request. Your support is crucial in making this research a success. I look forward to the possibility of working with you and the esteemed teaching staff at [School Name].

Thank you for your cooperation.

Sincerely,

XXXXX XXXXXX

Appendix 2 – Participant Consent Form

Participant Consent Form	
Researcher's name:	XXXXX XXXXXX
Organisation	Hibernia College Dublin
Title of study:	Usage and Perceptions of Chat GPT as a Pedagogical Resource among Secondary School Science Teachers: A Survey-Based Study

Consent (to be completed by the participant) (Please circle response)

Have you been fully informed/read the information sheet about this study? **Yes/No**

Have you had an opportunity to ask questions and discuss this study? **Yes/No**

Have you received satisfactory answers to all your questions? **Yes/No**

Do you understand that you are free to withdraw from this study at any time without giving a reason for withdrawing and without your withdrawal having an adverse effect for you? **Yes/No**

Do you agree to take part in this study, the results of which are likely to be published or presented at a conference? **Yes/No**

Have you been informed that a copy of this consent form will be kept by the researcher? **Yes/No**

Are you satisfied that any information you give to the researcher will be kept confidential? Your name and the name of the school will not appear in the research report. **Yes/No**

Participant's name (printed)

(signature) **Date**

Researcher's signature **Date**

Appendix 3 – Questionnaire

Thesis Survey

By participating in this survey, I certify that I have read all of the information provided about this voluntary research study and that I am aware that I can cease participation at any moment.

I am aware that Hibernia College Dublin personnel may analyze relevant data from the compiled data, protected by the use of pseudonyms, for the objectives of this research.

I am aware that any information I submit will be kept completely private and anonymous, and that after this research project is over, the data will be stored in a safe location for three years.

1. How many years have you been teaching as a fully qualified post-primary science teacher (biology, chemistry, physics, agricultural science)?

   Mark only one oval.

   - ◯ 0-5
   - ◯ 5-10
   - ◯ 10-15
   - ◯ 15+

2. How would you rate your familiarity with using Information and Communications Technology (ICT) in the classroom?

   Mark only one oval.

	1	2	3	4	5	
Not	◯	◯	◯	◯	◯	Very familiar

3. To what extent do you agree with the following statement: My school encourages the use of ICT in the classroom

Mark only one oval.

	1	2	3	4	5	
Stro	◯	◯	◯	◯	◯	Strongly agree

4. How many hours per week, on average, do you incorporate ICT into your Junior Cycle science or Senior Cycle biology, chemistry, physics, or agricultural science classroom teaching?

Mark only one oval per row.

	0-5	5-10	10-15	15-20	20+
Number of hours	◯	◯	◯	◯	◯

5. How often are you currently using Chat GPT for teaching and learning purposes

Mark only one oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very often

6. On a scale from 1(strongly disagree) to 5 (strongly agree), to what extent do you agree with the following statements?

Mark only one oval per row.

	1	2	3	4	5
I am confident using ChatGPT effectively	◯	◯	◯	◯	◯
ChatGPT can positively impact my overall teaching workload	◯	◯	◯	◯	◯
I am interested in receiving training on best practices for integrating ChatGPT into my teaching	◯	◯	◯	◯	◯
I am optimistic about ChatGPT's potential to imporve students' understanding of science concepts	◯	◯	◯	◯	◯
I understand the ethical considerations associated with ChatGPT	◯	◯	◯	◯	◯
I am concerned about potential biases in ChatGPT affecting student research	◯	◯	◯	◯	◯

I am interested in receiving training addressing ethical concerns related to ChatGPT	○	○	○	○	○
I am concerned students will use ChatGPT to complete their homework	○	○	○	○	○

7. What ethical concerns do you anticipate in incorporating ChatGPT in the classroom? (maximum 20 words)

_____

8. Identify potential barriers to implementing ChatGPT in the science classroom (maximum 20 words)

_____

9. How would ChatGPT influence the type of homework you assign, if any? (maximum 20 words)

_____

10. At present or in the future, how do you anticipate you will use ChatGPT in regards to teaching and learning? (select all that apply)

Check all that apply.

- [ ] Homework
- [ ] Student feedback and reports
- [ ] Creating assessments
- [ ] Lesson planning
- [ ] Creating worksheets
- [ ] Other: _____

11. On a scale from 1(not at all concerned) to 5 (extremely concerned), how concerned are you regarding the below statements?

Mark only one oval per row.

	1	2	3	4	5
Students will use ChatGPT to complete their Classroom-Based Assessments (CBAs)	⬭	⬭	⬭	⬭	⬭
ChatGPT will impact the authenticity of students' individual work	⬭	⬭	⬭	⬭	⬭

12. How would you prefer to receive training on ChatGPT? (Select all that apply)

Check all that apply.

- [ ] Online Continuing Professional Development (CPD) course
- [ ] Peer mentoring communities
- [ ] Self-paced online course
- [ ] In-person workshop session