

# Task 1

## Identifying Research Questions

Zafari et al. [1] aim to answer three quantitative questions: "What are the applications of AIED in education and which type of AI has had a lot of benefits for education"; "How is the distribution of AI applications at different levels and in which courses has AI been frequently involved"; and "Which technologies and devices are employed to implement".

Pierrès et al [2] pose two main questions, each with multiple sub-questions. Question one is "To what extent are ethical concerns considered in articles presenting AI applications assessing student (with disabilities) in higher education?" With the sub-questions: What are the ethical concerns mentioned in articles presenting AI applications assessing students in higher education; To what extent are students with disabilities mentioned? Question two is "What are the potential discrimination risks in using AI that assesses students with disabilities in higher education?" This has three sub-questions: What are the input data of AI EdTech; What type of decision is taken; and Who is involved in the decision-making process and how?

## Research Design, Methodology and Methods

Both papers have similar research designs in that they aim to discuss the uses of AI in education. Zafari et al. take a diagnostic design approach in which they show how the current literature corpus represents usage of AI in a specific age range of students (K-12). There is already research done in a similar way [3], [4] but overviews different age ranges or from different periods. The aim of this paper is to extrapolate previous findings from K-12 students from a more recent period in which AI has become more advanced and prevalent. Pierrès et al. also use a diagnostic approach, aiming to find out how the current literature corpus paints a picture of inclusive AI in education. However, Pierrès's paper has a more exploratory aspect as it also evaluates the potential risks involved with underrepresentation of disability in AI development.

Zafari and Pierrès both use literature reviews to conduct their research. However, Zafari uses a systematic literature review while Pierrès uses a scoping literature review. The difference between the two is subtle, but significant. The systematic review is useful for a more in-depth study of a specific field, highlighting gaps in the current knowledge base, while scoping reviews are typically used to provide an indication of the amount of relevant literature [5]. Within the systematic review, both papers make use of the PRISMA 4-stage framework (Pierrès uses the Scoping Review extension) [6], [7] which is a well-established framework for obtaining and screening bodies of literature for review. After using PRISMA, they then encode the contents of each paper in their reviews and the protocol for Pierrès' work is available online [8].

## Supporting the Questions

Both papers use an appropriate research design and methodology to research their respective questions: the literature review format is useful for finding out how the use of AI is being reported in the literature, and both the standard implementation and ScR extension of PRISMA are useful in enabling this. The discussion in Zafari's work reflects that AI has been used over the last decade to benefit the K-12 education level and it has highlighted

which AI applications and algorithms have proven to be most beneficial in certain scenarios. In fact, all three of Zafari's questions have been reliably answered using only systematic literature review. The systematic literature review provides important insight to the technicalities of AI use in education such as applications, algorithms and technologies, as well as more overarching aspects like the level of education and the field of study. Pierrès et al. and their scoping review are also successful in highlighting the risks posed to disabled students in higher education – they show that this ethnographic profile is underrepresented in the literature and elucidate (and elaborate on) eight major risks involved with this underrepresentation. The scoping review is useful in showing the extent of ethical and representation concerns without revealing technical details of the AI applications itself. This is important in highlighting areas in which more systematic reviews can be undertaken, as well as areas for more diagnostic study to be undertaken.

## Task 2

### Rewriting the Research Questions

Pierrès et al. [2] aim to assess the extent to which ethical considerations are taken in research pertaining to AI integration in education, with an emphasis on disabled students. The first question is broken down into the simple quantitative questions "What are the ethical concerns mentioned in articles presenting AI applications assessing students in higher education (HE)?" and "To what extent are students with disabilities mentioned?". These do not directly answer the question of "Could the Use of AI in Higher Education Hinder Students with Disabilities?", but instead serve as a preamble for the second question "What are the potential discrimination risks...". This question has important word choice as its answer will shed light on the specific hindrances to students with disabilities that could happen.

To answer the same question as in Pierrès et al.'s title "Could the Use of AI in Higher Education Hinder Students with Disabilities?", one could imagine taking a qualitative longitudinal approach that studies how students with various disabilities interact with AI educational technologies over the course of their higher education careers. This approach to research will remove the reliance on previous, secondary data as required by the scoping literature review and replace it with more reliable primary data. This also shifts the perspective from an exploratory perspective to a more descriptive approach.

The starting point for this research would be to complete a systematic literature review regarding the integration of AI technologies into education. This scoping review would serve to replace the first question of Pierrès' paper and give us an answer to the hypotheticals: "How are students with disabilities represented in the development of AI EdTech?" and "What risks to the student can underrepresentation of disabilities lead to?". The following remainder of the research would encompass "How has the current representation of disabilities in the development of AI EdTech affected those with disabilities?". These new questions will reflect the longitudinal nature of the research project. The literature review will be a constant process over the course of the research project to guide the process with new and relevant findings.

### New Research Design

#### *Systematic Literature Review*

To answer the question "Could the Use of AI in Higher Education Hinder Students with Disabilities?", this research project will take aspects of systematic literature review to inform the progress of primary research techniques taking the form of a longitudinal study, taking place over the course of higher education degrees. To begin, a systematic literature review will be performed to obtain answers to the following questions: "How are students with disabilities represented in the development of AI EdTech?", and "What risks to the student can underrepresentation of disabilities lead to?". These goals are similar to that of Pierrès *et al.*'s work in that they assess how AI EdTech is evolving, and the potential harm neglecting disabilities can lead to. Data will be collected from primary research via Scopus and the Web of Science research repositories to ensure that all articles are peer-reviewed and thus reliable. All full texts that meet the inclusion criteria set out in Pierrès' work will be included to ensure relevance to the subject at hand. This literature review will be used as part of the

longitudinal process and repeated throughout (see Fig. 1) to ensure the following primary research portion of the study is reliable and robust.

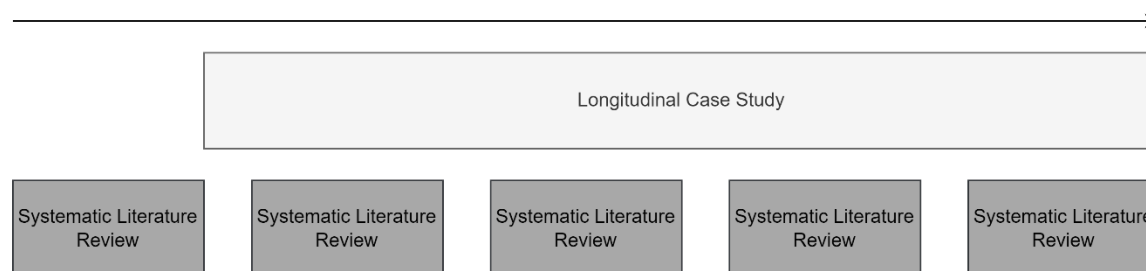


Figure 1 – Overview of Longitudinal Case Study research project. Each systematic literature review supports the case study.

### Primary Research

The primary research portion of the study will aim to answer the following question: “How has the current representation of disabilities in the development of AI EdTech affected those with disabilities?”. This question will be answered by following the lives of individuals that meet the following criteria:

Firstly, they must be entering into Higher Education (HE) or partway through an HE course. Secondly, they must have a diagnosed disability. Disability is defined by the United Nations as “result[ing] from the interaction between persons with impairments and attitudinal and environmental barriers that hinders their full and effective participation in society on an equal basis with others” [9] and we will be using this definition throughout. There is no condition placed on the attending university or department. This allows the data to be more readily generalised from the sample to the population.

The sample of individuals studied will represent the population comprising disabled students in Higher Education and will be between 15 and 20 in number. Individuals will be selected from a pool of volunteers to meet specific quotas such that there will be roughly equal representation of those with mental health disorders, those with learning disorders, and those with physical disorders. This number of individuals was chosen based on Boddy’s review on Marshall *et al*’s work [10], [11] which cites 15 to 30 individuals for an interview case study.

With regards to data collection, there will be a mixture of regular interviews, document analyses and questionnaires given to the participants over the duration of their HE courses. The interviews will be semi-structured so as to allow participants to go into a lot of depth regarding their experiences with AI EdTech, whilst also guiding the conversation through a series of themes (which may help with encoding data later in the process). Some interview questions will remain throughout the entirety of the research project such as “How has the university’s use of technology supported you?”, while other questions will be more topical and guided by the systematic literature reviews like “How do you feel about your university’s inclusion/exclusion of technology X?”. The sorts of documents that will be analysed throughout will be student performance metrics like assessment marks and other, more systemic documents like reports on the University and their relationship with EdTech – documents that are less about the individual, but about their environment and context. Articles used in the literature review may also be included in this portion of the study. Questionnaires will be handed to the students periodically. These will include more closed-

ended questions like "How often do you interact with AI on your course?" and "Do you feel included in advancements in university technology?". These are more quantifiable questions that can be analysed using quantitative statistical analysis techniques such as averages and measurement of change over time (which can be analysed using inferential techniques like regression).

Analysis of the acquired data from interviews, questionnaires and documents will be complex so a tool like Delve will be used to manage the storage and analysis of raw data [12]. Interviews will be recorded, and the transcripts will be encoded using open coding, axial coding and selective coding to generate codes, themes and narratives. Document analysis will comprise the same concept – emergent coding. The aim of this is to produce 15-20 individual narratives that link together.

These two qualitative measures will be used to generate a theory that can be tested that roughly answers the question of "Could the Use of AI in Higher Education Hinder Students with Disabilities?". This theory is then backed up using quantitative measures drawn from questionnaires relating to student interaction and support from universities. Naturally, due to the small sample size, it would be difficult to assure anyone statistically that the experiences of these students can be generalised to the entire population, but this acts as a proof-of-concept to support the theory and can be grounds for future quantitative research.

### *Critique of New Research Design*

Firstly, in order for this study to be generalisable to the entire population of Higher Education students with disabilities, the participants must be from a variety of universities and departments within those universities. What this does, however, is introduce multiple new confounding variables that, to measure the effects of, would be outside the scope of this study. Such variables would include Russell Group status, department and university funding, and access to AI EdTech. Despite this drawback, the sample size of 15 to 20 provides rich volumes of qualitative detail that describe the experiences of a wide range of individuals – this number of participants gives an insight into many manifestations of disability and their interplay in different university cultures and institutions.

Secondly, a major issue with this study being longitudinal is that it is expensive and time-consuming [13]. For one researcher to manage the volume of useful data, organise at least 15 individuals, build questionnaires and interviews and carry out a systematic literature review regularly is a mammoth task, especially when considering this can require between 3 and 7 years (depending on the course taken by participants), this can seem like an unfair task. Another disadvantage of the long period of time is that, of the 15-20 participants, we may expect at least one to drop out before the end of a three-year course [14]. This may lead to valuable data being lost and underrepresentation from specific groups.

## Task 3

### Key Characteristics of Quantitative Methods

Quantitative research methods aim to produce a quantifiable, numerical result that typically aids in supporting a hypothesis. In this sense, they provide an objective perspective of phenomena that can be measured and are often associated with “exact” or “hard” sciences. Quantitative studies are very useful in numerically representing relationships between variables and lend themselves well to experimental procedures in which variables are controlled or managed by the researcher.

Quantitative study also tends to be the favourite of researchers with a post-positivist worldview – the ontological belief that reality is governed by immutable natural laws, and that those natural laws can be observed and measured. Because we can measure these laws with numbers, we can analyse these numbers. This gives rise to statistical analysis, a process that is characteristic of quantitative study. Statistical analysis takes the form of descriptive and inferential analysis, the latter of which can provide vast amounts of useful information about a dataset.

### Key Characteristics of Qualitative Methods

Qualitative methods are the antithesis of quantitative methods. They are characterised primarily by their subjectivity – something that gives them a bad rap among the “hard” sciences. This subjectivity is difficult to quantify, thus allowing qualitative research scientists to avoid the need for statistical analysis.

Contrary to that of quantitative research scientists, qualitative research is undertaken by those with a variety of worldviews, the most common of which is constructivism. People with this paradigm believe that the world is not governed by immutable natural laws, but by the interpretation of every individual's experience. Because of this, constructivists understand the world through a social lens and their research methods reflect this – many qualitative studies involve participants through interview, questionnaire and social media, rather than studying manipulable subjects through experimentation.

The complexity of a qualitative study can grow quickly depending on the scope of the study. Grounded theory forms the basis of other analytical frameworks such as narrative study, case study and ethnography. Each framework has its own scope and focus that it aims to study.

Theories and hypotheses are generated through qualitative analysis and are then tested by quantitative analysis to either support or provide an alternative hypothesis. This relationship gives rise to mixed methods studies that can generate theory and test it simultaneously

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