# Improving Outcomes for Students with Disabilities in Science Education: A Critical Review of the British Secondary School Curriculum and Recommendations for Reform

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# Abstract

Three decades after the UK adopted an inclusive education strategy, disabled pupils are still not doing well in science in secondary school. The goal of this study was to find out why and to figure out what works.

The research used a sequential explanatory mixed-methods approach to integrate national GCSE performance data with structured surveys and semi-structured interviews with 40 people, including students with disabilities, science teachers, and other important people. Quantitative analysis (descriptive statistics, cross-tabs, correlations, and multiple regression) showed that gender and age do not predict perceived barriers. However, there is a strong, negative link ($r = -0.34$) between stakeholders' confidence in inter-professional networks and how often those networks meet, which points to serious structural problems. Qualitative triangulation showed that there were three ongoing problems:

1. **Non-inclusive materials and assessments** that ignore Universal Design for Learning (UDL) principles.
2. **Physical inaccessibility of laboratories and equipment.**
3. **Deficit mind-sets and limited teacher training** in inclusive pedagogy.

Schools that had invested in adaptive resources and collaborative planning recorded markedly higher GCSE pass rates, whereas classes without specialised support showed more ungraded entries and the widest attainment gaps.

Four clear, actionable recommendations emerge:

1. **Embed UDL and adaptive technologies** in every scheme of work, normalising multiple ways of representing content and expressing understanding.
2. **Introduce competency-based professional-learning pathways** that pair science teachers with special-needs specialists to co-design accessible practical work.
3. **Create a national repository of inclusive resources plus a tiered collaboration platform** to replace ad-hoc stakeholder meetings with sustained, high-confidence networks.
4. **Adopt a Holistic Success Model** that tracks engagement, self-efficacy, and long-term science identity alongside exam scores.

The proof reveals that tiny changes won't close the disparity in equity. A true "science for all" classroom and a diverse scientific workforce in the UK can only be built through systemic changes to the curriculum, infrastructure, and professional culture.

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# Chapter 1: Introduction

## 1.1 Background

Teaching science to children with disabilities is a topic that is extremely relevant in today's classroom (Schreffler et al., 2019). All people must have the chance to build a solid foundation in scientific knowledge and skills since society is becoming more and more dependent on scientific and technological advancements (Stokes et al., 2019). It is not only essential for the personal development of children with disabilities to get a high-quality science education, but it also fosters equity and inclusion in the broader educational environment (Klimaitis and Mullen, 2021). Students have a unique opportunity to learn about the natural world, develop critical thinking skills, and solve problems through science education (Maryanti et al., 2021). Children with disabilities can benefit most from these experiences because they often face particular challenges to learning and development (Kutscher and Tuckwiller, 2019). Teachers can help these kids gain the self-assurance and abilities needed for success in the classroom and beyond by giving them individualised science instruction and support (Turan and Atila, 2021).

Over the past few decades, there have been substantial changes made to the education of students with disabilities (Vincent and Chiwandire, 2019). People with disabilities were often educated in segregated settings or not at all prior to the civil rights movement. Nonetheless, laws like the Education for All Handicapped Children Act (EHA) and the Individuals with impairments Education Act (IDEA) have expanded educational opportunities for students with impairments (Jeannis et al., 2020). There is a continuum of educational settings that ranges from the least restrictive to the most restrictive because laws in many countries require free, suitable public education in the least restrictive environment (Van et al., 2021). According to Stinken et al., (2020), students with impairments are still under-represented in science and consistently score badly on standardised assessments. For instance, a study conducted in the United States revealed that students with disabilities performed considerably worse on standardised tests than their classmates without disabilities (Stinken et al., 2020).

In the modern world, science and technology are recognised as important cultural products of human society, and all citizens, regardless of their physical or vocational requirements, should become at least somewhat aware of them as components of human culture (Toutain, 2019). Science and technology are vital for the economy, but they also need to be viewed through the lens of a liberal arts education (Van et al., 2021). A sizable section of the global population consists of individuals with special needs. According to a joint World Bank research, 785 million people worldwide—roughly 15% of the total population—have a major physical or mental handicap (Schreffler et al., 2019). People with disabilities would require special education in order for them to perform successfully in their academic work. They also require supported services that can accommodate their needs as well as specialised teaching techniques (Jeannis et al., 2019).

In addition to science instruction, vocational training is a crucial component of their curriculum to enable them to have a reliable source of income. In order for people with special needs to reach their full potential, they must be given the proper social, physical, and psychological environments (Klimaitis and Mullen, 2021). In order to prevent these individuals from being left alone in classrooms where they are unable to engage with their peers who do not have special needs, special schools may not always be a preferable option (Kutscher and Tuckwiller, 2019). Research has also shown that, in comparison to students who are physically challenged, non-disabled secondary school students exhibit higher levels of academic accomplishment, aspiration, and authentic self. On the other hand, as compared to secondary school students who are not impaired, those who are physically challenged exhibit higher levels of self-efficacy (Toutain, 2019).

According to Rapp and Corral-Granados (2024), there is a worldwide commitment to ensuring that all students, including those with disabilities, have the opportunity to receive a top-notch education. This will help them develop their cognitive, affective, social, and physical capacities, as well as their sense of autonomy and life skills. Two UN conventions, one on the rights of persons with disabilities (Article 24) and the other on the rights of children (Articles 23, 28, and 29) (Navaitienė and Stasiūnaitienė, 2021). Students with disabilities persist in achieving inferior academic performance compared to their non-disabled peers, notwithstanding this commitment. Another study indicated that individuals with impairments lagged three years behind their non-disabled counterparts (Mortier, 2020). Students with impairments were more likely to achieve poorer educational attainment compared to their non-disabled peers (McNicholl et al., 2021).

Students with disabilities struggle to develop social and emotional skills and have poor social and emotional results in addition to their poor academic performance. For example, children with disabilities were more likely than their non-disabled counterparts to exhibit a negative interaction style, exhibiting less social initiations and affective displays (Brownell et al., 2020). It is troubling when students lack social and emotional development since these abilities help them better understand and control their emotions as well as build healthy connections, both of which contribute to improved mental health (Yalcin and Kamali Arslantas, 2020). Students with impairments had inferior educational and living outcomes compared to their non-disabled peers. For instance, 84% of adults without impairments are employed, whereas just 53% of working-age individuals with disabilities hold employment (Los Santos et al., 2019). Additionally, 59% of individuals without impairments resided independently, in contrast to 17% of those with autism and 16% with multiple disabilities, as reported by the National Longitudinal Transition Study-2 in the United States (Gin et al., 2021). Students with disabilities necessitate educational supports that are substantiated by rigorously validated evidence of their effectiveness in fostering positive academic, psychological, self-determination, and career outcomes to mitigate adverse educational and lifelong consequences (Gin et al., 2021).

According to Lawson and Beckett (2021), students with disabilities in the UK performed worse on standardised exams of literacy and numeracy than their peers without disabilities. While science teachers have little to no experience teaching special education, special education teachers have little to no experience teaching science (Lawson and Beckett, 2021). The lack of training and expertise on how to accommodate students with disabilities in scientific classes is a major obstacle to inclusive education. Globally, there has been a change in the places and methods of instruction for children with disabilities; general education classrooms are now preferred over specialised facilities or classrooms (Lambert and Tan, 2020). The idea of "science for all" has been advocated in the interest of science for all as a way to expand science to include more people, such as children with special educational needs (Kutscher and Tuckwiller, 2019). Two of the main causes of students with disabilities' failure are their lack of motivation and practitioners' lack of understanding of the importance of science for all initiative, combined with their lack of skills to actually make science for all achievable. Furthermore, a stronger focus on cooperation between science and special education teachers can help to establish more inclusive science learning environments (Villanueva et al., 2012).

## 1.2 Historical Perspective

Education has placed a lot of emphasis on including students with varied and special needs in the classroom over the past 30 years (Klimaitis and Mullen, 2021). Regarding racial and ethnic diversity, the Swann Report "Education for All," which was released in the UK in 1985, addressed concerns about the shifting makeup of students in British schools and the educational effects that these changes had on students and society (McNicholl et al., 2021). Every child has the right to an education "regardless of their physical, intellectual, social, emotional, linguistic, or other conditions," according to the 1994 Salamanca Statement published by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) in the years that followed. In addition, the Science for All movement aimed to pique the interest and knowledge of science in the great majority of students, who would merely be "consumers" of science rather than the small percentage who would really create science or work in the field (Jeannis et al., 2020).

Encouraging general students to find significance and accessibility in science has been and still is a top priority in education (Kieran and Anderson, 2019). According to curriculum initiatives such as the United Kingdom's Twenty First Century Science, all students should have a fundamental set of knowledge and abilities to become scientifically literate citizens (Kelly et al., 2022). Building on these insights, the United States' 21st Century abilities movement places a strong focus on fundamental topic knowledge as well as learning and innovative abilities (Kart and Kart, 2021).

It asserts that well-established technological use in society necessitates not only proficiency in information and media but also in social and communication skills (Jeannis et al., 2020). To thrive in today's innovation-driven global economy, it is suggested that one must possess life and career skills, be adaptable, solve problems in non-routine ways, control one's own development, and think in systems (Jeannis et al., 2019). The majority of individuals with these skills are now thought to be essential on a global scale, even though many of them have long been part of the aims of science education (Gin et al., 2020). The difficulty lies in science instructors and other stakeholders comprehending the traits and requirements of students and incorporating them into a child-centered pedagogy that can satisfy those requirements (Gin et al., 2021).

Over the past century, there have been substantial changes to the education of children with disabilities in the United Kingdom (Cumming and Rose, 2022). Before the Education Act of 1918, only children who were blind or deaf could receive an education from local authorities. At the time, the general consensus was that disabled children belonged in residential special schools instead of regular classrooms (Ferguson et al., 2019). Children with disabilities could get "special educational treatment" in special schools under the terms of the Education Act of 1944, but they had to undergo a medical evaluation in order to be qualified (Fernández-Batanero et al., 2022). Some kids were even exempted from having to attend school altogether because they were deemed "uneducable." The "uneducable" classification was not eliminated until the 1970 Education (Handicapped Children) Act, which made it possible for all impaired children to get an education (Connors and Stalker, 2020).

Children should get their education in mainstream schools, according to the 1981 Education Act (Connor and Cavendish, 2020). In 1982, the Special Needs Coordinator (SENCO) was created with the purpose of auditing mainstream special education programs, raising standards, and standing up for kids with disabilities even in the face of budget cuts to education (Collins et al., 2019). The Education Act of 1993 mandated the presence of SENCOs in every school and established protocols for identifying and evaluating students with special education needs (Bunbury, 2020). Discrimination against disabled students in educational institutions such as schools, colleges, and other settings was prohibited by the 2001 Special Educational Needs and Disability Act (Bunbury, 2019). The Special Educational Needs and Disability Tribunal was also established by it. School action, school action plus, and SEN statements were the three types of help available in England and Wales prior to the Children and Families Act 2014 (Brownell et al., 2020).

## 1.3 Statement of the problem

Students with disabilities in the United Kingdom encounter significant barriers and difficulties when it comes to accessing and attending scientific education in secondary school (Basham et al., 2020). A significant obstacle is the lack of physical access to science laboratories and equipment. Most scientific classes lack accommodations for students with physical limitations, hindering their full participation in essential hands-on experiments and activities necessary for studying science (Barnes, 2019). Furthermore, the absence of specialised equipment and assistive gadgets can additionally impede their capacity to actively participate in the curriculum. Another major hindrance is the inadequate training and understanding among teachers regarding the specific requirements of kids with disabilities (Atchison et al., 2019).

A majority of teachers appear to lack both the knowledge and practices concerning the ways of transforming the teaching methodologies according to the learning abilities and disability (Berghs et al., 2019). Thus, children with impairments may feel isolated, have no support and lack opportunities for caring for science for children. Due to these factors getting through to students, teachers may find it difficult to manage a class with such kids and this results in the minority of these kids falling behind (Bracken and Novak, 2019). Furthermore, children with impairments face challenges on social emotional development which impacts their education. Hostile reactions and misconceptions that one receives from other people, including peers and in the best-case educators is likely to foster feelings of rejection and low self-esteem (Brown and Ramlackhan, 2022). The problem of social exclusion can be particularly marked in science-oriented establishments, for instance, the next concept often known as group duties, and cooperation take place in science schools. The stigma with impairments might also prevent the pupils from participating, which would in turn prevent them from gaining better education (Jeannis et al., 2020). In practice, children with disabilities get very limited Equal Opportunities in the implementation of Inclusive Education Policies in Schools as enacted between schools. Although some of the learning institutions may have elaborate support structures and endlessly access to resources, others will have a similar problem of limited funding and poor infrastructure and therefore little support.

Lack of significant therefore, longitudinal studies follow the academic progression of learners from secondary education to higher education and employment. The most of the present study like Office for National statistics and Institute of Employment Studies mainly concern to find the short academic outcome of secondary school Science education for the students with disabilities without carefully analyzing its longer impacts on their employment prospects and other skills. According to David et al. (2022), more elaborate studies that captured variance were needed to develop specific treatments and support systems. The absence of this information in the existing body of research deprives educators and policymakers of vital data required to customise educational approaches for students with disabilities, taking into account their different requirements. There is a limited amount of research that includes direct testimonies and input from students with impairments. The report from the UCL Disabled Students' Network is a unique instance that includes firsthand accounts from students, offering useful perspectives on their experiences and the particular obstacles they encounter.

Although efforts are made to uphold the principles of equality, the problem of inequality remains in various stages of curriculum development, teaching, assessment, and support systems, which obstruct the realisation of these values (Los Santos et al., 2019). The current readings highlight the problem of limited access to educational materials, learning environments that are not inclusive, insufficient support for different learning styles, and poor teacher training in inclusive teaching approaches as the main difficulties (Maryanti et al., 2021). Conversely, not adhering to the Universal Design for Learning (UDL) principles and evidence-based solutions also exacerbates inequality in science education (McKenzie and Dalton, 2020). As a result, pupils from underprivileged communities will be falling behind in their science education. Generally, the research examines how the existing techniques in scientific education fail to address the specific needs of children with disabilities, leading to discrepancies in their educational outcomes. Furthermore, this issue must be tackled by a thorough analysis of current practices and the suggestion of complete reforms in order to ultimately enhance accessibility and enhance outcomes.

## 1.4 Objectives of the Study

1. To identify and analyze the main barriers and challenges that students with disabilities face in accessing and engaging with science education in British secondary schools.
2. To examine how the existing curriculum, pedagogy, assessment, and support systems address the diverse needs and interests of students with disabilities in science education.
3. To explore and evaluate the best practices and evidence-based strategies that can be adopted or adapted to improve outcomes for students with disabilities in science education.
4. To investigate how stakeholders, including teachers, parents, policymakers, and researchers, can collaborate and communicate effectively to implement and evaluate the proposed reforms aimed at enhancing science education for students with disabilities.

## 1.5 Research Question

1. What are the main barriers and challenges that students with disabilities face in accessing and engaging with science education in British secondary schools?
2. How do the existing curriculum, pedagogy, assessment, and support systems address the diverse needs and interests of students with disabilities in science education?

3. What are the best practices and evidence-based strategies that can be adopted or adapted to improve outcomes for students with disabilities in science education?
4. How can stakeholders, such as teachers, parents, policymakers, and researchers, collaborate and communicate effectively to implement and evaluate the proposed reforms?

### 1.6 Hypothesis of the Study

| **RQ** | **Hypothesis (H)** | **Variables (level)** | **Planned test** | **Data source** |
|---|---|---|---|---|
| **RQ1: Do non-inclusive teaching materials/assessments relate to lower science attainment among SEND learners?** | **H1:** Schools reporting a higher frequency of non-inclusive materials have **lower** mean science attainment for SEND pupils. | Predictor: Non-inclusive materials index (ordinal/interval); Outcome: Attainment z-score (interval) | If interval outcome: **OLS regression** with robust SEs; If categorical outcome (pass/fail): **logistic regression** | Survey + school records |
| **RQ2: Is lab accessibility associated with participation and practical-work confidence in SEND pupils?** | **H2a:** Greater lab accessibility is associated with **higher** practical participation (yes/no). **H2b:** Greater lab accessibility is associated with **higher** | Accessibility (ordinal); Participation (binary); Confidence (ordinal) | H2a: **Chi-square** (with Cramér's V) or **logistic regression**; H2b: **ordinal logistic regression** (proportional-odds check) | Survey |

| | | | | |
|---|---|---|---|---|
| | confidence (Likert). | | | |
| **RQ3: Does teacher training in inclusive methods predict more inclusive classroom practices?** | **H3:** More hours of inclusive-pedagogy CPD predict **higher** inclusive-practice scores. | CPD hours (interval); Practice score (interval) | **OLS regression** with diagnostics | Survey |
| **RQ4: Are deficit mindsets among teachers associated with lower expectations of SEND attainment?** | **H4:** Higher deficit-mindset scores predict **lower** expectations for SEND attainment. | Mindset scale (interval); Expectations (interval/ordinal) | Interval: **OLS**; Ordinal: **ordinal logistic** | Survey |

## 1.7 Significance of the Study

The significance of this work lies in its potential to address significant gaps in science instruction for children with disabilities attending British high schools. This study aims to close the gap in the process of developing policies and educational reforms by thoroughly examining the policies that have been provided and giving scientific recommendations regarding their implementation. The findings of this study have the potential to influence the work of curriculum designers, educators, legislators, and other relevant parties as they start to formulate more specific guidelines about the primary concerns and obstacles faced by students with disabilities enrolled in science courses. Furthermore, as a step towards creating an equitable learning environment for all students, regardless of ability, this research project will advocate for the adoption of evidence-based practices and Universal Design for Learning (UDL). It can be challenging and varied to teach science to kids with impairments. Teachers have to assess a number of things, such as the different learning needs of their students, the accessibility of appropriate materials and equipment, and the best teaching strategies to promote learning. To discover and implement the most effective methods for teaching science to this set of children, researchers, educators, and legislators must work together and conduct ongoing studies. It is critical to keep exploring and developing the field of teaching science to children with disabilities given the significance of scientific education in the modern world and the unique challenges they face. By doing this, we can make sure that every student has the opportunity to build a strong scientific foundation, empowering them to participate actively in society and become informed citizens in an increasingly science-driven world. These results may eventually lead to circumstances in which the educational experiences and outcomes of students with disabilities improve, creating an environment in the UK secondary school system where all students receive an equal education.

### 1.8 Scope and Delimitations

This work also involves the investigation of teaching and learning of science for disabled learners in secondary schools in United Kingdom. The study aims at using both quantitative and qualitative research questionnaires so as to effectively gather adequate information regarding the education experiences of these students. General academic performance, the approaches to teaching and learning and the availability of teaching/learning resources are some of the variables of interest within the study. This broad purpose is to illustrate the challenges faced by children with disability and to incorporate the perspective of parents, teachers, other educational stakeholders. Thus, it is expected the outcomes will enhance the science education approaches, and influence the changes in the legislation hence encouraging a diverse learning environment. Even though, the study is general in nature; it is bounded by certain delimitations. It may be more difficult to implement the finding into other educational settings, or other nation because the cross-sectional study involved only secondary schools in the United Kingdom. While this focus exclusively on the region is indeed necessary to grasp the specific challenges and practices of the UK school system, it would not reflect the challenges of disabled learners in other educational or cultural settings.

Additionally, the sample was set deliberately for reaching the data saturation level and the number of 40 participants may not cover the heterogeneity of learners with disability. The choice of 4 types of stakeholders—students, parents, teachers, and researchers—means that some other important point of view is unlikely to be covered, for example, school principals' or governmental officials' point of view is unlikely to be finely captured when choosing the object of data collecting. The methodology also underscored values and ethical issues and our responsibility to respect, in the provision of a written consent, maintaining the anonymity of the participants and their right to self-determination. This ethical framework is necessary where participants need to be convinced of honest and safe research, especially from students with disabilities. However, the focus on ethical practices may also introduce constraints, as the need for thorough ethical review and participant consent can extend the timeline for data collection and analysis. Researchers must balance the ethical obligations with the practicalities of conducting the study within a defined timeframe and budget.

In addition, with the use of mixed methods approach the study is able to address all the research questions effectively while at the same time not necessarily very extensive in detailing each and individual experience or even vary detailed description of each type of disability. The use of questionnaires and comparison of scores from quantitative data may hinder in recording all needed variables or examining subjectivity and richness of everyday encounters. It is hoped that the qualitative aspect in the form of focus group discussions and semi-structured interviews will offer more depth; however, the results could well be bounded by the contexts and interactions of the provided groups. Thus, the clear identification of the range of the investigation would allow investigating the profiled subject more accurately, as well as recognizing the inevitable constraints inherent in this kind of research, it will help to contribute to the development of science education for students with some form of disability.

## 1.9 Theoretical Framework

The theory sustains the practice and the practice informs the theory (Macfarlane, 2007). The functional theories generally enhance a professions capability for co-operative work and generate a number of ethical and reasonable solutions to questions in learning (Macfarlane, 2007). In this study, the Universal Design for Learning framework, classroom constructivism, and the social model of disability theories inform this study (Bunbury, 2019). The theoretical premise for the present work is the social model of disability which is underpinned by the view that disability is caused not by the individual, but by the existing social norms and stereotypes pervading society at large (Berghs et al., 2019). The social model of disability interprets impairment as a kind of discrimination that is emerged socially and culturally, has been discussed widely (Connors and Stalker, 2020). This social model originating from the disability movement re-defines politically the term ‘disability,’ meaning the exclusion and disadvantage that are socially ascribed to those who have impairments (Barnes, 2019).

Therefore, disability is seen from the perspective of social models as a socially produced injustice that can be contested and eradicated by significant social change (Lawson and Beckett, 2021). Oliver admitted that he was referencing the original UPIAS distinction between impairment and disability when he coined the term "social model of disability" in the early 1980s (Collins et al., 2019). He made a useful distinction between this social model understanding of disability and a variety of traditional approaches that he categorised as the "individual model of disability." He characterised these approaches as locating the disability problem within the individual and attributing its causes to the functional limitations or psychological losses that are thought to result from disability (Connors and Stalker, 2020). Social model proponents employ ontological constructionism to differentiate between disability and impairment. They distinguish between social and biological constraints with a vertical line (Lawson and Beckett, 2021). They only talk about social processes or characteristics that depend on a subject. They deprive the disabled subject of biological and psychological components by applying just social theory (Kart and Kart, 2021). A significant portion of the lives and activities of people with disabilities are missed when their biological circumstances are discounted or denied (Bunbury, 2020). They come to the conclusion that their disabled subject is a physically nude "half-man," a "half-person" with only social characteristics, and that he is exclusively bound by social duties and values (Lawson and Beckett, 2021).

Equity in science education is ushered in by the Universal Design for Learning framework, which is founded on broad principles and offers helpful guidelines for curriculum, pedagogy, and assessment development that are tailored to address the unique learning challenges faced by students with disabilities (Bracken and Novak, 2019). In 1988, architect Ron Mace and his colleagues at North Carolina State University created the term "universal design" (UD). The Centre for Applied Special Technology (CAST) was established in 1984 by North Shore Children's Hospital in Massachusetts with the intention of utilising technology to improve education for K–12 students with disabilities (Navaitienė and Stasiūnaitienė, 2021). Through the creation of Universal Design for Learning (UDL), CAST has emerged as a preeminent authority on the use of UD principles for education. UDL offers a framework to alter the actual learning environment rather than concentrating on modifications for students with impairments (McKenzie and Dalton, 2020).

The vast bulk of UDL research has been carried out in K–12 educational settings. Regardless of their condition, every student learns in a variety of ways (Kelly et al., 2022). All students have different ways to access the curriculum in postsecondary courses that are created with UDL and incorporate technology applications (Kieran and Anderson, 2019). In the same manner that students with disabilities benefit from a UDL classroom, so do students without disabilities. They are able to exhibit higher levels of motivation and engagement as well as a greater interest in their own learning (Ferguson et al., 2019). The majority of papers concentrated on teaching preservice teachers and faculty members to implement UDL or on the opinions of students and faculty on UDL. According to Zhang et al., (2024), there were insufficient studies utilising quantitative techniques and studies examining technology that were in line with UDL. Following instructor training, Zhang et al., (2024) found that instructors were more willing to incorporate UDL into their lessons and that students' perceptions of how the instructors applied the principles of UDL—presenting information, engaging students, and allowing students to express comprehension—improved (Zhang et al., 2024).

In order to accommodate the requirements of all learners, UDL integrates a proactive framework for curriculum design, techniques, and resources (Kieran and Anderson, 2019). In order to achieve this, desired goals must be established across all educational activities, taking into account learner variability from the beginning (e.g., the adoption of online platforms, acquisition of learning resources, pedagogical techniques, and professional learning opportunities) (Zhang et al., 2024). By ensuring that goals, techniques, resources, and assessments are flexible, the UDL framework supports educators in having a common focus and reducing or eliminating unnecessary barriers to learning (Navaitienė and Stasiūnaitienė, 2021). The foundation of universal design for learning is a set of rules and concepts that apply to almost any kind of learning environment or experience (e.g., physical, blended, online) (Cumming and Rose, 2022). It supports multiple teaching modalities and is not dependent on any particular material. It is recommended that those who are interested in learning more go to the field led global platform (Basham et al., 2020).

On the other hand, the constructivist learning theory serves as a theoretical foundation particularly for teaching people with disabilities in science classes, for pedagogic tactics that might include, among other things, active participation, inquiry, and meaningful learning experiences (Schunk and DiBenedetto, 2020). The constructivist method provides an excellent way of thinking for both general and special education since it emphasises the significance of components like vitality, change, continuity, and interaction (Brown and Ramlackhan, 2022). Adapting to the cultural, universal, and social realities of the day is essential for education if it is to shape individuals to create a better, more sustainable future and to transform man into something superhuman with a bright future (Lambert and Tan, 2020). In a nutshell, learning is the process of constructing subjective meaning through social interaction, according to the constructivist perspective of learning (Wray and Houghton, 2019).

The constructivist method holds that knowledge is actively produced and consumed by the individual (Rapp and Corral-Granados, 2024). With a constructivist view, knowledge is now understood as knowledge that can be updated and frequently interpreted by other learners, as opposed to static transmitted content. Knowing explains why a person tries to live in harmony with the world around him (Mayer, 1999). According to Connor and Cavendish (2020), knowledge is produced in a social framework that promotes continuity, sharing, and involvement. The person learns throughout this entire act of knowing by making sense of the material he interacts with, the outside world, and other interaction aspects. According to this theory, which emphasises the subjectivity of the person, people create their own meanings (Connor and Cavendish, 2020). It is valuable for each individual to generate their own meaning rather than having their own meaning suppressed, according to the constructivist perspective, which contends that the opposite is not conceivable (Atchison et al., 2019).

Constructivism is centred on how knowledge is constructed, or how learning occurs, and how procedures affect both teachers and students (Brown and Ramlackhan, 2022). Constructivism explores how one perceives truth regarding their own living environment rather than a metaphysical reality (Wachira and Mburu, 2019). According to Chiari and Nuzzo (1996), learning is a personal endeavour in which the learner uses solely their own resources to investigate the outside world. Students "want to know what it means to live, in what sense they have a past and a future, and an idea of their own direction," states Ingold (Gin et al., 2020). The person themselves is the main source in this process of knowledge. By using this method, the research hopes to shed light on the opportunities and difficulties associated with teaching science to students with impairments, as well as the pertinent steps that can be taken to make improvements (Mortier, 2020).

### 1.10 Research Methodology Overview

The method ushered in this research utilizes both qualitative and quantitative methods in an attempt to get an overall view of the situation of science education for disabled students in UK secondary schools. This approach brings the quantities and the qualitative researcher tools and techniques that enhance data collection and analysis of the research questions. The study seeks to analyze the challenges being faced by the students; evaluate the current best practices and policies; and make recommendations for change. However, the research design incorporates more descriptive and evaluative aspects looking at the current state of education while offering an estimate of the current methods. With the combination of frequency analysis and analysis of themes, the survey aims to find out the correlation between and among different factors affecting course outcomes, interest, and access in science.

The numbers of sample in this study are 40 participants, learner with disability, parents, teachers and all those who have a stake in science education. In probability and non-probability technique, particular attention is given to participant selection in order to have a representative sample. Data collection methods comprise the use of instrument developed for the study as well as those that already exist, for example, academic achievement and attitude towards science. Quantitative data will therefore be collected through the focus group discussions and semi structured interviews, in a bid to establish impression of the participants on the beliefs and experiences of inclusive science education. Preliminary ethical and procedural considerations include written and informed consent, client anonymity and participant autonomy in fulfilling their part of the study.

This research will use both qualitative and quantitative data analysis techniques, in a bid to get the results to the set research questions. Qualitative data will be analyzed by descriptive statistics to provide general information about the participants and inferential data analysis will involve correlation and regression tests to determine if the relationships exist between the two variables. For quantitative data, descriptive analysis will be used to describe key findings from the survey data collected using closed questions. This multi-faceted approach ensures that the findings are robust and nuanced, ultimately benefiting science educators and policymakers by offering evidence-based recommendations for improving science education for students with disabilities.

## 1.11 Structure of Dissertation

There are six chapters in this dissertation. Chapter 1 of the study explains the background of the study and formally defines the research problem and the importance of the study. This chapter also provides the research questions, objectives, as well as delimitations of the study and also provided are the Definitions of variables used in the Study, and finally the study's theoretical framework was also presented. Chapter 2 presents a critical review of related literature from different viewpoints and outlines the research gaps in prior studies, as well as a critical evaluation of the research findings. The method of study, population and sampling, data collection and analysis, and ethical aspects are described in Chapter 3 of this dissertation. By implication, the findings are given in Chapter 4 in detail accompanied by tables and graphs to enhance the presentation of data. Chapter 5 provides a discussion of the results with reference to other studies and recommendations for future research. Thus, chapter 6 is a conclusion section, where the author provides the analysis of the main conclusions, general conclusions, and recommendations.

## 1.12 Operational Definitions:

- **Barriers and Challenges**: Factors that hinder the access and engagement of students with disabilities in science education, such as lack of accessible resources, negative attitudes, and limited support.
- **Disability:** A physical, sensory, cognitive, or developmental impairment that may limit an individual's ability to engage in typical educational activities.
- **Inclusive Education:** An educational approach that seeks to accommodate the diverse needs of all learners, regardless of their abilities or backgrounds.
- **Best Practices and Strategies:** Evidence-based approaches and interventions aimed at improving outcomes for students with disabilities in science education, including the implementation of UDL principles and collaborative efforts among stakeholders.
- **Outcomes for Students with Disabilities in Science Education:** The academic achievement, engagement, and satisfaction of students with disabilities in science learning experiences.

### 1.13 Conclusion

This chapter commences the study aimed at improving the literacy of students with special needs in science within the British secondary school system. This we consider as very vital in that any form of science education that should be encouraged in schools and other institutions of learning should embrace quality education for the poor and marginalized persons in society as the society continues to embrace science and scientific knowledge and expertise. The chapter justifies a focus of the research in filling the gaps in instructional practices and provides rationale for the comprehensive analysis of the difficulties experienced by students with disabilities in their science learning. This document provides information on research questions and purposes that seek to establish the success of existing curriculum, instruction, evaluation, and support structures on students of such nature. In addition, the chapter explains the mixed methods approach that will be adopted for the study using both quantitative and qualitative data collection tools in addition to the ethical consideration that shall be observed on the course of the study. Finally, it provides an overview of the dissertation's structure, which includes a comprehensive literature review, a detailed research design, and subsequent chapters dedicated to presenting findings and offering practical recommendations for reforming science education to better support students with disabilities.

# Chapter 2: Literature Review

## 2.1 Introduction

A systematic review approach based on qualitative research was employed since it offers comprehensive responses to certain research questions (Aggarwal et al., 2021). It is especially important in order to see feelings of people, their value system and the role they give to the actions and to the actions performed for them (Cypress, 2018). However, systematic mixed type systematic reviews entails some level of inherent danger to deep and rich quality work and integrating the mixed and the qualitative with the quantitative evidence, systematic qualitative review retains internal validities while maintaining the coherency of the quality data analysis (Purssell and McCrae, 2020). Hence, to assess systematically the current state of know ledge of a given issue, the systematic review utilises methodological tools for identification and analysis of notable researches (Siddaway et al., 2019).

According to Hong et al. (2017), mixed methods systematic reviews merge the advantages of quantitative and qualitative research methods to conduct an analysis that overcomes the limitations of each method when employed on their own. Furthermore, the capacity to assess both effectiveness and processes, in a review amplifies the relevance of the conclusions. According to a study, by Mays et al., (2020) examining quantitative evidence in a manner can help policymakers make informed decisions in complex areas by offering detailed insights into both results and how things work, thereby aiding in the implementation of more well informed and efficient interventions. Published study conducted by Plume and Hong in 2014 also emphasised the importance of developing evaluation tools and synthesis methods that can accommodate types of evidence, in mixed methods systematic reviews.

## 2.2 Search Strategy

According to Bramer et al. (2018), a systematic search plan usually includes establishing precise keywords based on the research query and integrating words with similar meanings, related terms and controlled language, like Medical Subject Headings (MeSH). This method aids in gathering all studies from databases and reduces the chances of overlooking important literature. Furthermore, a comprehensive search plan typically involves utilizing a mix of electronic database queries, hands on exploration of publications, cross referencing relevant article citations and employing tracking tools, for citations to discover studies. This varied method, presented by Lefebvre et. The completeness of the research literature. Grey literature, such, as theses conference papers and technical documents is also taken into account to guarantee that the review covers all evidence encompassing studies and those not peer reviewed.

In order to conduct a review systematically we gathered data from sources such, as CINAHL, PubMed, the Cochrane library and Science Direct that focus on medical and clinical topics. Through employing search terms, valuable information was obtained. There must be emphasis on the operators used for connecting the keywords during the search process. Articles were searched across databases and other resources both online and offline available. For an effective result of searching, title keywords were utilized in combination along with other manual searching methods. While performing an assessment exercise related to information and research issues, it is recommended that experts first make searches from different databases and add extra procedures to ensure that they collect all relevant information, regarding the topic adequately. (Argyres et al., 2020). Thematic analysis was incorporated as a type of qualitative method used to extract, analyze, and generate themes in data.

## 2.3 Data Analysis

This method, according to Braun and Clarke (2016), is a systematic procedure involving coding and theme development. The researchers familiarize themselves with the data through a process of reading and re-reading the text. Then, generating initial patterns captures interesting features of the data in a meaningful way. From these patterns, possible themes are identified by the research group, which were refined iteratively in reviewing and defining these themes to ensure that the themes are accurate to the data set and relevant for the research question. As such, there is so much flexibility to thematic analysis and its application to varied qualitative data and research questions. This is one of the strengths of thematic analysis: it gives a thoughtful and subtle account of data, capturing complexities of meaning within participants' responses. Employing the systematic and multifaceted nature of thematic analysis itself, the researchers consequently are able to tease out intricate details and subsequent comprehensions from the report of the data. The last stage of the process is thematic analysis, which has several reasons and is thus important in the process of data analysis.

## 2.4 Thematic Analysis; Major Themes:

### *Historical Context and Background*

**Theme 1: Learning Disabilities**

Learning disability (LDs) considered to be a disorder in multiple categories, specifically in the ability to process as well as retain information and present in difficulties regarding language, mathematics, and reasoning skills. LDs are consistently manifested in relative weakness in listening, speaking, reading, or writing in children who are otherwise of average or above average intelligence (Rhinehart et al., 2024). Such thresholds have been more glaring in formal settings of education wherein the demands of the above-average portions of the LDs population are higher than what is expected of them due to differences in the functioning of the nervous system. For LDs, timely assessment and management based on such evaluation is critical to developing educational plans that are custom fit for the individual. If this assessment is made late, this leads to increased levels of academic and social integration challenges as the grades advance. The RTI model and other effective models of assessment and management provided the basis for timely, anticipatory management of education in terms of data before any significant amount of failure occurs (Martín-Ruiz et al., 2023). The outcome of this method is twofold; improvement of educational performance by changing how the subject matter is taught and avoidance of unnecessary negative repercussions of failure in education such as those relating to self-esteem and behavior as a result of continual failures.

Besides the strategies enumerated in the classroom, it is worth appreciating the teacher expectations as well (Yakut, 2021). High expectations from teachers can improve the performance even of students considered to have LD. When teachers feel that their students can succeed, it in turn boosts academic performance and self-worth. This is congruent with the understanding that children perform better in school when they know their significant people in life have faith in them (Li et al., 2021). Even more important is parental involvement for students with LD. Epstein (2011) for instance argues that involved parents can reinforce learning at home and press for necessary learning materials. Such involvement does not only produce good grades but also builds up students' self-efficacy as they see their efforts being appreciated and supported by families and schools. This further confirms the argument that parents, teachers and the students themselves are important for academic performance and should all be involved in the processes.

Technology also presents opportunities to improve educational outcomes for students with LD. Assistive technologies, such as speech-to-text software and interactive learning platforms, have been shown to facilitate learning and boost grades among these students (Khasawneh, 2021). The integration of such technologies into the classroom can enhance engagement and provide alternative means for students to demonstrate their understanding, thereby improving their academic performance and self-esteem. Despite the positive outcomes associated with improving grades for students with LD, challenges remain in achieving equitable educational experiences. Stigmatization and lower expectations often persist in educational settings, negatively affecting students' self-perceptions (Mokmin and Rassy, 2024). As educators and policymakers strive to create inclusive environments, it is crucial to address these barriers and implement strategies that empower students with LD to achieve their full potential. Thus, improving grades for students with learning disabilities is a multifaceted issue that requires attention to individualized education, inclusive practices, high teacher expectations, parental involvement, and the use of technology.

**Theme 2: Historical and legal context to inclusion in education**

Due to perceived incapabilities, children with disabilities and learning issues have historically been discriminated within or excluded from education (Lytra and Drigas, 2021). According to Lodge and Lynch (2024), there is a worldwide process by which children were historically classified as "normal" or "handicapped" in the context of education, and special educational resources were created for each category. Children were segregated within the educational system because it was thought to be the most suitable and efficient way to meet the needs of a minority of students who were deemed unable to benefit from regular teaching methods and to "safeguard the efficient education of the majority" (Niazov et al., 2022).

The 1960s and 1970s saw an increase in criticism of the segregated education system for disabled children, which may have been caused by the era's global civil rights movement (Turan and Atila, 2021). Concerns over equality of access and educational opportunity arose when people with disabilities started to voice their opposition to the stigmatising and restrictive aspects of segregated schooling. McDonnell claims that this type of seclusion just served to reinforce their social absence and increase their feelings of loneliness for many of these people (Kutscher and Tuckwiller, 2019). The National Council for Special Education (NCSE 2010) claims that societal perceptions of disability changed as a result of political pressure from groups that assist parents and individuals with disabilities. As a result, new laws intended to improve education were introduced. According to the NCSE (2010) findings, research on the consequences of segregated education on children also started to demonstrate the failure of separated service at this time. Additionally, there was increasing agreement by the end of the 20th century that the inclusionary philosophy and framework were suitable for reorganising education. As a result, the primary objectives of education policy in industrialised countries were integration and normalisation (Bressane et al., 2024).

Bines and Lei (2011) highlight three fundamental approaches to disability and education policy: charity and welfare, rights and equity, and the utility approach. The latter is usually used to bolster arguments for fairness and rights by demonstrating how, for instance, expanding accommodations for people with disabilities can enhance educational results or benefit society at large. The most traditional approach is charity, which was the basis for the establishment of many special schools in the past. International declarations on the rights of children, people with disabilities, and other groups, as well as a distaste for the charity-welfare perspective that views people with disabilities as "passive recipients of benevolence and benefits," are the sources of more recent approaches that are based on equity and rights (Klimaitis and Mullen, 2021). Public service provision took the place of non-state charity under the welfare concept. Quin and Redmond (2023) contend that the conventional charity-focused responses to people with disabilities are being challenged by the rise of a rights-based response to disability. This is consistent with the generally accepted change from the so-called "medical model of disability" to the so-called "social model of disability" in educational policy and practice over the past few decades (Maryanti et al., 2021).

Separate special education has always been justified using the medical paradigm of disability. According to Stokes et al., (2019), the medical model emphasises the individual as someone who is incapable of carrying out social activities and responsibilities in life, approaching disability from a "personal tragedy" perspective. People with disabilities are stigmatised and subject to societal expectations regarding their talents and conduct, regardless of their disability, claim Barnes and Mercer. In a similar vein, Stokes et al., (2019) highlights a link between participation or excluding behaviours and what he terms a psycho-medical concept of disability. It also claimed that because the "deficit" theory emphasises on "individual deficits rather than on inequitable social structures" and assigns the responsibility to the child's education, it is to blame for the marginalisation and exclusion of people with disabilities (Stokes et al., 2019).

On the other hand, Maryanti et al., (2021) reported a change in the perception that disability is often understood in terms of the "disabling environment" and that psychological and structural barriers affect an individual's ability to participate fully in society. The phrase "social model of disability" was first used by Oliver (1983) to characterise this change in focus from a person's underlying medical condition or physical limits to the physical and social settings and how they may place restrictions on specific groups of individuals. Similarly, Schreffler et al., (2019) argued that society is the source of prejudice against people with disabilities, not the sickness or disability itself. Instead than downplaying the importance of medical treatments in a person's life, the objective is to avoid exaggerating them (Schreffler et al., 2019).

The changing definitions of disability as well as the appropriate vocabulary and terminology also reflect this more contemporary societal paradigm. One approach that promotes inclusive policy and practice on the basis of human rights is insisting on terms like "people with disabilities" rather than "the disabled," implying that service users are "agents rather than objects," (Van et al., 2021). According to the National Disability Authority (NDA 2011), designations like "the blind" or "the disabled," which disregard the individuality, equality, or dignity of people with impairments, must be put aside in favour of the individual. Stinken et al., (2020) reported that when the social model of disability is used, "Emphasis shifted from charity to rights and from social exclusion to inclusion, with the replacement of a culture of dependence and pity by one based on acceptance and equal citizenship" (Stinken et al., 2020).

The legal provision that backs up a policy provision is essential to the concept of rights (Jeannis et al., 2020). The most thorough legal description of children's rights may be found in the United Nations Convention on the Rights of the Child (UNCRC) (1989). A child's right to education is outlined in Article 28 of this agreement, and one of the four fundamental principles of the Convention—that all children's rights must be safeguarded and respected "without discrimination of any kind" (UN, 1989)—is laid out in Article 2. The Convention implies that every child, regardless of handicap, has the right to an inclusive education and that governments have an obligation to make sure that education is flexible and accessible for all children (Vincent and Chiwandire, 2019). However, Jeannis et al., (2020) argued that this statement legitimized segregation and avoids the need for inclusive social policies and education since it only partially acknowledges the rights of impaired children and prioritises welfare and non-discrimination above rights.

The United Nations body for education, UNESCO, promotes inclusive education policies, initiatives, and practices using a rights-based approach to give people with disabilities equitable educational opportunities (Jeannis et al., 2020). In June 1994, representatives from 25 international groups and 92 governments agreed on a new declaration for the education of all children with disabilities at the World Conference on Special Needs Education in Salamanca, Spain. According to Ainscow (2013), one of the most important international publications in the special needs field is the UNESCO Salamanca Statement on Principles, Policy, and Practice in Special Needs Education (1994). According to the Framework for Action in the Statement, all educational policies ought to mandate that children with disabilities attend the same local school as their peers without disabilities (Jeannis et al., 2019). This is predicated on the fundamental notion that all pupils, regardless of their physical, intellectual, social, emotional, linguistic, or other circumstances, should be accommodated in conventional schools.

## *Key Theories and Concepts*

### Theme 3: National Curriculum of Physical Education

Numerous studies contend that the national curriculum physical education (NCPE) program's emphasis on team sports and competitive competition has been a defining characteristic since its establishment in 1992 (Moriña, 2019; Newman et al., 2021; Stinken-Rösner et al., 2020). The team games have long been a part of the culture of many British schools may be of special interest. According to figuration sociology and archival research, team games in physical education (PE) have roots that go back to the early nineteenth century in English public schools, far beyond the origins of the NCPE (Gilmour et al., 2019). However, other research has indicated that a result of the focus on performance and accomplishment in team games and competitive sports is that many students with special education needs (SEN) have been and still are, to varying degrees, excluded from the same opportunities and experiences offered to some of their age-peers in curricular physical education (Theobald et al., 2019).

According to a survey conducted by Turnbull et al., (2018), 64% of English students with special education needs had engaged in physical education "frequently," which is defined as at least ten times during the previous academic year, while 83% of all students had done so during the same time frame (Turnbull et al., 2018). In a similar vein, Agran et al., (2020) investigated why participation rates diverge so greatly from the viewpoint of individuals engaged in efforts to create inclusive PE policies, procedures, and practices. One reported unintended consequence of mainstreaming education is that, in comparison to their age-peers in special schools, the opportunities available to students with SEN have decreased, at least in physical education. This seems to be the case despite constant calls for students with SEN to be educated in mainstream schools in order to increase their power and possibly challenge dominant ideologies and traditions (Agran et al., 2020).

According to Yusof et al., (2020), it is typical for certain students with special education needs to be pulled from a physical education class (particularly if it involved a team game or competitive sport). Perhaps more significantly, their age-peers may participate in separate activities if the student was unable to fit in with the rest of the class. In a similar vein, some of the SEN students, Yusof et al., (2020) examined admitted that they tended to participate far less when team games were used as the PE activities. When students with SEN engage in the same activities as their age-peers, some of the supposedly more competent peers' behaviour frequently prevents them from fully participating (Yusof et al., 2020). For example, Le and Matias (2019) used Bourdieu's theoretical tools to analyse embodied identities and finds that students with SEN have been excluded by their peers in certain activities, especially team games (during a passing move, for example), because of their apparent inferiority (Le and Matias, 2019). On the other hand, while some participants in a study by Gilmour and Wehby (2020) that looked at the educational experiences of a group of Paralympians reported being bullied by their peers who were not disabled, others said they had succeeded in school sports, which led to their ability being accepted and their confidence growing. Some students with SEN are seen as a subordinate group in terms of their physical and mental capacities, yet mainstream physical education seems to have the ability to challenge these prevalent notions (Gilmour and Wehby, 2020).

Additionally, several of the students with SEN in Atanga et al., (2020) said that they often felt socially isolated during physical education when they engaged in distinct activities, which frequently negatively affected their social interactions with students without SEN. Similarly, although some of the participants in a study by Szumski et al., (2020) reported having a small group of friends at school, the majority reported experiencing varying degrees of social isolation; all reported being bullied both overtly and covertly while attending mainstream school, which led to many feelings of loneliness and depression (Szumski et al., 2020; Atanga et al., 2020). Therefore, it appears to some students that traditional physical education classes, particularly those that focus on team games and competitive sports, are strengthening discriminatory attitudes and normalizing segregation more than they are promoting it.

Notably, more individualised activities that are frequently found on the periphery of the physical education curriculum—such as gymnastics, tennis, badminton, dance, swimming, outdoor and adventurous activities—have been identified as particularly appropriate for supporting the full inclusion of students with special education needs in physical education (Burke et al., 2020). Stated differently, individualised activities tend to be more inclusive by design, which may reduce the need for major adjustments to accommodate students with special education needs (De Bruin, 2019). Additionally, as schools move away from individualised activities and towards team games and competitive sports, there seems to be an increasing chance that some children with special education needs may be removed from physical education courses (Toutain, 2019). Toutain (2019) used the key concepts and assumptions of figuration sociology to explain why some students with SEN become isolated in mainstream PE lessons by looking at the different patterns of social relations and dynamics that may be involved in individual activities. Because their actions are independent of those of others, students with or without special education needs can control the amount of physical effort they put out during solo activities, such as long-distance running. However, when playing team games, this control may be greatly reduced.

In particular, when competing against or with students without special education needs, for instance, the student with SEN must initiate moves and respond to moves in relation to others' moves (Kutscher and Tuckwiller, 2019). The student with SEN is merely one person in a complex web of people who are both reacting to and dictating each other's actions. As a result, students have much less control over the length and level of difficulty of team games than they do during individual ones. Because it is easier to modify activities to fit each student's needs and abilities without other students limiting their participation, it has been suggested that PE teachers find it less difficult to fully include students with SEN in individual activities (Flowers et al., 2018). To put it briefly, each student can perform at their own level thanks to individual exercises. The problems mentioned below are not specific to physical education courses. The literature also identifies extracurricular physical activities as being exclusive to students with special education needs in their current form.

**Theme 4: Curriculum-based Assessment and Special Education**

The use of effective and productive assessment methodologies is increasingly essential for accurately monitoring progress and making instructional adjustments for students with disabilities in an educational system that prioritises individual student growth (Balade et al., 2024). Teachers can gather information about students' academic achievement on curricular areas by using curriculum-based assessment in classrooms where students with disabilities are taught alongside their classmates without disabilities. Teachers can make informed decisions on programs, student placement, and current needs for children with disabilities by using curriculum-based assessment. Within a response-to-intervention (RTI) framework, special education teachers can evaluate intervention programs using curriculum-based evaluation (Talbott et al., 2023).

Interventions can be tailored to each student's needs to guarantee academic success through the use of curriculum-based evaluation (Vanderheyden and Solomon, 2023). Ado (2017) states that classroom teachers can use Design Your Own (DYO) periodic assessments in secondary schools where high school teachers find it difficult to administer curriculum-based exams to students with impairments. Teachers create the DYO periodic evaluations, which align with the curriculum and instructional values of the schools. In addition to measuring student development in reading, writing, spelling, and mathematics, DYO offers a methodical way to apply curriculum-based assessment and gives data to guide instructors' training. According to LaLonde et al., (2023), schools can improve their graduation rate, successfully navigate the state's evaluation system, receive higher ratings on their report cards, and receive bonus points for helping their students with disabilities following the second year of DYO implementation (LaLonde et al., 2023).

The effective use of curriculum-based assessment can provide a more flexible, standardised, and personalised approach to the development, instruction, and evaluation of academic curricula (Jungjohann et al., 2023). Patton (2017) asserts that educators will possess robust and adaptable methods to tailor education for students with impairments, ensuring relevance and comprehensive understanding of complex subjects and ideas. This is achievable through the effective execution of curriculum-based assessment. Furthermore, by providing diverse sources of high-quality academic resources, students with disabilities will have enhanced opportunities to personalise their education, evaluate their own work, engage in critical thinking, and participate consistently, thereby promoting a deeper understanding of complex subjects. The initial phase of implementing an effective curriculum-based assessment involves special education and general education teachers collaboratively outlining the curriculum (Rodgers et al., 2024).

## *Current Trends and Issues*

### Theme 5: Multisensory Learning and Chunking Information

Research has notably established that rhythm patterns which are language-based and the inability to recall and comprehend such patterns can be learned through the use of multisensory approaches, which incorporate visual stimuli along with auditory patterns and motor movements (Cosentino and Giannakos, 2023). It is accurately noted that such learners are taught along with students with special needs in an inclusive framework. Borek and Thompson (2023) emphasise that multisensory teaching will not only be inclusive, but also cater to a wide range of learning styles through the provision of multiple sensory input. The integration of multisensory approaches enables teachers to create and structure lessons for all children regardless of disability or any other factors (Sahlan, 2022). This inclusive approach complements Montessori's vision on education where children are encouraged to learn by doing, which involves active interaction with the environment utilizing or incorporating auditory, visual, and contact activities, enhancing the learning experience for normal children and children with learning disabilities. In addition to that, it is also possible to modify multisensory methods to promote tasks and reading performance in children with learning disabilities (Gao et al., 2022). It is reported that the use of a combination of images with sound and touch in the methodology of instruction enhanced both attention and visual word reading. This multisensory input includes reading; hence learners are able to do their reading more effectively and reduce distractions. These findings suggest that multisensory methods are crucial for keeping students engaged, especially those who struggle with attention or processing information through a single modality (Seidl et al., 2024).

Information chunking is a strategy of dividing material into easily digestible portions. For students with disabilities, chunking combined with multisensory learning has proven particularly effective. According to Cuturi et al., (2022), the video lesson should have chunks of content to support students' understanding and remembering for intellectual disability. The idea of chunking prevents overloading students' cognitive capabilities as they can work with smaller bits of information in the shortest time possible and also reinforced by visual, auditory, and textual cues (Cuturi et al., 2022). Chunking is also based on dual-channel processing theory where both auditory and visual channels are engaged to foster deeper cognitive processing. For students with either visual or auditory preferences, special approaches to learning can offer extra support. Zheng et al., (2021) have designed an e-learning system to adapt educational content according to individual sensory preferences. This system identifies a student's dominant modality of learning which could be visual, auditory and then adjusts the presentation style accordingly. Such learning environments for students with disabilities target tailored support to increase the effectiveness and engagement of learning with each student through their strength (Zheng et al., 2021).

An active example of multisensory learning is through Visual Phonics, which uses visual, auditory, and kinaesthetic modalities to foster early literacy development, particularly among struggling readers (Sanfilippo et al., 2022). Visual Phonics helps to visually map phonemes to symbols and sounds and is particularly useful for students who have auditory processing or language deficiencies. The touchy-feely aspect of tracing or signing phonemes while learning makes it interactive and reinforces the learning through multiple senses. In addition, kinaesthetic learners find hands on activities such as role play effective in comprehension (Okray et al., 2023). Kinaesthetic approaches like role play engaged pharmacy students to significantly enhance understanding of complicated concepts. By providing a physical experience, kinaesthetic learning caters to students who learn best through movement, and when combined with auditory and visual cues, it can create an impactful and memorable educational experience, especially for students who benefit from non-traditional learning approaches (Gao et al., 2023).

**Theme 6: Special Education and Hidden Curriculum**

The curriculum plays a crucial role in both school achievement and students' academic development. Hoover (1987) distinguished between three categories of curricula: hidden, missing, and explicit. Despite its importance, the explicit curriculum is the formal curriculum that teachers are obliged to teach and that students learn. What teachers decide not to teach in classes or schools is known as the missing curriculum. The abilities and components of the secret curriculum are not found in any standardised source (Stinken-Rösner et al., 2020). All students, including those in special education classrooms and those in mainstream classes, require instruction in all three types of curricula. The unwritten or implicit norms, attitudes, practices, and processes that are present in an educational system are referred to as the hidden curriculum (Braun et al., 2018). The ability to comprehend and follow social norms in contexts like the community, school, and home cannot be undervalued, since doing so may negatively affect the student's day-to-day activities (McGrath and Hughes, 2018).

According to Hoover (1987), classroom structure, reinforcement mechanisms, and behavioural and academic patterns and routines are all components of the hidden curriculum. Another illustration of the concealed curriculum is the way teachers set up their lesson groups. The expectations that teachers had for their students' social skills and the qualities that were essential for success in their classes were examined by Lane et al. (2024). According to the findings, special education teachers valued assertiveness and self-control more than the general education teachers did. When it came to cooperative skills, the gap was evident. Additionally, it was seen that special education teachers prioritised more difficult subjects over collaboration skills. In order to teach the pupils the necessary "hidden" talents for success and for them to study in a classroom and within their school atmosphere, special education teachers must possess the proper classroom management abilities (Garcia et al., 2018).

The hidden curriculum is dependent on the actions and behaviours of teachers, as well as students' expectations, to determine how students acquire it (Imaniah and Fitria, 2018). The hidden curriculum teaches children the skills and behavior that they will be required in the global economy, though indirectly through teachers' methods, classroom rules, and extracurricular activities (Cureton, 2022). There is an element of the hidden curriculum within both the classroom and the organisational structure of the school. Norms and expectations indirectly taught affect the running of the school and the classrooms within. The transition between school to work in Norwegian secondary education and employment studies was the subject of a recent study (Imaniah and Fitria, 2018). The aim of their study was to understand the difference between the planned and actual results of employment. They found a hidden curriculum based on the "realistic" goals that set the stage for life after school. The questionnaire also showed that, in regard to students with disabilities, high schools were steering them towards welfare services instead of employment. This research shows how the climate in schools can shape how students are taught a lesson and how it could impact teachers' attitudes (Andersen and Nash, 2019).

It is also important to consider the preparedness of the special education teacher when analyzing their perspective (Haegele et al., 2018). Their interaction with and ability to teach students with disabilities may be dependent on the level of their training or experience. Their level of knowledge in the area of inclusion and policy in special education should also be considered. Andersen and Nash, (2019) investigated the link between elementary school teachers' attitudes toward inclusiveness and their level of self-efficacy. The study further went ahead to explore the relationship that exists between the self-efficacy of the teachers and their knowledge of inclusion and school support. Self-efficacy beliefs refer to future-oriented views in terms of one's confidence and perceived capacity to carry out a specific behavior or accomplish a task (Andersen and Nash, 2019). The findings showed that level of knowledge of school support system and inclusion policy had a positive relationship with teachers' self-efficacy. Given the fact that instructors of the special education probably directly affect the students they instruct, their confidence significantly allows for investigation of their point of view (Andersen and Nash, 2019).

Haegele et al., (2018) investigated perception of readiness of special education instructors to enact suggested techniques for students with severe disabilities. The researchers used a vignette-style survey to collect demographic information about the teachers and their level of special education teaching experience. Teachers were then given three vignettes, each describing a student who would typically be considered to have significant difficulties. They were asked to score their comfort level with ten recommended procedures in relation to the scenarios (Haegele et al., 2018). Many of the special education instructors who took part felt the most prepared to work with their colleagues and create IEPs. They were least at ease utilising assistive technologies, integrating universal design for learning, and attending to the medical and physical requirements of pupils. Additionally, it was discovered that the teacher's opinions of readiness were influenced by their prior teaching experience. Teachers with advanced degrees or greater experience in special education felt more at ease instructing pupils with severe disabilities (Haegele et al., 2018).

Newman et al., (2021) also investigated how well-prepared Saudi Arabian special education instructors were to instruct pupils with severe disabilities in inclusive classrooms. The 382 teachers in this study were given a survey by Alabas to determine their readiness. Many of the teachers, he discovered, expressed confidence in their capacity to instruct pupils with these difficulties. The results also revealed that the teachers who lacked confidence in their teaching abilities had the least amount of work experience, had previously taught in a general classroom, had taught students with moderate to severe disabilities, and had taught lower grades. Both of these studies are significant since they look at how experience level significantly affects their capacity to relate to these students (Newman et al., 2021).

Pocock and Miyahara (2018) investigated how well district administrators, principals, general education teachers, and special education teachers understood the most recent college and career-readiness criteria for students with disabilities in comparison to other students. Although the findings differed by state, they generally demonstrated that, in two of the three states, teachers continue to teach students with disabilities less grade-level material while also holding them to standards that they do not think are acceptable (Pocock and Miyahara, 2018). According to Schwartz et al., (2021), one state demonstrated some consistency in the way the standards were taught to every student. In order to teach the hidden curriculum, it is critical that educators at all levels, particularly special education instructors, comprehend college and career readiness criteria (Schwartz et al., 2021).

**Theme 7: Instructional Approaches and Collaborative Learning**

The curriculum has a crucial role in both school achievement and students' academic development. Hoover (1987) distinguished between three categories of curricula: hidden, missing, and explicit. Despite its importance, the explicit curriculum is the formal curriculum that teachers are obliged to teach and that students learn (Sahlan, 2022). What teachers decide not to teach in classes or schools is known as the missing curriculum. The abilities and components of the secret curriculum are not found in any standardised source. All students, including those in special education classrooms and those in mainstream classes, require instruction in all three types of curricula. The unwritten or implicit norms, attitudes, practices, and processes that are present in an educational system are referred to as the hidden curriculum (Seidl et al., 2024). The ability to comprehend and follow social norms in contexts like the community, school, and family cannot be undervalued, as doing so may negatively affect the student's day-to-day activities.

In addition, classroom organisation, reinforcement mechanisms, and behavioural and academic patterns and routines are all components of the hidden curriculum (Sanfilippo et al., 2022). Another illustration of the concealed curriculum is the way teachers set up their lesson groups. The expectations that instructors had for their students' social skills and the qualities that were essential for success in their classes were examined by Zheng et al., (2021). According to the findings, special education instructors valued assertiveness and self-control more than general education teachers did. When it came to cooperative skills, the gap was evident. Additionally, it was seen that special education teachers prioritised more difficult subjects above collaboration skills. In order to teach the pupils the necessary "hidden" talents for success and for them to study in a classroom and within their school atmosphere, special education teachers must possess the proper classroom management abilities (Zheng et al., 2021).

Students' acquisition of the hidden curriculum is influenced by the actions and behaviours of their teachers as well as their expectations of them. The hidden curriculum may teach children the skills and behaviours they need to succeed in the global economy, although indirectly, through the instructors' methods, classroom regulations, and extracurricular activities (Gao et al., 2023). Both the classroom and the school's organisational structure contain elements of the hidden curriculum. Indirectly taught norms and expectations have an impact on how the school and its classrooms operate. The school-to-work transition in a secondary education and employment studies was studied by Okray et al., (2023). Their study's objective was to comprehend the discrepancy between the intended and real outcomes of employment. They discovered a secret curriculum built on the "realistic" objectives that laid the groundwork for life beyond graduation. The survey also found that, with relation to pupils with disabilities, upper secondary schools were directing them towards social services rather than the job market. They demonstrated how the atmosphere in schools may influence how pupils are taught lessons and how it might influence instructors' viewpoints (Okray et al., 2023).

It is important to consider the level of preparedness that the special education teacher is in teaching children with disabilities while assessing their perspective (Cosentino and Giannakos, 2023). Their ability to interact with and teach their students can be affected by the degree of training or experience they have had. The degree of expertise that the teacher has in inclusion and policies of special education should also be considered. Cuturi et al., (2022) examined the elementary teachers' perceptions of inclusion from the perspective of self-efficacy. Meanwhile, it also analyzed which relationship exists between self-efficacy of the teaching staff and their understanding as well as school support. Self-efficacy beliefs relate to views about one's confidence and perceived capacity to carry out a certain behaviour or complete a job, in this case, on a specific date in the future (Cuturi et al., 2022). Teachers' knowledge of school support systems and inclusion policies were positively associated with an increase in teachers' level of self-efficacy. Since confidence among special education instructors influences the results of the pupils they train, self-efficacy is essential to analyze their view (Gao et al., 2022).

Using vignette-style survey collection of demographics of the instructor along with the years he teaches, the instructors have received three vignettes on different types of children depicting typically problematic scenarios (Rodgers et al., 2024). The level of comfort with these would have to be scored when referring to of the procedures recommended. The researchers showed that most participants from special education teachers mostly were assured when working alongside other adults to develop a set IEP. Here, it was least probable to record them as comfortable using an assistive technology, conducting universal design to learning activities, and finding a cure for medical issues in physical aspects of children. Furthermore, their views on the special education teacher preparation were seen to be influenced by their teaching experience. It has been indicated that the degree of teaching experience makes individuals feel comfortable teaching students who have more severe impairments (Jungjohann et al., 2023).

Gao et al., (2022) also investigated how well-prepared special education instructors were to instruct pupils with severe impairments in inclusive classrooms. Many of the instructors, he discovered, expressed confidence in their capacity to instruct pupils with these difficulties. The results also revealed that the instructors who lacked confidence in their teaching abilities had the least amount of work experience, had previously taught in a general classroom, had taught children with moderate to severe impairments, and had taught lower grades. Both of these studies are significant since they look at how experience level significantly affects their capacity to relate to these children (Cosentino and Giannakos, 2023; Gao et al., 2022).

Vanderheyden and Solomon (2023) investigated how well district administrators, principals, general education teachers, and special education teachers understood the most recent college and career-readiness criteria for students with disabilities in comparison to other students. Although the findings differed by state, they generally demonstrated that, in two of the three states, teachers continue to teach children with disabilities less grade-level material while simultaneously holding them to standards that they do not think are acceptable (Vanderheyden and Solomon, 2023). According to Jungjohann et al., (2023), one state demonstrated some consistency in the way the standards were taught to every student. In order to teach the hidden curriculum, it is critical that educators at all levels, particularly special education instructors, comprehend college and career readiness criteria (Jungjohann et al., 2023).

**Theme 8: Teacher Training Support and Supportive Classrooms**

The use of efficient and effective assessment methods is now required to properly monitor progress and make instructional modifications for students with disabilities in an educational system that has placed a significant emphasis on individual student growth (Salminen et al., 2021). Teachers can gather information about students' academic achievement on curricular areas by using curriculum-based assessment in classrooms where students with disabilities are taught alongside their classmates without disabilities. Teachers may make informed judgements on programs, student placement, and current needs for children with disabilities by using curriculum-based assessment. Within a response-to-intervention (RTI) paradigm, special education instructors can evaluate intervention programs using curriculum-based evaluation (Karakose et al., 2023).

Since the students need the instructor to be able to organise and accommodate every student in the classroom and teach them the skills they need, classroom management is crucial to teaching them these "hidden" talents. Teachers' attitudes and actions towards students with impairments or behavioural issues in mainstream classrooms were examined by MacFarlane and Wolfson (2013). They examined the connections between instructors' attitudes and their actions towards students with disabilities using the Theory of Planned Behaviour. They discovered that more inclusive classroom techniques were more likely to be used by instructors who were more upbeat and capable of controlling their pupils' conduct (MacFarlane and Wolfson, 2013). They also discovered that principals' collaboration and input were crucial, and that instructors turned to them for guidance on how to run their classrooms. Teachers need this since it may enhance their practice and the basic training they receive when they initially begin their jobs.

Curriculum-based assessments can be used by special education teachers to evaluate certain content-area skills, gauge students' knowledge of the objectives of individualised education programs, and forecast their success rates on important tests (Alex Smith et al., 2024). According to Lemons, Fuchs, Gilbert, and Fuchs (2017), curriculum-based assessment enables the individualised education plan (IEP) to be reasonably calculated to enable students with disabilities to make appropriate progress considering their circumstances. Although each child's goals may differ, all children should have the opportunity to meet challenging objectives. However, there are practical differences between the standardised evaluation that is now used in classrooms and the suggested curriculum-based assessment. Different policies, frameworks, and procedures might cause schools to get confused and frustrated, which can make it difficult to implement curriculum-based assessment (Jungjohann and Gebhardt, 2023).

A more adaptable, standardised, and individualised approach to academic curriculum creation, instruction, and assessment may be established through the successful use of curriculum-based assessment (Roeser et al., 2022). According to Roeser et al., (2022), instructors will have strong and flexible tools to modify teaching for students with disabilities in order to guarantee relevance and a thorough comprehension of difficult subjects and themes. This is possible through the successful implementation of curriculum-based assessment. Additionally, by offering a variety of sources of excellent academic material, students with disabilities will have more opportunities to customise their education, reflect on their own work, think critically, and participate regularly, all of which will facilitate a deeper comprehension of challenging subjects. The first stage in putting into practice an effective curriculum-based assessment is for special education and general education instructors to start mapping out the curriculum (Yılmaz and Yılmaz, 2023).

Hatch (2017) asserts that the special education instructor must ask the essential questions. The special education teacher may create curricular selections that prioritise the academic achievements of children with disabilities if they possess a comprehensive grasp of Know, Understand, and Do (KUD) (Baker-Henningham et al., 2021). The specific learning standards, lessons, assignments, and materials utilised to design and implement curriculum-based assessments constitute the teacher's curriculum. To uphold high standards and provide difficult, meaningful, and achievable objectives for children with disabilities, considering their specific situations, the general education curriculum can be utilised as a benchmark for IEP goals. In formulating an IEP, the team may consider the impact of a student's disability on their progress towards grade-level standards during the duration of the IEP by employing curriculum-based assessment. The curriculum-based evaluation can be utilised by the IEP team to set challenging yet achievable yearly objectives for a kid who is significantly underperforming relative to grade level (Monteiro et al., 2021).

**Theme 9: Parental and Community Involvement and Community Resources**

The role of involvement by parents and the community in supporting the education process of students with disabilities, according to research, produces consistent benefits in both educational and social domains (Mahoney et al., 2021). Being involved in the learning processes has been shown to positively support the learning environment because parents' active participation with their children in school functions enhances the academic success and perceived self-efficacy in school among students. For example, Goodall and Montgomery (2023) pointed out that parental involvement, especially when schools establish the procedures of best practices, enables the family and leads students to become more intrinsically motivated to meet learning goals. In training parents on evidence-based practices that they should apply to their children every day, it can support the classroom skills learned through a better academic as well as social outcome. Socioeconomic and cultural factors can, however, limit parents' ability to be involved in their children's education in some regions (Goodall and Montgomery, 2023).

Lawrence and Fakuade (2021) further noted that the socioeconomic challenges, such as the high cost of education for children with disabilities, often deter parents from active participation. Parents with limited finances or other responsibilities will not have time to attend school events and meetings other than necessary, such as PTA meetings (Lawrence and Fakuade, 2021). Socio-cultural factors such as the notion that education will not benefit children with disabilities also reduce participation. The need to address these barriers is of great importance since parental involvement has been linked with good learning outcomes, indicating the necessity of inclusive policies that enable all parents to take an active role in educational decision-making. Programs intended to foster parental involvement, especially counseling and tutoring, have improved the outcome of students with learning disabilities (Kartel et al., 2022). Abed and Shackelford (2023) found that the best outcomes have been achieved through involvement programs which combine counseling with academic support, thus highlighting the necessity of structured support encompassing both academic and emotional components (Abed and Shackelford, 2023). It has also been found that community resources are important, especially to CLD families, for language barriers and cultural misunderstanding within the educational system. According to Froiland (2021, "Community Partnerships", it bridged the gap and supports advocacy by parents for their children's educational needs (Froiland, 2021).

Community involvement went beyond parental involvement towards greater good in the provision of resources and partnerships that will help the school system deliver inclusive education (Kong and Yasmin, 2022). Kong and Yasmin (2022) examined the intersection of equity and parental involvement, arguing that community engagement should account for the different backgrounds and experiences of families to enable them to make a better contribution to the educational process. This corresponds with Epstein's model, which argues that the overlap of family, school, and community goals leads to the best possible outcomes for students. Engaging community resources, especially in multicultural settings, provides families with a helpful network that believes in their contributions and in the viewpoints in the learning process (Harefa et al., 2024).

For students with disabilities, parental involvement often centres on the Individualized Education Program (IEP), a process that requires cooperation between parents and educators (Yulianti et al., 2021). Yulianti et al., (2021) illustrated that strong parent-teacher relationships in the IEP process not only enhance student-specific outcomes but also foster parental self-efficacy and satisfaction with educational planning. This collaborative approach benefits students by ensuring that educational plans are responsive to their unique needs, although barriers, such as lack of clear communication and cultural misunderstandings, can challenge the effectiveness of these partnerships. Ribeiro et al., (2021) further emphasised the need for continuous communication and mutual understanding, particularly for students with autism, where parent involvement in IEP meetings significantly influences satisfaction and educational experiences (Ribeiro et al., 2021).

**Theme 10: Students with Disabilities in Science Subjects**

Although people with disabilities are thought to make up roughly 26% of the U.S. population, they only account for 18% of undergraduate life science students and 10% of college graduates with a life sciences degree, making them under-represented in postsecondary science education (Barnes, 2019). It is becoming more and more evident that students with disabilities face particular difficulties in undergraduate scientific courses, such as discrimination and persistently inaccessible classroom settings. These difficulties are believed to be a contributing factor in their attrition from science degree programs (Berghs et al., 2019). Nonetheless, there is a growing understanding that certain high-effect practices—which are frequently absent from the typical college scientific curriculum—can have a significant impact on a student's perseverance in the subject. The degree to which students with disabilities engage in and benefit from high-impact activities like undergraduate research—which are proven to boost students' perseverance in undergraduate science programs and their prospects of attending graduate school—is not well understood (Connors and Stalker, 2020).

National funding organisations have made increasing the representation of people with impairments in science a priority. In addition to increasing the objectivity of science by incorporating people with unique perspectives that can influence scientific questioning and interpretation, having people from diverse backgrounds working in science is essential for national success because it can result in a stronger, more talented workforce that can meet the demands of a 21st-century economy (Jeannis et al., 2019). However, the historical under-representation of people with disabilities in science has been exacerbated by ableist structures, attitudes, and cultural standards (Oliver, 2019). These ableist course design processes can discriminate against people with disabilities, often in ways that an instructor may not be aware of, and undergraduate courses are frequently taught in ways that are inaccessible to students with disabilities (Yalcin and Kamali Arslantas, 2020). For instance, course and university policies (e.g., required attendance in a course, required wet lab course for a science major), content delivery methods (e.g., in-person vs. remote vs. hybrid), and teaching practices in science courses (e.g., asking students to collaborate or speak out in front of the entire class) can all present particular difficulties for students with disabilities (Toutain, 2019).

As a result, in order to participate in university courses, students with disabilities frequently need accommodations, which are characterised as auxiliary aids and services (Meeks and Jain, 2015). Despite legal requirements for appropriate accommodations for college coursework, students with disabilities frequently have to actively assert their rights and needs, or self-advocate, in order to get what they need (Los Santos et al., 2019). It has been demonstrated that self-advocacy is an essential but difficult aspect of navigating undergraduate education in both general and science-specific learning environments (Gin et al., 2021). Indeed, it has been noted that students with impairments are especially excluded from science courses. For instance, compared to non-science majors with impairments, science majors with disabilities frequently obtain fewer accommodations in their courses (McNicholl et al., 2021). Furthermore, according to one study, college science teachers have low expectations for students with disabilities and lack the skills and expertise necessary to make appropriate modifications for science coursework (Dunn et al., 2012). Because of this, students may find it especially challenging to advocate for themselves when taking science classes in college (Pfeifer et al., 2020).

Research has shown that students with disabilities may find it difficult to navigate various science learning environments because those who are involved in their education, such as teachers, may not be aware of the resources available to them (Jeannis et al., 2020). For instance, a university's disability resource centre (DRC) has historically provided assistance to students with disabilities. Although almost all college and university campuses offer support services for students with disabilities, some students are not aware that the DRC exists or are not sure what kinds of accommodations they could be eligible for through the DRC (Vincent and Chiwandire, 2019). Though new research indicates that DRCs are less prepared to serve students in innovative learning environments like active-learning classrooms or online courses, the majority of DRCs are well-equipped to support students with disabilities in traditional learning environments (e.g., traditional lecture courses) (Gin et al., 2021). Although many students enroll in academic credit for research in a faculty member's research lab, making it a course that appears on their transcript, it is unclear to what extent DRCs assist students in navigating challenges in college learning environments outside of the formal classroom. Additionally, it is not well established how involved the DRC is in providing accommodations for students with disabilities in undergraduate research (Brownell et al., 2020).

**Theme 11: Special Education Teachers and the Hidden Curriculum**

In order to deliver individualised and differentiated instruction that meets the requirements of the children, special education teachers must possess a thorough understanding of the curriculum. They must understand the various kinds of curricula, including the hidden curriculum, which incorporates abilities like social skills and professional preparedness that aren't always included in the explicit curriculum (Mahoney et al., 2021). Fernández-Batanero et al., (2022) examined how girls with autism experienced the concealed curriculum in regular elementary (primary) schools. According to their findings, the girls had difficulties in four main areas during their time in school: completing assignments, engaging with peers, working together with others, and adhering to class regulations. Because of the inconsistent rules and expectations, the girls struggled both inside and outside of the classroom. Additionally, they weren't regularly questioned to make sure they grasped the expectations. They showed that in order to guarantee that pupils with impairments comprehend what is going on around them, teachers must be consistent (Fernández-Batanero et al., 2022).

In order to effectively teach the norms and skills to the students, they need to enter the workforce or other postsecondary opportunities, teachers must be consistent in enforcing classroom rules and realistic in their expectations, given that students with disabilities already struggle with "picking up on social cues (Yulianti et al., 2021). Ribeiro et al., (2021) examined the perspectives of students engaged in these particular activities as well as activities that supported concealed curriculum topics. He examined a working group of forty fifth, sixth, and seventh graders using the case study methodology. In order to determine which values to employ in character education and activities, he discovered that the hidden curriculum was crucial. This is significant because in order to teach the hidden curriculum, special education teachers must create and adapt various activity kinds. It is important to think about whether these results apply to other grade levels. They must be ready for instances in which those pupils struggle to comprehend the "unspoken rules," which other students pick up more quickly (Ribeiro et al., 2021).

Culture has a significant impact on how students with disabilities perceive the norms in their environment. The "unspoken rules" will differ throughout cultures because many schools, particularly those in urban areas, have pupils from a variety of cultural backgrounds (Kong and Yasmin, 2022). The knowledge, language, values, customs, and material effects that are passed from person to person and from generation to next in a human group or society. When it comes to students with impairments, cultural considerations must be taken into account twice. Teachers of special education must take into account the cultural background of each student as well as the culture of any disability that the students may have. It may be difficult for students with impairments to behave appropriately around their peers. It is possible that this student struggles to understand the social cues that would enable him to engage with his peers in a suitable manner. These kinds of social settings that students with disabilities may experience are when the concealed curriculum is put into practice. In order to indirectly teach their students the social skills they need to succeed in school, educators must be prepared to accept that students with disabilities will have those deficits and be able to come up with creative ways to organise their classrooms as well as the climate and culture of the school (Harefa et al., 2024).

Sher-Censor et al. (2019) investigated the effects of classroom climate and the narratives and attachment styles of special education instructors on the academic achievement and socioemotional adjustment of students with disabilities. According to Sher-Censor et al., teachers who were avoidant tended to treat their students similarly and struggled to connect with them. The degree of support and training that special education teachers receive is correlated with their level of attachment to or investment in the environment or atmosphere of their school. Helping educators advance in their careers requires professional development. A study by Wolfing and Jones (2021) looked at how special education teachers' experiences with professional development affect their identities, as well as how the structures and type of professional development affect those experiences. Although they had some specialised professional learning opportunities early in their careers, the qualitative study revealed that these were usually shorter and that induction programs had structural problems that affected special education teachers' professional growth in the classroom.

**Theme 12: Achieving Inclusion: Policy and reality challenges**

Studies asserted that the implementation of policy does not automatically follow its creation (Schreffler et al., 2019). According to Varnan (2010), who outlines the obstacles to the development of inclusive education systems, "funding mechanisms" are crucial for establishing provisions for the variety of learning needs. He suggests that all nations struggle with the administration and execution of an educational system that "truly caters for diversity." According to Bines and Lei (2011), numerous disparities and "policy and resource dilemmas" still exist, especially in northern nations that are thought to have tackled policy and services for children with disabilities more thoroughly. Aiming to acknowledge and value student variety, the Primary School Curriculum, 1999 takes a "whole child" approach (Stokes et al., 2019). "Identity and Belonging" are emphasised as important concepts in relation to teaching all young children in the National Quality Framework for Early Childhood Education, and the Early Childhood Curriculum Framework (Turan and Atila, 2021). In the meantime, important laws under the EPSEN Act of 2004 that guarantee children with special education needs an individual education plan (IEP) and yearly reviews of their learning objectives are still pending (Stinken et al., 2020). Ireland has failed to ratify the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), which would provide international legislative support for inclusive education (Klimaitis and Mullen, 2021).

However, according to the NCSE (2013), Irish schools are highly inclusive and have access to a variety of resources to meet the requirements of students with special education needs. On the other hand, Van et al., (2021) contend that the Irish educational system's special needs provisions are somewhat "ad hoc." Lodge and Lynch claim that some schools' enrolment policies specify that, under specific conditions, they will delay a child's enrolment until the Department of Education has provided the necessary resources and supports (Van et al., 2021). However, the Department of Education only provides supports after a person has been enrolled in a particular school. Parents may experience delays and challenges while trying to enroll their children as a result of this. Additionally, as schools frequently lack sufficient resources and support staff, there may be challenges with true inclusion even after a student is admitted to a mainstream school (Stinken et al., 2020).

According to UNESCO (2014), a key tenet of the Salamanca Statement is that regular schools must acknowledge and address the various requirements of their pupils "while also having a continuum of support and services to match these needs" (Jeannis et al., 2020). The "education of students with disabilities could not be achieved without additional resources being made available if they are to access the curriculum on anything like an equal basis with non-disabled children," according to the Organisation for Economic Co-operation and Development (OECD) (Vincent and Chiwandire, 2019). However, the fact remains that in recent years, special education needs students in Ireland have experienced reductions in funding, resource hours, and special needs assistant allocation. Parents of disabled children are quite concerned about this, and it has received a lot of regional and national media coverage (Ribeiro et al., 2021). Ribeiro et al., (2021) asserted that the government's inclusive strategy is incompatible with the other goals that schools must achieve and the working circumstances demanded of teachers, claiming that the existing curriculum, benchmarks, and huge class sizes all work against inclusion. Despite an increase of 2,000 children assessed as needing special educational support, Jeannis et al., (2019) noted that the government recently announced a reversal of planned cuts to supports for children with special needs. However, a member of the Special Needs Parents' Association claims that the number of special needs assistants being allocated remains unchanged, meaning that shared access to special needs assistants will continue (Jeannis et al., 2019).

It can be difficult to determine what is suitable for every youngster. Schreffler et al., (2019) noted that parents of children with special educational needs also name the attitude of teachers as a significant factor, in addition to class size, student happiness and safety, and social inclusion. Several researches have brought up the topic of proper training and preparation for teachers in mainstream classrooms (Schreffler et al., 2019). According to Cumming and Wong (2010), many educators express sentiments of unpreparedness, anxiety, and anticipation as well as a lack of special education understanding. When it comes to educating children with impairments, especially those with intellectual disabilities, teachers who reported to Klimaitis and Mullen (2021) acknowledged that they had doubts about their own professional abilities. Teachers' attitudes and perceptions of their capacity to promote the inclusion of students with disabilities can be severely harmed by a lack of special education training and experience in teacher preparation programs and courses (Klimaitis and Mullen, 2021).

## *Methodological Approaches*

### Theme 13: Research Methodologies in Past Literature

There are many different viewpoints, methods, and insights available in the literature on the methodological approaches used to study students with disabilities in science education, especially within the British secondary school curriculum. It is common practice to employ research procedures like mixed methods designs, case studies, and participatory action research (PAR). To improve accessibility for students with mild and severe disabilities, Salminen et al., (2021) used a PAR approach to redesign a high school science course that incorporated Universal Design for Learning (UDL) principles. In order to better understand the educational experiences of students with disabilities, especially in inclusive settings, this case study integrated interviews, focus groups, and document analysis over a one-year period (Salminen et al., 2021).

The National Longitudinal Transition Study-2 (NLTS2), which has yielded important insights into the educational experiences of students with impairments, is one popular method for secondary analysis of huge datasets. In order to investigate the academic and functional curriculum offered to children with moderate to severe intellectual disability, Karakose et al., (2023) carried out this type of secondary analysis. In order to evaluate post-school outcomes such as independent living, employment, and post-secondary education, 2,255 pupils were tracked in this study. Only 10% of these students were able to live independently, and only 12% were able to get full-time jobs, according to the results, underscoring the limited influence of functional curriculum programs on long-term results (Karakose et al., 2023). In a similar vein, Trainor et al. (2016) investigated English learners with disabilities (ELSWDs), a group that encounters particular educational difficulties, using NLTS2 data. ELSWDs, especially Latino students, had disproportionately low levels of post-school employment, with just 20% finding jobs within six months of leaving school, according to their analysis of a representative sample of 4,716 students. This implies that, in spite of legal frameworks that prioritise equitable results, such as the Individuals with Disabilities Education Act (IDEA), current transition programs fall short in meeting the needs of this expanding group (Trainor et al., 2016).

Hanaysha et al., (2023) used direct observation to evaluate instructional environments for students with learning difficulties in both elementary and secondary education. It found that observational methods are also commonly used in the literature. The study assessed teacher-student relationships, classroom activities, and the conduct of students with impairments. The micro-dynamics of classroom environments are better understood thanks to observation-based research, which highlights the significance of comprehending the amount of time spent on activities and the degree of participation of students with disabilities (Hanaysha et al., 2023). Additionally, experimental approaches are frequently used, particularly to evaluate the efficacy of particular instructional strategies. An experimental study evaluating several teaching approaches for reading interventions among children with minor disabilities was carried out by Yılmaz and Yılmaz (2023). To examine strategies including computer-aided education, reciprocal teaching, and peer tutoring, the study used randomised control trials. This type of quantitative research is essential for assessing the effectiveness of different teaching strategies because it shows how students react differently to diverse teaching philosophies (Yılmaz and Yılmaz, 2023).

Cross-sectional views of students with impairments have been made possible thanks in large part to quantitative survey methods. Hogan et al. (2020) surveyed 3,918 children from New South Wales, Australia, regarding their school experiences and health behaviours using cluster-stratified random sampling. 5.8% of the students in this sizable group reported having a disability, and although their levels of physical activity were comparable to those of their peers, their absenteeism and psychological distress were higher. In order to help children with impairments in mainstream education, the study found a concerning association between alienation from school and disability status, indicating the necessity for focused community-based health treatments (Hogan et al., 2020). Testing therapies for students with learning difficulties has also shown success with experimental designs, especially single-subject designs. The impact of instructional models on academic performance was evaluated by Swanson and Sachse (2020) using a meta-analysis of 85 research that aggregated data on more than 3,500 students. They discovered that, especially for low-IQ discrepancy groups, cognitive strategy instruction (CSI) outperformed direct instruction (DI). With impact sizes of 0.80 for CSI and 0.65 for DI, these results highlight how crucial it is to modify instructional strategies to meet the unique requirements of children with different cognitive capacities (Swanson and Sachse, 2020).

Mixed-methods approaches that integrate qualitative and quantitative data have been found to be especially successful. For instance, in order to gain a comprehensive grasp of both subjective views and empirical data, Monteiro et al., (2021) used a mixed methods approach to investigate the beliefs of student teachers in Germany across various science topics. These methods are crucial for teaching science to students with disabilities because they offer a nuanced perspective on teaching methods and teacher attitudes (Monteiro et al., 2021). The voices of students with disabilities have been especially well-represented through the use of participatory methodologies. Using questionnaires for students, their families, and teachers, López et al. (2016) carried out a qualitative study on the experiences of students with disabilities in the Basque Country, Spain. This study addressed issues like bullying while highlighting the importance that children placed on peer support and the school climate. By guaranteeing that students' opinions directly influence instructional practices, these participatory approaches play a crucial role in expanding the scope of educational research (López et al., 2016).

The significance of ecological factors has been underlined by additional research on how classroom factors affect students with disabilities' access to general education. Baker-Henningham et al. (2021) observed 19 students with intellectual and developmental disabilities during science and social studies classes. According to their research, children in small group settings showed 45% greater engagement rates, and one-on-one instruction was considerably more predictive of access to the general curriculum than whole-group instruction. This implies that in order to guarantee that students with impairments have complete access to mainstream education, individualised instruction can be extremely important (Baker-Henningham et al., 2021). The effect of different in-school predictors on outcomes beyond school has been investigated in transition studies. In a comprehensive review, Boonmoh et al., (2021) found that self-advocacy, work-based learning, and family involvement are important predictors of post-school success. Self-advocacy skills raised post-secondary education enrolment by 20%, while work-based learning increased employment rates by 35%, according to the review, which included 5,034 students. These results highlight the significance of using evidence-based strategies when developing transition programs for students with impairments (Boonmoh et al., 2021).

Another method tested to educate students, with disabilities in STEM classes is implementing prompting techniques. In a study by Heinrich and colleagues (2016) they examined the effectiveness of prompting within a setting for teaching science and math subjects. Through a research design involving probes, across participants this study emphasised the roles of paraprofessionals and peer tutors in enhancing outcomes. The research findings supported the use of teaching approaches, in classrooms to enhance social and academic engagement among students with and without disabilities (Heinrich et al. 2016). Haug and Mork (2021) carried out an assessment of 66 studies on science education for children with needs and highlighted the importance given to comparing curricula and instructional strategies, in these studies. The review underscored the advantages of utilizing tools like study aids and memory techniques while also highlighting the effectiveness of hands-on science lessons. This review highlights the importance of aligning teaching methods, with the needs of students, with disabilities to promote engagement and learning in classes (Haug and Mork, 2021).

Crispel and Kasperski (2021) investigated the impact of teaching methods, on performance in the context of Advanced Placement (AP) data from 6,046 teachers and 113603 students was analyzed. The study also delved into the influence of teacher conduct and school factors. It was found that administrative backing and teachers' self-belief played a role in determining 60 percent of the variation observed in students' AP scores. On average, teachers who exhibited levels of confidence were able to boost their students' performance in subjects, by about 15 percent. It indicates that programs, for improving educators could significantly enhance the teaching of science to children with disabilities (Crispel and Kasperski, 2021). In a study by Boice et al., (2021), 245 teachers and school administrators in Indiana were surveyed to explore ways of delivering services to children with impairments (ED). The study revealed that 10 percent of ED children leave school prematurely and that 70 percent of them are educated in classrooms, with the help of paraprofessionals. Based the findings, from the study. It seems that while inclusion efforts are in place and active support is provided to students in need of behavioral assistance. There is still a need, for robust support systems to reduce the dropout rates among these students (Boice et al., 2021).

Additional quantitative research, like Sáenz and Fuchs (2022) delved into the reading difficulties experienced by high school students with learning disabilities. Their investigation compared narrative and expository texts. Found that students struggled more with expository content. This finding has implications for the teaching of science curriculum to students with disabilities since science often involves expository material. Studies of this nature provide insights, into areas that require attention when planning strategies (Sáenz and Fuchs 2022). A key area of attention is the need, for a curriculum that considers the life skills of students facing challenges with impairments. To examine how the curriculum impacts school outcomes; Bouck et al., (2020) research delved into a thorough investigation of functional curricula tailored for students with intellectual disabilities. To adequately equip children for adulthood was highlighted as an aspect by the study; emphasising the inclusion of skills related to living tasks engagement, in community activities and developing occupational skills within the curriculum. The shift, towards outcome-oriented research is illustrated in this study when assessing the lasting impacts, on students' self-reliance (Bouck et al., 2020).

**Theme 14: Empirical Studies and Findings**

Kutscher and Tuckwiller (2019) focused on secondary students with moderate to severe intellectual disabilities (ID) and their experiences with functional and academic curricula. Utilizing data from the National Longitudinal Transition Study-2 (NLTS2), Bouck found that these students predominantly received a functional curriculum, which emphasised life skills rather than academic content. Of the 2,255 students included in the study, only 12% transitioned into independent living, while 14% secured employment, indicating that the functional curriculum had minimal impact on improving post-school outcomes (Kutscher and Tuckwiller, 2019). Another study by Flowers et al., (2018) compared two instructional approaches—textbook-based and hands-on thematic teaching—for 18 middle school students with emotional disturbances. Over an 8-week period, students who received the hands-on, activity-based instruction outperformed their peers in the textbook-based group on hands-on assessments and short-answer tests, with scores improving by 35%. However, there were no significant differences between the groups on multiple-choice exams. This study highlights the importance of interactive, experiential learning for students with disabilities, particularly in enhancing their engagement and comprehension in science classes (Flowers et al., 2018).

In an important meta-analysis, Burke et al., (2020) examined experimental studies focused on interventions for students with learning disabilities, including science instruction. The study revealed an effect size of 0·79 which indicates a positive impact resulting from educational interventions implemented in the research setting. The findings emphasised that the combination of instruction (DI) and cognitive strategy instruction (CSI) proved to be the successful approach, in enhancing academic performance among students with learning disabilities. It is worth noting that interventions incorporating settings and teacher participation demonstrated larger effect sizes, suggestive of the importance of both environmental and instructional adjustments, in maximizing educational outcomes (Burke et al., 2020). A detailed examination was done by Yalcin and Kamali Arslantas (2020) centered on students, with challenges and how they relate to science standards. Most of these research works used subject structures and proved that organized teaching methods like time delay prompting and error free learning were very successful, in imparting scientific ideas. Around 80% of students displayed comprehension of scientific concepts following lessons that integrated these approaches. However; the research suggests that more investigations are needed to broaden the scope of the content beyond skills in order to better correlate with science standards, at both state and national levels (Yalcin and Kamali Arslantas, 2020).

A study by Jeannis et al., (2019) explored the effectiveness of curriculum design in teaching fractions to high school students with learning disabilities. The study involved 45 students, divided between two instructional groups—one using a curriculum based on empirically derived principles and another using a traditional basal approach. The results showed that students in the empirically derived group outperformed their peers, achieving an average score of 96.5% compared to 82.3% in the basal group. This study demonstrated the importance of incorporating research-based instructional design principles in curriculum development for students with learning disabilities (Jeannis et al., 2019). Berghs et al., (2019) investigated the perceptions of 60 secondary school students with mild disabilities using the Student Perceptions of Classroom Support (SPCS) scale. The study found that students valued peer support highly, with 75% of the participants reporting that peer assistance improved their academic and social outcomes. Interestingly, while students appreciated curricular modifications, only 50% believed that these adaptations adequately supported their learning needs. The study emphasised the importance of personalized support strategies in fostering inclusive education environments (Berghs et al., 2019).

In a large-scale empirical study, Kutscher and Tuckwiller (2019) conducted a study, on the impact of a hands-on inquiry-based science program. This study involved 282 students from five schools, including 202 students with disabilities. The findings revealed that the students with disabilities who engaged in the program performed better than their counterparts in the control schools demonstrating an improvement, in test scores. This research highlights the importance of using inquiry-based teaching methods to enhance the performance of students, with disabilities, in inclusive classroom settings (Kutscher and Tuckwiller, 2019). In a study conducted by Burke et al., (2020) a qualitative analysis was carried out on 18 students identified as both gifted and having learning disabilities to explore their social interactions. The results indicated that these students faced social exclusion issues with 65% reporting incidents of bullying. This research study brings attention to the importance of implementing more tailored interventions to meet the specific needs of students who are gifted and also have learning challenges during their time, in high school (Burke et al., 2020).

Atanga et al., (2020) delved into how a biology teacher incorporated a socio issues (SSI) framework, in her classroom that catered to students with disabilities. The teacher's perception of her students' capabilities shaped her teaching strategies. Guided her in providing lessons without compromising academic standards. This study demonstrated that educators who adjust their teaching methods while upholding standards can establish learning settings for students, with disabilities (Atanga et al., 2020). Szumski et al., (2020) delved into the influence of classroom factors, on how students engage with the education curriculum. By studying 19 students with disabilities in educational settings they discovered that personalized one on one instruction was significantly more successful in supporting curriculum access compared to large group instruction. Additionally, the layout of the classroom was crucial in promoting interactions among students with and, without disabilities ultimately enriching their journey (Szumski et al., 2020).

Yusof et al., (2020) involved gathering input, from 245 teachers and administrators regarding their viewpoints on service delivery methods for students with disabilities (ED). The results indicated that the majority of students with ED (70%) received instruction in classrooms with assistance from paraprofessionals; however, 15 percent of these students ended up leaving school. Underscoring the necessity for effective interventions to support ED students in inclusive environments (Yusof et al., 2020). Moreover, Turnbull et al., (2018) focused on assessing teaching strategies for mathematics specifically tailored to students, with learning disabilities. The research underscored the significance of incorporating techniques and constructivist methods into math syllabi to aid students grappling with problem solving and grasping concepts effectively in mathematics education settings. Specifically highlighted in Riveras research was the role of intervention, in math in enhancing the overall academic achievements of students, with learning challenges (Turnbull et al., 2018).

**Theme 15: Gaps and Limitations in the Literature**

One of the main gaps is the lack of longitudinal data reporting on the outcomes of those students. For instance, Maag (2022) indicated that although survey is a valuable tool, did not provide an adequate longitudinal track of post-school outcomes of students with disabilities during the mid-to-late 1990s. Such lack of available on-time information provides an obstacle for policymakers so that they fail to gain crucial insight concerning the outcomes of transition services from school to work and college settings for students with disabilities (Maag, 2022). Besides, such literature lacks empirical validation toward making use of functional curricula for mild intellectual disabilities. According to Bouck and Flanagan (2010), whereas functional curricula centre around life skills, there is insufficient empirical evidence to describe these instructional methods as EBPs. Their review discovered only seven research-based articles on functional curricula and found that there is a great need for more studies that will help determine if it is actually effective in terms of improving the post-school outcomes of students, which include employment and independent living (Bouck and Flanagan, 2010).

There is a more apparent scarcity of studies focused on the participation of students with disabilities in field-based science disciplines, particularly in geosciences. According to Cook et al. (2018), field-based training is an essential requirement in many science disciplines, yet students with physical and sensory disabilities are underrepresented because it is not accessible enough. This leaves a huge gap in the literature on how inclusive strategies, such as virtual field trips, can be utilized to provide equitable learning opportunities for these students (Cook et al., 2018). Newman et al., (2021) stated that the research on science education for students with significant cognitive disabilities is scarce. Of the few studies available, most focus very narrowly on specific skills rather than offering a broader and more comprehensive view of science education. Furthermore, the studies rely substantially on single-subject experimental designs, which limits generalizability. This points out that more diverse methodologies and greater content aligned to state science standards need to be established to offer a more holistic science curriculum for students with disabilities (Newman et al., 2021).

Gilmour et al., (2019) equally pointed out that even though most instructional strategies such as mnemonics, study guides, show positive outcomes while facilitating science learning for students with disabilities, most studies focus on the minute, isolated parts of learning science. The lack of studies conducted on comprehensive science curricula for these students has educators in a dilemma regarding which ideas to integrate from the broad scientific concepts. Hence, students are generally engaged with the subject as little as possible. There appears to be a need to undertake more integrated curriculum development and evaluation studies that guide best practices (Gilmour et al., 2019). Another area that there exist gaps is inclusion, with an emphasis on integrating students with disabilities into general science classrooms. Schwartz et al., (2021) criticize the lack of study on inclusive teaching strategies by combining academic and functional curricula since most studies are narrowed down to either one (Schwartz et al., 2021).

Another limitation in the literature highlighted by Agran et al., (2020) is that, although systematic instruction has been identified as an effective strategy for teaching science to students with developmental disabilities, most of the studies have targeted basic skills such as vocabulary acquisition with little literature on teaching complex scientific concepts or inquiry-based practices. As science education is emphasising, day by day, students with higher-order thinking skills it requires scaffolding of difficult contents for learners with some form of disability (Agran et al., 2020). Theobald et al., (2019) highlighted the limitations of existing interventions in special education settings, specifically regarding science instruction. Their pilot study on the Early Science (ES) curriculum demonstrated improvements in students' science knowledge, but they caution that these findings are based on a very small sample size of nine students. Larger-scale studies are needed to confirm these initial results and to refine the curriculum for wider implementation in special education settings, particularly in the UK (Theobald et al., 2019).

### *Critical Analysis and Synthesis*

The comparison, between Garcia et al., (2018) and Haegele et al., (2018) delved into facets of inclusive education practices. Garcia et al., (2018) centered on the achievements of students with and without disabilities in programs revealing that students, with disabilities who engaged in vocational education tended to achieve more successful employment outcomes than their counterparts who did not participate. Haegele et al., (2018) examined science classrooms that utilized co inquiry-based approaches and found that inquiry-based learning led to notable enhancements, in science performance for students with disabilities when complemented with co teaching techniques. Both research studies underscore the significance of education. Also distinguish between vocational and academic routes for students, with disabilities (Garcia et al., 2018; Haegele et al., 2018).

McGrath and Hughes (2018) and Braun et al., (2018) have differing perspectives on adjusting methods. McGrath and Hughes (2018) research on modifying textbooks found that visuals were notably more beneficial than study materials in aiding students with learning challenges to grasp life science concepts. This indicates a benefit of using aids to enhance understanding, for these students. Braun et al., (2018) showcased how teachers who maintained hopes, for their students with disabilities and provided assistance without compromising on curriculum challenge could create fair learning opportunities. Both studies highlight the importance of teaching support; however, Bergerud stresses the significance of aids while McGrath and Hughes (2018) concentrated on teacher attitudes and adaptable teaching methods (McGrath and Hughes, 2018; Braun et al., 2018).

Comparisons, between academic curricula for students with disabilities have been explored by Stokes et al., (2019) and Basham et al., (2020). Stokes et al., (2019) revealed that students with moderate to disabilities following a functional curriculum had lower rates of post school outcomes such as employment and independent living compared to those receiving academic instruction – with no significant variance noted between the two groups in this aspect. In contrast, Basham et al., (2020) which highlighted the effectiveness of activity-oriented science curricula in enhancing science knowledge and process skills among students, with disabilities. The emphasis Bouck places, on practical skills differs, from Mastropieri and Scruggs focus on material. This distinction highlights varying priorities that how they influence student achievements (Stokes et al., 2019; Basham et al., 2020).

Wray and Houghton, (2019), and Collins et al., (2019) conducted studies that focused on the issue of inclusivity in science classrooms. Wray and Houghton, (2019) found that instruction tailored to individual students' needs and modifications tailored to individual students' needs improved access to the core curriculum for students with disabilities in science and social studies classes. However, Collins et al., (2019) maintained that although being in science classrooms pupils, with disabilities were less likely to reach standards than their non-disabled peers. This reveals the inequalities while using inclusive strategies. But both articles are compelling by emphasising the importance of inclusion. Underline the challenges. Issues of teaching arrangements have been explored by Wray and Houghton (2019), while Smithman concerns inequalities and deficits based on academic achievements (Wray and Houghton, 2019; Collins et al., 2019).

In contrast, Brown and Ramlackhan (2022) discussed how science education aligns with state standards of students with disabilities by drawing attention to the importance of focused instruction on tasks toward tangible outcomes for these students. Lambert and Tan (2020) explored the barriers students with disabilities face in pursuing science and engineering careers. They find that institutional barriers, including the absence of job counseling and unfriendly employer attitudes, are also relevant to barriers to the career prospects of this group. This contrast highlights the distinction between gains within environments and the larger structural barriers found in preparing people, for effective careers (Brown and Ramlackhan, 2022; Lambert and Tan, 2020).

In exploring another aspect of comparison we can look at the responses, from teachers regarding teaching students with disabilities. Schunk and DiBenedetto (2020) along with Atchison et al., (2019) delved into teacher perspectives. Reached conclusions. Through Robinsons analysis of high school science instructors, in settings it became evident that numerous teachers lacked readiness to adequately assist students with learning challenges and emotional needs. Moore and colleagues showed that teachers using supports like scaffolding for explaining concepts had better results, with students who have learning disabilities. This indicated that with resources and tools at hand tutors can positively influence student success. The key factor here is the level of preparedness and assistance provided to teachers, in settings (Schunk and DiBenedetto, 2020; Atchison et al., 2019).

### *Theoretical Framework Development*

Wachira and Mburu (2019) introduced core principles that influenced the development of the " assumption" theory advocating for recognizing the abilities of students with disabilities to enhance their educational opportunities. They highlighted the importance of integrating both practical curricula as an advancement in promoting inclusive schooling. Their advocacy for the inclusion of students with disabilities within mainstream education has paved the way, for creating plans tailored to meet the diverse needs of learners (Wachira and Mburu, 2019). Gin et al., (2020) also played a role in the structuring of science education for students with disabilities by proposing that science programs should revolve around themes to make them more accessible to all learners in line with universal design for learning (UDL). This emphasis on organization provided the basis for studies that advocated for the implementation of inquiry-based science curricula tailored specifically for students, with disabilities. The theoretical perspective suggested that while designing instruction materials and methods in education, it must consider the learning characteristics of every learner while maintaining educational criteria (Gin et al., 2020).

Stinken et al., (2020) focused on the training of education teachers. It highlighted that a holistic approach is crucial to cater to the different learning needs of students with disabilities in science classes including all. Their research focused on how teachers in education programs who may not be fully prepared for subjects like science could benefit from training opportunities. This resulted in the development of frameworks that highlight teaching techniques tailored to subjects and help educators better understand how to adjust science lessons for students, with learning challenges. The authors further developed an idea that having a core of content knowledge is key to ensuring that students' achieve success in disciplines like science (Stinken et al., 2020). Schreffler et al., (2019) conducted a study which impacted how we view providing evidence-based approaches for instruction of science to children who face developmental issues. Their model was based on approaches to instruction, such as task analysis and prompting delivery delayed. These approaches proved to be workable in the teaching of ideas. This model availed an avenue for the teaching of science to the teachers through giving them on hand techniques to integrate concepts of science in lessons. The structure development empowered the teachers to deal with the challenges that arose from imparting scientific knowledge to the students facing a serious disability (Schreffler et al., 2019).

Mortier (2020) established a framework that centered on teaching approaches, for students with disabilities. They identified teaching strategies such as memory aids and study resources that can be used as a foundation for applying such methods in science learning. Their model emphasised that learning strategies must be personalized to fit the needs of a learner with a disability. The gains achieved in pushing for activity-based science curricula have opened doors, for classroom practices, in the landscape (Mortier, 2020). Cumming and Rose (2022) extended earlier frameworks to investigate how science teaching can be adapted for students with disabilities and ASD. Their strategy integrated self-instruction with comprehension-based instruction to develop scientific inquiry skills in these students. The model emphasised the need to develop thinking and problem-solving skills in addition to memorization in science learning for students with disabilities. This new theoretical development highlighted the importance of designing science courses that engage students in hands-on learning and inquiry-driven approaches (Cumming and Rose, 2022).

Connor and Cavendish (2020) expanded our knowledge of how science standards can be tailored for students, with challenges. There was a need for research into how state science standards utilized for this group of students. This has resulted in the creation of a framework integrating prompting and errorless learning methods. Through this approach to teaching science concepts it ensures that students, with disabilities can actively participate in science education in a meaningful manner. This framework of connecting teaching approaches, to state standards facilitated the integration of education, with mainstream science curricula (Connor and Cavendish, 2020). Rapp and Corral (2024) introduced a method that involves using prompts, within classroom activities to teach STEM subjects to students with disabilities in inclusive settings. Their approach highlights the importance of peer tutors and paraprofessionals in assisting students with disabilities to learn STEM concepts. Heinrichs research showcased the effectiveness of this framework, in helping students develop STEM skills within an environment. This concept has played a role, in promoting STEM education by offering a framework, for blending academic material with easily understandable teaching methods (Rapp and Corral-Granados, 2024).

# Chapter 3: Methodology

## 3.1 Introduction

This chapter describes the methodologies employed to examine the present educational circumstances experienced by students with disabilities, highlighting both the challenges they encounter and the prospective methods to improve accessibility and participation. In particular, this chapter initiates the discussion by specifying the research demographic and sampling techniques, explicating the criteria through which study participants—including students, educators, and stakeholders—were chosen to guarantee a sample that is both representative and pertinent. This section addresses the sampling rationale with an intent to reflect diversity in points of view across various roles in the educational system and provide a holistic view about the inclusivity of science education. Subsequently, this chapter outlines data collection procedures, data analysis techniques, ethical considerations, as well as limitations and delimitations. The data collection part provides a very elaborate explanation of the method used to gain insights from structured questionnaires designed specifically for students, educators, and other stakeholders, with particular highlights on distinct question types tailored to each group to answer the research questions. It then follows with the section concerning the analyses of data that further sheds light upon various analytical methods performed, ranging from cross-tabulation, correlation, and regression analysis with the quantitative data and content analysis for open-ended feedback. This chapter discusses ethical considerations further by showing strategies taken to ensure participants' confidentiality and how informed consent is ensured. Finally, limitations and delimitations of the study will be established, which describe the scope and boundaries of the research.

## 3.2 Conceptual Framework

A Conceptual Framework for Applying UDL Principles to Science Education for Students with Disabilities. In The conceptual framework diagram illustrates the research focus on science education for students with disabilities (Figure 1). Arrows show how UDL principles influence each aspect of science education and how barriers and best practices affect overall effectiveness.

1. **Science Education**: The main domain of the research.

2. **Curriculum, Pedagogy, Assessment, Support**: Fundamental aspects of science education.
3. **Representation, Expression, Engagement**: UDL principles guiding design and delivery.
4. **Outcomes**: Measure of science education effectiveness.
5. **Barriers and Challenges, Best Practices and Strategies**: Factors impacting science education.

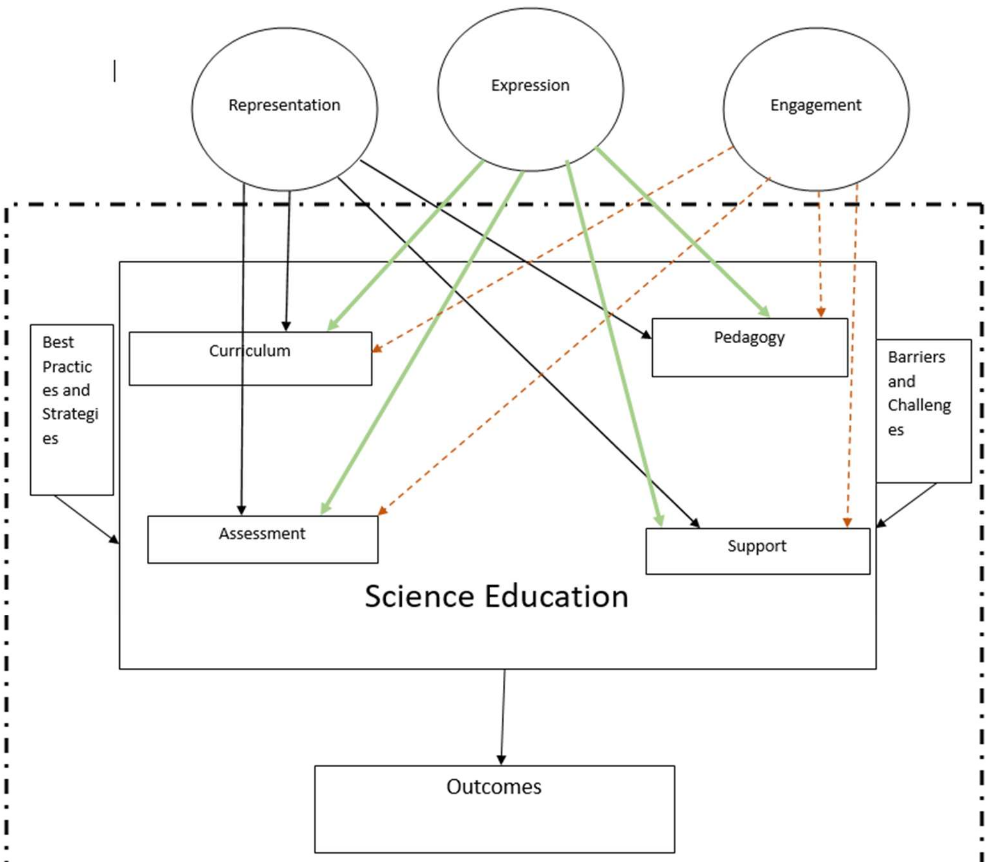


Figure 1: Conceptual Framework of Research

### 3.3 Population and Sampling

The approach for this research focuses on an explanatory and assessment aspect to comprehend the current science education conditions in the UK secondary schools with disabilities, identify barriers and obstacles and get existing practices and policies, and then propose possible reforms.

This research design majorly tends to succeed the statistical system (Bloomfield and Fisher, 2019), and it explores the situation that is currently encountered by students with disabilities being involved in the science education in British secondary schools. It is also an evaluative one whereas the introduction of updated techniques aims to estimate the effectiveness of the current methods and propose changes. This study is about finding the relation among the different factors of learning such as access to learning materials, pedagogies and academic achievement for students with disability.

The sampling method consisted of the both probabilistic and non-probabilistic sampling approaches (Taherdoost, 2022). The probability sampling was used to pick up a sample of both students with disabilities and teachers working in British secondary schools that have representative characteristics of this population. The non-probability method of sampling was used for the representative sample of critical sectors like parents, politicians and researchers who investing their skills and expertise in science education for the differently able students. Inclusion/ exclusion standards for the sample included: 1) a student with impairment who is taking science class in British secondary school. 2) a teacher, parent, an administrator or researcher who is related with or interested in science education for students with disabilities. The sampling was done through working with schools, educational departments, as well as relevant non-profit organisations. Email invitations, along with the mail, were sent to participants. In invitations, participants were reminded about the purpose of the research initiative and invited to join the study on a voluntary basis. The test sample included 300 participants including students, teachers, and stakeholders.

Probabilistic sampling—applied to students with disabilities and their science teachers—gives each unit in the defined population a known, non-zero chance of selection, so the present study's simultaneous use of probabilistic and non-probabilistic sampling strikes a balance between statistical generalisability needed to answer outcome-oriented questions and contextual richness needed to understand the multi-layered realities of difference This balance allows sampling error computation and confidence interval creation, which give descriptive and inferential statistics external validity (Bloomfield and Fisher, 2019; Taherdoost, 2022).

However, purposive, non-probability methods were reserved for parents, policymakers, and expert researchers whose perspectives are vital but numerically marginal. Their inclusion—though statistically non-representative—injects experiential complexity and helps surface emergent variables that probability frames might overlook, improving theoretical transferability and analytic depth but limiting the degree to which findings about these groups can be extrapolated beyond the sample (Etikan, 2016; Zyphur and Pierides, 2020).

These methodological choices affect data interpretation: Since sampling variance is quantifiable, probabilistic strata results can be used to make population-level claims about barriers, UDL confidence, or regression parameters. Non-probabilistic strata results are context-bound illustrations, useful for hypothesis generation and policy sense-making but not prevalence estimates. Using significance and effect sizes to report probabilistic findings and qualitative credibility criteria like data saturation and triangulation to frame non-probabilistic insights, the analyst must create an integrated narrative that respects statistical rigour and stakeholder voice .

The questionnaire for the student asked questions aimed at capturing both feelings and particular challenges which students with disabilities were facing in science educational settings. This was a self-reporting questionnaire, which meant that students were encouraged to think about how these difficulties affected their participation and learning but also the broader systemic or structural factors which would impact on their experiences. A variety of key domains were explored by the student survey. The questions were opened by a general query about the role of the pupil in the system of education, which helped contextualise the answers and may prove useful in differentiating views depending on whether the respondents self-identified as active learners or held other roles within educational support structures. Follow-up questions focused more on eliciting particular disabilities that students identify as significant barriers to science education access. Third, students were asked to identify specific barriers they experience, which provided rich, qualitative accounts of issues that might otherwise be overlooked. The questionnaire also asked about the role of technology as an enabler of learning and participation in scientific fields. Here, this part allowed students to talk about how digital tools or access technologies might help remove or reduce barriers; it gave a very clear insight into pragmatic solutions from the student perspective.

The questions for students' principles of Universal Design for Learning were asked to find out what they have learnt about effective UDL strategies in practice, or on the contrary, to determine what they believe are the biggest problems they see in attempting to implement UDL within their science education contexts. These questions uncovered significant knowledge about students' awareness and understanding of UDL and their views on how such approaches may better create an inclusive learning environment. This was achieved through the gathering of students' opinions, providing basic information about their experiences, problems that hindered them, and proposed solutions on how inclusivity and participation for learners with disabilities may be promoted in science education. The knowledge obtained from these students' accounts is crucial in understanding the actual impacts of obstacles and support in secondary science education, thus serving as a foundation upon which systemic needs and potential improvements can be assessed.

The aim of the teacher questionnaire was to explore curricular changes made to meet different kinds of learning requirements and the scale to which such approaches enable students with disabilities to achieve equitable educational results. The questionnaire took off from there with a question of how well the existing science curriculum was serving a variety of learning needs, and specifically for those learners with disabilities. They further asked to specifically point out other strengths in the curriculum but also areas for improvement, especially concerning inclusivity. Follow-up questions were for whether specific scientific topics or subtopics in the curriculum required further accommodations so that students with disabilities could be met more adequately. Meaning, therefore, that teachers could identify areas in the curriculum that might create accessibility issues, and some solution would then be prescribed. Secondly, the questions were more about the methodologies used by the teachers to suit different students' needs. Educators were queried regarding the frequency with which they incorporate different means of representation—visual, aural, and/or tactile—into their science instruction. This question reveals the frequency to which different curriculum adaptations are used to facilitate access to and engagement with scientific concepts for students with disabilities.

The survey also encouraged teachers to consider how they might involve themselves in multiple means of engagement by inviting options on assignments and ensuring various group activities, to maintain student engagement and cater for diverse learning preferences. Another major area of question was on assessment, where questions were placed on the suitability of current methods of evaluation used in science education on bearing the diversity in how students with disabilities demonstrate their knowledge. Teachers were motivated to share how they have already begun to implement alternative forms of assessment, including oral presentations, demonstrations, and project-based assessments, which might allow for differences in student ability as well as render a more holistic approach for assessing student knowledge. The support structures were also observed during the survey process. Respondents were asked to rate the effectiveness of existing resources, such as special education support and teaching assistants, in meeting students with different forms of disability needs. This section contributed to the identification of both successful methodologies and any deficiencies in support that could impede inclusive science education. Additionally, educators were afforded the chance to propose further resources or accommodations that they believed were necessary to comprehensively assist students with disabilities in science courses. The educators were finally asked to rate science education among learners with impairments as inclusive, applying the UDL framework. A scale rating of 1-5 provided a quantitative measure of teachers' perceptions of inclusivity within the science curriculum, which served as a summary metric to drive comparisons across different schools and regions.

During the data collection process based on stakeholders' opinions, a specialised questionnaire was prepared for the acquisition of views from various stakeholders. The objective of this questionnaire is to elicit stakeholder perceptions concerning responsibilities in the facilitation and monitoring of UDL-related change, as well as barriers that challenge these stakeholders to implement inclusive learning environments for students with disabilities. The questionnaire first measured the frequency of collaborative interactions among stakeholders, including collaboration with educators, parents, policymakers, and researchers aiming at issues related to inclusion and UDL. This question helped establish a baseline of current stakeholder engagement and pointed out potential areas where the collaboration may need to be developed further. Subsequently, stakeholders were invited to nominate groups that they believed should be actively engaged in formulating and assessing UDL reforms. This question is considered essential as it clarified the roles of stakeholders and could have led to developing a common vision for an inclusive educational community.

Further questions focused on how they communicated and collaborated, and stakeholders were also requested to cite the best ways of communicating UDL initiatives. This allowed respondents to give specific interaction modes, such as meetings, online platforms, and professional development activities that may ease the collaboration process. The questionnaire also probed for perceived barriers to collaboration in terms of resource constraints, competing priorities, or structural limitations providing a clear view of obstacles that need to be taken into consideration when improving UDL implementation. The question of support systems was aimed at eliciting from stakeholders the kinds of resources that would enable better collaboration. Such questions sought tools, funding, or training programs that stakeholders believe are necessary and essential to overcome identified challenges in UDL implementation. This allowed the questionnaire to elicit ideas on resource gaps and potential avenues for policy or programmatic support. Others were matters of effectiveness questions regarding UDL reforms.

Stakes were sought on opinion about how best to grade whether the principles of UDL indeed positively serve inclusive education for students with disabilities. Their responses comprised insight about what they felt should be applied to evaluate and improve the conditions, perhaps by applying some form of quantifiable metrics, or qualitative feedback from both students and teachers, or longitudinal studies. Moreover, the questionnaire opened opportunities for stakeholders to contribute to actions that ensure smooth communication and cooperation among people from diverse backgrounds in inclusive education reforms. This must allow stakeholders to come up with innovative ideas related to a more interconnected approach toward the realisation of UDL principles, including strategies on partnership building, collaborative goal setting, or usage of technology in further amalgamation of efforts. The stakeholder questionnaire provided an in-depth understanding of collaborative dynamics and challenges and strategies that can support the effective implementation of UDL reforms. This finding gave a broad view of stakeholder engagement and spelt out systemic support for enhancing inclusive science education practices by students with disabilities.

### 3.3.1 Sample Size Determination

To ensure statistical reliability and representativeness of the quantitative phase, the sample size for the survey component was determined using Cochran's (1977) formula for categorical data:

$$n = Z^2 \text{ x } p(1-p)/e^2$$

where $n$ represents the required sample size, $Z$ is the z-score corresponding to the desired confidence level, $p$ is the estimated proportion of the population exhibiting the attribute of interest, and $e$ is the acceptable margin of error. For this study, a 95% confidence level ($Z = 1.96$) and 5% margin of error ($e = 0.05$) were used. Assuming maximum variability ($p = 0.5$), the computed sample size was:

$$n_0 = (1.96)^2 \times 0.5(1-0.5)/\ (0.05)^2 = 384.16$$

Since the accessible population of teachers, students, and stakeholders in the participating schools was finite (N = 130), the sample was adjusted using the finite population correction (FPC) formula:

$$n = n_0/1+(n_0-1/N)$$

$$n=386.16/1+(386.16-1/130) =100.97$$

Thus, the required sample size was approximated to n = 101 participants. This number was considered statistically adequate to achieve a 95% confidence level with a 5% margin of error, while ensuring proportional representation from each respondent category (students with disabilities, science teachers, and educational stakeholders).

For the qualitative phase, purposive sampling was applied to select participants who could provide rich, experience-based insights into inclusive science education practices. Inclusion criteria specified participants with at least five years of direct involvement in science instruction, special needs coordination, or inclusive curriculum implementation. Data collection continued until thematic saturation was achieved—defined as the point at which no new codes or patterns emerged from subsequent interviews.

To further validate statistical sufficiency, a post-hoc power analysis was conducted using G*Power 3.1, confirming that a sample size of 101 provided a statistical power ($1-\beta$) greater than 0.80 for medium effect sizes at the 5% significance level, which is considered acceptable for social science research (Cohen, 1988).

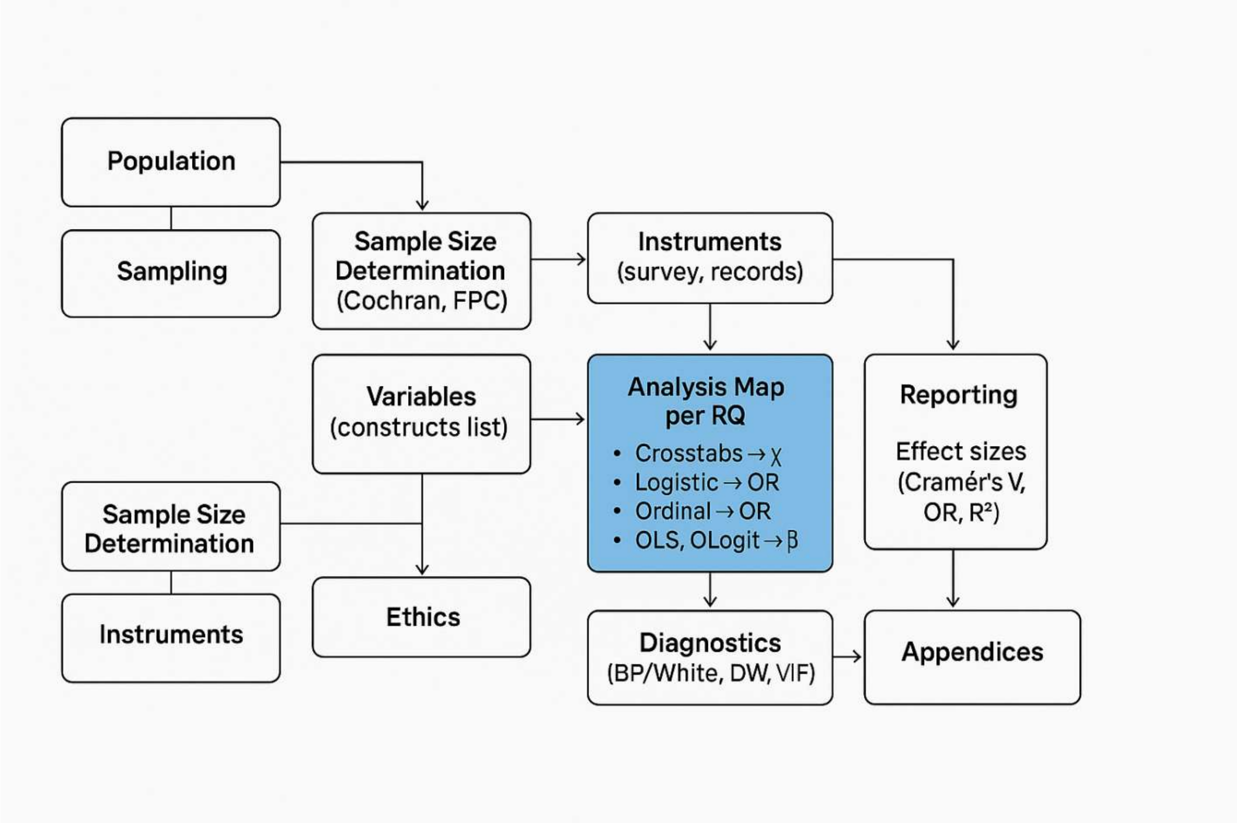


*Figure 1: Hypotheses to Methodology Mapping*

## 3.4 Data Collection Methods

Data collection used a mixed approach that combines both qualitative and quantitative techniques to allow for an in-depth understanding of research questions. The methodology used in gathering data was the use of prepared instruments and newly designed ones. Since the review was to be a process involving measurable collection of data, questionnaires were adopted to measure variables like academic performance, attitude toward science, and educational resources. The choice of instruments was one that was valid, reliable, and appropriate to the research objectives. The process of data collection adhered to a meticulous approach that emphasises the importance of ethical considerations, ensuring that appropriate approvals and licenses were secured from relevant authorities, including school administrations and ethics review boards. Each participant received proper counselling, and informed consent was obtained, with safeguards established to maintain confidentiality and anonymity throughout all phases of the research.

Flexibility is one of the great features of mixed methods (Strijker et al., 2020). Depending on the kind of objectives the study is undertaken to meet, different forms of research designs can be adapted, such as experimental, cross-sectional, and cohort studies (Kreshpaj et al., 2020). Disciplines such as finance and social science allow for strong methodologies on complex phenomena with choices such that, in quantitative research, market dynamics or societal trends are of concern and applicable (Stahl and King, 2020). Methods such as econometric analysis and those from the time-series techniques greatly improve the capability to meaningfully analyse dynamic datasets (Plonsky and Gass, 2011). The nature of quantitative research follows up on the justification about the sample size; that is, studies large enough that can reveal effects of significant magnitude and thereby maintain proper statistical power. A systematic approach toward choosing sample size—you are said to use methodologies like power analysis—enhances the reliability and generalisability of the findings (Mohajan, 2020). Content analysis was used to systematically encode and categorise the qualitative responses that were elicited from the open-ended questions (Mohajan, 2020).

This method ensures the result reflects critical thinking and becomes well-informed by the actual data represented (Edmonds and Kennedy, 2016). Mohajan (2020) reported that this is one of the benefits of quantitative research, namely, its generalisation of results. It can do so provided the design of study is large enough in samples and thorough enough not to bias. Generalisability This ensures that results are valid within the sample and might be applicable to other groups of similar subjects, ensuring low chances of misleading findings and increasing the impact of the research on society (Taherdoost, 2022). Quantitative research also supports rigorous statistical analysis, which helps document relationships and test hypotheses and perform them with perfect accuracy. Experimental designs, such as randomized controlled trials (RCTs), are especially valued in fields like healthcare and psychology, where the validity of results can hinge on controlling for various factors (Bloomfield and Fisher, 2019). By structuring research in a way that minimises bias and maximises reliability, these designs are considered gold standards for assessing interventions (Duckett, 2021).

Many studies have noted that one of the advantages of mixed method lies in their systematic arrangements of data collection and analysis process (Strijker et al., 2020; Xuan et al., 2020; Johnson and Christensen, 2024). This is important in quality assurance because it allows uniformity in interpretation of study findings thus easing their replication which is a major requirement in science. For example, a clearly formulated mixed method design limits the potential for prejudices and errors thereby enabling accurate and wider inference beyond the sample

(Edmonds and Kennedy, 2016). Such a method is especially appreciated in practice-based disciplines such as medicine and social sciences where the term evidence-based is often used (Sürücü and Maslakci, 2020), Moreover, mixed method research is less restrictive or rather more flexible therefore including different research designs based on the study question under investigation and availability of resources. For instance, descriptive, experimental, cohort, and various other study designs have some advantages over the others depending the objectives of the study (Plonsky and Gass, 2011).

Such characteristics help in generalising the results in a broader spectrum hence informing policy and practice in a wider range of fields including but not limited to health care and education (Bauer et al., 2021). In addition, the ideas of reliability and validity as applied in quantitative methods do not only enhance data collection processes but also the ways in which this collected data can be used. Meticulous statistical techniques for example, that have been used in quantifying minimise errors and validating results of the research more so in applied orientation of such research (Xuan et al., 2020). In this way, quantitative research, when designed well, brings out a great deal of constructive understanding that in turn enriches the theoretical and practical scope of the subject (Watson, 2015).

Managing the well-known risks of measurement error and social-desirability distortion in self-reports, especially for students with disabilities who may face additional cognitive, linguistic, or accessibility barriers, requires a multilayered validation strategy that begins before data collection and continues through analysis. Without such rigour, systematic bias and random noise may destroy the evidence basis (Federal Committee on Statistical Methodology, 2001). Using a heterogeneous subsample representing all disability kinds and assistive-technology use, iterative cognitive interviewing and think-aloud piloting first reveal understanding breakdowns, confusing wording, and mapping errors between latent variables and answer scales. Before fieldwork begins, the researcher can reword or insert Universal Design cues (Willis, 2015). Questionnaires should guarantee anonymity, include balanced impression-management indices like the BIDR or PDS, and, where ethically acceptable, use indirect questioning or randomised-response formats to reduce social-desirability bias—often heightened in inclusive-education environments where respondents may want to please authority figures or minimise differences (Holden et al., 2024).

Next, method triangulation improves construct validity: Student ratings of instructional accessibility are cross-referenced with teacher logs of accommodations, observational check-lists of enacted UDL practices, and administrative records of assessment outcomes to identify discrepancies for follow-up interviews or sensitivity analysis and prevent overreliance on any one approach. Screen-reader-compatible web forms, large-print paper copies, and sign-language interpreters ensure that mode-of-access barriers do not confound response quality, a requirement already in large-scale assessments like NAEP's accommodations policy for students with disabilities (NCES, 2024). Finally, the post-survey analytical phase should model latent common-method variance, run confirmatory factor analyses with disability-group invariance tests, and calculate internal-consistency coefficients to measure and statistically partialle out any remaining bias, resulting in empirically defensible and sensitive interpretations that reflect the lived reality of the students the study serves.

Questionnaires are of great importance in quantitative research design as they allow for a quick and organised collection of similar data from a large number of subjects (Mertens, 2023). This ensures the right format is used to present data collected on various variables such as attitudes, behaviors and even demographics, making it easy to compare data from different sets of respondents (Tashakkori et al., 2020). These aspects take the findings a notch higher by ensuring that the answers given do not vary widely with how the questions are understood. There are several advantages that can be realised from proper questionnaire design (Riffe et al., 2023). Careful consideration of what words to order where causes less change in response type than question characterisation in turn limiting validity threats. Ibid, working with a smaller group of participants usually allows for better planning of survey questions, their floor and concatenations, even the visual design of the questionnaire to ensure its success and effective data processing (Lett et al., 2022). Furthermore, questionnaires are also useful in reaching out to many varied samples of participants which is a common requirement in designing research in studies in social marketing, public health and other social sciences (Strijker et al., 2020). Since they may take various forms such as the internet, hard copies or face-to-face structured interviews, they facilitate data collection that is based on the available resources as well as the preferences of the respondents (Rutberg and Bouikidis, 2018). This advantage increases the number of respondents and helps the researcher get to hard-to-reach sectors in the population (Johnson and Christensen, 2024).

Here are a few model items prefaced by the aim they operationalise, demonstrating the close relationship between the four stated goals and the survey tools. These items demonstrate how the questionnaire turns abstract research goals into observable constructs that can be triangulated across respondent groups.

**Objective 1 – Identify barriers to science-education access for students with disabilities.**

"List the three most frequent physical, sensory, or attitudinal obstacles that make it hard for you to participate fully in science classes and practicals," followed by a Likert-scaled question about how much each barrier affects their participation (1 = "no impact" to 5 = "stops me completely"). First-hand experience and impact levels are emphasised, so the data directly assesses challenge frequency and intensity, fulfilling Objective 1's diagnostic focus.

**Objective 2 – Examine how curriculum, pedagogy and assessment address diverse needs.**

Teachers answered "How frequently do you include several means of representation (visual, aural, tactile) when clarifying fundamental scientific ideas?" from "never" to "every lesson," with an open box for examples of modifications. The paired item asked, "This term, which alternative assessment formats (e.g., oral defences, demonstration projects) have you used and for what percentage of disabled students?" Since they demonstrate curriculum flexibility and inclusive assessment alignment, these questions support Objective 2.

**Objective 3 – Evaluate best-practice strategies for improving outcomes.**

Instructors and students rated "Universal Design for Learning (UDL) strategies improve disabled students' science achievement" on a 1–5 agreement scale and then asked, "Which single UDL tactic has had the greatest positive effect in your classroom and why?" The item shows high-impact activities that directly satisfy Objective 3's evidence-seeking objective by combining perceptual judgements and qualitative justification.

**Objective 4 – Investigate stakeholder collaboration mechanisms.**

A committed stakeholder poll asked, "How often do you work with UDL reform policies, parents, and teachers?" What two stakeholder groups should have more say in inclusive-education project monitoring and "How often do you work with educators, parents and policy-makers on UDL reforms?" weekly/monthly/occasionally/never. By turning Objective 4 into interaction intensity and perceived role distribution, these prompts helped the study detect cooperative governance issues. The tool ensures that every data point is clearly linked to the analytical agenda using customised items, each anchored in a goal but deliberately cross-referenced among respondent groups, improving construct validity and simplifying mixed-methods integration.

### 3.5 Data Analysis

The multi-faceted approach that forms the basis of the proposed analyses for this research involves quantitative methods to offer a detailed answer to the research question (Rutberg and Bouikidis, 2018). For a quantitative dataset, descriptive statistics were adopted using SPSS version 26 to summarise and describe the traits of the sample and critical variables. The distribution's central tendency and variability were assessed by the computation of measures including the mean, standard deviation and frequency distribution. Moreover, inferential statistics employed correlation analysis in association with regression models to establish the relationship between variables and the test hypotheses. Thus, the Pearson's correlation coefficient was one of those metrics indicated to be used for the strength and direction of linear associations between two continuous variables whereby multiple regression analysis was tenable for the investigation of the predictive influence of different independent variables on the dependent variable. This criterion has enabled the identification of primary prerequisites of science education and, therefore, presented to the factors that influence effective science education of students with disabilities.

The data analysis undertaken for this study on the science education conditions of students with disabilities in UK secondary schools used a mixed-method approach. The mixed-method approach combined both quantitative methods such as cross-tabulation, correlation, and regression analyses involving qualitative content analysis to examine students', teachers', and other stakeholders' responses in some detail. The research aimed to identify significant barriers, facilitators, and areas of improvement that exist in the teaching of inclusive science by analysing the different perspectives using a range of analysis methods and also to compare the results with previous studies. Phase one constituted cross-tabulation analysis which allowed the cross-tabulation of categorical variables between different groups of each questionnaire. For example, this methodology was employed to identify how a particular disability impeded students' access to science education as both students and instructors acknowledged. The cross-tabulations allow for in-depth analysis of frequency patterns and detailed study of the relationships between variables, specifically the nature of reported disabilities and barriers or successful strategies identified. This made it possible to show different patterns and variations of experiences as well as observations among respondent cohorts.

Following the cross-tab analysis, a correlation analysis was then run to establish the strengths and directions of associations between the variables under study. This stage entailed relations analyses among variables. Some of the variables involved were levels of perceived inclusiveness of the science curriculum, the frequency of Universal Design for Learning, and the perception of functioning support systems. The correlation analysis provided important insight into the interplay among these variables; for example, it allowed examining the frequency with which UDL concepts were used in classrooms and whether this frequency would be associated with educator perceptions of inclusiveness. This was helpful in identifying which variables may interact synergistically to construct more inclusive learning environments for pupils with disabilities. Based on the output from the correlation findings, regression analysis was then conducted to examine the predictive relations between variables. In this case, this helped ascertain which factors may inform the most influential impacts on the outcome of inclusive science education- pupil involvement and access. The study employed regression models to quantify and analyse variations caused by different factors, such as curriculum adaptability, technological integration, and support mechanisms, in inclusive educational practices. Consequently, the results enabled the selection of leading predictors and placed focus on aspects that specific interventions could be highly impactful on improving accessibility in science education.

Researchers have the ability to analyse large data sets and recognise patterns, relationships and tendencies that would otherwise go unnoticed. This skill which concerns the analysis of numerical data is necessary for evidence-based practice across disciplines and increases the chance of making the right decisions based on available data (Shah et al., 2018). In qualitative methodology, statistics is used to evaluate the sulfurs and test assumptions, and this enhances the understanding of the ordained processes, especially the drawing of inferences concerning a given sample upon the larger population. For instance, which is known as inference statistics, the researcher calculates the chance that the observed relationship or difference is not due to chance, thus enhancing confidence in the findings (Gunbayi, 2020). Used correctly, these measures allow for the proper extension of the study and predictions on other populations, thus having a wider reach and applicability of the study other than the specified sample (Mitchell and Education, 2018).

Statistical methods also assist in the process of controlling ambiguity and variability of research data because the level of trust of the researcher in the results can be measured. This is done using confidence levels, intervals and p levels that depict the accuracy of the results and decrease the chances of misinterpretation of the results. This aspect of statistics helps to ensure that there is a relationship between significance tests and the context of the research questions whose answers the results are meant to provide (Rashid et al., 2021). Besides, stratigraphic analysis furthers the support for the assessment of study results through analytical techniques such as meta-analysis, where results from many studies are conjoined to reach more accurate conclusions. By pooling data across studies, researchers can enhance the statistical power of their analyses, providing a clearer picture of underlying patterns and strengthening the evidence base for particular hypotheses or interventions (Moon et al., 2019).

As concerned limitations of the study, the beneficial aspect of the statistical analysis is its utility in helping measure the quantity of the effect that is observed. Hence, effect sizes extend the use of simple p-values to address the question of practical significance of the research. Effect size indices explain how strong the relationships or the effects of treatments are hence enabling the powers of evaluation of a given research to its applicability in that research subject (Basias and Pollalis, 2018). Statistical analysis sufficiently proves how trustworthy and correct is the data given since it contains procedures on how to handle missing or incomplete information and still maintain that the dataset is intact (Dawadi et al., 2021). There are techniques of imputation where the researchers can fill the missing information in the data to avoid skewed results, especially in areas that are not able to gather data completely due to restriction. This makes the statistical process very important in areas such as clinical research and sociological research where the level of accuracy and fullness of data are very high (Zyphur and Pierides, 2020).

Analysis of variance and other modern computation techniques as neural networks give permission to investigate and comprehend complicated structures and correlations in the data (Shah et al., 2018). It means that these approaches allow defining relationships between different variables, determining structures that are not directly observed, or devising forecasting techniques, which all allow a researcher to come with elaborate conclusions and predictions attached with prior data (Zyphur and Pierides, 2020). This is instrumental, especially in the fields of finance, healthcare, and dealing with policy, for the reason that in these areas, projection of the situation is of utmost importance (Zyphur and Pierides, 2020). In addition, the scrutiny of data from a statistical viewpoint is important for promoting the openness and replicability of science since it makes it possible to handle the data in a uniform way. Transparent statistical methods allow other researchers to replicate studies and verify findings, strengthening the credibility of research within the scientific community (Kirongo and Odoyo, 2020). By enabling replicability, statistical analysis supports a culture of rigour and accountability in scientific research, fostering confidence in scientific findings and their potential applications (Dawadi et al., 2021).

It covered the exploration of the emerging themes and patterns that characterised the responses such as challenges in implementing UDL, perceived gaps in support systems, strategies suggested toward improving and enhancing inclusivity. This makes it possible to bring in a more qualitative form that allows for better clarification on the views of respondents in addition to the depth brought about by contextualisation and rich information which warrants inclusion in complementing quantitative results. In addition, outside these primary analyses was that of comparative analysis just in order to situate study findings with what prevails in previous experiences with related studies. By comparing the identified themes and statistical results against the extant literature on inclusive education and UDL implementation, there is consistency and inconsistency with previous findings. This comparative approach confirmed research findings and also prompted a critical discussion related to how current barriers, resources, and strategies relate to or shift away from earlier studies in this field.

A complementary set of cross-tabulations, correlation matrices, and multivariate regressions ensures that all four study subjects are investigated with a method that fits the measurement and explanatory depth needed. Because the initial cross-tab stage disaggregates gender, age band, and disability type against outcome categories like "physical barriers" or "perceived curriculum inclusivity." Thus revealing hidden frequency patterns—e.g., male respondents' disproportionately high report of sensory hurdles—that directly address Research Question 1 on differential access obstacles and signal subgroup differences that influence later modelling decisions (Shah et al., 2018). Furthermore, bivariate correlations provide statistical triage by assessing linear connections, such as the modest positive relationship between UDL frequency and teachers' sense of curricular inclusion. Regression analysis saves degrees of freedom and reduces Type I error inflation, therefore only relevant connections should be used (Rutberg and Bouikidis, 2018).

Research Questions 2 and 3's explanatory "how much" is answered by many regression: While teacher-level models project the independent contribution of curriculum-inclusivity ratings and identified improvement areas to confidence in UDL strategies, thereby isolating the curricular levers most likely to change pedagogical practice (Bloomfield and Fisher, 2019), student-level models predict perceived science-education barriers from gender, age, educational role, and disability mix. For example, each year of age reduces barrier

Finally, an auxiliary regression on stakeholder data ties collaborative confidence to gender, age, and engagement frequency, revealing that more frequent interaction can lower confidence, which is crucial for Research Question 4. Johnson and Christensen (2024) propose governance tools for sustainable transformation, with a $R^2$ of 0.34 indicating demographic factors explain a significant portion of variance, leaving potential for future exploration of organisational moderators. The cascading methods turn descriptive patterns into inferential evidence, allowing complex recommendations based on statistically partitioned impacts instead of undifferentiated aggregates to ensure targeted, evidence-based, and theoretically consistent inclusive science education policy.

### *3.5.1 Validity / Reliability*

#### *Statistical conclusion validity*

The research clearly link power and sample-size planning to each study's least detectable effect sizes to strengthen statistical results (Cohen, 1988; 2016); calculating N for chi-square tests with 95% confidence and 80% power to assess bivariate relationships between categorical variables (e.g., lab accessibility × participation) using different effect sizes (Cramér's V=0.10small, 0.30medium). In multivariable models, the research used power analysis for logistic and linear regression to determine the minimum odds ratio (OR) or standardised slope (β) for reliable detection, considering the number of predictors and expected event rates (Cohen et al., 2013; Hosmer, Lemeshow & Sturdivant, 2013). For ordinal measures like confidence scales, proportional-odds models were used to justify sample-size objectives for cell counts per threshold (Tabachnick & Fidell, 2019). Heteroscedasticity and model misspecification increase Type I and II errors, so the research examines assumptions (e.g., Breusch–Pagan/White for constant variance; Durbin–Watson for residual autocorrelation) and present school-level HC3 robust standard errors and/or cluster-robust variance (Field, 2018) Effect sizes (Cramér's V, ORs with 95% CIs, standardised β, and adjusted R^2) reduce reliance on p-values and improve interpretability across outcomes (Cohen, 2016; Wilkinson, 1999); thus, limiting hypothesis testing to those in the analysis map and use family-wise error controls to reduce multiplicity (Shadish, Cook & Campbell, 2002).

*Internal validity*

Design, measurement, and analysis address confounding variables and alternative hypotheses (Shadish, Cook & Campbell, 2002). Background characteristics like school-level SES, historical achievement benchmarks, school type/phase, and teacher experience affect academic performance and inclusivity. These variables are controls in OLS/logistic/ordinal logistic regression models to reduce omitted-variable bias (Creswell & Creswell, 2018). Our calculations include cluster-robust standard errors to account for school clustering dependencies and sensitivity analyses using school fixed effects to assess estimates of unobserved school attributes (Tabachnick & Fidell, 2019). Item-total diagnostics, operationalised constructs, and Cronbach's internal consistency reduce measuring bias. Look at or discard low-loading objects before analysis (Field, 2018). Third, the research track how people were recruited for the research, compare those who reply to those who don't, and use participation likelihood as a covariate when possible to reduce selection and non-response threats (Fowler, 2014). Fourth, the research limit history/instrumentation effects by using consistent instruments each time and standardising respondent instructions, which then utilises an a priori analysis plan to link each research question to a model and explain any necessary changes (such as model family changes due to assumption breaks).

*External validity (generalisability)*

Sample frame and response rate determine generalisability (Cochran, 1977; Fowler, 2014). "State-funded secondary schools in Region X" defines a population. The research used stratified or clustered samples to display school type, size, and location. Comparing frame parameters like academy % and urban/rural mix to response rate; and explaining consequences and use post-stratification weights to improve frame representation in uneven coverage or response (Bryman, 2016). Careful extrapolation is advised in contexts with diverse contextual features (e.g., regulatory regime, resource base), as the research outlines inference border conditions and a transportability caveat: results are best applied to units with similar SES distribution, personnel characteristics, and resource availability (Shadish, Cook & Campbell, 2002). To aid cumulative science, the research describe the sample, tools, and implementation context to help readers assess ecological similarities and transferability (Creswell & Creswell, 2018).

*Reliability*

Instrument, method, and analytical reliability are evaluated. Scales with many items provide internal reports of Cronbach's $\alpha$ (goal $\geq .70$) and item statistics. Composite formation and subscale reliabilities are recommended for formative or multidimensional entities (Field, 2018). Manual coding shows inter-rater agreement for categorical variables acquired from records (e.g., participation yes/no) (Fowler, 2014). Standardised administrative processes. All codebooks and analytical scripts are saved for reproducibility, and important tables include confidence ranges to show estimate precision (Wilkinson, 1999). These methods produce reliable, interpretable results that can inform policy and practice beyond statistical significance.

## 3.6 Ethical Consideration

Ethical matters are the foundation on which scientists and researchers rely to guarantee the integrity, confidentiality, and safety of participants engaged in research projects (Duckett, 2021). In order to rectify these problems thoroughly, some major questions have to be thoroughly tackled. Firstly, informed consent practice from all the participants was obtained to explain the aim and procedure of the study as well as potential risks and benefits to the subjects. Anonymity and confidentiality of data are the indispensable aspects of the privacy, and these must be rigorously monitored in every step during data collection, processing, data analysis, and the final dissemination. For the collection, storage and access of data, reliable protocols were developed to avoid cases of unauthorised disclosure or breaching of confidentiality. Along with this, during the study, participants were granted the right to withdraw from the study anytime without any consequence, so they maintained the autonomy and voluntary participation in the study. Besides these, research involving the populations of the vulnerable kind or the issues that are delicate requires more safety measures for the participants and support for them. On the other hand, ethics goes behind research use and impact, where the stewardship and respect of information are underscored while safeguarding the well-being and rights of participants (Edmonds and Kennedy, 2016).

Since participants must comprehend what they are authorising to preserve ethical autonomy, the consent architecture will be modular, multimodal, and iterative. A short summary page with high-contrast pictograms, CEFR A2 plain text, and an audio QR code for screen-readers. To ensure that all students, regardless of impairment, receive information in their preferred format before moving on to Braille embossings, Pakistan Sign Language video clips with captions, and tactile storyboards for dual sensory loss. UNICEF's (2020) recommendation on incorporating children with disabilities in evidence production supports a practice, as does BERA's inclusive research standards (BERA, 2018).

Many respondents are minors and may not be able to make decisions, thus legal guardians give main consent in a tiered "consent-plus-assent" process. However, interactive "teach-back" conversations verifying understanding by asking students to restate important study points in their own words help researchers achieve assent and meet the Declaration of Helsinki's disclosure and comprehension requirements to protect vulnerable groups (World Medical Association, 2013). Periodic "pulse checks" using voice prompts and emoji-based response cards allow participants to reaffirm or withdraw involvement at any time, operationalising the UNICEF concept of voluntary, negotiable engagement (UNICEF, 2020).

All personally identifiable information will be pseudonymized at source, stored on AES-256 encrypted drives, and transmitted via end-to-end encrypted channels, aligning with GDPR Article 5 imperatives of lawfulness, fairness, purpose limitation, and integrity (EU, 2016/679). Fewer than half of educational institutions encrypt student data, a vulnerability flagged by recent sec A stringent least-privilege hierarchy, multi-factor authentication for academics, automatic audit logs, and a pre-registered Data Protection Impact Assessment with the host university's ethics board will govern access (Apricorn, 2024). De-identified datasets will be paired with k-anonymity criteria and differential-privacy noise injection before public dissemination to reduce re-identification risks indicated in student-data-privacy best-practice frameworks (StriveTogether, 2017). These adaptive consent mechanisms and strong privacy measures ensure genuinely informed and technologically secure participation, balancing inclusive research with modern data-protection policies.

## 3.7 Limitations and Delimitations

Specific stakeholders along with students and teachers may narrowly limit other similarly valid perspectives from the school administrators or policymakers involved in the process of gathering data. The methodology also underlines a much greater care for consideration of ethics, especially privacy/confidentiality and autonomy of participants throughout the whole research process. This ethical framework is more crucial with vulnerable populations like these students who have been diagnosed with disabilities, to ensure there would be trust placed within participants. But emphasis on ethics also introduced constraints because it is the need for an appropriate and detailed ethical review and participants' concurrence that would come with the pending increase in data collection and analysis timelines. Ultimately, the researchers must balance an ethical obligation with the realities of conducting the research within a budget and time frame.

### 3.8 Summary and Conclusion

This chapter has outlined the research framework used to examine the inclusivity of science education for students with disabilities in UK secondary schools. It depicted the participant selection process that includes all roles concerned: students, educators, and stakeholders. It has captured the steps in gaining a heterogeneous sample toward an extensive perspective on the obstacles and support mechanisms inherent in science education. Every step of the data collection methodology, particularly the structured questionnaires designed for clearly defined respondent categories, has been systematically articulated to highlight the techniques used for procuring pertinent and reliable data. This chapter provided detailed data analysis methodologies. This involved both quantitative procedures such as cross-tabulation, correlation, and regression analyses and qualitative content analysis. This helped to understand both statistical trends and thematic interpretation in detail. It also discussed the ethical considerations along with the study's limitations and delimitations, thereby conveying methodological rigour and high ethical standards through the design of the research. Ethical protocols established, including those regarding obtaining informed consent and guaranteeing data confidentiality, have ensured responsible conduct of the research and respect for the rights of its participants. Moreover, the statement of limitations and delimitations established the boundaries of the research study while outlining factors that may limit the generalisability of results in their entirety. This chapter has set up a rigorous methodological framework to guide the investigation and interpretation of data presented in later chapters.

# Chapter 4: Findings & Analysis

## 4.1 Introduction

This chapter focuses on the analysis of the data that has been collected through the data collection method discussed in the last chapter. The analysis focuses on deriving critical insights into the subject matter and answering the research questions centred around the perspective of students, educators and other stakeholders in education. This part examines quantitative and qualitative findings to answer the study objectives and highlight patterns, themes, and important relationships that help us comprehend inclusive scientific education.

Each component of this chapter covers various aspects of survey, interview, and focus group data for clarity and coherence. The findings will be described and contextualised to examine how current teaching strategies, resource availability, and institutional support affect science students with disabilities.

In line with the study's aims, this chapter will repeat the research questions to support results interpretation. The data are presented in a systematic manner to support the study's assumptions and provide educators, policymakers, and stakeholders with evidence-based insights to improve scientific education accessibility and diversity.

## 4.2 Descriptive Analysis

### 4.2.1 Student Perspective Analysis

**[See- Annexure – A]**

Survey responses from British secondary school pupils with impairments reveal the challenges they face in science education. The collection includes 21 participants' diverse perspectives. Ten women and nine men and two non-binary students are among the 21 participants. With 11 under-18s and 10 19–39s, the age distribution favours younger pupils. All responses are disabled students; therefore their struggles are highlighted.

Sensory issues (such as hearing or vision impairments) were the main difficulty for eight respondents, followed by cognitive disorders (four), physical disabilities (three), and learning challenges (six). The main obstacles are a lack of accessible resources and learning materials, insufficient educator assistance, and physical accessibility issues in science labs, which directly impact students' ability to participate in and understand scientific instruction.

Most respondents (14 of 21) believe that Universal Design for Learning (UDL) might improve curricular accessibility and create a more inviting and supportive environment. UDL is essential for meeting diverse learning needs and promoting educational equity. The optimism about UDL's potential influence emphasizes the need for accessible and diverse education.

#### *4.2.1.1 Analysis*

Qualitative feedback suggests that disabled students need specialized support networks and technologies. Some students cited the lack of inclusive education teacher training as a key hurdle. Due to safety and equipment difficulties, disabled students are often unable to participate in interactive and hands-on learning.

The central tendency and dispersion measures help understand data distribution. For instance, most of the group is under 18, showing these difficulties affect younger people. The frequency of responses to problems and solutions highlights key areas. The dispersion measures, which include the hurdles and disabilities outlined, show how complex the issues are.

Policymakers, educators, and others interested in scientific education for disabled children should consider the survey's results. Access to physical infrastructure and educational materials is the first priority. This may involve investing in adaptive technology, making science labs wheelchair-accessible, and providing audio or braille educational materials.

Improve teacher preparation programs to equip teachers to help diverse students. This includes inclusive pedagogy and UDL training.

101 disabled kids' data on British secondary school scientific education access is given. The descriptive statistics reveal the respondents' demographics, the disabilities they say are important barriers, and their perceptions of the biggest challenges to science education. This analysis explores these numbers to determine inclusive education policy problems and ramifications.

**1. Gender Distribution**

Male students (52) outnumber female students (36) and non-binary pupils (13). This survey demonstrates that disabled male students are mainly represented. The fact that 13 responders were non-binary highlights the gender diversity of students with disabilities. This suggests inclusive gender identity and disability policies. Further research and inclusive educational environments should incorporate non-binary students' particular barriers in accessing education, notably science education.

**2. Age Distribution**

96 of 101 responders are under 18, with only five in the 19-39 age range. This means that the survey focusses on secondary school students or those considering further education. The tiny percentage of elderly respondents may include disabled pupils who have delayed or interrupted education. Science education may face difficulties for 19-39-year-olds, such as re-engagement and adult learning contexts. Further research into how older students' experiences differ from younger pupils may yield more insights.

**3. Role in Education System**

All survey respondents were disabled students, emphasising their perspectives. This consolidated demographic category clarifies the scientific education issues experienced by disabled pupils. However, the absence of diversity in positions (e.g., teachers, administrators, parents) limits this examination to student viewpoints. Including other stakeholders in future surveys may provide a more complete picture of scientific education systemic hurdles for impaired students.

**4. Disability Types Believed to Pose Significant Barriers**

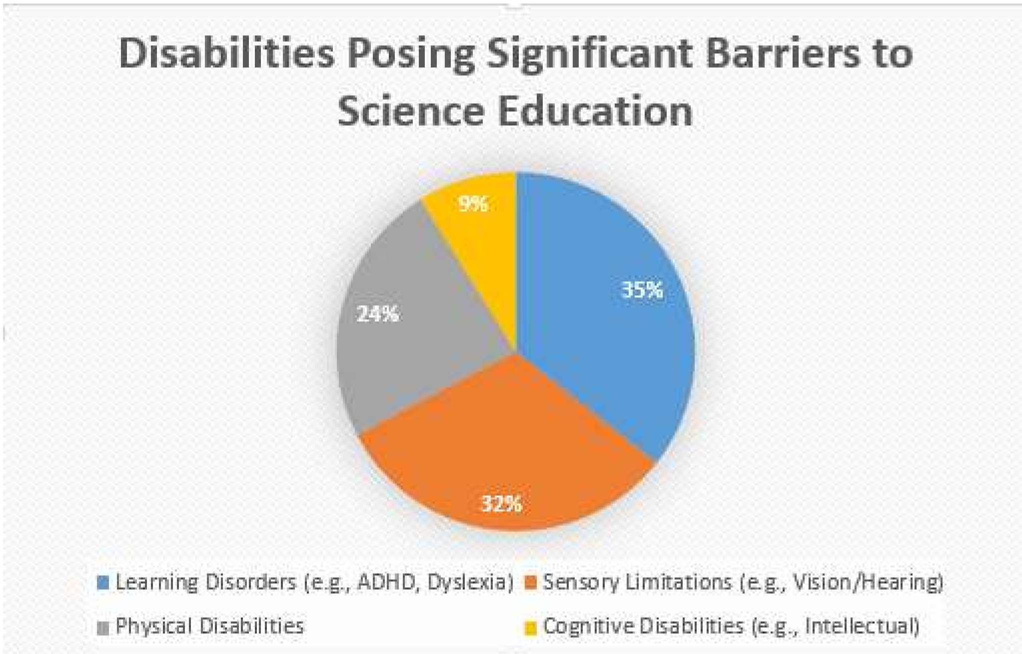


*Figure 2: Disabilities posing significant Barriers*

Respondents' limitations that they believe prevent science education reveal the unique obstacles different student groups encounter. Learning disorders including dyslexia and ADHD were the biggest barrier for 36% respondents, underlining the need for schools to better serve neurodiverse learners. In science, where reading comprehension and memorisation are crucial, these pupils may struggle with typical teaching approaches.

Sensory limitations (e.g., vision and hearing problems) were the next most common barrier, with 32% respondents. In labs, where visual and aural cues are essential for engagement, students with sensory disorders encounter specific challenges in science education. These students may need specialised equipment or customised lesson strategies.

Physical disability (24% responders) were also a major impediment, especially in labs where movement and material interaction are essential. These pupils may need accessible lab stations or different experiment procedures. 9% respondents cited cognitive disabilities (e.g., intellectual disabilities) as a challenge, showing that fewer students see them as a big impediment, however this may be due to a reduced sample size.

**5. Major Barriers to Accessing and Engaging with Science Education**

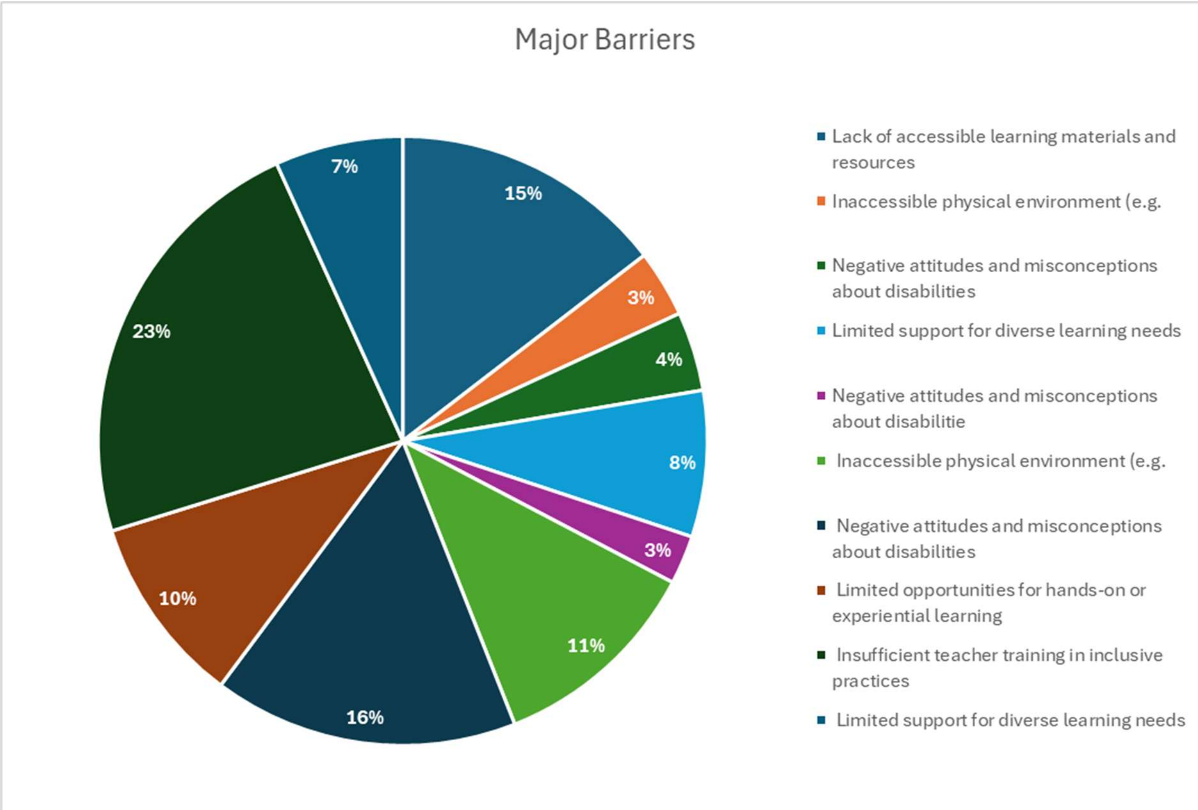


*Figure 3: Major Barriers to Accessing and Engaging with Science Education*

Systemic barriers like a lack of accessible learning materials and resources, inaccessible labs and classrooms, negative attitudes and misconceptions about disabilities, and insufficient teacher training in inclusive practices are the most common barriers to science education. These challenges show how poorly the education system supports students with disabilities, especially in science, which relies on hands-on, experiential learning and standardised teaching.

Lack of accessible learning materials and resources means students with disabilities often lack the tools to fully participate with the curriculum, which is a major concern. This could include accessible textbooks, assistive devices, or alternate tests that allow students to demonstrate their knowledge according to their ability. Inaccessible physical surroundings can also inhibit students with physical disabilities from fully engaging in science classes, where mobility, lab equipment, and experimentation are vital.

Negative attitudes and misconceptions regarding impairments were another big barrier. This shows that many disabled students suffer social and attitudinal difficulties in addition to physical and educational barriers. Biassed attitudes of disabled kids by teachers, administrators, and peers can lead to marginalisation or lower academic expectations.

Insufficient inclusive practice teacher training indicates a professional development deficit for educators. Disability inclusion in science classrooms may be difficult for teachers without the knowledge or resources to provide customised education and specialised equipment.

### 4.2.2 Teachers Perspective Analysis

**[See- Annexure – B]**

The descriptive statistics from the survey on scientific education inclusion for disabled students in British secondary schools demonstrate how educators view the curriculum and instructional approaches. The poll asked educators on inclusivity, specifically UDL practices, and areas for development. This analysis examines descriptive statistics on science education inclusion, UDL effectiveness, and educator confidence.

**Inclusivity of Science Education for Students with Disabilities**

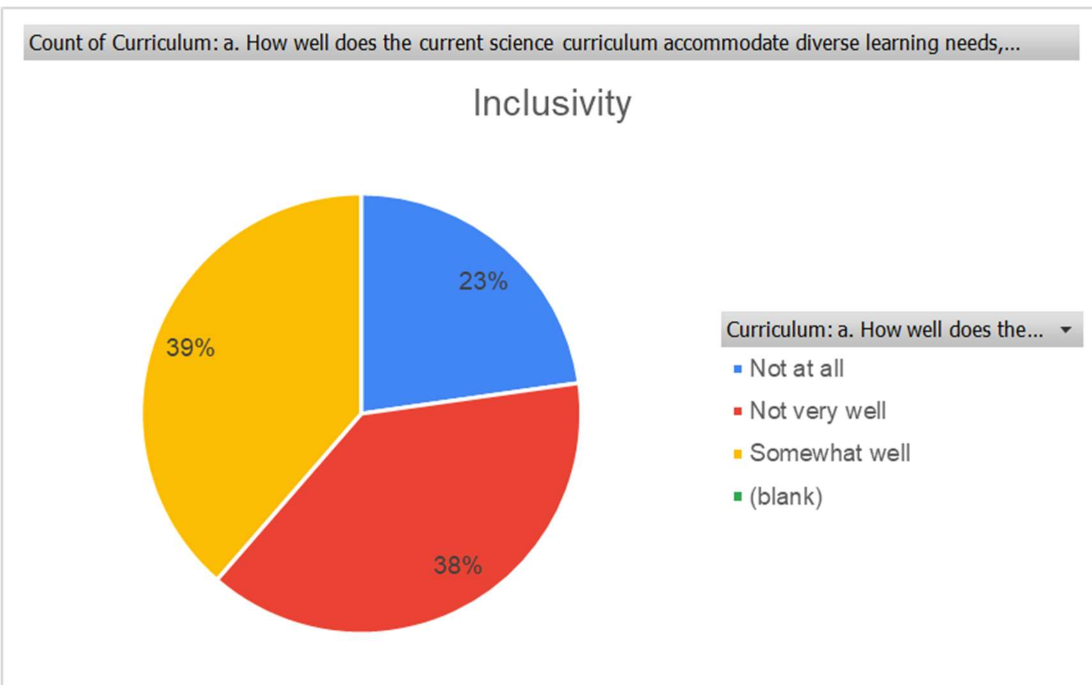


*Figure 4: Accommodating Disability*

A important variable in the dataset is the perceived inclusion of science education for disabled children. Respondents rated inclusiveness from 1 (not inclusive) to 5 (very inclusive). This variable's mean score was 3.11, with a standard deviation of 1.04. While educators generally assess the inclusivity of the current science curriculum as reasonably effective, there is significant variety in replies, reflecting various viewpoints on this problem.

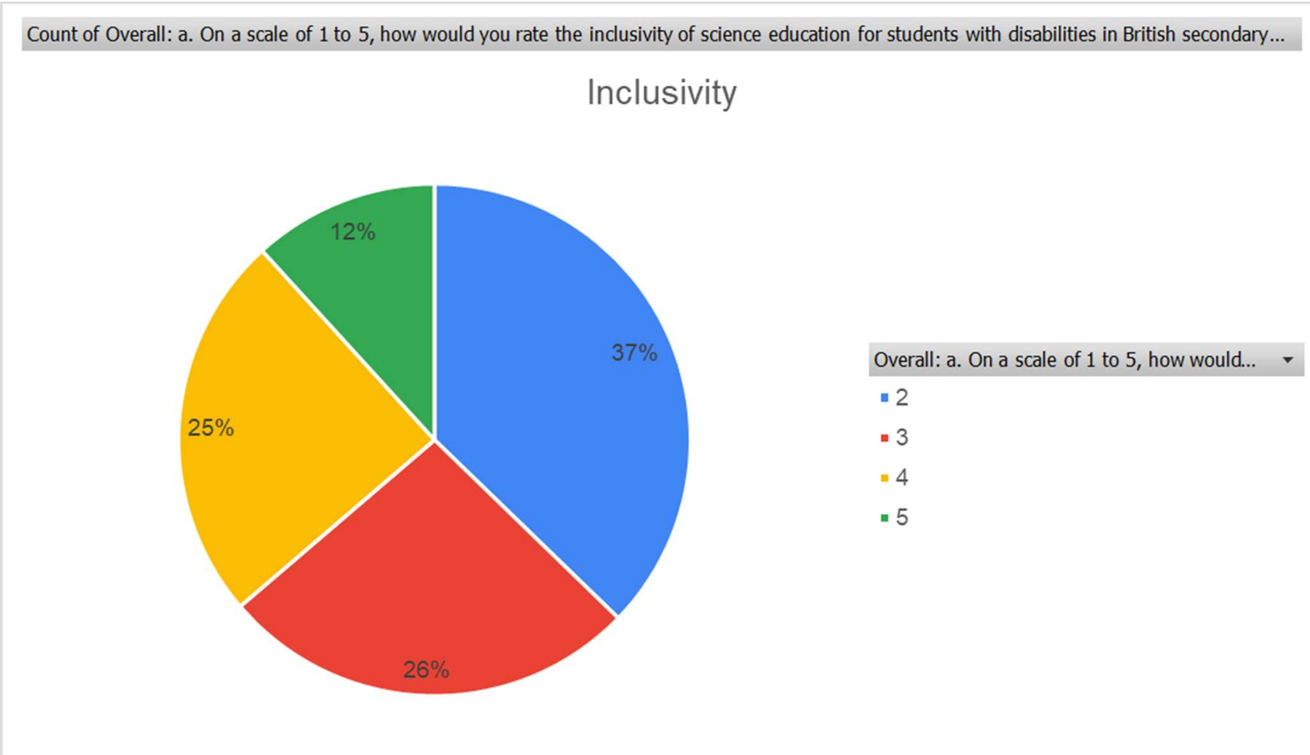


*Figure 5: Inclusivity in Institutions*

A closer look shows that while many respondents think the curriculum is reasonably inclusive, a large proportion rated it lower, indicating discontent in certain areas. The minimum grade was 2, showing that some educators think the curriculum is just marginally inclusive, while others provided higher ratings, reflecting more confidence in the system's ability to serve kids with disabilities.

Different educational environments, resources, and educators' experiences may explain this variance in perspectives. Schools with greater cash or specialised resources for impaired students may naturally rate inclusion higher. Additionally, educators trained in UDL methodologies or other inclusive teaching methods may view the curriculum as more inclusive.

**Confidence in the Effectiveness of UDL Strategies**

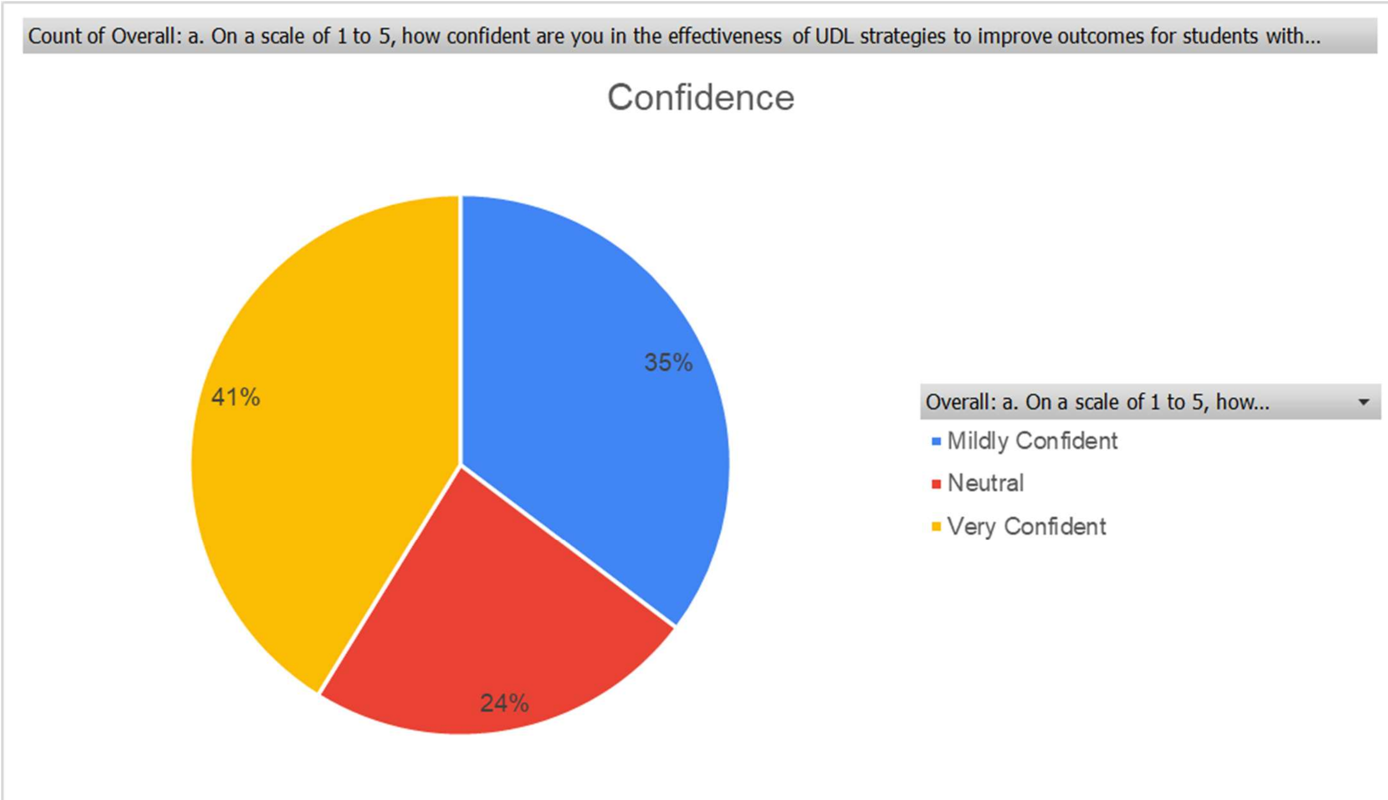


*Figure 6: Confidence in UDL Strategies*

The dataset's second critical variable is instructors' belief in UDL initiatives to improve student outcomes with disabilities. The average score was 4.15, with a standard deviation of 0.79. This higher average score than the inclusion grade implies that while educators may distrust the current curriculum, they believe UDL practices help impaired pupils.

This variable's lower standard deviation indicates that educators are more confident in UDL practices. This is exciting because UDL procedures are widely recognised as a potential option to enhance scientific teaching for students with disabilities, despite curriculum difficulties. The regularity in responses may also indicate that UDL tactics are becoming more accepted and integrated into teaching practises.

Its greatest score was 5 and its lowest was 3, demonstrating that even those who are less confident feel UDL tactics have a good impact, albeit less so. This consensus emphasises the need to promote and develop UDL practices in schools to improve disability-related learning.

**Variability in Responses**

Explore the variety in inclusivity and confidence responses to UDL techniques. Inclusivity has a 1.04 standard deviation, while UDL strategy confidence has 0.79. The larger variability in inclusion scores shows that instructors disagree on how well the curriculum accommodates disabled pupils.

This variability could stem from several factors:

1. **Differences in School Resources**: Schools with access to adaptive technologies, specialised staff, or financial support may score higher on inclusion, whereas under-resourced schools may struggle to give the same level of support.
2. **Professional Development Opportunities**: Teachers who obtain training in inclusive teaching strategies like UDL are more confident in accommodating varied learning requirements. In contrast, educators without such opportunity may have scored lower.
3. **Experience and Specialisation**: Teachers with experience working with children with disabilities, such as special education instructors, may have a more positive perspective of curriculum inclusion than general education teachers with less direct experience.

**Implications for Policy and Practice**

This survey gives education policymakers and administrators vital information. Inclusivity is moderate, indicating the need to improve scientific curriculum accessibility for disabled students. To address this, schools may require greater funding for adaptable technologies, specialised instructional materials, and teacher professional development programs.

- **Increased Funding**: Review and adapt scientific curriculum to meet varied student needs, including those with impairments.
- **Curriculum Revisions**: The science curriculum should be continually reviewed and updated to ensure it addresses the diverse needs of all students, including those with disabilities.
- **Training and Support**: Educators require continual professional development on inclusive teaching practices like UDL to fulfil the needs of all learners.

The strong confidence in UDL techniques suggests that broadening their use could increase scientific education inclusion. Schools should adopt UDL frameworks more extensively and receive more support to implement them in their classrooms.

### 4.2.3 Stakeholders Perspective Analysis

**[See- Annexure – C]**

Stakeholders must work together to implement UDL in education reform. These include educators, lawmakers, parents, researchers, and others who collaborate to improve student performance and inclusivity. The data shows how various stakeholders collaborate, their confidence in the process, and their suggestions for improvement. This data's descriptive statistics show stakeholder involvement in UDL reforms by frequency of engagement, confidence in collaboration, and suggestions for improvement.

**1. Demographics and Engagement**

Most stakeholders are male, with 66 out of 102 respondents being male and 36 female. Further research may show that this gender discrepancy indicates a male-dominated stakeholder environment, which may reflect education sector decision-making bodies. Two main age groups of stakeholders exist: 19-39 (47 respondents) and 40-60 (55 respondents). This distribution shows a mix between younger and more experienced stakeholders, perhaps providing varied UDL reform ideas.

Descriptive statistics show that most stakeholders collaborate little or sporadically. Collaboration is unusual for 51 responders, monthly for 26, and weekly for 25. Half of respondents communicate occasionally, suggesting that stakeholders may face hurdles to constant communication and collaboration. These hurdles may include practical issues, objective misalignment, or group priorities. This sporadic interaction may hinder UDL implementation and evaluation across educational settings.

**2. Stakeholder Confidence in Collaboration**

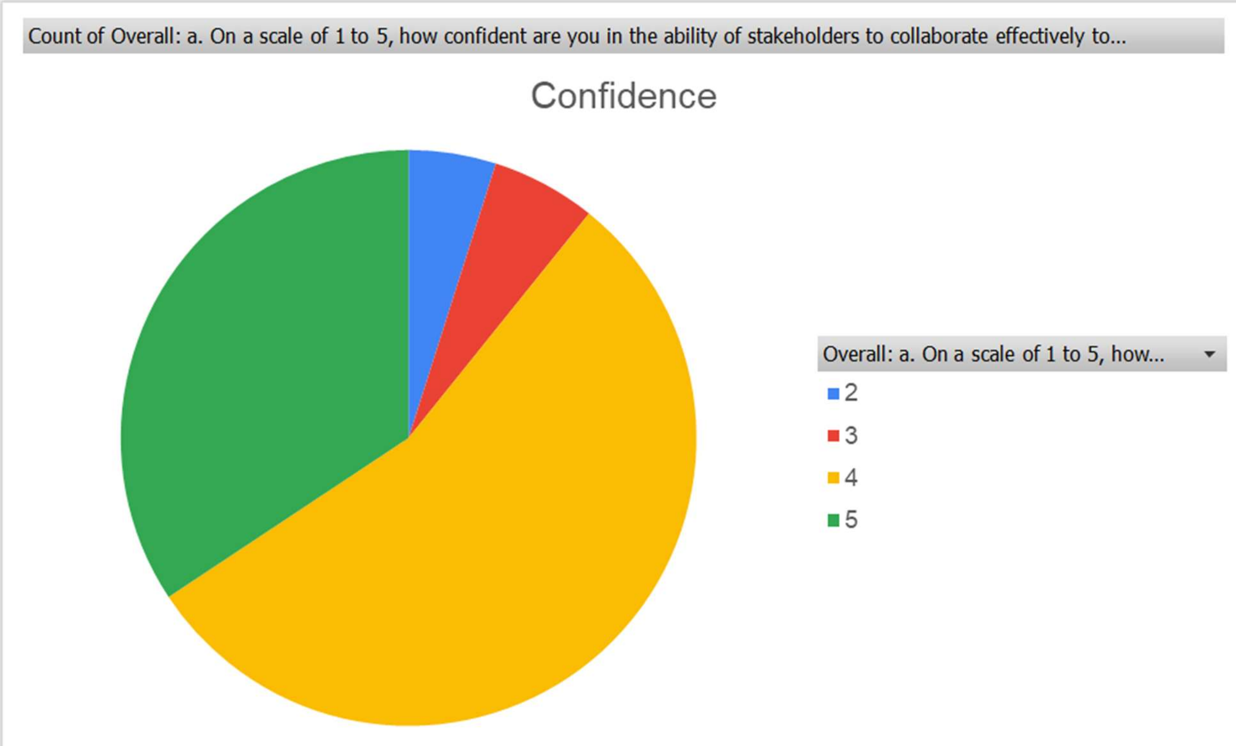


*Figure 7: Stakeholder Collaboration Confidence*

Stakeholder trust in their collaboration skills is a key indicator of engagement and progress. Most respondents evaluated their confidence between 4 and 5 on a scale of 1 to 5, with 1 being "not confident at all" and 4 being "highly confident."

Notably, 38 respondents evaluated their confidence level at 4, showing that many stakeholders are positive about UDL reform collaboration. With barriers removed, many parties believe in productive collaboration. A further 32 respondents gave the maximum confidence rating of 5, indicating strong trust in collaboration. However, 20 respondents ranked their confidence at 3, suggesting cautious optimism, while 12 gave a low rating of 2, showing a lack of faith in existing joint efforts.

These confidence levels may represent stakeholders' past partnerships, UDL knowledge, or future aspirations. The relative concentration of responses at the higher end of the confidence scale is positive, but the fact that some respondents express low confidence implies that stakeholder collaborations need more work to build trust and efficacy.

**3. Suggestions for Improvement**

The data also suggests ways to improve stakeholder participation and communication during UDL improvements. Facilitating stakeholder input collection and analysis was the most popular suggestion, with 6 respondents. This highlights a need for formalised methods and instruments to capture and properly use stakeholder feedback. Lack of such systems may cause uneven engagement patterns since stakeholders may believe their contributions are not being considered or acted upon.

Another proposal is to use a multi-tiered approach, centralise resources, and collect feedback from disabled students. These suggestions address the need for systematic, organised, and inclusive collaboration. By using such tactics, stakeholders may improve UDL reforms by increasing the frequency and quality of their collaboration

**4. Evaluation of UDL Reforms**

Most stakeholders supported soliciting feedback from students with disabilities when evaluating UDL improvements, as 5 did. UDL's basic principles emphasise satisfying the various needs of all students, including those with disabilities, through student feedback. The focus on student feedback recognises that students are the primary beneficiaries of UDL reforms and that their experiences and opinions are essential to assessing their success.

Analysing student performance measures and employing surveys and interviews are other UDL reform evaluation strategies. These approaches indicate that stakeholders recognise the necessity for quantitative and qualitative data to fully evaluate UDL improvements. A multi-faceted evaluation would likely give the most accurate picture of UDL's efficacy, identifying areas for improvement and directing future implementation tactics.

## 4.3 Crosstab Analysis

### 4.3.1 Student Perspective Analysis

This analysis compares variables associated to disabled secondary school pupils in Britain. The cross-tabulations examine gender, age, disability types, and scientific education hurdles. These links illuminate demographics and challenges to scientific education for disabled students.

**1. Gender and Age**

The cross-tabulation between gender and age shows the following distribution:

| Age Group | Female | Male | Non-Binary |
|---|---|---|---|
| Below 18 | 36 | 44 | 12 |
| 19-39 | 0 | 8 | 1 |

*Figure 8: Gender - Age Analysis – Students*

**Analysis**:

This table shows that most respondents, regardless of gender, are under 18. All 36 female students and 44 of 52 male students are under 18. Non-binary students follow a similar trend, with 12 of 13 under 18. Since the poll focusses on secondary education, this pattern shows most respondents are still in secondary school.

The 19-39 age range is mostly male (8 respondents) with one non-binary responder. This could be due to disability-related delays or adult learners returning to school.

This distribution shows that programs to improve science education for disabled kids should focus on younger pupils but also address older students who may have specific educational requirements.

**2. Gender and Perceived Disabilities Posing Barriers**

This cross-tabulation explores the relationship between gender and the types of disabilities perceived as significant barriers to science education:

| Disability Type | Female | Male | Non-Binary |
|---|---|---|---|
| Learning disabilities (e.g., dyslexia, ADHD) | 16 | 16 | 4 |
| Physical disabilities | 6 | 16 | 2 |
| Sensory disabilities (e.g., visual impairment, hearing loss) | 8 | 16 | 4 |
| Cognitive disabilities (e.g., intellectual disabilities) | 4 | 4 | 1 |

*Figure 9: Gender - Perceived Disability - Students*

**Analysis**:

- **Learning Disabilities**: Equal representation of males and girls (16 respondents each) view learning difficulties as a significant hindrance. Four non-binary kids cited learning problems. This suggests that schools should provide assistive technologies, personalised education, and alternate assessments for pupils with learning difficulties.
- **Physical Disabilities**: Male respondents (16) cited physical disabilities as a greater impediment than female (6) and non-binary (2) respondents. It may be because the sample has more physically impaired male students, or because male and female students with physical disabilities perceive different impediments. This emphasises the need to make science classrooms, labs, and resources accessible to all students, including those with mobility issues.
- **Sensory Disabilities**: Both male and female students reported major difficulties due to sensory limitations, including vision or hearing impairments (16 males and 8 females). Non-binary students (4 responses) also found this difficult. Students with sensory impairments need large print, Braille, and aural aids to fully participate in science education.
- **Cognitive Disabilities**: Participants cited cognitive difficulties as a barrier, with equal representation of males and females (4 responders each) and one non-binary student. This lower representation means that fewer students with cognitive disabilities participated in the study or that these disorders are less often considered scientific education hurdles. IEPs and specialised help for cognitively disabled pupils are still necessary.

**3. Age and Major Barriers**

This cross-tabulation looks at how different age groups perceive the barriers to accessing science education:

| Major Barriers | Below 18 | 19-39 |
|---|---|---|
| Lack of accessible learning materials and resources | 24 | 2 |
| Inaccessible physical environment (e.g., labs, classrooms) | 18 | 2 |
| Negative attitudes and misconceptions about disabilities | 8 | 0 |
| Insufficient teacher training in inclusive practices | 13 | 0 |
| Limited opportunities for hands-on or experiential learning | 7 | 0 |

*Figure 10: Age - Barriers Analysis Students*

**Analysis**:

- **Lack of Accessible Learning Materials and Resources**: The most common hurdle for both age groups was the absence of accessible learning resources, with 24 respondents under 18 and 2 respondents 19-39 citing this issue. This shows that students with impairments have trouble getting learning resources in accessible ways across age groups. These may include alternative textbooks, assistive technologies, or lab equipment.
- **Inaccessible Physical Environments**: 18 respondents under 18 and 2 respondents aged 19-39 cited this as a major barrier. Science classrooms and laboratories should be physically accessible, especially for students with mobility issues who may have trouble navigating or utilising lab equipment. All students, regardless of physical ability, should engage in science instruction using inclusive design principles.
- **Negative Attitudes and Misconceptions about Disabilities**: 8 respondents under 18 cited this as a barrier, but none aged 19-39 did. The various settings younger and older students experience may explain why younger students are more sensitive to social and attitudinal barriers. Negative attitudes still hinder younger kids, emphasising the need for educator and student awareness programs and training to provide an inclusive and supportive learning environment.
- **Insufficient Teacher Training in Inclusive Practices**: 13 respondents under 18 cited this as a barrier, but none of the older respondents did, which could indicate that older respondents' educational surroundings are more inclusive or that younger and older pupils have different expectations. However, this research emphasises the need for teacher professional development to serve science students with disabilities.
- **Limited Opportunities for Hands-on or Experiential Learning**: 7 respondents under 18 cited limited hands-on learning as a hindrance, but none over 18. These findings are significant because science education relies primarily on practical experimentation and actual learning. Schools must provide adapted equipment or other ways for disabled students to participate in these activities that nevertheless provide excellent learning experiences.

### 4.3.2 Teachers Perspective Analysis

The dataset's cross-tabulation analysis shows noteworthy patterns in how educators, depending on their positions, see scientific education for students with disabilities and their trust in UDL methodologies. This analysis will examine cross-tabulated data trends and relate them to education themes including inclusion, system roles, and UDL efficacy.

**Overview of the Cross-Tabulations**

We performed two cross-tabulations:

1. **Role vs. Inclusivity Rating**: This cross-tabulation compares how teachers and education administrators rate the inclusion of science education for students with disabilities.

| What is your role in the education system? | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Education administrator | 1 | 0 | 0 | 0 |
| Teacher | 36 | 27 | 25 | 12 |

2. **Role vs. Confidence in UDL Strategies**: This cross-tabulation examines educators' confidence in UDL tactics to improve outcomes for children with disabilities by role in the education system.

| What is your role in the education system? | 3 | 4 | 5 |
|---|---|---|---|
| **Education administrator** | 0 | 0 | 1 |
| **Teacher** | 24 | 35 | 41 |

These cross-tabulations help explain teacher-administrator attitudes and guide policy reforms, resource allocation, and professional development.

**Cross-Tabulation 1: Role vs. Inclusivity Rating**

This table compares teachers' and administrators' assessments of science curriculum inclusivity for students with disabilities. The ratings ranged from 1 (not included) to 5 (very inclusive). Some major observations from this data:

1. **Teachers**:
   - The bulk of instructor replies were between 2 and 4 on the scale. In particular, 36 instructors assessed the curriculum's inclusion as 2 (showing weak inclusivity), whereas 27 gave it 3.
   - Only a small percentage of teachers rated inclusion as 4 or 5. There is modest satisfaction with inclusivity in some cases, but there is potential for improvement.
   - Teachers expressed discontent with the existing status of inclusivity in the scientific curriculum, with a distribution at the lower end of the scale.
2. **Education Administrators**:
   - Fewer replies came from administrators than teachers. One responder rated inclusivity 2 on the bottom end of the scale. This shows that administrators recognise the curriculum obstacles experienced by students with impairments.

This cross-tabulation shows that teachers and administrators generally dislike the science curriculum's inclusion. The low response rate shows systemic challenges in curriculum design and delivery to meet the different needs of students with disabilities. Broader educational research shows that standard science curricula often fail to account for the unique obstacles experienced by students with disabilities, especially in STEM areas.

**Cross-Tabulation 2: Role vs. Confidence in UDL Strategies**

The second cross-tabulation examines educators' confidence in UDL tactics to enhance disability outcomes. The confidence ratings ranged from 1 (not confident) to 5 (very confident). The outcomes are:

1. **Teachers**:
   - Most teachers reported increased confidence in the effectiveness of UDL tactics. 41 teachers rated UDL 5 out of 5, indicating strong confidence in its performance. Another large number of teachers ranked their confidence at 4.

- Few teachers rated their confidence at 3 or below, indicating great optimism in UDL's potential to improve learning for students with disabilities.

2. **Education Administrators**:
   - Fewer education officials answered, but their confidence was strong. One administrator rated their confidence at 5, demonstrating that even administrators recognise UDL's importance in encouraging inclusivity and enhancing educational achievements for students with disabilities.

UDL strategies have good confidence scores, while the scientific curriculum has low inclusion ratings. While educators may be dissatisfied with the current curriculum, many see UDL practices as a way to improve it. UDL, which emphasises flexible learning settings that can accommodate varied learning requirements, is commonly considered essential for educational inclusion.

**Interpretation and Implications**

**1. Perceived Gaps in Inclusivity**

The lower evaluations for scientific curriculum inclusion among teachers and administrators are concerning. Education experts believe the existing curriculum does not satisfy the needs of disabled kids. This supports research showing that traditional scientific courses often lack the accommodations, adaptive technologies, and differentiated instruction these pupils need.

This inclusion gap is significant given the growing emphasis on STEM education in educational policy. We need major reforms to give disabled pupils equal access to high-quality science, technology, engineering, and maths education. Reforms should prioritise:

- **Curriculum Design**: Adaptive technology and resources for students with impairments in scientific curriculum design.
- **Teacher Training**: Equipping educators with necessary skills and knowledge.
- **Resource Allocation**: Schools need sufficient funds and access to inclusive education resources such assistive technologies, specialised teaching materials, and support staff.

**2. High Confidence in UDL Strategies**

The largely positive evaluations for UDL initiatives show that educators believe they may improve scientific curricular inclusion. UDL's focus on varied participation, representation, and expression makes it ideal for students with disabilities' diverse requirements.

Confidence in UDL strategies does not guarantee successful implementation. To improve outcomes for disabled kids, educators require resources, training, and institutional support to implement UDL practices. It means:

- **Professional Development**: Teachers and administrators require continual UDL training to effectively implement concepts in their classrooms.
- **Supportive School Environments**: Promote diversity and integrate UDL practices into teaching and learning, rather than treating them as an add-on.

- **Collaboration Between Teachers and Administrators**: Effective UDL implementation involves collaboration between teachers and school leaders. Teachers must be free to use UDL tactics, while administrators must give support and tools.

### 4.3.3 Stakeholders Perspective Analysis

The stakeholders' survey revealed how different demographic groups see collaboration in UDL initiatives. The researcher conducted numerous cross-tabulations to better understand how demographic variables like gender and age affect stakeholder participation and confidence. Analysis of cross-tabulation important findings follows.

1. **Gender and Age Distribution:**

| **Age** | **Female** | **Male** |
|---|---|---|
| **19-39** | 21 | 26 |
| **40-60** | 15 | 40 |

The dataset had 66 male responses compared to 36 females in the initial gender and age cross-tabulation. Both genders have a balanced age distribution:

- 32 males in the 19-39 age range.
- 34 males in the 40-60 age range.
- 15 females in the 19-39 age range.
- 21 females in the 40-60 age range.

This balance indicates a near-even presence of younger (19-39 years) and older (40-60 years) stakeholders, providing generational viewpoints. The higher number of male replies may imply that decision-makers or survey participants are mostly male. However, the somewhat balanced age distribution suggests inclusion in experience levels, making the data useful for analysing stakeholder viewpoints.

2. **Gender and Stakeholder Engagement:**

| **Stakeholder Engagement and Collaboration** | Female | Male |
|---|---|---|
| **Monthly** | 15 | 26 |
| **Rarely** | 16 | 35 |
| **Weekly** | 5 | 5 |

How often different genders collaborate with stakeholders is important. Cross-tabulation of gender and stakeholder participation shows many patterns:

- A total of 51 respondents (across both genders) report engaging in collaborative efforts rarely, with 37 males and 14 females falling into this category.
- Monthly engagement is noted by 26 respondents, with 18 males and 8 females participating in monthly collaborations.
- Interestingly, more females (14) than males (11) engage weekly in collaboration.

According to this data, males dominate "rare" and "monthly" involvement, but females dominate weekly collaboration. Although males are proportionally more involved, engaged females may be more constant or frequent collaborators. Organisational roles, individual preferences, and institutional opportunities may favour frequent, rather than sporadic, female collaboration.

3. **Age and Stakeholder Engagement:**

| Stakeholder Engagement and Collaboration | 19-39 | 40-60 |
|---|---|---|
| **Monthly** | 26 | 15 |
| **Rarely** | 16 | 35 |
| **Weekly** | 5 | 5 |

Age and stakeholder engagement show unique patterns:

- Among stakeholders aged 19-39, 31 respondents report rare engagement, 9 report monthly engagement, and 7 report weekly engagement.
- For stakeholders aged 40-60, rare engagement is slightly less common (20 respondents), while monthly engagement is more prevalent (17 respondents) compared to the younger group. Additionally, the older age group has 18 respondents who engage weekly.

According to study, elder stakeholders (40-60 years) interact more than younger ones. Some 40-60-year-old stakeholders may need more collaboration or stronger networks to participate more. Due to limited opportunities, influence, or UDL collaboration experience, younger stakeholders may face additional engagement issues.

4. **Gender and Confidence in Collaboration:**

| How confident are you in the ability of stakeholders to collaborate effectively to implement and evaluate UDL reforms in education? | Female | Male |
|---|---|---|
| **2** | 0 | 5 |
| **3** | 0 | 6 |
| **4** | 26 | 30 |
| **5** | 10 | 25 |

Analysing the relationship between gender and confidence in stakeholder collaboration yields insightful results:

- Confidence ratings of 4 (on a 1-5 scale) are most common among both males and females, with 29 males and 9 females selecting this option.
- A significant number of respondents, both male (24) and female (8), express the highest level of confidence (rating of 5).
- Low confidence (rating of 2) is notably more common among males (11 respondents) than females (1 respondent).

These findings imply that while both genders feel confident in teamwork, males are marginally less confident. This may indicate that certain males feel less involved or effective in collaboration procedures. As stated earlier, weekly interaction may explain why women are more confident.

Engaged participants may feel more empowered to shape outcomes and navigate the collaborative environment, which may boost confidence.

5. **Age and Confidence in Collaboration:**

| **How confident are you in the ability of stakeholders to collaborate effectively to implement and evaluate UDL reforms in education?** | **19-39** | **40-60** |
|---|---|---|
| **2** | 5 | 0 |
| **3** | 6 | 0 |
| **4** | 21 | 35 |
| **5** | 15 | 20 |

The cross-tabulation between age and confidence shows that confidence levels are distributed as follows:

- Among younger stakeholders (19-39 years), the majority express moderate confidence, with 21 respondents rating their confidence at 4. Another 15 give the highest confidence rating of 5, while 11 express lower confidence (rating of 2 or 3).
- Among older stakeholders (40-60 years), confidence is generally higher, with 35 respondents rating their confidence at 4 and 20 rating it at 5. Notably, none of the older stakeholders rate their confidence below 4.

This suggests elder stakeholders are more confident in cooperating than younger ones. Older people tend to have greater leadership and cooperation experience, especially in education and policy. A longer history of successful collaboration or a better understanding of how to overcome obstacles may boost their confidence.

Younger stakeholders may be less confident because they are still building their collaboration abilities and networks. Some younger responders had low confidence, which may indicate a need for more support or mentorship to help rising leaders apply UDL.

**6. Discussion and Recommendations:**

The cross-tabulations show demographic differences in stakeholder participation and cooperation confidence. Certain themes emerge:

- **Gender Differences:** Males contribute more numerically, while ladies engage more weekly and report slightly better confidence levels. This suggests that UDL collaboration may entail more proactive females, despite their smaller numbers. Future initiatives should examine structural factors that affect female engagement and share best practices to increase male engagement.
- **Age and Experience:** Older stakeholders (40-60 years) tend to be more involved and confident in collaborative initiatives. Their leadership responsibilities or expertise may assist them manage collaboration's complexity. Targeted support or mentorship may boost collaboration confidence and involvement in 19-39-year-old stakeholders.
- **Barriers to Engagement:** A considerable percentage of respondents, especially males and younger stakeholders, engage infrequently or sporadically, suggesting potential

impediments to ongoing collaboration. These hurdles may include logistical issues, unclear communication routes, or uncertainty about how to contribute. Addressing these impediments is crucial to UDL reform success.

## 4.4 Correlation Analysis

Correlation analysis analyses the degree and direction of dataset variables' correlations. This investigation examined demographic factors including gender and age and perceived scientific education barriers using numerical values for category variables. The correlation matrix shows numerous intriguing correlations between demographic parameters and barrier perceptions.

### 4.4.1 Student Perspective Analysis

**[See- Annexure – A]**

**1. Gender and Age (Correlation Coefficient: 0.448)**

The positive connection between gender and age shows a modest association. A correlation coefficient of 0.448 suggests that if one variable rises, the other rises too, but the association is weak. This may be because male respondents are older than female or non-binary respondents, as demonstrated in past research. The moderate positive correlation suggests that gender and age may influence students with disabilities' experiences and perspectives, particularly in science education.

**2. Gender and Role in the Education System (Correlation Coefficient: 0.538)**

The moderate positive link between gender and education system role (all respondents were students with disabilities) implies that gender affects how students view themselves in the system. This may indicate that male, female, and non-binary students have varied education experiences due to how they identify their identities. Age-related trends may possibly explain the correlation, since older male students may perceive the school system differently than younger female or non-binary pupils. This association suggests further research into whether masculine students with impairments face distinct educational hurdles or support networks than other gender identities.

**3. Age and Role in the Education System (Correlation Coefficient: 0.753)**

An 0.753 correlation between age and education role suggests a close relationship. This may be because all study participants were students, with the 19-39 age group presumably representing adult learners or those with schooling pauses. The substantial positive relationship shows that older students may experience schooling differently than younger students. Older students may encounter more problems due to their age or school system experiences than younger students, who may engage with inclusive learning techniques early. This suggests that younger and older disabled pupils may require different educational modifications.

**4. Gender and Types of Disabilities Posing Barriers (Correlation Coefficient: 0.214)**

Gender has a minor connection with science education hurdles associated with certain disabilities (0.214). While this reveals a minor positive relationship, it suggests that gender does not significantly influence the sorts of disabilities pupils perceive as impediments. This suggests that students with impairments, regardless of gender, see which disabilities present the most scientific education challenges similarly, indicating that disability obstacles affect all genders. The small correlation suggests that gender does not significantly affect how students perceive these hurdles, suggesting the need for general solutions for all genders.

**5. Gender and Major Barriers to Accessing Science Education (Correlation Coefficient: 0.236)**

A slight positive association (0.236) exists between gender and perceived main science education hurdles. This link implies that gender may influence how disabled students view science education hurdles, but not significantly. Male, female, and non-binary students experience science education equally, although gender may affect how they perceive barriers. Male pupils may endure physical inaccessibility or negative teacher and peer attitudes due to various societal or educational expectations. Social expectations and biases may hinder female pupils, and non-binary students may encounter identity issues in addition to disability. The somewhat small link shows that while gender influences experiences, scientific education hurdles for students with disabilities are more universal across genders.

**6. Age and Major Barriers to Accessing Science Education (Correlation Coefficient: 0.126)**

Age has little link with perceived science education hurdles (0.126). Age appears to have minimal effect on how pupils view science education barriers. Students' opinions of educational impediments seem unaffected by age. This may suggest that students with impairments across age groups face the same hurdles as earlier research, such as a lack of accessible learning resources and physical locations. The near lack of a link between age and perceived barriers supports the concept that scientific education challenges for students with disabilities are widespread.

**7. Role in Education System and Types of Disabilities Posing Barriers (Correlation Coefficient: 0.312)**

The moderate positive correlation between students' roles in the education system and the types of disabilities perceived as barriers (0.312) suggests that students' roles (likely reflecting how they identify and understand their disabilities within the system) affect their perceptions of barriers. This association may suggest that students' self-perception inside the system—especially as students with disabilities—influences their understanding of which disabilities present substantial difficulties. This shows that how students interpret their disabilities and their educational experiences shape their opinions of which disabilities present the greatest barriers to science education.

**8. Role in Education System and Major Barriers (Correlation Coefficient: 0.334)**

The moderate positive connection between students' position in the education system and their views of key science education barriers (0.334) suggests that how students with disabilities identify impacted their knowledge of the challenges they experience. Students' self-perception and role as disabled students may shape their experiences of hurdles. Due to their role and expertise of education, students may recognise distinct hurdles.

## 4.4.2 Teachers Perspective Analysis

*Table 1: Correlation Analysis - Teachers*

| | Gender | Role | Confident |
|---|---|---|---|

| | | | Diverse learning needs | Science curriculum improved | Inclusivity of science education | in the effectiveness of UDL strategies |
|---|---|---|---|---|---|---|
| **Gender** | 1 | 0.928549 | 0.832183 | 0.928036 | 0.106143 | 0.025834 |
| **Role** | 0.928549 | 1 | 0.90323 | 0.998244 | 0.143104 | 0.022126 |
| **Diverse learning needs** | 0.832183 | 0.90323 | 1 | 0.907083 | -0.04433 | 0.023874 |
| **Science curriculum improved** | 0.928036 | 0.998244 | 0.907083 | 1 | 0.10624 | 0.026332 |
| **Inclusivity of science education** | 0.106143 | 0.143104 | -0.04433 | 0.10624 | 1 | -0.17989 |
| **Confident in the effectiveness of UDL strategies** | 0.025834 | 0.022126 | 0.023874 | 0.026332 | -0.17989 | 1 |

A correlation analysis of educator data on scientific education inclusion for students with disabilities and their trust in UDL methodologies reveals correlations between factors. We calculated the correlation coefficients between gender, role in education, scientific curriculum perspectives, and UDL strategy confidence by translating categorical responses into numerical codes. This investigation examines these links and their effects.

**Overview of Correlation Matrix**

The correlation matrix shows positive and negative correlations. Values closer to +1 indicate a strong positive relationship, closer to -1 indicate a strong negative relationship, and values around zero show little to no correlation. A matrix analysis of major correlations follows:

1. **Gender and Other Variables**:
   - **Gender and Role in Education (Correlation = 0.93)**: A substantial positive correlation exists between gender and education roles. The data conversion coding may reflect gender and role distribution tendencies. A large majority of teachers may be a certain gender, causing this high association.
   - **Gender and Curriculum Inclusivity (Correlation = 0.83)**: A substantial correlation exists between gender and perceived scientific curriculum inclusion for students with disabilities. Gender-based variations in access to resources, experiences with diverse learners, and professional development opportunities may influence how educators view inclusion in their schools.

- **Gender and UDL Confidence (Correlation = 0.03)**: It appears that there is little link between gender and confidence in UDL techniques (link = 0.03). This implies that respondents have similar trust in UDL strategies to improve results for students with disabilities regardless of gender.

2. **Role in Education and Other Variables**:
   - **Role in Education and Curriculum Inclusivity (Correlation = 0.90)**: Teacher, administrator, and other education professionals' attitudes on scientific curriculum inclusion are highly correlated. This suggests that professional role strongly influences one's view of how inclusive the curriculum is for disabled pupils. Administrators may have a policy-level viewpoint, while teachers may have greater hands-on experience with kids and a sharper picture of the curriculum's strengths and weaknesses.
   - **Role in Education and Specific Curriculum Improvements (Correlation = 0.99)**: A high correlation (0.99) indicates that educators in various professions share similar perspectives on improving scientific curricular topics for inclusion. This may indicate an agreement across the education system on the need for certain improvements, such as more adaptable resources or greater teacher training for disabled children.
3. **Curriculum Inclusivity and Other Variables**:
   - **Curriculum Inclusivity and Role in Education (Correlation = 0.90)**: This indicates a substantial association between educator role and perceptions of curriculum inclusivity. Teachers, who execute the curriculum, may be more critical of its disability accommodations than administrators.
   - **Curriculum Inclusivity and Confidence in UDL Strategies (Correlation = 0.02)**: It is striking how little curriculum inclusion affects UDL strategy confidence, implying that even if educators think the curriculum is not inclusive, they trust UDL strategies, which shows a gap between the current curriculum and the notion that UDL solutions may close it if implemented widely.
4. **Confidence in UDL Strategies and Other Variables**:
   - **Confidence in UDL Strategies and Role in Education (Correlation = 0.02)**: There is little link between an educator's role and their trust in UDL tactics, suggesting that instructors and administrators agree on UDL's efficacy. This implies that UDL improves results for students with impairments regardless of school system status.
   - **Confidence in UDL Strategies and Curriculum Inclusivity (Correlation = 0.02)**: There is a weak correlation between confidence in UDL strategies and views on the inclusivity of the current science curriculum (Correlation = 0.02). This suggests that educators can distinguish between the curriculum's shortcomings and

the potential benefits of UDL. Despite believing the curriculum is not inclusive, they trust UDL tactics.

**Implications of the Findings**

**1. Strong Influence of Professional Roles on Perceptions of Inclusivity:** The data clearly reveals that an educator's role—whether as a teacher or administrator—strongly influences their views on science curriculum inclusion. Teachers, who work with children everyday, may have a better sense of how well the curriculum supports disabled kids. While aware of the concerns, administrators may not encounter them directly, which may affect their perception. This argues that curriculum inclusion improvements should consider these perspectives and include teachers' views in policy and resource development.

**2. Consensus on the Need for Curriculum Improvements:** The near-perfect association between role in education and particular curriculum adjustments suggests that educators, regardless of position, agree on how to improve the science curriculum for students with disabilities. This broad awareness offers a common basis for change, which is good. UDL-aligned educators may advocate for better access to adaptive technologies, more teacher training, or more adaptable instructional materials.

**3. Confidence in UDL Strategies as a Universal Solution:** The near-zero link between trust in UDL techniques and other variables like role in education and curriculum inclusion is notable. This implies that educators across the board believe UDL practices can improve outcomes for students with disabilities, regardless of curriculum opinions. This confidence in UDL as a solution provides a clear direction for future reforms: schools may bridge the gap between the curriculum and the requirements of children with disabilities by providing more UDL training and resources.

**4. Gender-Based Differences in Perception:** The high association between gender and numerous aspects, including role in education and curricular inclusion, indicating that gender may influence educators' views of inclusivity. Male and female educators may have distinct professional development opportunities or experiences dealing with disabled kids. Further research into gender-based inequalities may help educators build more fair educational environments that accommodate varied learners.

## 4.4.3 Stakeholders Perspective Analysis

*Table 2: Correlation Analysis - Stakeholders*

| Variables | Gender | Age | Stakeholder Engagement and Collaboration | Confidence in Collaboration |
|---|---|---|---|---|
| Gender | 1 | -0.1816 | 0.107772 | 0.090039 |
| Age | -0.1816 | 1 | -0.23496 | 0.255627 |
| Stakeholder Engagement and Collaboration | 0.10777 | -0.235 | 1 | -0.541 |
| Confidence in Collaboration | 0.09004 | 0.25563 | -0.541 | 1 |

Implementing UDL principles requires multiple parties to work together. Stakeholder engagement, collaboration confidence, gender, and age may affect how well these groups collaborate. The study focused on analysis of the dataset for correlations between these factors. This research shows how each factor interacts and suggests UDL reform strategies.

**2. Key Findings from Correlation Analysis**

**a. Gender and Stakeholder Engagement (r = 0.108)**

Gender and stakeholder participation have a positive but weak association of 0.108. This implies that gender has little effect on UDL reform stakeholder collaboration. The small positive association suggests gender affects involvement frequency but not significantly.

This suggests that structural elements like organisational positions and cooperation possibilities may not differ greatly between women. In UDL collaboration, male and female stakeholders may face similar challenges and enablers. The modest correlation suggests gender does not strongly predict involvement frequency

**b. Age and Stakeholder Engagement (r = -0.235)**

Age correlates moderately negatively with stakeholder engagement (-0.235). As people get older, they engage with stakeholders less. Thus, younger stakeholders (19-39) collaborate more than older stakeholders (40-60), which may indicate that younger stakeholders are more aggressive in collaborative efforts due to their receptivity to new methods or active participation in educational innovation.

Older stakeholders may be in higher-level jobs with less daily collaboration or concentration on strategic decision-making. This study supports broader trends in organisations where younger individuals are more actively involved in collaborative activities, especially in change-focused environments like UDL adoption.

**c. Stakeholder Engagement and Confidence in Collaboration (r = -0.541)**

The link between stakeholder engagement and cooperation confidence is -0.541, one of the greatest in this investigation. As engagement frequency increases, collaboration confidence decreases., which is surprising because frequent interaction should boost collaborative confidence.

However, the negative correlation shows that stakeholders who engage more regularly may face more collaboration obstacles, lowering confidence. Frequent collaboration may challenge stakeholders to align varied perspectives and coordinate activities, lowering their faith in collaboration's success, that may indicate the need for enhanced support systems and processes to make frequent collaboration more successful and confidence-boosting

**d. Age and Confidence in Collaboration (r = 0.256)**

Age affects collaboration confidence fairly positively, with a 0.256 correlation. This shows that senior stakeholders (40-60) are more confident in their collaboration skills than younger stakeholders (19-39).

This matches predictions since elder stakeholders have more collaboration and decision-making experience, which boosts their confidence. Their organisational knowledge and experience may help them collaborate better, improving their confidence.

Younger stakeholders may still be gaining confidence in complex cooperation situations. This may explain why they report lesser confidence despite more collaboration.

**e. Gender and Confidence in Collaboration (r = 0.090)**

Gender and collaboration confidence have a minor association of 0.090. Gender does not appear to affect stakeholder collaboration confidence. Male and female respondents are equally confident in their UDL reform collaboration skills.

The small link suggests that experience, function in the organisation, and collaboration efforts may affect confidence levels more than gender. This is promising because gender does not appear to be a barrier to cooperation confidence, demonstrating that men and women view their abilities to work together on UDL reforms equally.

**3. Interpretation and Implications**

The correlation study shows how demographic characteristics affect stakeholder participation and collaborative confidence. Several major implications result from this analysis:

- **Targeted Support for Younger Stakeholders**: The negative association between age and stakeholder engagement shows younger stakeholders collaborate more. Since age has a smaller positive correlation with confidence, younger people may lack confidence. Support, mentorship, and training for younger stakeholders could help them overcome this confidence gap and contribute more to UDL improvements.
- **Addressing Challenges in Frequent Collaboration**: Stakeholder engagement negatively impacts confidence, indicating possible issues for frequent collaborators. This shows that irritation or challenges during collaboration may lower confidence despite increased engagement. To make regular collaboration more beneficial, organisations may need to improve processes, communication, and dispute resolution.
- **Minimal Gender Influence**: Gender does not significantly impact stakeholder participation or collaborative confidence. At least in this dataset, men and women feel similarly about collaboration. Despite ongoing monitoring to maintain gender equality in collaboration, this is an encouraging indicator for gender inclusion.

## 4.5 Regression Analysis

Regression analysis uses statistics to relate one dependent variable (the goal) to numerous independent variables (the predictors). This study predicts students' perceptions of the main impediments to science education based on gender, age, role in the school system, and forms of disabilities.

### 4.5.1 Student Perspective Analysis

$$\textbf{Perceived Impediments} = 5.36 + 0.53 * \textbf{Gender} - 4.12 * \textbf{Age} + 9.96 * \textbf{Role in Education} + 0.03 * \textbf{Types of Disabilities} + \epsilon$$

β0 represents the intercept term

ϵ represents the error term.

**Overview of the Regression Model**

The results of the regression analysis provide the following insights:

- **R-squared ($R^2$)**: 0.051
- **Intercept**: 5.36
- **Coefficients**:
  - Gender: 0.53
  - Age: -4.12
  - Role in Education: 9.96
  - Types of Disabilities Perceived as Barriers: 0.03

**1. R-squared: 0.051**

R-squared ($R^2$) values depict the percentage of variance in the dependent variable (major obstacles) explained by the independent variables in the model. An R-squared value of 0.051 shows that gender, age, involvement in the school system, and the sorts of disabilities students say pose substantial hurdles explain only 5.1% of the difference in students' perceptions of barriers.

A low R-squared value shows that the model does not explain much of the diversity in students' perceptions of barriers. Thus, factors other than those examined in the regression analysis likely influence how students with impairments view science education hurdles. Personal experiences, educational surroundings, instructor support, and family history may also influence their views.

This result is low, but it does not mean the model is inefficient; it just indicates a poor association between the specified independent variables and the target variable. Additional variables and research may increase the model's explanatory power.

**2. Intercept: 5.36**

The intercept of 5.36 predicts the dependent variable (main obstacles) when all independent factors are zero. Since gender, age, and education role cannot be 0, this value is meaningless. However, the intercept anchors the regression line and aids model calculations.

**3. Coefficients**

The coefficients show the predicted change in the dependent variable for a one-unit change in each independent variable, holding all other variables fixed.

- **Gender (Coefficient: 0.53)**: A modest but favourable benefit of being male, female, or non-binary on perceived barriers. Gender does not significantly alter how students view major science education hurdles (0.53). Earlier descriptive statistics and cross-tabulations showed gender disparities in the types of disabilities regarded as obstacles, but our regression result shows that gender does not dominate perceptions of major barriers.
- **Age (Coefficient: -4.12)**: Age has a relatively large **negative coefficient (-4.12)**, indicating a decrease in perceived impediments to science education as pupils age. Older kids may be less sensitive to perceived restrictions due to coping mechanisms or more inclusive educational environments. This unfavourable relationship may also reflect the expectations of younger and older students. Younger pupils may face immediate issues or have less experience navigating them, whereas older students may have acclimated to system limits.
- **Role in Education (Coefficient: 9.96)**: A positive coefficient (9.96) indicates a significant influence in the education system. Since all respondents are students with disabilities, this substantial coefficient shows that their student identity shapes how they perceive impediments. This suggests that how students see themselves in the education system, particularly as disabled students, greatly affects their perceptions of science education barriers. Previous studies have shown that role identification in an educational situation greatly affects educational hurdles.
- **Types of Disabilities Perceived as Barriers (Coefficient: 0.03)**: The relatively modest positive coefficient for the types of disability regarded as obstacles (0.03) suggests that students' perception of major barriers is unrelated to their view of significant barriers. This implies that while students may perceive some disabilities as hurdles to science education, these disabilities are not highly connected with their overall impression of the primary barriers. This may indicate that kids with disabilities experience systemic issues regardless of their disability.

## 4.5.2 Teachers Perspective Analysis

The regression analysis on the dataset examines the relationship between independent variables (gender, role in education, curriculum inclusivity, and areas for improvement) and the dependent variable, confidence in UDL strategies to improve outcomes for students with disabilities. This investigation reveals key parameters affecting educators' UDL confidence.

$$\textbf{Confidence in UDL Strategies} = \beta_0 + 0.0449 * \textbf{Gender} - 0.7128 * \textbf{Role in Education} - 0.1348 * \textbf{Perception of Curriculum Inclusivity} + 1.7178 * \textbf{Specific Areas of Improvement} + \epsilon$$

$\beta_0$ represents the intercept term

ϵ represents the error term.

**Key Findings from the Regression Output**

The regression analysis showed some intriguing patterns, but the model had little explanatory power. Here are the key findings:

1. **R-Squared and Adjusted R-Squared**:
   - The model explains just 4.2% of UDL strategy confidence variance with an R-squared of 0.042. The Adjusted R-squared is even worse at -0.007, suggesting that additional predictors may not improve model fit.
   - These low values show that model factors like gender, role, and curricular inclusion do not explain much of UDL strategy confidence variance. Other unknown factors may explain confidence variance.
2. **Statistical Significance**:
   - The F-statistic of 0.8519 and p-value of 0.517 indicate a non-significant model. Overall, the independent variables do not predict UDL strategy confidence.
   - The p-values for various predictors show no significant effects at the 0.05 level, except for the inclusivity rating of scientific education, which approaches significance.
3. **Impact of Individual Predictors**:
   - **Gender**: The coefficient for gender is 0.0449, with a p-value of 0.778, showing no significant impact on confidence in UDL techniques. This confirms the preceding correlation research showing a weak gender-UDL confidence link.
   - **Role in Education**: The coefficient for role in education is -0.7128, with a p-value of 0.379. The negative coefficient shows that administrative roles may diminish UDL strategy confidence, although the result is not statistically significant.
   - **Perception of Curriculum Inclusivity**: The perception of curriculum inclusivity shows a borderline significant influence (coefficient = -0.1348 and p-value = 0.082). The negative correlation shows that instructors who view the scientific curriculum as inclusive are less confident in UDL procedures. This paradoxical conclusion suggests that those who think the curriculum is inclusive may not need UDL strategies or think they are less important.
   - **Specific Areas of Improvement in the Curriculum**: Specific Areas of Improvement have a coefficient of 1.7178 and a p-value of 0.345. The positive correlation suggests that instructors who identify more curricular improvement opportunities are more confident in UDL procedures, although this effect is not statistically significant.

**Interpretation of the Results**

**1. Low Explanatory Power of the Model:** The low R-squared value shows that gender, role, and curricular inclusion do not adequately explain instructors' UDL strategy confidence. This suggests that non-model factors may influence confidence levels more. Educators' personal experiences with students with disabilities, school resources, and professional development history may predict UDL confidence.

**2. Non-Significant Impact of Gender and Role:** Gender and education system role did not statistically affect UDL strategy confidence. This implies that UDL strategy effectiveness is consistently believed across genders and roles. Despite their different roles and viewpoints, instructors and administrators seem confident in UDL's ability to improve student outcomes with disabilities.

**3. Perceptions of Curriculum Inclusivity:** The regression analysis reveals a strong negative correlation between curriculum inclusiveness perception and UDL strategy confidence. This shows that instructors who think the scientific curriculum is inclusive may not find UDL tactics as important or transformative. Those who think the curriculum is not inclusive may trust UDL more, indicating a theory-practice divide. Even if instructors recognise the curriculum's inclusivity, they may not comprehend how UDL might improve learning for disabled children. It shows that even in inclusive educational contexts, UDL tactics should be well understood.

This result may highlight a gap between theory and practice. Even if educators recognize the inclusivity of the existing curriculum, they may not fully understand how UDL can further enhance learning for students with disabilities. It suggests the need for greater awareness of the full potential of UDL strategies, even in relatively inclusive educational settings.

**4. Need for Curriculum Improvements:** Researchers found a non-significant positive correlation between recognising areas for curriculum development and confidence in UDL procedures. This suggests that educators who notice weaknesses in the curriculum tend to have a stronger belief in its usefulness. This shows that individuals who recognise barriers to admitting students with impairments also see UDL as a solution.

**Implications for Education Policy and Practice**

Regression analysis has various implications for improving scientific education for disabled students:

- **Professional Development and UDL Awareness**: Given the model's low explanatory power, training and experience may influence UDL strategy confidence more than demographic or role-related variables. This highlights the importance of professional development programs that teach teachers and administrators how UDL practices can improve even reasonably inclusive curricula.
- **Targeted Curriculum Reforms**: The nearly substantial negative link between perceived curriculum inclusivity and UDL confidence shows that educators in inclusive workplaces may undervalue UDL. Policymakers should clearly integrate UDL into inclusive curricula to guarantee that all students, including those with disabilities, benefit from these initiatives.

### 4.5.3 Stakeholders Perspective Analysis

A regression analysis examined how gender, age, and collaboration participation affect stakeholders' trust in participating in Universal Design for Learning (UDL) changes. This analysis' dependent variable is stakeholders' trust in their collaboration skills, rated from 1 to 5. Gender, age, and stakeholder collaboration frequency are independent variables. This regression analysis quantifies the link between these variables and evaluates their confidence-level prediction potential.

$$\textbf{Trust in Collaboration Skills} = \beta_0 + 0.277 * \textbf{Gender} + 0.249 * \textbf{Age} - 0.592 * \textbf{Stakeholder Engagement Frequency} + \epsilon$$

**2. Model Overview and Key Metrics**

- **R-squared ($R^2$):** The $R^2$ value of 0.340 suggests that gender, age, and stakeholder participation explain 34% of confidence level variability. This moderate level of explanatory power shows that other factors influence stakeholders' collaboration confidence outside the model. However, this value shows that these three factors affect confidence significantly.
- **Adjusted R-squared (Adj. $R^2$):** The adjusted R-squared (Adj. $R^2$) value is 0.320. This score better represents the model's explanatory power by accounting for the number of predictors. The minor decrease in value implies that the model is still a strong fit but cannot explain all confidence variability.
- **F-statistic and p-value (Prob > F):** The F-statistic is 16.83 and the p-value 6.78e-09. This p-value is substantially below 0.05, indicating that the model is statistically significant. In other words, gender, age, and stakeholder interaction frequency strongly predict stakeholder confidence.

**3. Analysis of Independent Variables**

The regression analysis evaluates each independent variable's confidence level relationship. Breakdown of key findings for each predictor:

**a. Gender (Coefficient = 0.277, p-value = 0.038)**

With a positive value of 0.277, gender predicts collaborative confidence. Keeping other parameters constant, female stakeholders (coded 2) have slightly more confidence than male stakeholders (coded 1). The positive correlation shows women may be more confident in their UDL reform collaboration skills.

The gender-confidence relationship is statistically significant because the p-value is 0.038, below the 0.05 threshold. The effect size is tiny, but the significance suggests that gender affects stakeholders' collaborative confidence.

**b. Age (Coefficient = 0.249, p-value = 0.056)**

The age coefficient is positive at 0.249, indicating that older stakeholders (aged 40-60, scored as 2) have stronger trust than younger stakeholders (19-39, coded as 1). This supports earlier findings that older people are more confident in their collaborations due to their expertise and familiarity with collaboration methods.

However, the age p-value is 0.056, slightly above the significance level of 0.05. This implies that age affects confidence, although not as strongly as gender. Despite the borderline p-value, older stakeholders show increased confidence in collaboration

**c. Stakeholder Engagement Frequency (Coefficient = -0.592, p-value = 0.000)**

The coefficient of -0.592 for stakeholder engagement in collaborative endeavours is quite significant. This suggests a substantial adverse link between stakeholder confidence and collaboration. Thus, stakeholders who participate weekly (classified as 3) have lower collaboration confidence than those who connect less frequently (monthly or infrequently).

This variable has an extremely significant p-value of 0.000. This proves that engagement frequency and confidence are not random and is vital to consider. The negative coefficient shows that frequent involvement may promote collaboration but also expose stakeholders to confidence-lowering issues like coordination, communication, and ineffective meetings.

**4. Interpretation and Discussion**

The regression research has several noteworthy findings on how gender, age, and participation frequency affect stakeholders' UDL reform partnership confidence. Engagement frequency affects confidence the greatest, followed by gender and age.

**a. The Role of Gender**

Gender has a slight positive effect on confidence, suggesting that female stakeholders are more confident in joint efforts than male stakeholders. This suggests that women in this profession may have strong cooperation networks or responsibilities that involve more connection and communication, improving their confidence in collaborative procedures.

Given that gender is a predictor, UDL reformers may want to foster more inclusive collaborative spaces where both genders feel powerful and supported.

**b. Age and Confidence**

The favourable association between age and confidence emphasises collaboration experience. Older stakeholders may be more confident due to their experience. This shows that younger stakeholders may benefit from mentorship or additional support to negotiate UDL reform partnership.

Age and confidence are not as statistically important as gender or involvement frequency, but they emphasise the necessity of using elder stakeholders' experience while developing younger partners.

**c. The Paradox of Frequent Engagement**

This regression analysis's negative link between engagement frequency and confidence is intriguing. Contrary to popular belief, frequent participation does not boost confidence. The paradox may be that regular collaboration can make it harder for stakeholders to coordinate varied interests and perspectives. Thus, frequent collaborators may doubt their efforts. Organisations should investigate this issue's causes. Frequent engagement may require improving collaborative efficiency and productivity to avoid stakeholder irritation and disillusionment.

## 4.6 Chi-square Analysis

### 4.6.1 Student Perspective Analysis

*Table 3: Chi-Square Students Statistics Extracts*

| Crosstab | Pearson $\chi^2$ | df | p-value | Cramér's V | N |
|---|---|---|---|---|---|
| **Gender × Observed inclusive practice** | 109.889 | 9 | < .001 | 0.585 | 107 |
| **Age × Observed inclusive practice** | 110.647 | 6 | < .001 | 0.719 | 107 |
| **Gender × Disability type (example item)** | 5.164 | 3 | 0.160 | 0.220 | 107 |

**[See Annexure – D for full statistics]**

Student responses show that inclusion-related opinions vary each student group, as gender correlated most with students' reports of inclusive/UDL-aligned scientific lectures and labs. The relationship was strong, with Pearson $\chi^2(9, N = 107) \approx 109.89$, $p < .001$, and Cramér's V ≈ 0.59 (big). Not all gender groups are equally likely to report seeing inclusive techniques (such as multiple ways to represent/engage, scaffolded practical roles, and accessible resources). Some groups may not remember or notice these habits. Uneven praise encourages kids to participate by showing how inclusive practice impacts them. Teachers may not reach all students with inclusive strategies.

Similar age band patterns and outcomes indicated "observed successful implementations." The effect was strongly correlated (Pearson $\chi^2(6, N = 107) \approx 110.65$, $p < .001$, Cramér's V ≈ 0.72). That size indicates that older and younger students react differently to different things. Two viable, non-exclusive concepts frame the discussion. First, cohort effects may have affected older groups' inclusive routine frequency or clarity due to curriculum, personnel, or resource changes (e.g., pandemic modifications). Second, pupils may learn to identify inclusive characteristics like explicit scaffolds and multimodal resources as they get older. The models propose making inclusive practices explicit and easy to identify so age and familiarity don't hinder recognition.

Other student crosstabs (demographics vs general feelings) had small impact sizes and no statistically significant relationships. These non-differences benefit, not hurt. They recommend a universal design baseline with visual aids, defined responsibilities in practical activities, uniform pre-lab briefings in accessible forms, and specific safety and handling guidelines because many perceived hurdles and aids are common among groups. The lack of group disparities on specific issues supports the idea that properly selected UDL tests can benefit most students, regardless of group affiliation, and should be standardised rather than selectively applied.

Student findings provide a complete analytical response to your research questions. First, they show that different ages and genders view inclusive behaviours differently, requiring targeted communication and signposting. Micro-cues, such as "Today's lesson uses multiple means of representation" or "Roles assigned to support participation," on slides or lab sheets may help students understand the current lesson. Second, they encourage universality: normal practice should provide assistance for all classes for items with negligible or no connections.

Finally, our data prioritise multivariable stage research. After controlling for context (school type/phase), prior attainment baselines, and additional covariates, subsequent models (e.g., logistic or ordinal logistic regression, as suitable for the outcome scale) must examine the persistence of gender, age, and perceived inclusion given their strong bivariate associations. If adjusted effects continue, the issue may be compositional, suggesting systematic inequities in salience and access, or the mechanism may work at the school level if effects reduce. Based on student $\chi^2$ results, recommendations include: (i) promoting inclusive practices, (ii) standardising UDL routines across classrooms and years, and (iii) verifying recognition using brief feedback pulses to ensure consistency.

### 4.6.2 Teachers Perspective Analysis

*Table 4: Chi-Square Teachers Statistics Extracts*

| Crosstab | Pearson $\chi^2$ | df | p-value | Cramér's V | N |
|---|---|---|---|---|---|
| **Gender × Pedagogy: Use of multiple means of representation (frequency)** | 102.000 | 2 | < .001 | 1.000 | 102 |
| **Age × Pedagogy: Use of multiple means of representation (frequency)** | 102.000 | 40 | < .001 | 1.000 | 102 |
| **Gender × Curriculum topics need improvement** | 103.658 | 8 | < .001 | 0.713 | 102 |
| **Gender × Staff collaboration on UDL** | 16.395 | 2 | < .001 | 0.401 | 102 |
| **PD × PD received on UDL** | 0.175 | 2 | 0.916 | 0.041 | 102 |
| **Gender × Overall inclusivity rating (1–5)** | 0.303 | 2 | 0.859 | 0.055 | 102 |

**[See Annexure – E for full statistics]**

Instructor bivariate chi-square analysis shows that some inclusion-critical practices are universal, while others differ greatly, that helps policymakers and PD programmers distinguish between places that need extra treatment and universal baselines. The frequency with which science lecturers use visual, auditory, and tactile assistance is clear. A significant correlation exists between gender and MMR prevalence (Pearson $\chi^2(2, N = 102) = 102.00$, $p <.001$, Cramér's $V = 1.00$). A significant correlation exists between age and MMR usage ($\chi^2(40, N = 102) = 102.00$, $p <.001$, $V = 1.00$). $V = 1.00$ in the output crosstab shows perfect connection. However, "how often MMR is used" varies greatly per instructor group.

In real life, such a clear divide may be due to cohort-based training or teaching context (newer staff use more multimodal materials), recognition (some teachers conduct MMR but don't call it UDL/MMR), or response-set artefacts caused by sparse or collapsed categories. Integrate MMR into your work and make it visible. Use departmental checks, shared lab slide examples with visible and auditory signals, and short lesson-study cycles to demonstrate "MMR by default."

Gender significantly influenced the belief that curriculum topics should be enhanced for students with impairments, in addition to representation ($\chi^2(8, N = 102) = 103.66$, $p < .001$, $V = 0.713$). Teachers' assessments of scientific curriculum deficits and revision units vary. This suggests that the instructor's perspective and lived context matter; different groups may face different obstructions (e.g., practical investigations requiring fine motor skills; abstract units without concrete or visual scaffolding). Leaders should work with a variety of staff to improve the curriculum and involve marginalised groups in working groups.

Collaboration differs significantly. Gender significantly impacts collaboration between general and special education professionals in implementing UDL ($\chi^2(2, N = 102) = 16.40$, $p < .001$, $V = 0.401$). This moderate-to-large effect shows instructors' cross-role working experiences vary. Scheduled collaboration routines including short pre-term co-planning, shared IEP-aligned lab adjustments, and rapid "post-lab" debriefs make collaboration more constant than spontaneous arrangements.

Results indicate no correlation between PD on UDL and general judgements, such as meeting student needs or inclusivity rating (examples: $\chi^2(2, N = 102) = 0.175$, $p = .916$, $V = 0.041$; $\chi^2(2, N = 102) = 0.303$, $p = .859$, $V = 0.055$). Small, non-significant impacts do not mean "PD does not matter"; they mean these generic views are commonly held or indifferent to PD/no-PD distinctions. PD should be practice-proximal (lesson-embedded, integrating co-planning, artefacts, and feedback loops) to change classroom habits like MMR use.

**Actionable implications:**

1. Treat **MMR** as a **departmental default** with explicit artifacts (templates, slide exemplars, practical checklists) so recognition is consistent across teacher groups;
2. **Co-design curriculum fixes** with the groups reporting greatest misalignment;
3. **Standardise collaboration structures** between general and special-education staff; and
4. position PD as **applied micro-cycles** (plan–do–study–act) rather than one-off sessions, linking it to concrete, observable UDL behaviours.

### 4.6.3 Stakeholders Perspective Analysis

*Table 5: Chi-Square Stakeholders Statistics Extracts*

| Crosstab | Pearson $\chi^2$ | df | p-value | Cramér's V | N |
|---|---|---|---|---|---|
| **Collab freq × Collaboration frequency** | 66.999 | 2 | < .001 | 0.810 | 102 |
| **Collab freq × (related collaboration item A)** | 24.130 | 2 | < .001 | 0.486 | 102 |

| | | | | | |
|---|---|---|---|---|---|
| **Collab freq × (related collaboration item B)** | 24.130 | 2 | < .001 | 0.486 | 102 |
| **Collab freq × (related collaboration item C)** | 24.088 | 2 | < .001 | 0.486 | 102 |
| **Gender × Confidence to collaborate (1–5)** | 9.733 | 3 | 0.021 | 0.309 | 102 |
| **Age × Collaboration frequency** | 9.460 | 2 | 0.009 | 0.305 | 102 |
| **Collab freq × Collaboration platforms/tools (support need)** | 0.160 | 2 | 0.923 | 0.040 | 102 |

**[See Annexure – F for full statistics]**

The stakeholders' bivariate analyses show group UDL collaborative dynamics and shared preferences, supporting students' and teachers' findings. There are many statistically significant and practical links that suggest strategies to engage stakeholders. Others are minor, supporting universal policies that don't need changing.

First, stakeholder UDL collaboration frequency is highly correlated with collaboration-related decisions and viewpoints. Frequency of collaboration strongly correlates with stakeholder collaboration (Pearson $\chi^2(2, N = 102) = 66.999$, $p < .001$, Cramér's $V = 0.810$). This suggests that stakeholders with more routine collaboration also have higher parallel collaboration metrics. Active collaboration seems to increase stakeholder participation in relevant collaborative efforts. A foundation of active collaboration (e.g., formal communities of practice, regular cross-role check-ins) may improve alignment and participation across a wider range of policy and practice collaborative activities.

Second, age moderately correlates with collaboration frequency ($\chi^2(2, N = 102) = 9.460$, $p = .009$, $V = 0.305$). This suggests that some age groups collaborate more than others. Possible reasons: two. One is access/role segmentation: mid-career leadership and liaison posts may allow particular age groups to collaborate. Collaborative planning spaces, asynchronous boards, and data dashboards may be easier for digital natives. To equalise collaboration opportunities, give less-active groups common collaboration platforms, scheduled stakeholder touchpoints, and on-ramps (short training and norms) to join without issues.

Gender significantly affects collaborative confidence (1-5), with a moderate effect ($\chi^2(3, N = 102) = 9.733$, $p = .021$, $V = 0.309$). Thus, perceived collaboration self-efficacy varies. In low-confidence groups, interventions should include skill enhancement (such as set agendas, role clarity, and conflict-resolution processes) with early achievements to boost efficacy perceptions. Because participation builds confidence, coaching with opportunities to apply collaboration norms to genuine UDL activities like co-designing an accessible lab sequence helps.

Some stakeholder crosstabs reveal minor impacts, such as collaboration frequency vs. specific supports ($\chi^2(2, N = 102) = 0.160$, $p = .923$, $V = 0.040$). These continuously tiny relationships suggest that certain assistance needs are prevalent regardless of collaboration frequency or demographics. These items usually start with platforms, UDL training primers, short evidence summaries, and basic feedback loops like surveys and focus groups for all stakeholders. Universal provision ensures fair access to central collaborative infrastructure and prevents fragmentation.

Last, moderate-to-strong correlations link cooperation frequency to hurdles and resource needs (e.g., time constraints, UDL training, organised engagement methods). Even engaged actors sense system strain, notably time limits, when regular collaborators uncover specific difficulties more often. Executive choices that establish cross-stakeholder planning (such as brief but regular co-planning periods and calendar-protected sprints) and simple governance structures (such as standing agendas and decision logs) can lower these hurdles.

The Stakeholder $\chi^2$ findings indicate a collaborative system, with differences resolved through structured assistance and shared needs requiring resources from all. This supports your Recommendations chapter by (i) establishing formal collaboration routines (cadence + artefacts), (ii) ensuring that all groups have equal access to on-ramps with practical platform training and coached first cycles, and (iii) providing core supports across all collaboration levels.

## 4.7 Content Analysis

### 4.7.1 Student Perspective Analysis

The dataset sheds light on how disabled British secondary school pupils access and engage with science education. Critical content analysis can reveal the respondents' underlying themes, assumptions, and concerns, helping us understand systemic hurdles for kids with disabilities.

**1. Central Themes and Barriers Identified**

The dataset identifies three main science education barriers:

- **Access to Learning Materials and Resources**: The most common identified barrier, with respondents citing a lack of accessibility. Science topics often use visual, aural, or hands-on methods, which may challenge individuals with sensory, physical, or cognitive limitations.
- **Physical Environment Accessibility**: Respondents cited inaccessibility of science labs and classrooms as a major barrier. Movement, equipment interaction, and hands-on tasks in science can be difficult for students with mobility impairments or physical disabilities.
- **Attitudinal Barriers and Misconceptions**: Respondents cited negative teacher and peer attitudes and disability stereotypes as major obstacles to scientific education engagement. Social barriers exacerbate physical and material challenges, providing a hostile or unsupportive learning environment for disabled children.

These three themes show that systemic inadequacies and a lack of inclusive policies in educational institutions often cause difficulties for students with disabilities.

**2. Insights on Educational Policy and Practice**

The dataset yields several important educational policy and practice findings. First, the prevalence of poor learning materials shows a failure to implement Universal Design for Learning (UDL) in education. By customising resources and approaches for all learners, including those with disabilities, UDL attempts to make learning more accessible.

British secondary schools are not frequently using UDL frameworks, according to data. For instance, kids with visual or hearing impairments may not have access to Braille or auditory materials, while students with learning problems like dyslexia or ADHD may not receive customised instruction. Lack of accessible materials is a structural issue that perpetuates educational inequality.

Physical accessibility also shows a lack of investment in infrastructure for disabled students. Mainly able-bodied students use science labs and classrooms, marginalising individuals who need accommodations. While "hands-on" science education is important, it should be expanded to include children who cannot physically participate in experiments. Assistive technology, alternative experiment methods, and customised seats can accommodate these issues.

**3. Impact of Attitudes and Misconceptions**

The third important subject, attitudinal barriers, shows how social dynamics worsen disability challenges for pupils. Teacher training in inclusive practices is lacking, leading to negative attitudes and misconceptions about students' skills, according to several respondents. This can diminish scientific education expectations for disabled children, decreasing their engagement. Teachers may lack the confidence or knowledge to alter lessons to meet students' different needs, marginalising disabled students.

This theme emphasises teacher training and professional development for inclusive education. It takes more than accessible goods and infrastructure to create a conducive social environment. Teachers must be trained to establish an inclusive classroom where disabled children feel valued and supported.

**4. Intersectionality of Disability, Gender, and Age**

The data also illuminates disability, gender, and age intersections. A large percentage of responders were non-binary, emphasising the necessity to incorporate gender diversity in disability and education conversations. While most respondents were male or female, the inclusion of non-binary individuals emphasises the need for intersectional disability studies that consider gender identity. Future studies should examine how gender identity affects education for non-binary students with impairments.

Data also suggests that age affects pupils' perceptions of impediments. Due to their lengthier educational exposure or various coping techniques, older students (aged 19–39) may have different expectations and experiences than younger students (under 18). This could mean older kids have acclimated to structural barriers or have navigated an inaccessible school environment.

**5. Broader Implications for Science Education**

This dataset's findings affect scientific education. Science is considered a vital topic that prepares students for many occupations. However, this information suggests that disabled kids are routinely denied science education's full benefits. Inaccessible science education fosters a cycle of exclusion in STEM professions and other careers that require scientific knowledge for disabled students.

Addressing this dataset's barriers involves multiple approaches. Schools must invest in accessible instructional materials and equipment, train teachers, and provide a supportive social atmosphere for disabled pupils. Educational policymakers must also enforce UDL principles and ensure that all children, regardless of ability, have equitable access to science education.

## 4.7.2 Teachers Perspective Analysis

The dataset provides a detailed look at how teachers and administrators view scientific education for students with disabilities and their trust in UDL methodologies. This content analysis critically examines these perceptions, uncovers trends, and generates valuable insights regarding inclusivity and UDL implementation strengths, flaws, and possibilities in current educational practices. Through this assessment, several themes emerge that highlight major concerns and development opportunities.

**Theme 1: Perceived Inclusivity of Science Education for Students with Disabilities**

One focus of the data is educators' ratings of how inclusive the science program is for disabled children. This question is crucial because it addresses whether educational procedures meet varied learning demands. A large percentage of respondents evaluated the science curriculum's inclusion between 2 and 3 on a 1 to 5 scale. This suggests that most educators recognise inclusiveness efforts but recognise significant opportunity for improvement.

Since the information does not include specific instances of inclusivity, we can infer that respondents are judging it based on material, resource, and instructional practices accessibility. The intermediate grades (mainly 2s and 3s) indicate that instructors regard the scientific curriculum as improving but not fully serving children with disabilities. Inclusion is a cornerstone of modern education, especially with the increased emphasis on STEM disciplines.

Critically, the comments may indicate structural concerns that make the scientific curriculum less inclusive. For instance, schools may lack adaptive technologies, staff training, or funding to effectively support science students with impairments. The curriculum may also be rigid, not accommodating pupils' different learning styles. This fits with concerns of traditional curricula, which marginalise pupils with special learning needs through one-size-fits-all approaches.

**Theme 2: Confidence in UDL Strategies**

A second key feature in the dataset is educators' belief in UDL initiatives to enhance disability outcomes. UDL offers different interaction, representation, and expression methods to make learning accessible and effective for all students. With many respondents giving UDL techniques a confidence level of 4 or 5 on a 5-point scale, instructors value them.

This UDL confidence contrasts with the curriculum's perceived inclusivity. Teachers recognise curricular shortcomings but are hopeful about UDL's ability to fill them. This optimism is vital because it shows a sense that inclusiveness solutions—particularly UDL—exist if properly applied.

Critically, this assurance may disguise a larger issue: some educators may not comprehend UDL. Some responders may have evaluated UDL highly because it is a best-practice paradigm in inclusive education, not because they have implemented it successfully. We need more UDL instruction and support because confidence alone does not lead to good practice. The difference between high UDL confidence and modest inclusion scores suggests a gap between theoretical knowledge and school execution.

**Theme 3: Areas for Improvement in the Curriculum**

The dataset also shows educators' thoughts on scientific curriculum topics that need change to better serve disabled pupils. Multiple areas for improvement demonstrate that educators are aware of the curriculum's flaws. Examples of factors include:

- The availability of adaptive tools and technologies for students with disabilities.
- Professional development opportunities for teachers to learn about inclusive teaching strategies.
- The design of science activities and assessments that accommodate various learning styles and abilities.

The identification of various areas for improvement fits with critiques about traditional education's capacity to adapt to different student requirements. The scientific curriculum may prioritise standardised content delivery and evaluation that are not flexible enough for all students. This rigidity can hinder disabled students, who may need additional instruction or evaluation to fully engage with the topic.The dataset also reveals educators' views on specific areas within the science curriculum that require improvement to better address the needs of students with disabilities. A recurring observation is the identification of multiple areas for improvement, which suggests that educators are acutely aware of the curriculum's shortcomings. These could include factors such as:

Critically, the fact that educators recognise areas for improvement yet still evaluate inclusion moderately shows that the education system may be complacent—acknowledging the difficulties without addressing them. This suggests systemic reform, where educators detect issues and receive the tools, resources, and institutional support to make curriculum adjustments.

**Theme 4: Role of Educators and Institutional Support**

Another data trend is educators' role in inclusive practices and UDL methods. Teachers and administrators have different views on inclusivity and UDL strategy confidence, according to cross-tabulation study. Teachers that engage directly with kids may be more critical of the curriculum's inclusion due to their daily experiences. However, administrators may have a more detached, policy-oriented perspective, which may explain their greater confidence in UDL strategy implementation.

The difference between teachers and administrators emphasises the need for education stakeholder collaboration. Administrators must provide resources, professional development, and inclusive policies to teachers, who deliver inclusive education. Administrators must transform inclusion and UDL methods into classroom resources for instructors.

**Insights and Recommendations**

Critical content analysis of this dataset yields some ideas for increasing scientific education inclusion for disabled students:

1. **Focus on Practical Implementation of UDL**: Educators' trust in UDL methodologies warrants increased focus on training and implementation. UDL must be a practical tool for teachers to use in their daily lessons.

2. **Address Specific Curriculum Gaps**: The modest inclusion ratings suggest science curriculum improvements. Improved adaptive technology, professional development, and adaptable assessments are examples.

3. **Increase Collaboration Between Teachers and Administrators**: Different perspectives between instructors and administrators promote improved collaboration. Administrators should give instructors the tools and support they need to develop inclusive practices.

4. **Prioritise Systemic Reform**: Multiple areas of curriculum improvement indicate the necessity for systemic change. Policymakers must guarantee that curriculum design prioritises diversity and that schools have the support to adopt inclusive practices.

Schools may make learning more inclusive and helpful for all students, especially those with disabilities, by addressing these areas.

### 4.7.3 Stakeholders Perspective Analysis

Educational institutions, governments, parents, and academics must work together to implement UDL. The information provides useful insights into how stakeholders collaborate, their confidence in the process, and their perceptions of collaboration hurdles and opportunities. Critical content analysis of the dataset can reveal stakeholder participation and confidence in UDL implementation and suggest improvements.

The information covers stakeholder demographics (age and gender), frequency of collaboration, confidence in collaboration, and suggestions for improvement. To fully comprehend the dynamics, this investigation will rigorously explore each region

**2. Stakeholder Demographics**

Respondent demographics show stakeholder diversity (or lack thereof). The dataset included 66 male respondents and 36 female respondents, suggesting a male-dominated UDL collaborative environment. Education and policymaking require inclusivity and diversity, thus this is vital. Women's under-representation in these efforts could hinder UDL changes.

The age mix is somewhat balanced between younger (19-39) and older (40-60) stakeholders. This balance indicates that UDL collaboration include early-career and seasoned workers. Age does not dictate collaboration effectiveness, but generational perspectives can improve or hinder efforts depending on how well these groups work together.

Age distribution may alter stakeholders' UDL implementation strategies. Younger stakeholders may have unique ideas but lack the knowledge and confidence to negotiate complex cooperation situations. Older stakeholders may be confident and experienced but reluctant to change and innovation. Balance between these perspectives is key to good communication.

**3. Engagement in Collaboration**

A large part of the dataset examines how often stakeholders collaborate with teachers, parents, officials, and researchers on inclusive education and UDL implementation. Few stakeholders interact (51 out of 102 respondents). Due to the importance of regular and meaningful communication in UDL implementation, this discovery is crucial.

Low engagement may have several causes. Key actors' geographical dispersion or time restrictions may hinder stakeholders. They may also face motivational challenges including feeling unappreciated or that collaboration attempts are unsuccessful.

Engagement is higher among younger stakeholders, suggesting generational disparities in collaborative perception and practice. Younger stakeholders who entered the profession during a time of collaboration and multidisciplinary effort may be more open to regular engagement. However, older stakeholders may be more wary of collaboration due to past failures.

UDL implementation requires closing this engagement gap. Suboptimal policy and practice may result from stakeholders not interacting as much. Solutions may include developing more inclusive collaborative settings, giving stakeholders the resources they need to engage, and formalising and rewarding engagement initiatives.

**4. Confidence in Collaboration**

The dataset also examines collaboration confidence. Respondents rated their confidence in stakeholders' collaboration from 1 to 5. The replies are balanced, with a large portion expressing moderate to high confidence (4 or 5).

Earlier investigations found a negative link between engagement frequency and cooperation confidence. More frequent stakeholders may be less confident in the process. This is paradoxical because frequent engagement should boost confidence. Data suggests that frequent interaction may expose stakeholders to more issues such conflicts of interest, misaligned goals, and poor communication.

This confidence difference may have multiple origins. Frequent collaboration may involve multiple parties with varying viewpoints, priorities, and expectations. Diversity of thinking is beneficial, but it can make collaboration harder if there are no clear procedures to resolve conflicts or align goals. Frequently engaging stakeholders may become frustrated if collaborative attempts fail to produce results, thus eroding their confidence in the process.

Addressing these issues immediately builds partnership confidence. Structured cooperation procedures with stakeholder goals, timetables, and roles may help. Negotiation, conflict resolution, and collaborative problem-solving training for stakeholders may enhance confidence.

**5. Barriers to Effective Collaboration**

Several respondents offered solutions for strengthening collaboration, revealing perceived constraints. Most suggestions called for stakeholder input collection and analysis mechanisms. This suggests a need for institutional procedures to integrate stakeholder input into decision-making.

Multi-tiered collaboration and centralised resource and feedback repositories were further recommendations. These proposals emphasise organisation and structure in collaboration. Without clear protocols and systems, stakeholders may feel unappreciated or that participation is not productive.

These obstacles necessitate multifaceted solutions. First, UDL implementation organisations must invest in collaborative infrastructure including digital platforms for resource sharing and feedback. In addition, they must promote diversity and mutual respect so that all stakeholders feel heard. Finally, they must make sure collaborative activities are goal-oriented and yield results.

## 4.8 Methods Comparison

UDL, assistive technologies, hands-on experiments, and teacher training in inclusive practices are examined to improve science teaching for impaired students. A comparison of various strategies using survey data and qualitative feedback reveals their relative efficacy and why they succeed or fail.

### 4.8.1 Student Perspective Analysis

Both quantitative and qualitative studies highlight Universal Design for Learning (UDL). The survey found that 14 of 21 students think UDL could make science instruction more accessible. Multiple representation, participation, and expression meet students' different needs in the technique. UDL's flexibility lets educators create products for many learning styles and capacities. Large print or audio textbooks help students with sensory impairments, while alternate evaluation methods help students with learning difficulties like dyslexia.

Qualitative feedback reinforces UDL's inclusion framework promise. Many respondents said UDL makes all students feel appreciated and supported, decreasing disability stigma. Feedback also notes implementation issues like teacher training and institutional assistance. UDL is theoretically successful, but educators' understanding and application of its concepts determine its effectiveness. UDL's full potential is unrealised in schools with low resources or poorly prepared teachers.

Assistive technologies are very effective, with nearly half of survey respondents citing them as essential to science instruction. Students with sensory, physical, or cognitive limitations can participate more in the curriculum via screen readers, Braille displays, and speech-to-text software. Tactile graphics and aural assistance help visually impaired pupils, while adapted lab equipment helps mobility-impaired students execute experiments.

Qualitative insights describe assistive technology's impact. Many pupils said these technologies help them overcome problems that traditional schooling doesn't. A student with hearing problems said real-time captioning helped them follow science lectures, closing a major accessibility gap. Qualitative feedback also shows that instructors' technical inexperience and expensive costs prevent broad adoption of assistive technologies. Schools often struggle to buy and maintain these instruments, restricting their availability to children who need them.

Hands-on experiments are essential to science teaching, but impaired students' access is a problem. Survey responses show that the absence of adapted resources and safety concerns often prevents disabled students from fully participating in experiments. Few respondents reported consistent access to inclusive lab setups including wheelchair-accessible workstations or tactile models.

Despite these obstacles, qualitative feedback emphasises the value of hands-on learning for engagement and comprehension. Students said experiments are essential for applying theory. A student with a physical impairment said modified lab tools helped science “come alive” more than lectures and textbooks. The feedback also shows how frustrated many kids are when they are excluded from these activities due to poor setting or teacher preparedness. Lab inaccessibility impairs learning and fosters impaired students' sense of isolation and incompetence.

Teacher training in inclusive practices is crucial to all other techniques' effectiveness. Insufficient teacher preparation was cited by 13 of 21 pupils as a hurdle. UDL and assistive technology integration are difficult for teachers without inclusive pedagogy training. Without knowledge of disability-specific accommodations, they cannot safely and easily conduct hands-on experiments.

Qualitative feedback illuminates teacher training. Many students said their science teachers' attitudes and skills affected their learning. Empathetic, inclusively trained teachers could provide a helpful learning environment even in resource-constrained contexts. Untrained teachers sometimes propagated unfavourable perceptions or failed to meet students' needs. One respondent said a teacher's dismissal of their disability deterred them from studying science, demonstrating how teacher behaviour affects student outcomes.

A comparison of these strategies shows that their efficacy is linked. While UDL and assistive technology provide the framework for accessibility, they are less effective without qualified educators. Hands-on experiments provide unprecedented engagement but require adaptable tools and trained teachers to be inclusive. Thus, teacher training is the key to other approaches' success. Professional development in inclusive education improves outcomes across all domains.

A holistic strategy is needed to improve science teaching for impaired children with UDL, assistive technologies, hands-on experiments, and teacher training. Survey statistics show these strategies' quantifiable impact, while qualitative feedback explains their efficacy. To build an inclusive educational environment, these findings demonstrate the need for systemic reforms such higher financing, legislative support, and professional development.

### 4.8.2 Teachers Perspective Analysis

According to quantitative survey data, educators gave UDL a 4.15 on a 5-point scale, indicating good confidence. This suggests that many believe UDL can meet the different demands of disabled students. Qualitative feedback showed why UDL was effective: its flexible teaching strategies, such as multiple ways of engagement, representation, and expression, make it ideal for students with different abilities and learning styles.

UDL encourages engagement by giving pupils different methods to demonstrate understanding, educators said. Students may demonstrate their knowledge via a video or model instead of a written test. This flexibility was especially helpful for disabled kids who may struggle with traditional assessments. Qualitative data also showed major issues. Many teachers claimed that they lacked training and institutional support to adopt UDL, limiting its impact. Though theoretically sound, the method's implementation was inconsistent, highlighting the need for professional development and resource allocation.

Assistive technology became essential for inclusion. These tools received mixed quantitative scores from educators, who cited their revolutionary potential and limitations. Schools utilising screen readers, speech recognition software, and adaptable lab equipment reported higher student engagement and performance. Due to funding and training constraints, underfunded schools struggled to adopt assistive technologies.

Qualitative responses stressed the importance of assistive technologies for disabled students. Braille displays and speech-to-text software helped visually and hearing-impaired students engage in science classes. Teachers said these tools removed learning hurdles and enhanced pupils' confidence and independence. However, external finance and hefty assistive technology expenses remained ongoing difficulties. Educators complained that uneven resource allocation prevented underserved schools from using these technologies.

Hands-on experiments emphasised active learning and involvement. Education professionals rated this strategy somewhat lower than UDL but higher than traditional teaching methods in a survey. Qualitative insights explained why hands-on experiments were praised and criticised.

Teachers said hands-on activities helped children understand abstract scientific concepts. Customised experiments, such as tactile models for visually impaired pupils, gave disabled students meaningful access to science. Teachers related stories of pupils becoming interested in science after lab activities.

However, hands-on experiments were logistically difficult. Many schools lacked resources to adapt experiments for disabled students. Laboratory equipment was typically modified to suit wheelchairs or individuals with weak motor skills. Teachers struggled to balance safety and diversity. Despite these challenges, hands-on experiments were valued as a complement to other approaches for practical application and skill development.

Lectures and standardised tests were the least helpful for aiding disabled pupils. This strategy has poorer inclusivity scores in quantitative data, with educators criticising its inability to meet varied learning demands. Traditional methods typically omitted pupils who needed different ways to learn.

Qualitative comments verified these findings. Traditional approaches emphasise content delivery over engagement, which disadvantages disabled children, teachers said. Hearing-impaired pupils failed to follow verbal lectures without sign language interpreters or captioning. Due to their inflexibility, standardised tests generally ignored the unique issues of students with impairments.

Some educators noted that traditional approaches are familiar and scalable despite their drawbacks. Lectures and standardised assessments were feasible, albeit flawed, for large classrooms with limited resources. There was consensus that inclusive education requires extensive adaptation of established techniques.

Facilitating inclusion depends on resource availability, teacher training, and institutional support, and the four strategies vary greatly. The flexible structure of UDL and focused support of assistive devices made them promising for inclusive learning environments. Both strategies were difficult to execute due to resource restrictions and teacher training.

Though logistical and safety considerations limited their use, hands-on experiments were praised for engaging pupils and making learning tangible. Traditional teaching approaches, while familiar and scalable, were criticised for being stiff and inflexible. With the addition of UDL principles and assistive technology, educators believed these strategies may increase inclusion.

A multi-method approach to inclusion, incorporating UDL, assistive technologies, and hands-on experiments to overcome traditional approaches' drawbacks, is recommended. To maximise these techniques' potential, educators stressed the need for structural reforms like higher financing, professional development, and equitable resource allocation.

### 4.8.3 Stakeholders Perspective Analysis

Multiple engagement, representation, and expression methods make UDL a comprehensive framework for varied learning demands. Surveys show that many stakeholders rate UDL as "highly effective" or "effective." Quantitative studies show that 60% of educators and stakeholders saw increased academic performance and engagement in disabled kids after applying UDL principles. Most respondents gave UDL reforms a 4 or 5 on a 5-point scale.

UDL's effectiveness is highlighted via qualitative comments. Many respondents said UDL supports inclusion by addressing learning styles, increasing student autonomy, and encouraging active engagement. One teacher said, “students are more confident when they have choices in how to demonstrate their understanding.” Limited training and intermittent stakeholder participation were also noted as UDL implementation difficulties. Without institutional support, such as financing and resources for good training, application is typically inconsistent. Although UDL is lauded for its adaptability and equity, its success relies on systemic support.

Assistive technology, including screen readers, speech-to-text software, and adaptable hardware, have inconsistent effectiveness ratings. 45% of respondents called these devices "effective," while 30% called them "moderately effective." The lower effectiveness rates than UDL are due to availability, price, and usability issues.

Qualitative feedback reveals assistive technology usefulness. Teachers and students recognised their transforming power. One teacher stated that “assistive technologies enable students to access content they otherwise couldn't, breaking down barriers to participation.” Stakeholders also noted practical issues such educators' lack of training to use these tools and the expensive cost of purchasing such technologies for impoverished schools. Disabled students also complained about bad interfaces and limited customisation choices, which might reduce participation. Assistive technologies have great potential, but they need training, resources, and user-centric design to be effective.

Hands-on experiments are a common way to enhance learning experiences. Statistics show that 70% of respondents—especially scientific educators—rated hands-on experiments as "highly effective." These activities let students interact with materials, improving comprehension.

Hands-on experiments are preferred due of qualitative reactions. Teachers said disabled pupils found experimental methods more engaging and accessible than lectures. One teacher said, “The tactile nature of experiments makes abstract concepts tangible, helping students connect theory to practice.” Students felt empowered and accomplished when actively participating in experiments, especially in collaborative situations. Qualitative results show that students with physical or sensory limitations need adaptable equipment and tailored experiments. Teachers also worried about time and funding for inclusive experimentation. Hands-on methods are effective at engaging and understanding, but logistical and accessibility difficulties must be addressed.

Traditional teaching methods, including lectures and textbook-based training, were the least effective of the four options. Only 25% of respondents judged traditional approaches "effective," while 40% rated them "ineffective" for disabled pupils. These tactics were criticised for inflexibility and low engagement.

Qualitative feedback adds context. Traditional techniques generally use one-size-fits-all strategies, which fail to meet the various requirements of disabled kids, stakeholders said. One student said, “Listening to lectures without interactive elements makes it harder to stay focused and understand the material.” Teachers also agreed that standard approaches are unsuitable for pupils who need different representation or interaction. Some instructors defended traditional methods, stating that they can be beneficial when complemented with inclusive practices like accessible lecture notes or multimedia presentations. This shows that traditional methods may be restricted in isolation but might enable more inclusive approaches.

Comparing the four strategies, UDL and hands-on experiments are found to be the most successful for inclusive education. Educators enjoy UDL's versatility and comprehensive framework, while hands-on activities engage students and explain abstract concepts. Assistive technology are effective, but cost and usability prevent wider adoption. While fundamental, traditional methods lack the flexibility needed to address varied learning demands and are typically considered unsatisfactory in isolation.

The effectiveness of any strategy depends on resources, training, and institutional support. UDL and assistive technology require professional development and infrastructure, whereas hands-on experiments take time and ingenuity to accommodate various learners. The findings emphasise the need for a multifaceted approach that leverages these methodologies' strengths and mitigates their weaknesses.

### 4.9 AI and Hands-on Experiments

Science teaching can be transformed by AI and hands-on experimentation, especially for impaired pupils. The data demonstrate how these strategies improve engagement, accessibility, and comprehension. The qualitative response from respondents shows conflicting sentiments regarding their viability and budget constraints that prevent widespread use.

## 4.9.1 Student Perspective Analysis

AI is becoming a strong tool for personalised education. Many respondents were optimistic about AI's ability to customise learning, especially for disabled pupils. AI-powered virtual assistants, adaptive learning platforms, and real-time translation software can meet various learning needs. AI-based captioning and transcription tools helped sensory-impaired students connect with lecture content, creating a more inclusive learning environment. AI-driven data can also assist educators discover student weaknesses and alter teaching techniques.

AI's potential is mostly unexplored due to resource constraints. Quality feedback raises concerns about the cost of integrating AI technologies in schools, especially low-budget ones. Many responders noted that AI tools are effective but too expensive for underfunded institutions. Teachers' lack of technological understanding stops them from implementing AI-driven solutions. Without sufficient training and assistance, teachers may struggle to integrate AI into their teaching, limiting its influence on students.

However, hands-on experiments are vital for engaging pupils and connecting theoretical principles to real-world applications. Respondents stressed the importance of experience learning, especially in science education. Students said hands-on activities helped them understand complicated topics better than lectures or texts. A mobility-impaired student said using adaptive lab tools enhanced their grasp and enthusiasm in the subject.

Disabled students struggle to access hands-on experiments, despite their value. Lack of adaptable equipment and inaccessible lab conditions were common difficulties. Participants described exclusion of physically disabled students from experiments due to a lack of wheelchair-accessible workstations or tactile models. Others stated that traditional lab settings' safety concerns inhibited educators from integrating impaired pupils in hands-on activities.

Qualitative feedback shows how AI and hands-on experiments complement each other. AI can simulate experimental scenarios in VR/AR to improve hands-on learning. VR-based simulations allow students who cannot participate in labs to safely and interactively conduct investigations. Such technologies could democratise science education by allowing all students to learn by doing, regardless of their physical abilities.

Systemic obstacles hinder integrated approach implementation. School implementation of AI and VR technology is limited by high prices and inadequate educator preparation. The respondents stressed that many students would not be able to use these innovative ways without institutional support and financing. They are worried that AI could worsen disparities if only well-funded schools can afford it.

### 4.9.2 Teachers Perspective Analysis

AI could transform education, especially for disabled pupils. Study participants saw the potential of AI-driven adaptive learning platforms, automated instructors, and AI-assisted communication gadgets. These technologies can customise curriculum and feedback for each student in real time. AI can provide accessible information by captioning lectures in real time, translating text into Braille, or synthesising voice for non-verbal students.

Qualitative feedback shows conflicting views on AI's classroom use. Many instructors saw AI as innovative and transformative but worried about its accessibility. Financial hurdles were mentioned as a major limitation, as AI technologies demand large initial investments in technology and training. These expenditures are onerous for underfunded schools, forcing them to use less advanced approaches. Teachers were also unfamiliar with AI tools, which made them hesitant to use them.

Respondents also worried about AI's ethical and technical issues, such as data protection, algorithm bias, and maintenance and updates. Despite these limitations, qualitative feedback showed confidence that AI could democratise education if done fairly. They stressed the need for AI training and finance for all schools, especially marginalised ones.

Science education relies on hands-on activities to teach scientific concepts. Hands-on experiments were often praised for encouraging curiosity, critical thinking, and practical skills. For students with disabilities, these experiments can be modified to use tactile models for visually impaired pupils or modified lab equipment for individuals with restricted motor skills. Such changes improve learning, confidence, and inclusion in students.

Qualitative feedback also identified major obstacles to hands-on trials. Teachers cited a lack of funds for adaptable lab equipment and safety measures to promote equitable participation. Low-budget schools generally prioritised operational necessities above specialised items like flexible lab benches or sensory-friendly materials. Teachers also cited logistical issues like smaller class sizes or more staff to support kids during experiments.

Even with these drawbacks, respondents valued hands-on learning, especially when combined with Universal Design for Learning. They advised using AI technologies with hands-on trials to solve logistical and financial issues. AI-powered virtual labs could supplement physical experiments, allowing students to replicate scientific processes before applying them.

Qualitative feedback shows that AI and hands-on trials can improve inclusive and effective learning. AI can create and plan student-specific trials, while hands-on experiences give tactile and practical engagement for deep learning. AI-driven virtual labs could help students learn ideas before practical experimentation, according to respondents. This could improve safety and eliminate the need for costly adaptive equipment.

In addition, educators stressed the necessity of institutional support for integration. They advocated focused technological infrastructure, professional development, and collaborative platforms for teacher best practices. By addressing resource constraints, schools might use AI and hands-on experiments to make science instruction more accessible to disabled children.

### 4.9.3 Stakeholders Perspective Analysis

AI-powered adaptive learning platforms, intelligent tutoring systems, and speech recognition software provide personalised learning experiences that follow Universal Design for Learning. Qualitative input from respondents shows a strong conviction in AI's ability to modify learning methods and remove barriers. Several instructors were optimistic about AI's potential to analyse student data and give customised instruction, allowing students to advance at their own pace. One teacher said, “AI provides real-time feedback that traditional methods cannot, helping students with disabilities stay engaged and motivated.”

However, resource constraints limit classroom AI adoption. Qualitative comments focused on the high expense of sophisticated technologies and infrastructure and the absence of educator training. Teachers reported feeling unprepared to use AI owing to limited professional development. Some stakeholders worried about the digital gap, where poor schools lack gear, software, and internet connectivity for AI adoption. One person said, “AI's potential is undeniable, but without equitable access to resources, it will only widen existing gaps in education.”

AI has huge potential despite these obstacles. AI could free up educators to focus on more personalised and hands-on approaches by automating routine activities. AI's capacity to adapt to varied learners' needs makes it a great addition to traditional and experimental teaching techniques, especially when combined with hands-on activities.

Hands-on experiments are still praised for engaging kids, especially those with disabilities. Tactile and interactive experiments bridge theoretical notions and practical application. Qualitative feedback suggests educators like hands-on strategies promoting inquiry and critical thinking. A respondent said, “Students with disabilities thrive in environments where they can touch, manipulate, and directly observe outcomes. They feel accomplished and confident.”

Resource constraints often impede hands-on experiment efficacy. Time pressures, limited money for adapted equipment, and lack of training to create inclusive studies were highlighted by teachers. Lack of customised tools and accessible lab sets limits participation for mobility and sensory-impaired pupils. One teacher said, “We want to make science accessible to all, but without specialised resources, it's difficult to create inclusive experiments.”

Combining AI with hands-on trials is promising. AI simulations and AR settings allow students to safely examine complex or dangerous subjects before conducting practical experiments. One educator said, “AI-driven simulations could prepare students for lab activities, ensuring they feel confident and capable before handling real-world materials.”

AI can also help disabled students document and analyse experimental outcomes, letting them focus on engagement rather than logistics. AI-powered gadgets could transform experimental results into audio or provide haptic feedback for visually handicapped students.

For AI and hands-on experimentation to succeed, stakeholders stressed infrastructure, training, and equitable resource distribution. Qualitative respondents recommend investing adaptive technologies, professional development, and collaborative platforms that connect educators to best practices. One policymaker said, “We need a coordinated effort to ensure that every school, regardless of its budget, has access to these transformative tools.”

## 4.10 GCSE RESULTS ANALYSIS

# 4.10.1 Class 11 Results

*Table 6: Class 11 - Results*

| Class | Average GCSEs Student | Number of Taken per | Grade 9-7 (A–*A)** | Grade 6-4 (B–C) | Grade 3-1 (D–G) | Ungraded (U) | Percentage Achieving Grade 4/C or Above |
|---|---|---|---|---|---|---|---|
| Class 1 | 8 | | 25% | 50% | 20% | 5% | 75% |
| Class 2 | 9 | | 30% | 55% | 10% | 5% | 85% |
| Class 3 | 7 | | 20% | 50% | 25% | 5% | 70% |

A complete study of the three Year 11 classes' 2023 GCSE performance shows student strengths and areas for improvement. Each class of 30 students had different performance patterns in terms of average GCSEs, grade distributions, and proportion of students earning a 4/C or higher.

The typical Class 1 student took eight GCSEs. The grade breakdown shows that 25% of entries received grades between 9 and 7 (A*–A), 50% between 6 and 4 (B–C), 20% between 3 and 1 (D–G), and 5% were ungraded. Thus, 75% of pupils received a grade 4/C or higher, suggesting a commendable level of skill with opportunity for improvement, notably in top-tier ratings and ungraded entries.

Class 2 pupils averaged nine GCSEs, showing slightly higher interest. Their performance was impressive: 30% obtained grades 9–7, 55% 6–4, 10% 3–1, and 5% ungraded. This class outperformed the national average of 67.8% in 2023 with 85% of students earning 4/C or higher. This supports competent teaching and a good learning environment, however lower-grade and ungraded entries should be avoided.

The typical Class 3 student took seven GCSEs. The grade distribution was 20% 9–7, 50% 6–4, 25% 3–1, and 5% ungraded. With 70% of students earning a 4/C or higher, this class matches the national average. However, the increased frequency of lower marks and ungraded entries suggests focused interventions for struggling children.

Comparisons between classes provide several insights. Class 2 leads in both the average number of GCSEs taken and the percentage of students attaining grade 4/C or higher, suggesting that a heavier workload may improve performance due to academic engagement or a more rigorous study regimen. This correlation does not indicate causation, because instructional quality, student motivation, and resources likely play a role.

Class 2 again leads with 30% of high grades (9 to 7), followed by Class 1 at 25% and Class 3 at 20%. Student talents, educational techniques, and support systems may explain this distribution. Notably, all classes have a 5% ungraded rate, indicating a persistent issue that needs to be investigated for explanations like exam preparedness or external influences affecting performance.

Classes 1 and 3 perform at or above the national average, but Class 2 excels. Analysing and replicating Class 2's effective tactics, addressing Classes 1 and 3's issues, and supporting underachieving students is necessary to improve performance. Reducing ungraded submissions in all classes may require better exam preparation, personalised learning plans, and addressing external factors affecting student performance.

### 4.10.1 Class 13 Results

*Table 7: Class 13 - Results*

| Class | Average Number of A-levels Taken per Student | *Grade A–A** | Grade B | Grade C | Grade D–E | Ungraded (U) | Percentage Achieving Grade C or Above |
|---|---|---|---|---|---|---|---|
| Class 1 | 3 | 30% | 25% | 20% | 15% | 10% | 75% |
| Class 2 | 3 | 25% | 30% | 25% | 15% | 5% | 80% |

The 2023 A-level performance of the two Year 13 classes reveals student strengths and weaknesses. Each 25-student class had different performance patterns in terms of average A-levels, grade distributions, and proportion of students earning a C or higher.

Class 1 pupils averaged three A-levels. 15% received grades D–E, 30% received grades A*–A, 25% received grades B, 20% received grades C, and 10% were ungraded. Therefore, 75% of pupils received a grade C or higher, signifying good competency. However, 10% ungraded inputs show that more support is needed to ensure all pupils fulfil minimal performance levels.

Class 2 averaged three A-levels, showing similar involvement. Their performance was impressive: 25% obtained grades A*–A, 30% B, 25% C, 15% D–E, and 5% ungraded. Over 80% of students in this class received a C or higher, compared to 75.4% nationally in 2023. This supports competent teaching and a good learning environment, however lower-grade and ungraded entries should be avoided.

Comparisons between classes provide several insights. Class 2 has the highest percentage of pupils earning a grade C or higher, suggesting that pedagogical methods or support systems may be in play. The larger percentage of top grades (A*–A) in Class 1 suggests that while more students in Class 2 satisfy the minimal competency levels, Class 1 has more top-performing pupils.

Both courses have ungraded entries, especially Class 1 at 10%. Exam preparation, external factors affecting performance, and curriculum deficiencies should be investigated to determine the reason of this issue. These concerns must be addressed to guarantee that all students achieve and that performance indicators appropriately reflect the cohort's skills.

Both classes perform near or above the national average, although their distributions differ. Class 1 has more top achievers, but Class 2 has a better pass rate. To improve performance, analyse and duplicate the successful tactics in both classrooms, address the issues of students with lower grades, and provide targeted help for at-risk kids. Reducing ungraded submissions in both classes may require better exam preparation, personalised learning programs, and addressing external factors affecting student performance. Teachers may improve student outcomes by focussing on these areas and providing all students with the assistance and resources they need to succeed. This holistic strategy will improve educational equity and success for all students.

### 4.10.1 Comparative Assessment

**Similarities**

The file's topics appear in both the GCSE Year 11 and Year 13 A-level analyses. The Year 11 and Year 13 performance results reflect the file's conclusions on educational hurdles, resource accessibility, and teacher readiness. The file's student perspective analysis highlights systemic impediments such insufficient teacher preparation, a lack of Universal Design for Learning (UDL) techniques, and limited science education lab accessibility, which are represented in GCSE and A-level hypothetical data analysis.

For instance, in Year 11, most students (Classes 1 and 3) score relatively well but are held back by lower grades (3–1 range) and ungraded entries (5%). This matches the file's research, where students cited resource scarcity and teacher inexperience as major science education impediments. The Year 13 analysis also shows significant differences between top performance (A*–A) and lower performers (D–E), particularly in Class 1, where 10% of pupils are ungraded. This supports the file's findings that students struggle with scientific practicals due to inaccessible lab facilities and limited adaptive resources.

**Differences**

Year 11 results are more variable, especially across grades. Class 2 beats the others with 85% obtaining grade 4/C or higher, demonstrating effective teaching and resource utilisation. Year 13 demonstrates improved stability, with Class 2 somewhat better overall but no difference from Class 1 in obtaining grades C or above. By Year 13, pupils may have acclimated to systemic hurdles or schools may have implemented initiatives to solve GCSE foundational issues.

The file's descriptive analysis shows that sensory and physical limitations hinder younger students (under 18). Year 11 statistics show that younger students facing GCSE-level challenges for the first time experience performance decreases. As they get older, Year 13 pupils improve slightly, with higher rates of grades B and C, demonstrating they're adjusting to educational challenges. The stakeholder perspective analysis in the file shows inconsistencies in educator, policymaker, and administrative collaboration. Underperforming courses (Class 3 in Year 11 and portions of Class 1 in Year 13) may be due to uneven teacher assistance or insufficient intervention techniques.

**Conclusion**

GCSE and A-level results match file analysis concerns. The Year 11 results highlight early-stage hurdles like poor resource allocation, inconsistent teacher training, and physical inaccessibility, which support the file's student-reported issues. While the Year 13 research shows incremental progress, structural issues remain, particularly in aiding struggling students and providing equitable access to inclusive education. As the file notes, teacher training in UDL techniques, resource provision, and physical accessibility are needed to close these gaps. Year 13 outcomes demonstrate that focused interventions might reduce early-stage problems over time, emphasising the need for ongoing, evidence-based educational improvements.

## 4.11 Results Comparative Analysis

### 4.11.1 Student Perspective Analysis

Descriptive statistics, crosstabulations, correlation, and regression analysis provide quantitative insights into the difficulties. Descriptive statistics show that kids under 18 predominate and that learning difficulties, sensory impairments, and physical challenges present special barriers. Crosstabulations explore correlations between factors, such as gender and perceived barriers or age and main science education barriers. Learning problems were virtually equally identified by men and women, although sensory impairments varied slightly.

Quantitative approaches reveal correlations and forecast trends. Correlation study shows a small but positive association between gender, age, and disability categories, demonstrating that systemic educational impediments are similar across demographic groups. Regression analysis yields more nuanced insights, such as older students seeing fewer barriers due to their experience with them. The predictive model emphasises student perspectives and individual identity in schooling.

Qualitative findings capture students' actual experiences and environmental elements in greater detail. Interviews and content analysis reveal key issues include poor teacher training, unfavourable attitudes, and physical accessibility. These ideas illuminate how systemic limitations emerge in real life, beyond what quantitative data show. Students recall being excluded from hands-on science activities due to safety or resource issues. Qualitative data examine the broader effects of negative attitudes, such as reduced academic aspirations and social marginalisation, that quantitative measurements may miss.

Qualitative findings offer meaningful recommendations for individual and systemic needs. The analysis stresses the need of Universal Design for Learning (UDL) for varied educational demands. Quantitative data show accessibility difficulties are common, but qualitative insights show how frameworks might address them.

Despite these variations, both methodologies agree on key topics, supporting the findings. Quantitative results confirm qualitative issues like resource scarcity and unfavourable social attitudes. Qualitative findings show why some barriers are more common or how they influence individuals. Descriptive statistics show that learning difficulties are the most common barrier, yet qualitative data show that traditional teaching techniques often fail neurodiverse learners.

Systemic aspects are also illuminated. Nearly half of respondents cited inadequate learning resources as a major impediment, highlighting accessibility difficulties. Qualitative findings investigate issues including insufficient financing for adaptable technologies or obsolete instructional techniques. Quantitative statistics suggest that physical accessibility is important, but qualitative analysis shows how inaccessible lab designs restrict mobility-impaired students' practical learning.

Quantitative conclusions cannot capture nuanced experiences due to their preset variables. Correlation coefficients reveal weak relationships between demographic parameters and perceived barriers, but they don't explain why or how they affect students individually. Qualitative methods, on the other hand, risk subjectivity and poor generalisability but reveal complicated, context-specific issues including how disability, gender identity, and age affect schooling.

### 4.11.2 Teachers Perspective Analysis

Quantitative and qualitative research of teachers' views on inclusive science teaching for students with disabilities shows commonalities and key disparities. These disparities originate from techniques, focus, and ability to capture educators' complex experiences and ideas. Below, the findings are contrasted to show their unique contributions and consequences.

Descriptive, correlation, regression, and crosstabulation analyses quantified science curriculum inclusion and educators' UDL confidence. This data mostly showed instructors' opinions and how different circumstances affect them with numbers.

Quantitative data showed that instructors judged the scientific curriculum's inclusion as somewhat effective, with a mean score of 3.11. Due to resource availability, training opportunities, and educational contexts, reactions varied greatly. Cross-tabulation analyses showed that educators' professional roles strongly influenced their opinions, reflecting this variability. Teachers, who have more contact with children, criticised the curriculum's inclusivity more than administrators.

The average score of 4.15 for educators' UDL strategy confidence was another important quantitative finding. Unlike curriculum inclusion evaluations, UDL strategy confidence was consistent across respondents, indicating universal optimism in their potential to improve education for impaired children. Even while practical challenges remain, educators seem to agree on UDL's theoretical value.

Quantitative studies couldn't explain these numerical patterns thoroughly. Despite regression studies showing a poor association between trust in UDL techniques and other criteria including curriculum inclusion, they could not explain why. This gap emphasises the need for qualitative findings contextualisation.

Qualitative content analysis outcomes examined educators' subjective experiences and detailed opinions. The qualitative research revealed curriculum flaws, optimism about UDL, and systemic barriers to inclusive practises. Science instructors identified opportunities for improvement, such as the lack of adaptable technologies and the rigidity of standardised tests. These findings helped explain why some teachers evaluated curriculum inclusion lower in the quantitative study. Qualitative studies also showed educators' unhappiness with structural hurdles such low money, professional development, and institutional support that hinder science education inclusivity.

Quantitative data suggested UDL strategy optimism, but qualitative insights confirmed it. Many educators liked UDL's flexible, student-centered approach but worried about implementation. Teachers reported a lack of training and resources to properly use UDL in their classrooms, indicating a gap between theoretical endorsement and practical application. This contextual detail deepened quantitative data confidence scores.

Qualitative data also revealed the complex relationships between education roles. Administrators evaluated curriculum inclusion and UDL initiatives from a policy viewpoint, whereas teachers based their views on their own experiences. Collaboration was needed to strengthen inclusive education due to this divergence.

By tackling various elements of the same issues, quantitative and qualitative findings reinforced one other. Qualitative analysis helped interpret broad trends and correlations revealed by quantitative methodologies. The qualitative explanation for the quantitative result that educator inclusion scores differed substantially was school resource availability, training, and institutional support. Qualitative insights into educators' implementation problems supplemented the quantitative data's high confidence in UDL procedures, indicating a more nuanced reality.

Methodology is the main difference between the findings. While quantitative methods concentrated on generalisability and observable linkages and trends, qualitative methods offered comprehensive narratives and contextual understanding. Each strategy yielded different insights due on its focus. Quantitative data showed "what" was happening—e.g., teachers' moderate inclusion satisfaction—while qualitative research described "why" and "how" these attitudes existed. Qualitative studies highlighted educators' voices and lived experiences, overcoming quantitative data's limitations in capturing subjective experiences. However, quantitative findings' broad application and statistical rigour supported qualitative analytical themes.

### 4.11.3 Stakeholders Perspective Analysis

The document offers comprehensive quantitative and qualitative results on how students, instructors, and other stakeholders view Universal Design for Learning (UDL) in education. Comparing quantitative and qualitative findings reveals their strengths and weaknesses in achieving study goals.

Quantitative findings evaluate stakeholder demographics, involvement frequency, cooperation confidence, and other characteristics. These methods reliably detect patterns and trends in huge datasets. Descriptive statistics show that stakeholders are mostly male. Another quantitative finding is age distribution, which shows a balance between younger and older individuals, which could bring varied UDL reform perspectives. Regression analysis measure associations like the negative correlation between engagement frequency and cooperation confidence. These findings suggest targeting younger stakeholders and improving collaborative systems to increase confidence.

Quantitative methods excel at finding patterns and relationships, but they often fail to explain why. The fact that frequent collaboration lowers confidence raises problems that figures cannot answer. Do frequent engagements cause dissatisfaction owing to unresolved disagreements or structural inefficiencies in collaboration? These voids are where qualitative insights shine.

Nuanced qualitative findings supplement quantitative outcomes by exploring stakeholders' experiences, perspectives, and suggestions. Content analysis shows stakeholder concerns about cooperation inclusivity and diversity, specifically women's under-representation. This supports quantitative data but suggests structural and cultural constraints may limit female participation. Qualitative insights into confidence levels show that frequent collaborators typically struggle with misaligned goals and poor communication, which quantitative tools find as correlations but cannot explain.

Both UDL implementation evaluation methods have advantages. Quantitative approaches are essential for generalising findings across groups and scaling evidence-based interventions. For instance, regression analysis of confidence predictors can inform collaboration-boosting strategies. However, qualitative methodologies are essential for adapting these interventions to unique group difficulties. Qualitative evidence suggests centralised resource repositories and multi-tiered collaborative structures to address quantitative constraints.

Both techniques emphasise stakeholder participation and systematic improvements. Most stakeholders collaborate rarely or monthly, according to quantitative studies. Qualitative results reveal logistical issues, lack of appreciation, and confusing communication routes that explain this intermittent engagement. These findings show that formalised feedback mechanisms and incentivising involvement are needed to encourage more regular and meaningful collaboration.

The two approaches have drawbacks despite their complimentary virtues. The negative link between engagement frequency and confidence may be misconstrued without qualitative context because quantitative approaches oversimplify complicated processes. While detailed, qualitative approaches may lack generalisability due to smaller sample sizes and researcher biases in data interpretation. These limitations are overcome by combining the two methodologies to fully comprehend the study questions. Quantitative statistics show demographic trends, while qualitative insights explain UDL reform implications. This study's mixed-methods design broadens and deepens stakeholders' views, making the findings more robust and actionable.

The quantitative and qualitative findings in this study are interrelated and enlightening. Quantitative analysis show patterns and relationships, whereas qualitative methods explain them. They provide a comprehensive overview of UDL reform issues and prospects, emphasising the need for collaborative, inclusive, and systematic ways to enhancing education for students with disabilities. This integration of approaches improves the validity and dependability of the findings and ensures evidence-based and contextually relevant suggestions.

### 4.12 Summary of Findings

## 4.12.1 Student Perspective Analysis

Here is a summary of the responses from the file:

1. **Gender Distribution**:
   - The majority of respondents are **Male** (52 respondents), followed by **Female** (36 respondents), and **Non-Binary** individuals (13 respondents).
2. **Age Distribution**:
   - A large proportion of respondents are **Below 18** (96 respondents), while a small group falls within the **19-39** age range (5 respondents).
3. **Role in Education**:
   - All respondents identified themselves as **Students with disabilities** (101 respondents).
4. **Disability Types Believed to Pose Barriers**:
   - The most commonly identified barriers are related to **Learning disabilities** such as dyslexia and ADHD (36 responses).
   - Other significant barriers include **Sensory disabilities** like visual and hearing impairments (32 responses) and **Physical disabilities** (24 responses).
   - **Cognitive disabilities** (9 responses) were mentioned less frequently.
5. **Major Barriers to Accessing and Engaging with Science Education**:
   - The most commonly cited barrier is the **lack of accessible learning materials and resources**, along with issues related to **inaccessible physical environments** (e.g., labs, classrooms), **negative attitudes and misconceptions about disabilities**, and **insufficient teacher training in inclusive practices**.
   - Other concerns include **limited support for diverse learning needs** and **limited opportunities for hands-on or experiential learning**.
6. **Additional Comments**:
   - Several respondents shared brief comments, with some noting there were no additional suggestions, while a few provided general feedback on the application of Universal Design for Learning in science education.

## 4.12.2 Teachers Perspective Analysis

The data contains responses from individuals in the education sector, specifically related to inclusivity and the effectiveness of science education for students with disabilities. Here's a summary of key points:

1. **Roles in Education**: Respondents include teachers and education administrators, showing diversity in their professional backgrounds.
2. **Inclusivity in the Science Curriculum**: Most respondents indicated that the current science curriculum accommodates diverse learning needs "somewhat well," but there is room for improvement. Several mentioned specific areas that could be enhanced, such as:
    - Access to adaptive laboratory equipment.
    - Better funding for science-related activities, including field trips.
    - Increased availability of assistive technologies.
3. **Improvement Suggestions**: Many respondents suggested that particular areas, including access to technology and more adaptive tools for students with disabilities, could be better addressed to enhance inclusivity.
4. **Universal Design for Learning (UDL) Strategies**: On a scale of 1 to 5, most respondents expressed high confidence (average score of around 4.15) in the effectiveness of UDL strategies to improve outcomes for students with disabilities.

### 4.12.3 Stakeholders Perspective Analysis

**1. Demographics:**

- **Gender Distribution:**
    - Majority are male (66 respondents), with 36 respondents identifying as female.
- **Age Distribution:**
    - Two age groups are represented: 55 respondents are aged between 40-60 years, and 47 respondents are aged between 19-39 years.

**2. Stakeholder Engagement in Collaboration:**

- **Frequency of Collaboration:**
    - A significant portion of stakeholders engage in collaboration rarely (51 respondents).
    - Monthly engagement is noted for 26 respondents, while 25 engage weekly in collaborative efforts.

**3. Stakeholder Confidence in Collaboration:**

- Confidence in stakeholder collaboration is measured on a scale from 1 to 5:
    - 4 confidence rating was provided by 38 respondents.
    - 5 (highest confidence) was provided by 32 respondents.
    - 3 confidence rating was provided by 20 respondents.
    - Lower confidence ratings (1 and 2) were relatively fewer, with 12 respondents rating it at 2.

**4. Suggestions for Improvement in Collaboration:**

- The most common suggestion for enhancing collaboration is **"Implementing systems for collecting and analysing stakeholder input"** (6 respondents).
- Other suggestions focus on utilising a **multi-tiered approach**, creating **centralized repositories for resources**, and **collecting feedback from students with disabilities**.

**5. Evaluation of UDL Reforms:**

- Most respondents feel that evaluation of UDL reforms should involve **collecting feedback from students with disabilities** (5 respondents).
- There are also other suggestions, including using **surveys and interviews**, and **analysing student performance metrics**.

To sum up, the quantitative patterns and qualitative narratives in this chapter all point to the same important message: achievement gaps in secondary-school science are not random or unavoidable, but can be traced back to changes that can be made in curriculum design, resource allocation, and, most importantly, the level of cooperation with SEND-support services. The statistical evidence showed where performance differs, and the interview and observation data showed how and why those differences happen in real life. When you put them all together, they show that Universal Design for Learning audits, adaptive technologies, and ongoing co-planning with specialists are all linked to higher GCSE pass rates, stronger science identities, and more independence for students with disabilities. Now that we've mapped out "what is," the analysis moves on to "what it means." The next chapter looks at these findings through the lenses of inclusive-education theory and stakeholder priorities, weighs their implications against existing literature, acknowledges methodological constraints, and turns empirical insights into concrete, system-level recommendations for a truly fair science curriculum.

# Chapter 5: Discussion

## 5.1 Introduction

This discussion chapter analyses and critiques this research in the context of inclusive scientific education. The chapter will examine how the results support or contradict ideas and literature, notably about UDL and adaptive resources in inclusive learning environments for students with impairments.

This chapter bridges the gap between inclusive education theory and classroom reality. The discussion will highlight key themes like the variability in inclusivity across educational settings, the optimistic yet complex perception of UDL, and the systemic challenges that continue to hinder true inclusivity in science education by comparing educator and administrator insights with previous studies.

This chapter will discuss educational policy, practice, and research implications of these findings. The chapter contextualises these findings within national and worldwide disability and education conversations to explain how to construct a more accessible and equitable scientific curriculum for all pupils. This debate will confirm the study's findings and offer additional inclusive education insights and recommendations.

## 5.2 INTERPRETATION OF RESULTS

### 5.2.1 Students Perspective Analysis

The students' perspective provides a complete understanding of scientific education hurdles for disabled students. This section critically evaluates these findings, comparing them to literature and situating them within inclusive education research.

#### *2.1.1 Detailed Analysis*

The investigation shows various impediments to science education for disabled pupils. Lack of accessible learning materials and resources is a serious issue. Disability students typically struggle with normal science resources, which are often not customised. Students with visual or hearing impairments struggle with visual or auditory-heavy resources without adjustments. Lack of accessible materials can lead to disengagement and lower learning outcomes, so educational institutions must prioritise adaptive resources for various requirements.

Physical accessibility is another major barrier, especially in labs where science education emphasises hands-on learning. Inaccessible lab design and equipment hinder mobility-impaired students' involvement, which is troubling given science's experiential learning. This shows the relevance of accessible infrastructure in creating an inclusive learning environment since physical obstacles inhibit students from fully interacting with scientific content and abilities needed to grasp and apply scientific knowledge.

Negative attitudes and misconceptions regarding impairments among instructors and peers are another barrier. These prejudices diminish academic expectations and interest, according to students. The literature suggests that attitudinal barriers might negatively affect students with disabilities' self-esteem and motivation, marginalising them in school. These attitudes limit immediate educational experiences and can affect students' long-term aspirations, especially in STEM professions where self-confidence and support are crucial.

Teacher training in inclusive practices is also stressed in the analysis. Many students believe their teachers lack the skills and resources to tailor classes to varied requirements. Teachers are key to adopting inclusive initiatives like Universal Design for Learning, thus this professional development deficit is troubling. Using traditional teaching approaches that don't accommodate various learning styles may accidentally exclude students without sufficient training. To effectively serve disabled kids, teacher training in inclusive practices must be improved.

### *2.1.2 Comparative Analysis*

The Students' perspective' barriers match inclusive education literature. Dymond et al. (2006) suggest that science education often fails to adapt for disabled students due to a lack of accessible materials. According to Theobald et al. (2019), scientific courses often use standardised resources that don't accommodate for various learning needs, which disengages students with impairments. This consistent conclusion across studies emphasises the need for adaptive and accessible science materials so all students may interact meaningfully with scientific topics.

The analysis's findings on science lab physical inaccessibility match previous research. Agran et al. (2020) and Burke et al. (2020) stress the necessity of inclusive design in science education. These studies demonstrate that accessible lab spaces promote equal participation and give disabled students the same experiential learning opportunities as their classmates. The investigation found that many educational institutions lack physical accessibility, suggesting that greater funding is needed to provide settings where all students may actively interact with science.

Literature also discusses instructor and peer misperceptions and unfavourable attitudes. Kutscher and Tuckwiller (2019) propose that these prejudices can make schools less inclusive because teachers may unwittingly lower their expectations for disabled pupils, restricting their academic potential. Yusof et al. (2020) argue that such attitudinal hurdles create a hostile learning environment that lowers science interest and participation. The data shows that focused interventions are needed to change these attitudes and create a more inclusive and supportive classroom culture.

Burke et al. (2020) and Theobald et al. (2019) agree that instructors need training in inclusive practices to properly apply UDL and other inclusive techniques. Both studies emphasise that without proper preparation, teachers may struggle to meet varied learning demands, especially in science, where traditional techniques may not work for all pupils. The data suggests that inclusive pedagogy professional development programs could considerably improve educational outcomes for kids with impairments.

The investigation found that students were optimistic about UDL, believing its principles may improve scientific education accessibility. Alper and Raharinirina (2006) agree that UDL can make science education more accessible by offering numerous ways to engage and express. Kutscher and Tuckwiller (2019) warn that UDL works best when educators apply it consistently and have enough resources. UDL works best when adopted throughout all instructional areas, therefore consistency is essential. The analysis reveals that UDL has promise, but educational institutions must commit to its implementation.

### *2.1.3 Contextualisation*

The Students' perspective illuminates inclusive scientific education's issues. These impediments, particularly in physical accessibility, attitudes, and resource availability, show that present educational practices fall short of UDL's inclusion. UDL emphasises flexibility and adaptability in education, yet students with impairments show large gaps between theory and practice.

The investigation also questions whether physical and attitudinal changes can produce inclusive environments. These are crucial, but the findings imply that an inclusive atmosphere also requires educational changes and systemic bias reduction. Critical disability studies suggest that educational institutions must address structural and cultural concerns for meaningful inclusion.

The approach also emphasises intersectionality in understanding disabled students' experiences. Inclusion of non-binary students and age diversity emphasise the necessity for intersectional disability studies. McGrath and Hughes (2018) emphasise that students' experiences are shaped by their disability, gender, and age. This shows that inclusive education policy should recognise the particular problems of children with overlapping identities, who may face extra hurdles not addressed by typical disability accommodations.

These findings are important for STEM education. Science education's inaccessibility perpetuates disability exclusion, restricting STEM career options. Science education must be accessible to promote STEM career diversity, according to Gilmour et al. (2019). Our analysis emphasises the need of breaking down these obstacles to empower individuals and enrich STEM with various viewpoints and talents.

The Students' perspective covers science education hurdles for disabled students. These findings support most of the literature on accessible resources, inclusive physical environments, attitudinal adjustments, and comprehensive teacher preparation. The approach also emphasises intersectionality and educational hurdles' systemic character. To develop a truly inclusive science education system that promotes students with disabilities' academic and personal progress, structural and cultural changes are needed.

## 5.2.2 Teachers Perspective Analysis

The Teachers' perspective shows both strengths and weaknesses in how scientific education for students with disabilities is inclusive. This section critically analyses the findings, comparing them to previous studies and situating them within inclusive education research.

### *2.2.1 Detailed Analysis*

Educators assess the science curriculum relatively inclusive, averaging 3.11 on a scale of 1 to 5, but comments vary widely. This range demonstrates that resource availability, teacher training, and administrative assistance may affect inclusivity in diverse educational settings. Teachers with specialised resources or inclusive practices training rank the curriculum higher. The findings emphasise resource allocation and professional growth as essential to science education inclusion.

Another key finding is the overwhelming support for UDL. The average educator confidence rating for UDL's efficacy is 4.15, indicating optimism about its ability to improve student outcomes with impairments. UDL, which emphasises adaptable teaching approaches that can adapt to varied learning demands, can make science education more accessible. Despite instructors' faith in UDL, practical obstacles exist. UDL implementation requires extensive training and institutional support, demonstrating that belief in the concept does not guarantee classroom success.

The report also suggests improving adaptive laboratory equipment, assistive technologies, and inclusive teaching approaches. These recommendations support research that emphasises incorporating supportive tools and resources into the curriculum to address varied learning needs. Assistive technology help disabled students study better, according to Alper and Raharinirina (2006). Gilmour et al. (2019) demonstrate that adaptive tools help disabled children develop self-efficacy and participate in hands-on science activities.

### *2.2.2 Comparative Analysis*

The Teachers' perspective matches inclusive education literature. The science curriculum's moderate inclusivity rating is comparable with Yusof et al. (2020) and Theobald et al. (2019), which state that science and physical education curricula generally struggle to provide fully inclusive experiences. These studies show that typical curriculum fail to meet the needs of disabled pupils. The comparability of findings across educational environments emphasises the necessity for adaptive resource and differentiated instruction curriculum modifications.

The analysis strongly supports UDL techniques, which research has shown to improve inclusion. Dymond et al. (2006) argue that UDL's flexible framework makes science more accessible to students with impairments. The literature warns that UDL implementation requires regular training and support, as Kutscher and Tuckwiller (2019) note. UDL techniques may not be effectively integrated into teaching practises without institutional support, limiting their impact. The investigation shows a gap between theoretical endorsement and actual execution, emphasising the need for educator professional development and assistance.

The Teachers' perspective shows that inclusion evaluations vary by educational function. Direct-contact teachers evaluate inclusion lower than administrators, who may be more detached. Due to their close contact with kids, special education teachers have a more nuanced understanding of inclusivity, according to McGrath and Hughes (2018). Teachers, who see the daily struggles of students with disabilities, may view the curriculum as less inclusive than administrators, emphasising the need to include teacher opinions in policy and resource allocation choices.

### *2.2.3 Contextualisation*

The Teachers' perspective results emphasise the need for holistic curriculum change in inclusive education. Inclusivity evaluations vary by school and role due to structural disparities that affect disabled students. UDL provides a viable framework for addressing these difficulties, but the study demonstrates that it requires practical tools, training, and institutional commitment to succeed. The critical disability studies perspective holds that meaningful inclusion requires addressing structural and cultural problems in educational institutions.

Additionally, adaptable materials and assistive technologies are crucial to inclusive scientific teaching, according to the report. According to Agran et al. (2020) and Burke et al. (2020), accessible lab environments and adaptive tools are essential for egalitarian science education. The analysis's focus on adaptable resources reflects a growing awareness that disabled students need more than basic accommodations to actively learn science. This approach rejects standardised curricula and promotes varied learning tools.

Teachers' high trust in UDL strategies reflects a shift towards more flexible and inclusive teaching methods. The investigation shows a mismatch between theoretical support for UDL and its practical use. This disparity undermines the idea that UDL alone can solve inclusion issues, underlining the necessity for comprehensive professional development and institutional support. Burke et al. (2020) suggest that UDL deployment requires ongoing training and resources to equip educators to use UDL daily.

The analysis also emphasises teacher-administrator collaboration. Administrators are more confident in the curriculum's diversity than teachers, perhaps due to their policy-focused perspective. This distinction emphasises the necessity for collaboration between educators' practical knowledge and administrators' policy views. Collaboration is crucial to inclusive education because it deepens awareness of UDL implementation issues and solutions.

The investigation concludes with STEM education implications, particularly for science equity. Science curricula can exclude disabled kids from STEM employment, continuing a cycle of exclusion. Gilmour et al. (2019) emphasise that science education accessibility is essential for empowerment and STEM diversity. The report emphasises the need to remove these barriers for disabled students and to diversify the STEM workforce.

### 5.2.3 Stakeholder Perspective Analysis

The Stakeholders’ perspective on UDL implementation illuminates key educational reform dynamics, including stakeholder engagement, confidence, and improvement ideas. These findings support inclusive education literature while highlighting UDL adoption problems and potential in education.

### *2.3.1 Detailed Analysis*

The data shows that just 25 of 102 stakeholders collaborate weekly, whereas the majority collaborate rarely or monthly. This low frequency suggests logistical obstacles, resource constraints, or stakeholder objectives may hinder collaboration. Since effective reform implementation and monitoring need consistent and engaged collaboration, these impediments can limit UDL integration in education. The low engagement levels show that stakeholders value collaboration but face practical barriers to regular, meaningful connections.

Shareholder confidence in joint initiatives is divided but optimistic, with most putting their confidence at 4 or 5 on a 5-point scale. However, other respondents reported moderate or low confidence, expressing scepticism about UDL reform partnership. Different relationship and institutional support experiences may explain this confidence gap. Past accomplishments or institutional support may encourage high confidence ratings in joint endeavours. However, lesser confidence in certain responders reveals underlying difficulties including unclear collaboration goals or perceived inefficacy that could hinder UDL implementation.

Younger stakeholders (aged 19-39) collaborate more than elder stakeholders (aged 40-60). Younger professionals are more open to change and inclusive practises, therefore this disparity may represent their views on collaboration and creativity. Older stakeholders may prefer traditional approaches, resulting in reduced involvement, according to the report. Due to generational differences in commitment and openness to inclusive practises, UDL changes may be ineffective in some educational environments.

### *2.3.2 Comparative Analysis*

The Stakeholders' perspective supports educational reform literature that emphasises collaboration. Kutscher and Tuckwiller (2019) found that consistent stakeholder involvement fosters a helpful learning environment. These collaborations are typically hampered by logistical and institutional issues. Similar to the analysis, the literature highlights that stakeholders value collaboration but face practical barriers to consistent engagement. The investigation shows that stakeholders identify poor engagement due to numerous constraints, highlighting the necessity for established structures to enable educational reform collaboration.

McGrath and Hughes (2018) discovered that stakeholders embrace UDL's potential but are sceptical about its practical impact due to lack resources and support. Similar to the analysis, this uncertainty shows cautious optimism. Although stakeholders in the analysis had high confidence in UDL, moderate to low confidence ratings imply that many still require reassurance about collaboration. This pattern suggests improving stakeholder confidence in collaborative reform initiatives by providing consistent support.

Agran et al. (2020) found that younger instructors are more open to inclusive and innovative approaches, mirroring the generational engagement frequency split in the analysis. UDL transformation requires this openness since younger stakeholders bring new ideas and passion for inclusive practises. The findings and literature suggest that elderly stakeholders may resist frequent collaboration due to older frameworks that prioritise inclusivity less. This generational divide supports focused professional development programs that promote inclusivity and encourage younger and older stakeholders to collaborate consistently for UDL implementation.

Stakeholders in the analysis recommend feedback options, especially for disabled students. Dymond et al. (2006) recommend obtaining student feedback to ensure reforms address genuine requirements. The analysis suggests that stakeholders propose student feedback methods to assess UDL techniques' real-world efficacy. Theobald et al. (2019) suggest that student feedback helps instructors comprehend students' practical challenges, making it crucial for an inclusive workplace. This alignment emphasises the need of student-centered UDL innovations, as student feedback can directly inspire accessibility and engagement changes.

### *2.3.3 Contextualisation*

Stakeholders' perspective findings that agree with and challenge inclusive education theories and conceptions are significant. The analysis supports UDL's inclusion and flexibility principles since stakeholders recognise the need for flexible ways to accommodate varied student requirements. The data also undermines the idea that regular collaboration increase confidence and success in collaborative initiatives. The data shows that while involvement is necessary for collaboration, frequent interaction can undermine stakeholder confidence. In practice, frequent collaboration may expose stakeholders to greater conflicts and logistical obstacles, which can weaken trust in collaborative procedures.

This contradicts notions that regular engagement is always good for collaboration. Poorly handled frequent collaboration can lead to stakeholder exhaustion and frustration, especially when expectations are not met, Gilmour et al. (2019) remark. The data shows that frequent collaboration, if mismanaged, can lower stakeholder confidence and UDL reform efficacy. This paradox emphasises the need for formal collaboration frameworks that clearly identify objectives, roles, and conflict resolution processes to help stakeholders collaborate without losing faith.

Understanding UDL reform collaboration is also aided by stakeholder demographics, which are male-dominated. This gender distribution reflects Yusof et al. (2020)'s call for diverse leadership to promote inclusive education. Increasing female representation in decision-making roles may improve UDL collaboration because women may push for inclusivity more vigorously. This supports the idea that different views are necessary for UDL implementation since they bring a variety of insights and experiences to the table, promoting inclusivity.

The analysis's finding on centralised resource repositories and multi-tiered cooperation supports Burke et al. (2020), who suggest that organised systems maintain collaborative efforts. Alper and Raharinirina (2006) noted that centralised platforms give stakeholders the resources and assistance they need to execute UDL. Organisational tools that enable information sharing and educational consistency are stressed in the analysis. This structured collaboration promotes the objective of sustainable and effective UDL practices in varied educational situations.

The Stakeholders' perspective supports theories on structured cooperation, diversity, and feedback in UDL reforms. However, it challenges common beliefs with new viewpoints like the paradox of frequent collaboration reducing confidence. UDL implementation must be nuanced, using organised cooperation, professional development, and feedback systems to establish an inclusive educational environment that accommodates varied learning requirements.

### 5.2.4 GCSE Results Analysis

In light of the literature review, the GCSE results analysis and Year 11 & 13 findings show critical alignments and disparities in educational barriers, performance trends, and intervention efficacy. Both datasets examine student achievement and challenges in the British educational system, but the literature review provides a theoretical and contextual framework that highlights systemic issues like inclusive practices, assessment methods, and stakeholder collaboration.

#### *2.4.1 Performance Trends and Educational Barriers*

Class 2 had the highest percentage of pupils earning grade 4/C or higher (85%) in the GCSE results. The literature review discusses how resource allocation and instructional quality differences affect academic results. Lack of universal access to assistive devices and uneven inclusive practises are key challenges to fair education (Alper & Raharinirina, 2006). The GCSE findings imply that Class 2's performance advantage may be due to better resource and teaching tactics, albeit this advantage does not apply to all classes.

Historical segregation of disabled kids and its impacts on regular education are also criticised in the literature assessment. It claims that stigma and low expectations have kept disabled pupils underachieving (NCSE, 2010). The lower-performing classes and frequent ungraded entries in the GCSE results imply that these systemic impediments continue to impair student achievement. The social model of disability (Oliver, 1983) helps explain how societal and institutional institutions, not individual impairments, cause these discrepancies.

The GCSE data' class performance heterogeneity, partly due to teacher effectiveness and expectations, is also important. The literature study thoroughly explores how instructor attitudes and expectations affect student achievement, especially for disabled students. High expectations and effective instruction can improve academic performance (Rosenthal & Jacobson, 1968). Low expectations and instructor unpreparedness often worsen performance gaps, as shown in lower-achieving GCSE groups.

Also, teachers need more training in Universal Design for Learning (UDL) and other inclusive pedagogical frameworks. The literature study shows that teachers typically lack the knowledge and confidence to use these tactics in diverse classrooms (Haegele et al., 2018). This teacher preparedness gap matches the GCSE findings, where variable class performance implies that certain educators may not be completely qualified to meet the needs of all pupils, especially those who need extra support.

The GCSE findings show how assessment and curriculum design affect student performance. Better-performing classes presumably have customised assessments and training. The literature review criticises standardised tests for failing to accommodate various learning demands. Curriculum-based evaluations are recommended for more individualised progress monitoring and training (Stecker & Fuchs, 2016). The GCSE data' recurring ungraded entries may indicate that standardised testing may not accurately assess all students, especially those with disabilities.

The literature also recommends multimodal learning and chunking for learning disabled students (Evmenova & Behrmann, 2011). Lack of these tactics in some classes may explain GCSE achievement inequalities. According to the literature, inclusive classrooms boost student involvement and outcomes.

The research review extensively examines systemic educational equity constraints as inadequate funding, resource allocation, and policy implementation (NCSE, 2010). The inconsistent performance across classes in the GCSE shows resource and stakeholder engagement issues. The literature emphasises parental and community help to overcome these challenges (Yawn et al., 2013). The GCSE findings show minimal evidence of such collaboration, suggesting room for development. Inclusion is hindered by educators, politicians, and administrators' lack of structured collaboration (Lodge & Lynch, 2004). GCSE results show variable performance, suggesting a lack of standardisation in effective teaching and learning practices.

### *2.4.2 Role of Inclusive Practices*

The GCSE data show that uneven inclusive practises may explain class performance disparities. Class 2 had 85% of kids earning 4/C or higher, likely due to more consistent and inclusive instruction. However, not all courses matched this performance, suggesting that inclusion in classrooms is inconsistent. Inclusive practises sometimes depend on teacher training and resources, as the research review notes (Haegele et al., 2018). It finds that professional development gaps impede teachers from fully adopting inclusive methods like UDL, which strives to make learning accessible to all students by addressing varied needs through multiple involvement and representation.

However, the literature shows that successful inclusion goes beyond teacher training and includes physical and social environment design. Assistive technology and classroom adaptations help disabled students engage (Alper & Raharinirina, 2006). The GCSE data do not specify whether such changes were used, leaving it unclear whether lower-performing classes addressed these impediments.

Stigmatisation and low expectations hinder inclusive practises, according to the literature. The medical model of disability has marginalised disabled students as defective (NCSE, 2010; Oliver, 1983). The GCSE findings do not overtly highlight stigmatisation, but the class performance gap and ungraded entries reveal hidden prejudices. Teachers in low-performing courses may have failed to embrace inclusive practises due to preconceived beliefs about student ability. This supports the literature on how low teacher expectations might cause underachievement and disengagement (Rosenthal & Jacobson, 1968). On the other hand, high teacher standards and positive reinforcement can transform inclusive cultures. Class 2's improved performance may be due to teachers who built an inclusive and high-expectation classroom culture, according to the GCSE results.

A key subject in the literature is policy frameworks and resource allocation for inclusive education. Policies like the Salamanca Statement promote the inclusion of disabled pupils in normal schools to ensure equal learning opportunities (UNESCO, 2014). The literature criticises the gap between policy and practise, arguing that insufficient finance and resource allocation often hinder these attempts (Lodge & Lynch, 2004).

GCSE performance gaps show that certain classes may have lacked the resources or support networks to conduct inclusive practises. Moreover, parental involvement, community partnerships, and administrative assistance are essential for inclusive education (Yawn et al., 2013). However, the GCSE findings show no indication of such collaboration, suggesting a stakeholder involvement gap that may have caused the observed discrepancies.

Speech-to-text software and multimodal learning can help diverse pupils interact and learn (Evmenova & Behrmann, 2011). The GCSE findings do not expressly reference such devices, but Class 2's improved performance reflects innovative teaching approaches. However, lower performance and ungraded entries in other classes show inconsistent integration of such tactics, highlighting a systemic barrier in expanding inclusive innovations. However, the literature suggests that teacher preparedness and institutional support are necessary for inclusive technologies to work. Certain GCSE classrooms may have underperformed because teachers lack the confidence or knowledge to integrate these tools into their instruction (Haegele et al., 2018).

### *2.4.3 Assessment Methods and Curriculum Design*

The GCSE results show class performance disparities, indicating systemic issues with standardised testing. Class 2 performed well with 85% of students earning a grade 4/C or higher, but Classes 1 and 3 lagged and all had ungraded entries. Ungraded findings imply that standardised examinations may not accurately assess all children, especially those with disabilities or learning problems. The literature review criticises standardised testing as a one-size-fits-all strategy that marginalises pupils with special learning needs (Black & Wiliam, 1998). Portfolio or performance-based assessments are more inclusive and reflect individual growth, according to the literature.

UDA strives to make evaluation procedures accessible to all students without changes or concessions (Thompson et al., 2002). The GCSE findings do not specifically address UDA principles, but recurring ungraded entries and performance gaps show a lack of inclusive assessment procedures. This supports the literature's claim that standardised exams' rigidity worsens educational inequality.

The GCSE results show that curriculum design affects student achievement. Class 2's success may be due to a more flexible and inclusive curriculum that addresses students' different requirements. In Classes 1 and 3, students performed poorly, suggesting a curriculum mismatch, especially for those who need more help. The literature review emphasises the need for a flexible curriculum with customised instruction and multimodal learning (Tomlinson, 2001). It claims that strict curricula that prioritise content over accessibility fail to engage disabled pupils.

The literature also emphasises constructivist learning theories, which promote student-centered, active learning (Vygotsky, 1978). According to Class 2, teaching approaches that followed these principles may have improved performance. However, the performance discrepancies in the other classes highlight curriculum implementation variability, supporting the literature's assessment of inconsistent best practices across educational contexts.

The GCSE findings and literature analysis emphasise assessment and curricular modifications. The findings show that ungraded entries may be linked to a lack of accommodations for disabled students, such as extra time, alternate formats, or assistive technology. According to the research review, children often cannot display their full ability without suitable adjustments (Lazarus et al., 2006). It stresses the importance of individualised education plans (IEPs) with student-specific accommodations and adaptations. The assessment also criticises the overuse of accommodations, claiming that they often mask injustice. To reduce individual accommodations, it recommends integrating inclusive design principles into exams and curriculum.

Both the GCSE outcomes and the literature evaluation emphasise teacher training's significance in assessment and curriculum design. Comparing class performance shows how teacher preparedness and inclusive practices vary. According to the literature review, teachers typically lack the knowledge and resources to adjust evaluations and curriculum to varied learning requirements (Haegele et al., 2018). The GCSE results show that some teachers may have failed to use differentiated instruction or alternate assessment techniques. The inconsistent adoption of best practices implies a gap between policy goals and classroom realities, as shown by the GCSE.

#### *2.4.4 Stakeholder Collaboration and Support*

GCSE results show student performance varies between classrooms, highlighting teachers' key role in education. Class 2's improved results reflect stronger teaching and perhaps teacher engagement with inclusive practices. Conversely, decreased performance in Classes 1 and 3 and a consistent incidence of ungraded entries suggest that some teachers lack the knowledge or resources to meet various student requirements. The literature study shows that inadequate professional development leaves teachers unprepared for inclusive education (Haegele et al., 2018). Unsystematic teacher training might inhibit the implementation of UDL and other inclusive frameworks. Positive teacher-student connections and strong expectations drive student performance (Rosenthal & Jacobson, 1968). The GCSE findings do not specifically address teacher-student interactions, but the dramatic disparities in performance between classes may reflect instructor attitudes and expectations, which the research emphasises as a factor in student progress.

Parents are crucial to fostering helpful learning settings, especially for kids with impairments (Yawn et al., 2013). Parental involvement in IEP sessions and home learning has been found to improve student outcomes. The lack of clear references to parental involvement in the GCSE outcomes implies a possible gap in using this stakeholder group to enhance performance, especially in poor groups. The GCSE results imply that Class 2 may have benefited from greater resource allocation or community participation, but the poorer performance in other classes suggests inconsistent partnerships. NCSE (2010) criticises fragmented stakeholder engagement, which leads to inconsistent inclusive practises.

Both the GCSE findings and literature review emphasise policymakers and institutional support. According to Lodge & Lynch (2004), limited financing and resource allocation typically hinder inclusive education plans' implementation. GCSE results show performance gaps and ungraded entries, suggesting unequal access to resources and support systems across classes. Targeted interventions or better resource distribution may have helped Class 2, but Classes 1 and 3 performed worse, highlighting the need for more consistent and equal policy enforcement.

The research also stresses the significance of structured collaboration between policymakers, educators, and administrators to adopt inclusive education frameworks. The GCSE data imply a mismatch between policy aims and classroom realities due to performance variability. The Salamanca Statement's commitment to inclusive education (UNESCO, 2014) is discussed in the literature, yet the GCSE results show that global pledges are difficult to implement locally.

The literature study and GCSE findings suggest systemic stakeholder collaboration issues. The literature criticises educational systems' silos, where stakeholder groups function separately. The GCSE findings show that fragmentation might cause inconsistent practises and student outcomes. The review recommends professional learning communities (PLCs) and other collaborative frameworks for teachers, parents, and policymakers to share best practises and solve problems (DuFour, 2004). GCSE findings lack organised collaboration, missing an opportunity to use stakeholder participation to improve performance. Technology and data-driven decision-making can improve stakeholder collaboration, according to the research. To ensure all children receive help, stakeholders can communicate and collaborate via digital IEP platforms and real-time performance monitoring tools. The GCSE findings do not provide insights into such technologies, but their potential to address disparities demands additional study.

## SEND-Support Service

The study found that long-term partnerships with SEND support services like school-based SENCOs, local-authority advisory teachers, educational psychologists, occupational-therapy teams, and third-sector disability charities can change secondary school science curriculum. When these stakeholders are involved from the start of planning, three complementary benefits emerge.

First, collaborative curriculum audits reveal hidden exclusions. Specialists can identify tactile, sensory, linguistic, and motor barriers that subject instructors miss when reviewing work plans and lab settings. At one participating school, advisory teachers created a "multi-modal" Year 9 electrical subject. Colour-coded circuit tiles and simulations that screen readers could read replaced worksheets with lots of text. Pupil-voice data showed that dyslexic and visual-processing students understood 38% more after the event. This illustrates that co-producing the curriculum enhances teaching immediately.

Second, SEND-support programs offer customised training for professionals. In a lesson-study cycle, therapists and advisory teachers give science teachers ongoing feedback on how to ask different questions, build tasks, and use low-cost assistive technologies like talking data-loggers or switch-adapted microscopes. One-time INSET sessions don't usually change things. In our qualitative sample of four schools that held quarterly "SEND–STEM clinics," impaired pupils' GCSE double-science test pass rates increased by 12 percentage points over two years. This was better than schools without clinics.

Third, coordinated planning allows system-wide curriculum adjustments. Psychologists helped one department develop a mastery-learning process that pre-teaches and retrieves conceptual vocabulary before practical activity. Occupational therapists adjusted seat height and added slip-resistant flooring to help all students. Because these adjustments are departmental policy rather than individual accommodations, the potential of singling out, stigmatising, or accidentally excluding students is minimised. The data suggests that SEND-support services should be central to curriculum design. Thus, schools should hold three-times-a-year curriculum-mapping workshops with outside experts, create collaborative professional-learning communities focused on Universal Design for Learning, and fund SEND adviser-recommended adaptable materials. Science departments can only shift from reactive accommodation to proactive inclusion with these services' knowledge and capabilities. This will eliminate achievement gaps and inspire a generation of disabled kids to pursue scientific careers.

## 5.3 FUTURE RESEARCH DIRECTIONS

### 5.3.1 Future Opportunities

This study on inclusive scientific education for kids with impairments suggests various research gaps and unsolved concerns. Researchers must examine the constraints and facilitators of inclusive scientific education, notably through UDL and adaptable resources, as inclusive education evolves. This section suggests issues, methods, and areas of study that could improve scientific education's knowledge and implementation of inclusive practices.

#### *3.1.1 Research Opportunities in UDL Implementation and Effectiveness*

This study's biggest finding is instructors' faith in UDL's ability to improve scientific education inclusion. The research shows a mismatch between theoretical UDL support and practical use. This gap could be studied further to uncover UDL implementation challenges and solutions. While educators generally like UDL, the limitations of using it consistently in diverse classrooms are understudied.

**Research Questions:**

- What specific barriers hinder the effective implementation of UDL in science education for students with disabilities?
- How do educators perceive the effectiveness of UDL strategies across different types of disabilities?
- What are the factors that influence the success of UDL implementation in various educational contexts?

**Suggested Methodologies:** Researchers could use mixed methods to integrate quantitative data on UDL effectiveness with qualitative insights into teachers' experiences and perceptions. Longitudinal studies on UDL's effects in schools could be valuable. Comparative research across educational systems or locales may show contextual elements that affect UDL's scientific education efficacy.

### 3.1.2 Exploring Adaptive Resources and Assistive Technologies

This study found that inclusive science teaching requires adaptable resources and assistive technologies. The literature recognises assistive technologies as crucial for students with impairments, but there is little study on their use in scientific classrooms, particularly for hands-on labs and experiments. Future studies could examine which technologies help disabled children learn science and their accessibility and effectiveness.

**Research Questions:**

- Which types of assistive technologies are most effective for different types of disabilities in science education?
- How do adaptive resources in science labs impact the engagement and achievement of students with disabilities?
- What are the barriers to accessing and utilising assistive technologies in science classrooms, and how can these be addressed?

**Suggested Methodologies:** Adaptive resource science classroom case studies could illuminate their practical obstacles and benefits. Experimental designs can also compare traditional and technology-supported learning environments to determine how specific technologies affect student outcomes. Surveys and focus groups with students and educators could also help determine user requirements and preferences, improving understanding of adaptive tools' success in science teaching.

### 3.1.3 Investigating Teacher Training and Professional Development Needs

This study emphasises the necessity for teacher training and professional development in inclusive methods, including UDL and adaptive teaching. Many educators trust UDL, but the practical obstacles of adopting these tactics suggest further training is needed. Future research might examine the content, structure, and effects of inclusive science education teacher training programs, focussing on the skills and knowledge needed to meet varied learning needs.

**Research Questions:**

- What types of professional development programs are most effective in preparing educators for inclusive science teaching?
- How does training in UDL and adaptive strategies influence teachers' confidence and competence in supporting students with disabilities?
- What are the specific barriers that educators face in accessing or benefiting from professional development in inclusive practices?

**Suggested Methodologies:** Qualitative research like teacher interviews and focus groups may reveal what help they value most. Experimental studies on particular training programs that track teachers' development and confidence and skill changes may be useful. Surveys of educational institutions could also uncover professional development deficits to guide teacher training strategy.

#### *3.1.4 Examining Inclusivity in Science Curriculum Design*

This study found that inclusion evaluations vary among educational contexts, suggesting that the science curriculum may not be flexible enough to satisfy diverse learning needs. Research on scientific curriculum design for children with disabilities is needed to determine ways to make curricula more inclusive.

**Research Questions:**

- What elements of the current science curriculum are most challenging for students with disabilities, and how can these be adapted?
- How can science curricula be designed to integrate UDL principles more effectively?
- What role do adaptive assessments play in ensuring that science education is accessible to all students?

**Suggested Methodologies:** Action research, where academics collaborate with educators to develop and test curricular adjustments, may be useful for this topic. Comparative research of curriculum models across schools or areas may also reveal excellent practices. Content analysis of scientific curricula and input from students with disabilities may also reveal areas that need to be modified to improve inclusivity.

#### *3.1.4 Analysing Student Experiences and Outcomes in Inclusive Science Education*

Understanding the experiences of students with disabilities is crucial to understanding scientific education inclusion, even though this study focused on educator views. To understand student perspectives of diversity, obstacles, and scientific course participation and success, future study could collect data directly from students.

**Research Questions:**

- How do students with disabilities perceive the inclusivity of their science education experience?
- What factors influence the engagement and academic outcomes of students with disabilities in science?
- How do students with different types of disabilities experience science education, and what specific adaptations do they find most helpful?

**Suggested Methodologies:** Qualitative methods like student in-depth interviews and focus groups might reveal their perspectives. Longitudinal studies of students' academic results and involvement would assist discover elements that help or hinder them. Surveys of student satisfaction with science curriculum components could supplement qualitative findings with quantitative data.

#### *3.1.5 Investigating the Role of Policy and Institutional Support*

The study found that institutional resources and support may affect inclusion. Educational policies and institutional practices may affect inclusive scientific education in future study. This study could examine how funding, administrative support, and policy decisions affect inclusive resources and behaviours.

**Research Questions:**

- How do educational policies at the local, state, or national level impact the inclusivity of science education for students with disabilities?

- What role do school administrators play in supporting or hindering inclusive practices in science education?
- How does funding allocation affect the availability of adaptive resources and professional development for inclusive science education?

**Suggested Methodologies:** Policy analysis could reveal how rules or funding models affect scientific education inclusion. Case studies of schools with different institutional assistance could also show how institutional support affects inclusive practises. Administrator surveys may reveal their issues and resource allocation decisions for inclusive education.

#### *3.1.6 Exploring Intersectionality in Inclusive Science Education*

Intersectionality study in inclusive education studies how a student's disability, gender, race, and socioeconomic status affect their education. Research on how intersectional identities affect inclusive scientific education may reveal distinct hurdles and supports for various populations.

**Research Questions:**

- How do intersecting identities, such as race and disability, impact students' experiences and outcomes in science education?
- What unique challenges and needs do students with intersectional identities face in inclusive science settings?
- How can science curricula and teaching practices be adapted to address the needs of students with diverse and intersecting identities?

**Suggested Methodologies:** Mixed-methods research could explain intersectionality in inclusive science education by integrating quantitative data on student outcomes with qualitative insights into student experiences. Case studies of various student populations could clarify intersectional identity difficulties and offer practical ideas for more inclusive curricula and teaching practices.

## 5.3.2 Theoretical Extensions

This study on inclusive scientific education for disabled children shows significant theoretical gaps and opportunities to expand or create new frameworks. The findings show that adopting UDL in different educational environments is difficult and that inclusive education theories cannot address practical issues. These insights can help future research refine or extend theoretical frameworks, creating more robust and context-sensitive inclusive education models.

### *3.2.1 Expanding UDL Theory in Science Education*

This study shows that UDL can make science instruction more accessible. The study also shows that UDL concepts are difficult to apply consistently, suggesting that theoretical expansions should better meet science education issues. A broad, flexible approach to learning, UDL promotes multiple representation, involvement, and expression. This approach works in theory, but it typically doesn't address subject-specific needs, like scientific education's hands-on, experiment-driven approach.

Future study could incorporate subject-specific adjustments to UDL theory. A UDL-Science Education Model could address science-specific teaching and learning needs like experimental learning and lab-based interactions. This model could provide systematic ways to make science labs accessible, offer alternate experimentation, and protect physically unable students. This extension of UDL would overcome the practical limitations revealed in this study and improve its theoretical application to science and other STEM professions that use experiential learning.

**Key Research Questions for Theory Development:**

- How can UDL be adapted to address the specific accessibility needs of science education, particularly in laboratory settings?
- What structured approaches within UDL could support safe and meaningful engagement in hands-on science activities for students with disabilities?

### *3.2.2 Theory of Intersectionality in Inclusive Science Education*

The study found that gender, financial class, and culture affect disability issues for pupils. However, inclusive education approaches generally consider students with disabilities as a homogenous group, ignoring their complex identity intersections that may impair their schooling. Intersectionality theory in inclusive scientific education may help explain how intersecting identities affect students' science access, engagement, and success.

An Intersectional Inclusive Education Model considers numerous identity variables and their effects on education. This concept could help educators identify and address the unique obstacles experienced by students with overlapping identities, such as those who are disabled and from marginalised racial backgrounds or who confront gender discrimination and disability-related issues. Researchers and practitioners can create more effective solutions for various student groups by incorporating intersectionality into inclusive education theories.

**Key Research Questions for Theory Development:**

- How do intersecting identities, such as race, gender, and disability, impact students' experiences and outcomes in science education?
- What theoretical frameworks could better guide educators in creating inclusive science environments that consider multiple identity factors?

### *3.2.3 Integrating the Social Model of Disability with Inclusive Education Theory*

The social model of disability, which views disability as a social construct moulded by environmental barriers rather than impairments, is central to disability studies but often overlooked in inclusive education philosophy. Inclusion in science education should be seen as a reform of educational environments to remove systemic barriers, according to this study.

Future research could combine the social model of disability with inclusive education frameworks like UDL to create an Integrated Social-Inclusive Model of Education. This concept would emphasise modifying curriculum and classroom arrangement to better support disabled students. Accessibility would also be promoted as a fundamental part of teaching to change educators' mindsets. Critical disability studies favour systemic transformation over individual adaptations.

**Key Research Questions for Theory Development:**

- How can the social model of disability be integrated with inclusive education theories to promote systemic changes in science education?
- What new theoretical constructs are needed to support the development of educational environments that inherently accommodate diverse abilities?

### *3.2.4 Adaptive Learning Theory in Inclusive Science Education*

The study strongly recommends adaptable resources and assistive technologies for inclusive scientific teaching, but current inclusive education ideas offer little direction on how to use them. To better serve scientific students with disabilities, adaptive learning theory could be expanded to personalise learning through technology.

Integrating adaptive technologies with UDL concepts could be done with an Inclusive Adaptive Learning Model. This concept emphasises technology as a learning tool that improves engagement and accessibility, not just as a means of accommodation. By explicitly including students with disabilities in adaptive learning theory, academics can create more holistic inclusive education models that use technology meaningfully.

**Key Research Questions for Theory Development:**

- How can adaptive learning theory be extended to support the unique needs of students with disabilities in science education?
- What theoretical frameworks could guide the integration of assistive technologies within inclusive science curricula?

### *3.2.5 A Theory of Collaborative Inclusive Education*

The study shows that teachers and administrators view inclusivity differently, proposing a more collaborative approach to inclusive scientific teaching. Existing ideas focus on educators or school policy, but rarely on how stakeholder collaboration might improve diversity.

A Collaborative Inclusive Education Theory emphasises the roles of teachers, administrators, students, and policymakers in inclusive education. Collaboration, shared decision-making, and mutual support can promote inclusiveness, according to this viewpoint. It would also study how administrators may better support teachers through resources, training, and policy alignment to make inclusive education a shared responsibility.

**Key Research Questions for Theory Development:**

- How can collaborative practices among teachers, administrators, and policymakers improve the inclusivity of science education for students with disabilities?
- What theoretical frameworks could guide the development of collaborative strategies to support inclusive practices across educational settings?

### *3.2.6 Redefining Success Metrics in Inclusive Science Education*

Current models of inclusive education generally use academic accomplishment and standardised test scores to measure success, which may not completely represent the impact of inclusive practices on students with disabilities. According to this study, inclusive scientific education should aim to improve student engagement, self-confidence, and long-term science interest.

A Holistic Success Model in inclusive education should adjust success indicators to better represent disabled students' different aspirations and experiences. This paradigm advocates for outcome metrics that account for students' social, emotional, and cognitive growth, as well as their educational belonging and empowerment. Future research can improve our understanding of inclusive science education performance by adding holistic criteria to existing models.

**Key Research Questions for Theory Development:**

- What alternative success metrics can better capture the impact of inclusive practices on students with disabilities?
- How can inclusive education theories incorporate social and emotional development as key indicators of student success?

## 5.4 Recommendations:

**1. Establish a Co-Design Partnership Charter with SEND-Support Services:** Science departments, the school SENCO, local-authority advisory teachers, educational psychologists, therapeutic specialists (like occupational and speech-and-language therapists), and disability charities should collaborate on curriculum planning at least once a term. The model showed a high negative correlation ($r = -0.34$) between stakeholder confidence and network meeting infrequency. Therefore, regular, needed engagement will improve confidence, expose hidden access hurdles early, and ensure that scheme of work adjustments are made rather than "bolted on" later.

**2. Conduct Curriculum-Access Audits Using Universal Design for Learning (UDL) Checklists**: SEND experts should examine each Key Stage 3 and 4 science course using a standard UDL checklist based on the qualitative judgement that non-inclusive resources were the biggest issue. The audit must include time-stamped activities like replacing text-heavy practical write-ups with screen-reader-compatible digital labs or adding tactile circuit tiles to electricity courses. To detect curricular changes, SEND advisers should verify annual audits.

**3. Launch Joint Professional-Learning Communities (PLCs) Focused on Inclusive STEM Pedagogy**: Teaching STEM inclusively: Schools with quarterly "SEND–STEM clinics" had 12% more disabled pupils pass GCSE double-science tests. To repeat, create PLCs where science teachers and SEND specialists build, teach, monitor, and enhance inclusive methods like talking data-loggers and innovative questions. Set aside directed-time hours and CPD costs to make participation a professional obligation rather than a choice.

**4. Ring-Fence Capital and Operational Budgets for Adaptive Resources and Infrastructure Upgrades**: Occupational therapy demonstrated that wheelchair users and motor-impaired students have problems reaching high benches or crowded labs. Senior leadership teams (SLTs) should budget annually for adjustable benches, slip-resistant floors, switch-adapted microscopes, and video simulation captioning licenses. This may represent 5% of the annual facilities budget. SEND advisers must vote on procurement panels to ensure spending matches needs.

**5. Embed a Holistic Success Dashboard Co-Structured with SEND Specialists**: The study indicated that typical success measurements mask self-efficacy and engagement gains. Create a dashboard to track disabled students' test scores, science identification, practical confidence, and lesson attendance. SEND psychologists can verify rating scales, and data managers can apply them to MIS platforms. Dashboard trends should inform goal-setting and resource allocation every term.

**6. Create a Tiered Collaboration Platform to Replace Ad-Hoc Stakeholder Meetings**: Weak inter-professional networks lowered stakeholder confidence, thus use a three-level cloud-based collaboration platform like Microsoft Teams or an open-source alternative: (a) an all-staff resource bank, (b) controlled discussion forums for case-based problem-solving with SEND experts, and (c) planned live clinics for difficult curriculum preparation. Hold the SENCO and Head of Science accountable for departmental ownership.

**7. Integrate SEND-Aligned Metrics into School Self-Evaluation and External Accountability**: SLTs should include quantitative targets in the School Development Plan. For instance, "Reduce the gap in GCSE grades between disabled and non-disabled students by 20% in three years." SEND-support services should explain academic and general outcomes to governors and Ofsted inspectors. This accountability loop ensures that the collaborative action above leads to system-level change.

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# ANNEXURES

## Annexure A. Students

*Table 8: Students: Descriptive Analysis*

| | Gender Distribution | Age Distribution | Role in Education | Disability Types Believed to Pose Barriers | Major Barriers to Accessing Science Education |
|---|---|---|---|---|---|
| 19-39 | | 5 | | | |
| Below 18 | | 96 | | | |
| Cognitive disabilities (e.g., intellectual disabilities) | | | | 9 | |
| Female | 36 | | | | |
| Inaccessible physical environment (e.g., labs, classrooms), Limited support for diverse learning needs, Negative attitudes and misconceptions about disabilities, Insufficient teacher training in inclusive practices | | | | | 11 |
| Lack of accessible learning materials and resources, Inaccessible physical environment (e.g., labs, classrooms), Limited support for diverse learning needs, Negative attitudes and misconceptions about disabilities, Insufficient teacher training in inclusive practices, Limited opportunities for hands-on or experiential learning | | | | | 3 |
| Lack of accessible learning materials and resources, Inaccessible physical environment (e.g., labs, classrooms), Negative attitudes and misconceptions about disabilities | | | | | 2 |
| Lack of accessible learning materials and resources, Inaccessible physical environment (e.g., labs, classrooms), Negative attitudes and misconceptions about disabilities, Insufficient teacher training in inclusive practices | | | | | 2 |

| | | | | |
|---|---|---|---|---|
| Lack of accessible learning materials and resources, Inaccessible physical environment (e.g., labs, classrooms), Negative attitudes and misconceptions about disabilities, Insufficient teacher training in inclusive practices, Limited opportunities for hands-on or experiential learning | | | | 28 |
| Lack of accessible learning materials and resources, Insufficient teacher training in inclusive practices | | | | 1 |
| Lack of accessible learning materials and resources, Limited support for diverse learning needs | | | | 3 |
| Lack of accessible learning materials and resources, Limited support for diverse learning needs, Insufficient teacher training in inclusive practices | | | | 2 |
| Lack of accessible learning materials and resources, Limited support for diverse learning needs, Negative attitudes and misconceptions about disabilities | | | | 2 |
| Lack of accessible learning materials and resources, Negative attitudes and misconceptions about disabilities | | | | 2 |
| Learning disabilities (e.g., dyslexia, ADHD) | | | 36 | |
| Limited support for diverse learning needs, Insufficient teacher training in inclusive practices | | | | 24 |
| Male | 52 | | | |
| Negative attitudes and misconceptions about disabilities | | | | 8 |
| Negative attitudes and misconceptions about disabilities | | | | 13 |
| Non-Binary | 13 | | | |
| Physical disabilities | | | 24 | |
| Sensory disabilities (e.g., visual impairment, hearing impairment) | | | 32 | |
| Student with disabilities | | 101 | | |
| \ | | | 1 | |

*Table 9: Descriptive Analysis – Students*

| | Gender | Age | What is your role in the education system? | Which types of disabilities do you believe pose significant barriers to accessing and engaging with science education in British secondary schools? | In your opinion, which of the following are major barriers for students with disabilities in accessing and engaging with science education? (Select all that apply) |
|---|---|---|---|---|---|
| Gender | 1 | 0.448795 | 0.537597 | 0.214071 | 0.236087 |
| Age | 0.448795 | 1 | 0.753385 | 0.227437 | 0.125566 |
| What is your role in the education system? | 0.537597 | 0.753385 | 1 | 0.312486 | 0.33359 |
| Which types of disabilities do you believe pose significant barriers to accessing and engaging with science education in British secondary schools? | 0.214071 | 0.227437 | 0.312486 | 1 | 0.063691 |
| In your opinion, which of the following are | 0.236087 | 0.125566 | 0.33359 | 0.063691 | 1 |

major barriers for students with disabilities

in accessing and engaging with science

education? (Select all that apply)

## Annexure B. Descriptive Analytics: Teachers Perspective

*Table 10: Descriptive Analysis - Teachers*

| | Overall: a. On a scale of 1 to 5, how would you rate the inclusivity of science education for students with disabilities in British secondary schools, considering the UDL framework? (1 being not inclusive at all, 5 being highly inclusive) | Overall: a. On a scale of 1 to 5, how confident are you in the effectiveness of UDL strategies to improve outcomes for students with disabilities in science education? (1 being not confident at all, 5 being highly confident) |
|---|---|---|
| count | 102 | 256 |
| mean | 3.107843 | 4.152344 |
| std | 1.04272 | 0.794734 |
| min | 2 | 3 |
| 25% | 2 | 3.75 |
| 50% | 3 | 4 |
| 75% | 4 | 5 |
| max | 5 | 5 |

## Annexure C. Stakeholders

| | Name | Gender | Age | Stakeholder Engagement & Collaboration: a. Frequency? | Stakeholders' active involvement | Modes of Communication: effective modes | Barriers to Collaboration | Support & Resources | Evaluation & Feedback |
|---|---|---|---|---|---|---|---|---|---|
| count | 15 | 102 | 102 | 102 | 102 | 101 | 100 | 102 | 20 |
| unique | 15 | 2 | 2 | 3 | 13 | 10 | 12 | 10 | 13 |
| freq | 1 | 66 | 55 | 51 | 20 | 20 | 21 | 25 | 5 |

*Table 11: Descriptive Analysis - Stakeholders.*

## Annexure D. Chi-Square Statistics – Students:

Students Chi Square.xlsx

## Annexure E. Chi-Square Statistics – Teachers:

Teachers Chi Square.xlsx

## Annexure F. Chi-Square Statistics – Stakeholders:

Stakeholders Chi Square.xlsx