Accessible ICT-Enabled Examination Technologies for Students with Special Educational Needs in Higher Education: A Technical Evaluation of Usability, Reliability, Accommodation Quality, and Assessment Fairness

Hamida Al-Maamari[1,2*], Manjit Singh Sidhu [1,3*], Shaik Mazhar Hussain[4], Abbas M. Al-Ghaili[1,5], and Kirandeep Kaur Sidhu[6]

[1]Institute of Informatics and Computing in Energy (IICE), Universiti Tenaga Nasional (UNITEN), 43000 Kajang, Selangor, Malaysia

[2]Department of Engineering, College of Engineering and Technology, University of Technology and Applied Sciences, Suhar, 311, Sultanate of Oman.

[3]Department of Informatics, College of Computing and Informatics (CCI), UNITEN, 43000 Kajang, Selangor, Malaysia

[4]Department of Computing and Electronics Engineering, Middle East College, Muscat, Oman@

[5]Department of Computing, College of Computing and Informatics (CCI), Universiti Tenaga Nasional (UNITEN), Kajang 43000, Selangor, Malaysia

[6]Department of Population Medicine, MK Faculty of Medicine and Health Sciences, Universiti Tunku Abdul Rahman (UTAR), Sungai Long campus, 43000 Kajang, Malaysia

HOW TO CITE:

Hamida Al-Maamari*, Manjit Singh Sidhu *, Shaik Mazhar Hussain4, Abbas M. Al-Ghaili, and Kirandeep Kaur Sidhu (2026). Accessible ICT-Enabled Examination Technologies for Students with Special Educational Needs in Higher Education: A Technical Evaluation of Usability, Reliability, Accommodation Quality, and Assessment Fairness. International Journal of Special Education, 41(17s), 635-654

ABSTRACT:

Higher education institutions are increasingly adopting digital examination platforms; however, many ICT-based assessment systems have not been sufficiently evaluated to ensure accessibility for students with special educational needs (SEN). Accessibility in digital assessment extends beyond access to online learning resources and includes students' ability to independently complete high-stakes examinations while maintaining assessment integrity under conditions involving time constraints, identity verification procedures, platform limitations, and assistive-technology requirements. This study developed and applied a mixed-method technical evaluation model for ICT-enabled examination systems in higher education. The proposed model assesses usability, accommodation effectiveness, system reliability, response-time stability, assistive-technology compatibility, accessibility compliance, and perceived assessment fairness. The evaluation framework integrates accessibility auditing based on WCAG 2.2, EN 301 549, and Universal Design for Learning (UDL) Guidelines 3.0, along with interviews involving examination administrators, ICT personnel, and disability support officers, task-based usability testing, and system-log analysis. The evaluation considers measurable indicators, including error frequency, page reload incidents, support requests, unsuccessful submission attempts, response-time variation, and perceived fairness scores. These indicators provide evidence of the technical and procedural factors that contribute to barriers during digital examinations. By combining user experiences with objective

COPYRIGHT STATEMENT:
Copyright: © 2026 Authors.
Open access publication underthe terms and conditions of the Creative CommonsAttribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).

system-level evidence, the study identifies when, where, and how accessibility barriers emerge within ICT-enabled assessment environments. The findings highlight the importance of treating accessible examination systems as essential components of assessment quality rather than as supplementary accommodations. The proposed model supports higher education institutions in evaluating the reliability, inclusiveness, and fairness of digital examination infrastructures by linking assessment outcomes with platform design, system stability, accommodation delivery, and operational evidence.

Keywords: Accessible digital examinations; special educational needs; higher education; ICT-based assessment; inclusive assessment; system-log analytics; universal design for learning; assessment fairness.

1. Introduction

More and more, digital, mixed, virtual, and platform-based tests are being used instead of paper tests in college. There are now learning management systems, browser-based testing tools, online proctoring services, and file systems that do everything for you that many schools use for tests. Now tests can be given more quickly and in different ways thanks to this change. When you enter time digitally, you can see it right away, and tests can connect to school computers. Students with special needs are often added to the digital test rooms after they have been built. A lot of the time, the rooms are made with regular people in mind. This makes it very hard for people with disabilities to use. In a normal online class, you might have time to go over things again, get help, switch tools, or figure out how to use a process you don't understand. On a test, you can only do a few of these. It can be hard to do well when there are tight deadlines, name verification, tracking processes, not a lot of help available, and a lot of stress. Even small tech problems can make it harder. So, students shouldn't think of taking internet tests as an extra service. People should see it as a basic problem with the quality of the ICT that makes the test less fair and true.

Some students with special needs may need different ways to get into digital tests. Speaking to text input, text-to-speech support, magnification, captioning, adjustable contrast, flexible timing, question formats that can be read, alternative descriptions for visual content, uploading files and reading them out loud, and being able to submit them quickly are a few that come to mind. These wants are the same. As part of a linked test process, they first log in to make sure they are who they say they are. After that, it tells them what to do, lets them find questions, enter their answers, checks them, sends them, and then shows proof that the answers were entered correctly. During the test, a platform may not work if the timer can't be changed, the browser is closed, assistive technologies are blocked, the identity verification interface can't be used with a keyboard, or the page for sending doesn't give clear feedback. The platform may look accessible. It is possible for these things to go wrong and cause problems that aren't related to the design. You could say that the test checks more than just how smart or skilled a student is in school. It also checks how well they can handle technology.

In the past, college students have found that digital settings and tools that are easy to use to be helpful. Some students still say there are problems with how accessible things are done in different ways, staff readiness, openness, institutional support, and how accessible things are made (McNicholl et al., 2021; Moriña et al., 2024; Roberts et al., 2011). People often only think about making online learning accessible as something that needs to be done, not as something that should be built into the systems that are used to teach and test (Burgstahler, 2015; Lee, 2017; She & Martin, 2022). There are more

things to think about when judging because proof of success is different online. Some students might not do well on the test because they keep typing in the wrong answer, waste time because the login system isn't stable, or have trouble using a computer to move from one question to the next. Using a screen reader and not being able to see the picture could also make this happen. To make tests better, not just to make kids happy, it's important to make them open to everyone.

In some ways, the problem is also technology. IT-based tests are done on computers that have databases, timers, user interfaces, recognition levels, item-rendering engines, tracking tools, ways to submit, and tools for people who need help with their technology. It might be tough for some to move on to the next level. For example, question forms that work with screen readers can make it easier for people to find the right information, clear their minds, and give better answers. Visual help, on the other hand, can make things harder to find, lead to mistakes, and make it hard for people to do things on their own. Keyboard-first design can help students who have trouble using their hands because it saves them from having to use the mouse as much and meets their needs for better movement access. You might not be able to use the same tool well if you are pressed for time during a test. For the same reason, autosave that works and clear proof of filing can help justice, protect data, and avoid confusion. People can feel more worried and tests may not be as fair when they don't work or when mistake messages aren't clear. Which things are open should be based on how well they work, how stable they are, how well they fit, how well they make changes, and how well they fix problems.

Rules that are very important for technology and teaching right now made this possible. Screens should be clear, work well, be simple to understand, and last a long time. This can be checked with WCAG-based review. When you use ICT-based services or things, what are the rules? They are called EN 301 549 and tell schools to get rid of any hurdles that aren't needed. It's not enough to just test these cases and make sure the information is easy to find. The test process needs to be practiced in real life, with time limits, registration, proctoring, question help, the ability to use technology to help, and finally turning in the work. Also, counting views alone isn't enough. There may be times when the page changes, there are long breaks, students try again, entries fail, or more than one person asks for help, even if a student says they are mostly happy with a platform. It's important to know these secret touch patterns because they show where tech problems happen during the review process.

Accessible digital learning, assistive technology, and inclusive assessment in higher education are all topics that have been written about a lot. However, not as many studies have looked at ICT-enabled examination systems as high-stakes technical environments where accessibility compliance, platform reliability, accommodation quality, usability, and fairness all work together. Researchers studying e-authentication have found that security and identity verification tools can have an impact on students with special educational needs taking online tests (Laamanen et al., 2021; Okada et al., 2019). There is also a need to rethink assessment methods so that students are not hurt by the way tests are set up (Nieminen, 2024; Tai et al., 2023) according to studies on inclusive assessment. Still, we need a unified model for technical evaluation that links decisions about ICT design to measured results for accessibility and assessment. And this is the gap that this study fills.

This study is unique because it changes the way digital exams are evaluated from relying on people's opinions to using a more thorough technical evaluation that includes task-based examination simulation, system-log analytics, measuring the quality of accommodations, and fairness modeling. Students are asked if they think ICT-based tests are easy to use. This method also finds out when, where, and why technology fails on important tests. The study looks at how simple it is to use digital tests as a system requirement that can be tried, not as an extra feature that can be added after the platform is live.

The study's goals are to find out how easy and accessible ICT-based exam systems are for college students with special educational needs, how reliable digital exam platforms are when students need to make accommodations, whether accessibility features make exams more fair without affecting security or validity, and to create a useful technical evaluation model for accessible digital exams. The study is based on five questions: How well do test methods that use ICT give kids with special educational needs the freedom to move around? Taking digital tests on their own when they have tech problems: how hard is it for them? Does the system's dependability, how helpful the interface is, and how well it works with technology that helps people affect how the test is taken and how well it works? What could be wrong with the value of system logs that polls can't find? Why should universities follow certain rules when they make digital test tools that anyone can use?

2. Literature Review

2.1 Digital Transformation of Assessment in Higher Education

There aren't as many paper tests in college these days; most of them are done online. Instead, the tests are given on platforms that have learning management systems, browser-based testing tools, online proctoring systems, features for automatic reporting, and services for schools to log in. After this, tests will not be given all in one class. An ICT process with several steps will take its place. Computers will control admission, trip, time, name verification, answer entry, tracking, and filing. In other words, digital testing isn't just a new way of doing things. Now is the time to look at the framework that affects how well students do on tests and how well their grades are kept track of.

An early study on accessibility in e-assessment looked at how digital assessment can create new barriers if the technology design doesn't meet all students' needs (Ball, 2009; Konur, 2007). It can also make new ways to show data and let students get to it. More recent studies on online learning have shown that digital settings make it easy for more people to take part. Some institutions aren't ready, though, and some people don't know enough about accessibility. Also, these studies show that there isn't enough inclusive design practice (Lee, 2017; She & Martin, 2022). During tests, these worries get worse because there is less time and more stress to do well, which makes the tests harder. It could make students unhappy if the platform is too slow, has questions that are hard to read, stops a help tool, or makes the filing process hard to understand. This could also change the data that is used to grade their work. When you look at ICT, digital exams should be seen as ways to test your technical knowledge. It's important that these systems are easy to get to and use, that the platform is stable, that they work well with other technologies, that the data is safe, and that the identification is both open and safe. Colleges can't just use an online testing service to say that tests are now digital. That is, the tool needs to let kids with different kinds of disabilities use it in a way that is fair, on their own, and true.

2.2 Special Educational Needs and Digital Assessment Barriers

At different times during the test, students with special needs might have trouble with computer tests. Things like this happen with more than one type of post. To understand graphs, charts, tables, and diagrams, students who need help seeing can use screen readers, zooming, high-contrast settings, well-organized titles, relevant labels, and other tools. Students who need help hearing may need video with closed captions, clear written directions, visual alerts, and ways to communicate that are easy for everyone to use. Students who need help with their movement skills may rely on keyboard-only navigation, switch access, speech-to-text input, less clicking, and a stable focus order. Students who need help with reading, language processing, attention, or brain functioning may need easier navigation, regular page layout, clear time information, less interface clutter, and review functions that can be used in different ways.

Because of the nature of the test, these barriers are especially important. In regular online classes, students can pause, ask for help, go over material again, or find other ways to finish a job. During a

test, there is much less room for compensation. If the student can't get to the login stage, they might waste time on the test before they even get to the questions. If moving from question to question is hard to understand, your brain shifts its focus from answering to managing the interface. How much a student knows about the subject doesn't matter if the answer keys don't work with computers or speech recognition. It's more important how well they can use tech. It's hard to tell how much has been learned when these things keep going wrong. It doesn't matter what the thought is.
It's harder for college students who go to school online to get what they need because of technology, academic help, communication systems, and the way people live (Kent et al., 2018; Reyes et al., 2023; Roberts et al., 2011). For testing systems, this means that accessibility must be judged by how well people actually do the tasks, not just by how they feel about learning online in general. The main question is whether the student can take the test on their own, correctly, safely, and without any unnecessary technology problems.

2.3 Accessibility Standards for ICT-Based Assessment

Standards for accessibility give us a way to test and evaluate computer-based test tools. WCAG 2.2 is especially important because digital tests are often given through web-based tools. Its principles of perceivable, workable, understood, and strong design help find out if different sensory, motor, and brain paths can lead to test material. For instance, readability, different text, subtitles, and material that can be changed are all linked to perceivability. Access to the keyboard, the order of the focus, time controls, and avoiding contact risks are all parts of operability. Understandability is about having clear directions, a guidance system that you can count on, and mistake messages that make sense. Robustness is all about how well it works with different help tools and user agents. Everyone, not just websites, talks about being easy to use. This is because EN 301 549 tells us how to make ICT products and services easy for everyone to use. This is important to remember for digital test tools, which are more than just web pages with information. They have tools for verifying identities, supervising, filing, sharing files, talking to each other, and even shutting down browsers. If help tools are blocked while tracking or registering, you might be able to get to some information on a site, but the service level might not be met. You need to look at computers as a whole, not just select screens, to make sure that tests can be given. When it comes to designing schools, the UDL Guidelines 3.0 are all about getting rid of barriers so that everyone can learn and take tests. When it comes to tests, UDL does not mean lowering the standards of education. Instead, it means making sure that structure, navigation, time, or contact problems that aren't important don't get in the way of students showing what they've learned. Studies on Universal Design for Learning (UDL) in higher education show that inclusive digital design can improve access, acceptance, and participation when it is built into the structure of the course and the tests, rather than being added at the last minute (Al-Azawei et al., 2017; Cumming & Rose, 2022; Griful-Freixenet et al., 2017). For this study, these guidelines help a technical evaluation model where accessibility can be measured, checked, and connected to the truth of the assessment.

2.4 Assistive Technologies in Examination Contexts

Assistive technologies are important parts of digital test systems that everyone can use, but how useful they are depends on how well they work in the real exam process. If they work with the assessment platform, screen readers, text-to-speech tools, speech-to-text systems, magnifiers, captioning tools, keyboard navigation, alternative input devices, accessible PDFs, digital note-taking tools, and extended time settings can help students take part on their own. While general platform claims can be helpful, they can't be used to assume compatibility. It needs to be tried in a test environment with login, identification, directions, question showing, answer entry, review, submission, and proof.
For example, Fernández-Batanero et al. (2022); McNicholl et al. (2021); and Moriña et al. (2024)

all studied how assistive technology can help students get access and participate in higher education. But how well they work depends on how easy they are to use, how well they are supported by the school, how well they are trained, and how well they fit into the learning environment. When there is a test, this fit becomes more difficult. Some course pages may work with a screen reader, but question numbers, answer choices, timer changes, and mistake messages may not be read. Speech-to-text might let you write, but a locked-down browser might stop it. If the question menu isn't flexible, magnification might make the words bigger but mess up the flow. You can give more time in the platform settings, but the dates of the test or report may not match up with these options. Websites with assistive technology let you see things correctly and control what you type, which cuts down on mistakes and mental strain. You can get things done and be on your own when there is less technical conflict. Tests are more fair and true when you can finish things on your own. Because of this, testing methods and useful tools should not get different grades. It is best to test them in the same IT space that controls who can see what tests were done.

2.5 Research Gap and Technical Contribution

Open review, digital freedom, and easy access to technology are all important in higher education, according to more than one study. But it's not just about how well high-stakes tests work from a technical point of view. This research looks at how simple it is to use, how well schools support it, and how pleased students are with it. Researchers have looked at what teachers know about universal design, how students feel about digital learning, and the problems students face when they try to use these tools (Bong & Chen, 2024; Fichten et al., 2012; Lee & Kim, 2024; Lomellini et al., 2025).

Other research has found that the way tests are set up can affect how fair they are and how many students take them (Nieminen, 2024; Sireci et al., 2005; Tai et al., 2023; Weis & Beauchemin, 2020). Another study looked at how well tests and accommodations for everyone work. Still, there is a gap in the science between these two zones. Not much study has been done on digital test systems as combined ICT settings where task-based usefulness, accessible technology compatibility, system dependability, identification load, correctness of adjustments, and perceived fairness all work together in a real assessment process. Some tech problems that aren't being talked about can be found through perception polls, but not all of them. You can see these stressful times and how they affect how well a job is done in system logs, so students don't have to write down every time they can't move, change pages, stop for a long time, type something wrong, or click "Submit." The polls can also find problems that don't follow the rules, but they need to be linked to real user results to show that they teach.
A new method for reviewing technical information in higher education tests that use ICT is added by this study. It has several levels and can help more people take those tests. It connects standards for usability to how well tasks are done, system logs, service quality, platform dependability, and fairness models. That's not the point of this method. The point is to find out exactly where technology issues show up, how they change how the test is taken, and why they are important for fair and accurate marks.

3. Methodology

3.1 Research Design

Some different types of technical review are used to find out how fair, easy to use, reliable, and good at helping students with special needs ICT-based test tools are for these college students. It's more than just a way to find out how kids feel about PC tests. But it sees the test site as an IT thing whose technology behavior can change how hard or easy it is to take the test by yourself. We can use this method because sense data by itself doesn't tell us much about how simple it is to look at online. To back this up, it needs proof from places like job success, system logs, living situations, and what kids and school staff say. The five rater steps work together in this study. At first, the site is checked against ICT usability

guidelines to make sure it can be used by everyone. Of these are being able to read and use the interface, having a keyboard close by, being able to set the timer, seeing error messages, and making sure the request went through. When students reach the second level, they take a task-based test on a controlled digital exam that has standard settings that are simple to find. This is the third step, which is system log analysis. You can see how long someone works on a task, how many times they restart the page, go back, change their answer, try to submit but fail, ask for help, and take breaks. This is the fourth layer. Students rate how helpful they think the system is, how well it meets their needs, how free they feel, how much they believe the system, how accurate it is, and how fair the grades are. The fifth level is informal chats with some students, people who work in ICT, people who provide mobile help, and people who are in charge of the tests. What the platform says it can do, what the accessibility audit finds, what students actually go through while taking tests, and what the system logs say about delays that aren't clear can all be looked at in this way. As part of the study, people want to know where tech problems happen, how they affect test scores, and why it's important to know these things to be fair and honest.

3.2 Participants and Sampling

Athletes with special needs in college and people who work with computer tests and movement help took part in the study. 150 students got together. Some had already taken digital tests, while others had to use test tools that could connect to the internet as part of their studies. Thirty of the students in this group took the task-based test while information from the system logs was being used. The sample of staff was made up of twelve ICT officers, mobility support officers, or accessibility experts. The other forty were teachers or people in charge of tests. Students can take part if they are currently registered in a college program and have a recorded or self-reported need for test accommodations, assistive technology, or exam rooms that are easy to get to. Accessibility needs can be about being able to see or hear, moving around, reading and language processing, controlling attention, managing brain load, managing time, test nervousness, or relying on assistance technology. The study won't treat the kids as a single, uniform group. Instead, the sample method will try to show the range of accessibility needs, since different technology problems might show up at different stages of the examination process. Staff members will be able to give institutional and expert views on setting up the platform, providing accommodations, fixing problems, enforcing policies, and making sure exams are safe.

3.3 ICT Examination Environment

An ICT examination environment with a virtual LMS-based digital examination platform set up to look like a typical higher education test environment was used. The setting had directions on how to take the test, timed question pages with multiple-choice and short-answer questions, file-upload questions, answer review, final submission, and proof of submission. People thought of the platform as a full computer system, not just an online test form. This means that the study looked at more than just the question display. It also looked at how to get around, how to set the timer, how to use help technology, how to deal with errors, how autosave works, and how to check the final answer.

The surroundings will have both normal test settings and some settings that are easier for people with disabilities to use. Some of these are high-contrast displays, keyboard-only navigation, screen-reader support, more time, different question forms, voice or text-based directions, expanded text mode, and the ability to share files. When online proctoring or safe browser features are used, they will be checked to see if they work with assistive technologies. This is because security tools can accidentally stop screen readers, speech-to-text systems, magnifiers, or other input devices. So, the testing setting will let the study check to see if accessibility features work as part of the real testing process, not just as separate interface choices.

3.4 Instruments and Measures

A number of tools will be utilized to record the technical and educational aspects of open digital

examination. To begin, an accessibility compliance plan will be made using WCAG accessibility guidelines, ICT accessibility standards, and objectives for inclusive evaluation design. The list will look at things like the structure of the navigation, the order of the focus, keyboard access, screen-reader output, reading, contrast, time flexibility, form labels, mistake recovery, alternative content, file upload accessibility, login accessibility, and proof of submission. Each requirement will be given a score based on how well it meets the requirements and how bad the technology problems that were found are. Second, a task completion summary will keep track of whether or not students successfully complete each part of the test. This includes logging in, proving their identity, reading the instructions, navigating to the next question, typing in their answer, reviewing their answer, uploading any necessary files, and submitting their work at the end. Third, a system usage test will be used or changed to find out how easy people think it is to use, how clear the interface is, how predictable navigation is, how well errors are fixed, how confident people are, and how independent they feel. Fourth, an Accommodation Quality Scale will be created to check if the accommodations that were given were technically possible, correctly set up, simple to use, and in sync with the test process. It's possible that this measure will ask about extra time, different forms, dealing with helpful technology, clear directions, and getting help. Fifth, signs from the system log will be looked for on the page. The amount of time spent on the task, the number of navigation errors, page reloads, backtracking events, failed login attempts, failed submission attempts, help requests, the number of times input is fixed, long pauses, and events that use assistive technology when they can and should happen are some of these signs. Finally, students and staff will be asked to fill out a semi-structured interview form to share their thoughts on issues related to living, technology, the platform's dependability, personal concerns, and limits on academic ethics.

Table 1. Technical Evaluation Dimensions for Accessible ICT-Based Examinations

Dimension	Technical Indicator	Data Source	Measurement Method	Relevance to Accessibility
Keyboard navigation	Successful completion without mouse use; focus order accuracy	Accessibility audit; task simulation	Keyboard-only walkthrough and task success recording	Indicates whether students with motor-access needs can operate the exam independently
Screen-reader compatibility	Accurate reading of questions, options, timers, errors, and submission confirmation	Accessibility audit; task simulation	Screen-reader testing and observed interaction	Determines whether content and controls are semantically accessible
Timing flexibility	Correct application of extended time and timer visibility	Platform settings; system logs	Configuration audit and time-stamp comparison	Shows whether accommodations are accurately delivered under exam conditions
Error recovery	Clarity of error messages and ability to correct mistakes	Task checklist; logs	Error event coding and successful recovery rate	Reduces risk of avoidable failure during high-pressure assessment
Authentication burden	Failed login attempts, time lost, inaccessible verification steps	System logs; interviews	Login event analysis and staff validation	Identifies whether security procedures create unequal access barriers
Submission reliability	Failed submission attempts, autosave	System logs; task checklist	Submission event tracking	Protects assessment evidence and reduces uncertainty

	success, confirmation clarity			
Assistive-technology compatibility	Compatibility with screen readers, magnifiers, speech-to-text, and alternative inputs	Audit; task simulation	Compatibility testing across examination stages	Confirms whether tools work inside the real exam workflow
Accommodation accuracy	Match between approved accommodation and platform configuration	Platform settings; questionnaire	Accommodation configuration review and student rating	Measures whether institutional support is technically implemented correctly

Note. The dimensions represent the technical evaluation structure used to assess accessibility across the digital examination workflow.

3.5 Procedure

The steps for the study will be carried out one after the other. First, the testing site will be set up with normal choices that are also accessible. Before the students take the test, the study team will do an initial accessibility compliance check to look for any possible technology problems. Second, the students in the task-based subgroup will take a fake digital test that is meant to look like real tests that students take in college. There will be a login screen, directions, question navigation, answer entry, review, and a final submit. Students will use the settings or tools that make learning easier that are right for them.

The system will keep track of interactions during the exercise, such as the length of tasks, how users navigate, mistakes, reloads, calls for help, input adjustments, and submit events. Observers can also write down when a job is finished and when social problems are seen, but they can't talk to the student unless it's ethically necessary to do so. After finishing the exercise, students will fill out the evaluation about how easy it was to use, how good the accommodations were, how independent they felt, how reliable they thought it was, and how fair they thought it was. Then, a small group of students will be asked to talk about the mechanical problems they had in semi-structured interviews. Interviews will also be done with ICT staff, disability support officers, and test managers to find out if the problems seen are caused by the design of the platform, mistakes in setup, staff routine, security settings, or limits in institutional support.

3.6 Ethical Considerations and Data Privacy

Before the data was collected, ethical approval was sought, and all subjects gave their consent after being fully told. They were told that the mock tests would not affect their grades, their ability to get accommodations, or their school records, and that they could choose not to take part. The data from the system logs were made nameless before they were examined. The study group did not include any identification records, medical records, or disability statement files that could be used to figure out who the person was. Log events like reloads, stops, calls for help, navigation mistakes, input changes, and attempts to send were only looked at as touch events. There was only access to the raw data by the study team. The results were shared as a whole to protect student privacy and make sure that individual movement patterns could not be tied to specific students.

Table 2. Participant and Testing Profile

Participant Group	Sample Size	Accessibility Need Category	Testing Mode	Data Collected
Students with special educational needs	120–180	Visual, hearing, motor, cognitive, reading, attention, anxiety-related, or mixed access needs	Questionnaire-based evaluation	Usability, accommodation quality, independence, reliability, perceived fairness

Task-based student subgroup	30–40	Selected to represent varied accessibility and assistive-technology needs	Simulated digital examination	Task completion, time-on-task, errors, help requests, reloads, failed submissions
Academic staff/exam administrators	30–50	Not applicable	Questionnaire or interview	Examination workflow, accommodation delivery, assessment validity, support constraints
ICT/accessibility support officers	10–15	Not applicable	Semi-structured interview	Platform configuration, accessibility testing, troubleshooting, technical readiness
Platform/accessibility audit team	2–4 evaluators	Accessibility and ICT evaluation expertise	Compliance audit	WCAG-related findings, severity level, required technical fixes

Note. The task-based subgroup was selected to represent varied accessibility and assistive-technology requirements during simulated examination tasks.

3.7 Data Analysis

If the sample size is big enough, descriptive statistics, reliability analysis, correlation, group comparison tests, and regression or structural equation modeling will be used to look at the quantitative data. Accessibility compliance, job finish, mistake frequency, help requests, reaction time, adjustment correctness, and perceived fairness will all be summed up by descriptive data. For parts of the poll that measure things like usefulness, level of accommodations, system reliability, independence, and fairness, reliability analysis will be used. We will use correlation and regression analysis to see if usefulness, accommodation quality, assistive technology compatibility, and system stability can be used to predict how fair people think a test is. It is sometimes useful for group studies to find differences between students who use standard settings and those who use settings that make them easier for people with disabilities to use. The error-path plots, contact dates, pause analysis, repeat frequency, and send failure trends will all be there. We are going to look at information from the system logs by event code and picture. Thematic coding will be used to figure out on a technical level why the problems in the qualitative interview data are happening. We will look at how to connect the style of the platform, how users can get in touch with it, and how fair the scores are to put the results together.

4. Results

There were five ways to look at the results: to make sure they were easy to find, to see how well people did on the tasks, to see what the system logs said, to rate the value and quality of life, and to give each person their own expert opinions.

4.1 Accessibility Compliance Results

The study found that the ICT-based test tool didn't always work well on the test for people with disabilities. The best times for people to work together were when they were reading simple lines, being given standard questions, having access to longer texts, and seeing them at regular times. Most students were able to quickly understand how these parts of the test were set up and answer simple text-based questions. But jobs where they had to talk to people with different levels of skill were not done as carefully. It could recognize people, show results for screen users, let you move around with just the keyboard, fix mistakes, share files, and show proof that the last send went through. It became very clear when students had to switch between system jobs during a test. This trend shows that it wasn't just a matter of how the information was laid out.

The attention wasn't where it should have been when I tried to check my name, go over the questions, and share a file. Some of the keys worked. It was hard for kids to type on computers and other devices. When testing with a screen reader, it was also clear that the answer

choices, menu buttons, timer changes, and mistake messages were not fully understood. Some question writing could be seen by screen reader users, but they didn't always get enough information about what to do next or how the test was going. You could set the time on the site, but there were timing issues when extra time clashed with proctoring or report due dates. Not all warning messages could be seen by technologies that help people, and messages that said an entry failed didn't always say how to fix the problem. This was another big problem with error recovery.

This test showed that the site mostly met some basic usability standards. However, the whole test process didn't always work. This way, accessibility wasn't just a feature on a screen, but a state at the system level. However, even if the platform can be read, it may still be wrong if it is hard to join in, view, or file.

Table 3. Accessibility Compliance Audit Matrix

Requirement Area	Tested Function	Compliance Status	Severity Level	Observed Technical Problem	Required Fix
Keyboard access	Login, navigation, answer input, review, submission	Partial	High	Focus order was inconsistent during review and file-upload stages	Redesign focus sequence and test full workflow using keyboard-only access
Screen-reader compatibility	Question text, answer options, timer, errors, confirmation	Partial	High	Timer updates and error messages were not consistently announced	Add semantic labels, ARIA live regions, and screen-reader-tested feedback
Timing control	Extended time and countdown display	Partial	Moderate	Extended time did not always synchronize with proctoring deadline	Integrate accommodation timing with monitoring and submission systems
Readability	Font size, contrast, spacing, question display	Mostly compliant	Low	Enlarged-text mode worked but sometimes increased scrolling burden	Improve responsive layout under enlarged display settings
Authentication accessibility	Identity verification and login recovery	Partial	High	Verification screens required visually dependent interaction	Provide accessible alternatives for identity verification
Error recovery	Validation warnings and failed submission messages	Non-compliant in some stages	High	Error messages were visual only and lacked corrective guidance	Provide accessible, specific, and recoverable error feedback
Assistive-technology compatibility	Screen reader, magnifier, speech-to-text, keyboard input	Partial	High	Some tools were blocked or unstable during secure browser mode	Conduct compatibility testing before deployment
Submission confirmation	Final submission and receipt message	Partial	Moderate	Confirmation was visually displayed but not always accessible to screen readers	Provide accessible confirmation, downloadable receipt, and email backup

Note. Severity levels indicate the observed accessibility impact of each technical issue during the audit.

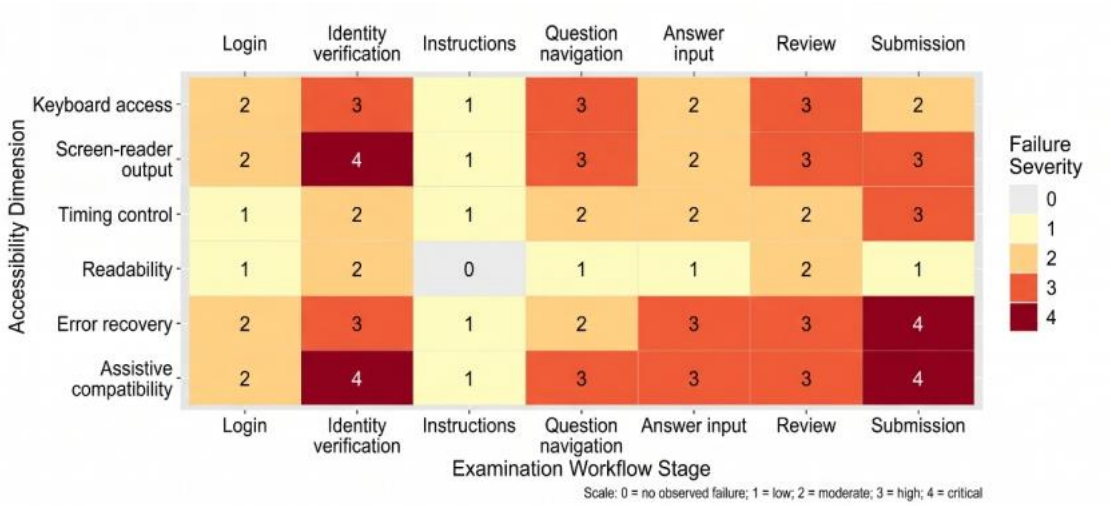

Figure 1. Accessibility Failure Heatmap Across Examination Workflow

4.2 Task-Based Performance Results

A task-based test made accessibility issues stand out the most when students went from reading to using the system. Most people were able to start the test and finish the easy text questions, but they did worse when they had to write their name, go through several pages, share files, check their answers, and turn in the whole thing. They had to learn how to use the platform, keep track of time, make choices when they were rushed for a test, and use helpful tools in these steps. People got the most done when they could read directions and answer written questions on the same screen. Most people didn't finish their tasks when they were asked to share files or make changes to their final entry.

Many times, students who set up their computers in a way that made them easier to use did more work on their own than students who left them alone. More so when the computer was set up so that it was easy to use, let you write bigger, and gave you more time. But the moving features did not make everything better. But it was harder to move up and down in larger text mode, which made it easier to read. This made it possible for some students to miss the accept or control keys. It was hard to type answers when the focus suddenly changed to a different question screen because you could only move your fingers on the keyboard. Screen reader users did less work on their own when question numbers, answer choices, or mistake messages were read out loud wrong. Adding features for accessibility shouldn't be seen as a separate job. Instead, it should be seen as an important part of the whole process. Most of the mistakes were going back and forth between wrong questions, not sharing a file, going over an answer without finishing it, and not being sure about the last bit of work. Students usually asked for help when they weren't sure if they had saved an answer or turned in the right test. You can finish a job faster if it's easy to answer questions, get feedback from the system, and make sure the work can be done again.

Table 4. Task-Based Examination Performance Metrics

Task	Mean Completion Time	Error Rate	Help Requests	Successful Completion %	Accessibility Feature Used
Login and access examination page	3.8 minutes	18%	9	86%	Keyboard navigation; screen reader
Complete identity verification	5.4 minutes	31%	14	72%	Alternative verification support
Read instructions and locate timer	2.6 minutes	12%	5	91%	Enlarged text; screen reader
Navigate between question pages	6.2 minutes	27%	13	76%	Keyboard-only navigation

Answer text-based questions	8.7 minutes	15%	6	88%	Text-to-speech; speech-to-text
Upload file-based answer	7.1 minutes	36%	17	64%	Keyboard navigation; magnification
Review answers before submission	4.9 minutes	29%	12	70%	Enlarged text; screen reader
Submit examination successfully	3.5 minutes	24%	11	78%	Accessible confirmation support

Note. Performance metrics are based on task-based examination simulation data.

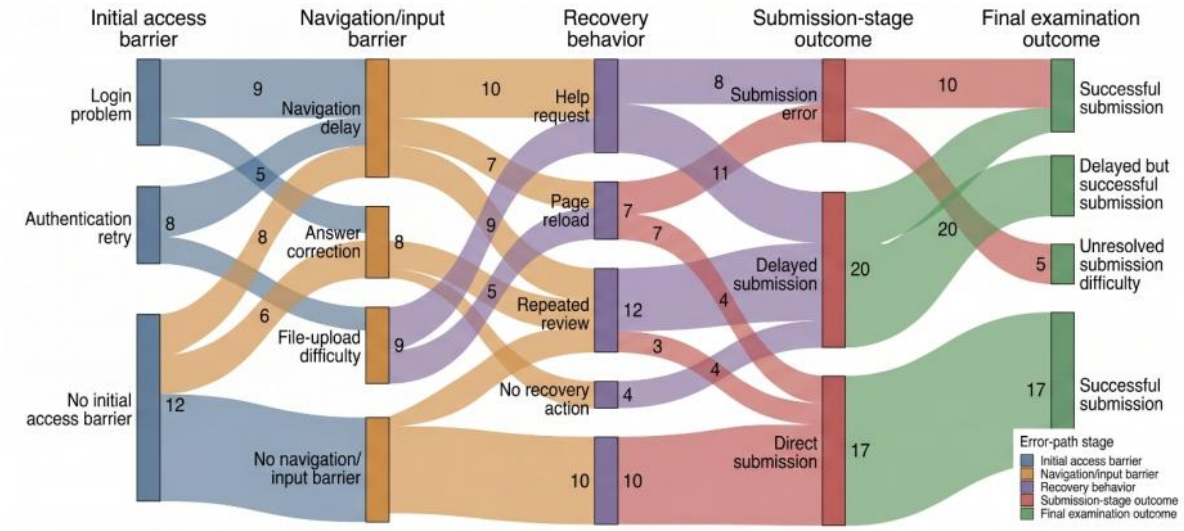

Figure 2. Error Path Sankey Diagram for Examination Completion

4.3 System-Log Analytics

We saw issues with seeing things in the system logs that the polls didn't fully explain. The most important things to look for in the logs were long stops, multiple page reloads, back-navigation events, changes to data, failed submit tries, and timestamps for help calls. Some students thought the test was easy, but it was really hard to finish because of all the technology issues. If someone wants to look over a question again, they often hit the screen again. They did these things because they didn't know if their answers were kept or how to get back to questions they hadn't cleared out yet. When there was a problem, you were asked to send a file, and your name was checked. There were long breaks between screens. They didn't have enough time to figure out what the system was saying or get back on track after getting lost in the interface. The amount of page reloads made it clear whether the platform was stable or if people were trying to go back to places they couldn't reach. There were times when people who used help tools had to reload more often. The link between test protection and getting to help wasn't stable, it looks like. They had to fix more of what they wrote when they used tools that turned speech into writing. There were times when the answer boxes didn't move to the right, and the mouse would move all over the place. People might not have sent because the acceptance messages weren't clear enough or the proof offers were too far away.

This shows how proof from system logs can be useful. A poll can tell you if students thought the app was easy to use or not. But logs make it clear what went wrong. People do things and stops more often when they can't get input or when guidance isn't stable. During tests, doing the same thing over and over again takes time and mental energy. People are less independent when they are wasting time and don't know what to do next. And when they are less independent, they don't think the test is fair and true.

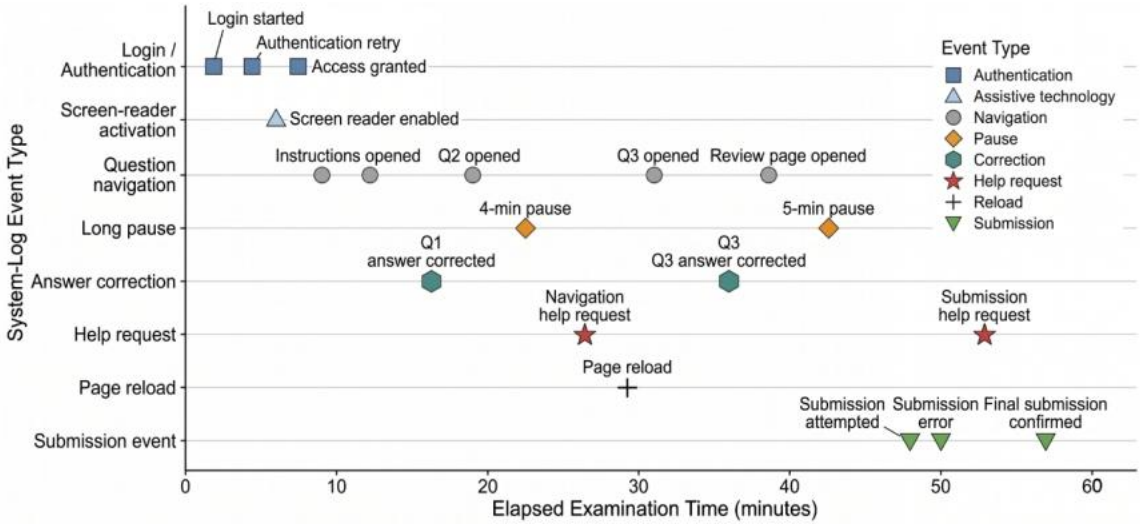

Figure 3. System-Log Timeline of Student Interaction During Digital Examination

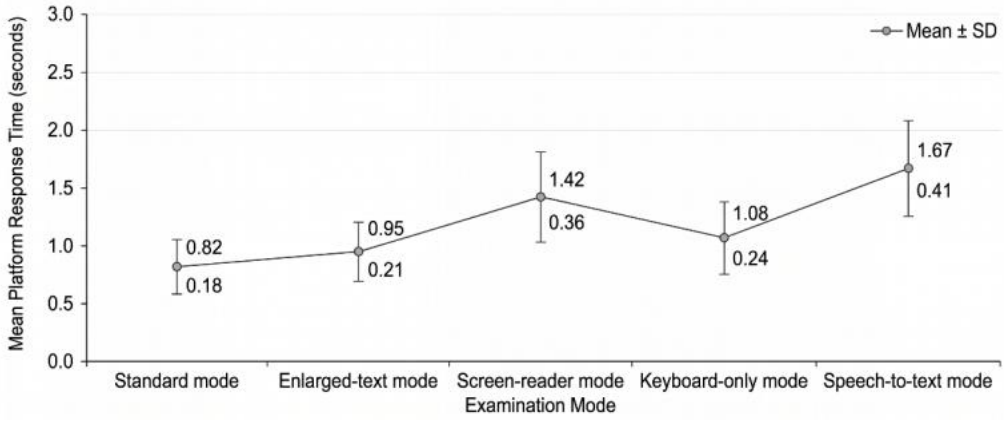

Figure 4. Response-Time Stability Under Accessibility Settings

4.4 Usability and Accommodation Quality

The most important connections were found between how fair people thought the test was and worth, quality of life, system security, and how well people interact with useful technology. They were more likely to think the test was fair if they said it was simple to use, gave them feedback often, let them make the necessary changes, and was always the same on the platform. It was also more fair when the layout was simple to understand. It wasn't as strong, though, when system security and home quality were taken into account. This means that students may be able to use a pretty tough interface as long as the platform is stable, methods are used properly, and help tools always work. Students thought something was fair based on both whether or not accommodations were given and how well they did on the test. This meant that the quality of the accommodations was very important. It was only fair to give more time when the timer, the proctoring session, and the report's due date were all in sync. It was also better to be free when you could use a screen reader to read out choice boxes, error messages, and accepting messages. This result supports the idea that getting the right kind of housing is a problem with both how they are managed and how they are technically done. Additionally, how well the method worked was very significant. They didn't trust the testing process as much after turning in an exam and then having to start over, wait, or get an answer that wasn't clear. While freedom and technology for help were working together, the line was straight. They did well on tests and didn't need extra help from staff when tools worked together. The outcomes indicate that how fair something is depends on how clear it is, how stable it is

technically, how well it works with useful technology, and how well it works after changes are made.

58% of the difference in how fair people thought the test was could be explained by this model (R^2 =.58, adjusted R^2 =.56, F(5, 144) = 39.77, p <.001).

Table 5. Predictors of Perceived Examination Fairness

Predictor	β	Standard Error	t-value	p-value	Interpretation
System usability	.29	.06	4.83	< .001	Better usability significantly predicts higher perceived fairness
Accommodation quality	.34	.07	5.21	< .001	Accurate accommodation delivery is the strongest fairness predictor
System reliability	.31	.06	4.96	< .001	Stable platform performance increases confidence in assessment fairness
Assistive-technology compatibility	.27	.07	4.02	< .001	Compatibility supports independence and fairer participation
Interface clarity	.18	.06	2.74	.007	Clear instructions and navigation contribute modestly to fairness

Note. β = standardized regression coefficient; dependent variable = perceived examination fairness.

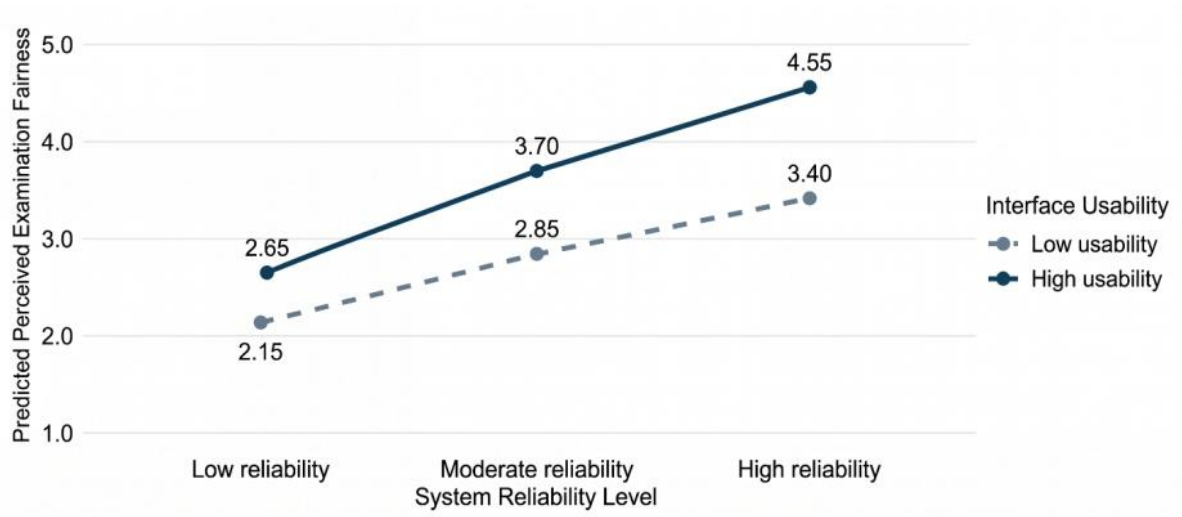

Figure 5. Fairness–Usability–Reliability Interaction Plot

4.5 Qualitative Technical Feedback

People who worked for us and students who were there helped us figure out what went wrong with those tech things. They said that problems that were hard to fix, not ones that took a long time, were usually the hardest ones. I'm not sure if an answer was saved, the timer started over, or the writing was finished. It made me feel bad. People checked more often because of this. They said that tools didn't always work to get help. There were pages that worked with their tools but not when they checked, went over, or sent. It was clear from what the staff said that some of the problems were with the way things were set up, not with the kids not being able to do their work. The people in charge of ICT said that settings were often changed by hand and that private browser limits or proctoring tools weren't always used to make sure they were right. People who help disabled people said that the old ways might not work as well now that the site has changed how the show works. How ready the staff is, how the platform is built, and how well the technology

is kept up to date all play a role. These numbers prove it.

4.6 Integrated Findings

What four technology things need to be in good shape for digital tests to be useful to everyone? They are how stable the platform is, how simple the interface is to use, and how well the rooms work. The kids had the most trouble when they made a lot of small mistakes. It wasn't true for all of them because some people broke the rules. It became more dangerous to be unable to access some parts of the computer when warning messages weren't clear and the send button wasn't reachable. The same was true for extra time that wasn't planned for when proctoring due dates. They did some things over and over again on the test, then stopped, tried again, and failed. This showed that there was pressure lying around. The most important thing we can learn from this is that fair ICT-based tests need stable technology contact, not just the ability to make changes. Because of this, we have to test the whole exam process all the time, even before it's used and after all the changes are made.

5. Discussion

5.1 Technical Interpretation of the Findings

The results show that accessibility in ICT-enabled tests isn't just about how certain accessibility features look; it's also about how they work during the whole grading process. There were some issues with the site that made it hard to identify people, find your way around, fix mistakes, connect to technology that helped, and make sure that your work was submitted. This trend backs up the idea that being able to get digital tests is a problem with the system as a whole. On the off chance that a platform has an easy-to-understand interface, students may still get different grades if they can't get to the choices while timed parts of a test are going on. Professional interaction and pressure to make decisions were the worst when they happened together. Not having enough support for screen readers, for example, not only made it harder to get to things, but it also wasted time, broke trust, limited freedom, and made it harder to fix mistakes. It takes more work for the student to figure out what happened if a timer update, validation warning, or entry proof is not stated correctly. This starts a chain reaction where not getting feedback makes you more unsure, and being anxious makes you need to check or ask for help more than once, which takes time during the test. When a lot is at stake, this technical problem turns into a question of how fair the evaluation is. In the same way, reaction time unreliability should be seen as a problem with usability as well as platform speed. For students who use assistive technologies, an unreliable response time could stop them from reading, speaking, navigating, or fixing mistakes. Once this happens, the digital method will no longer offer the same chances to show academic understanding. So, the results back up what has already been said: inclusive assessment needs to look at the practical and material conditions of assessment, not just the official access of accommodations (Nieminen, 2024; Tai et al., 2023)\.

5.2 Contribution to Accessible Assessment Engineering

This study's major addition is the creation of a method for judging available digital tests as well-designed ICT assessment systems based on proof. Previous studies have taught us a lot about how to use helpful technology, make online learning accessible, use inclusive evaluation, and make accommodations in higher education (Fernández-Batanero et al., 2022; McNicholl et al., 2021; Moriña et al., 2024; She & Martin, 2022). This study adds to previous research by showing that test accessibility can be checked using a number of different types of technical evidence, such as compliance tracking, task-based simulation, system-log analytics, measuring the quality of accommodations, evaluating usefulness, and fairness models.
This method is important because problems with usability on tests are often hard to see. A student may finish a test, but only after many page reloads, long breaks, entry changes, going backwards, or asking for help. These secret costs won't be seen if evaluations only look at finished work or general happiness. What are the problems? Does it only happen when we do certain things, like check our name, look over

something, add a file, or send something? That makes the review of value better and more accurate.

The study's use of the amount of changes to track scientific growth is also important. Just because an accommodation has been accepted doesn't mean that everything is fair. They need to be set up properly, work with useful technologies, and stay stable when security settings are turned on. This change needs to be known so that measurement engineering is simple. People are now more interested in whether or not a school has an accomodation policy than in whether or not its ICT system can reliably provide that accommodation during the test. In this way, the study shows how to connect accessibility standards, proof of how people and computers communicate, and the reliability of assessments.

5.3 Implications for Higher Education Institutions

The results show that universities should include digital exams that are easy for everyone to access as part of their ICT quality assurance. Accessibility testing should happen before the test is given, not after students say they are having trouble. Screen-reader trials, magnification checks, speech-to-text compatibility, timer syncing, accessible identification, and submit proof testing should all be part of the testing that happens before the test. Instead of just checking a few pages, these checks should be done across the whole process. This is because many problems only show up when students move from logging in to answering questions, reviewing their work, and submitting their work. Also, schools should make it easier for teaching staff, ICT units, mobility support offices, and people in charge of exams to work together. When tasks are split up, it's often harder to provide accommodations. For instance, disability support staff may agree to more time, but ICT staff must set it up properly, and test managers must make sure that proctoring or filing dates don't get in the way of it. If the government doesn't tie its hands, the things it lets you do might not work right.

Also, this means everyone buys. Schools should make sure that test systems have safe ways for students to get help, questions that make sense, time limits that can be changed, useful tools, and strong mistake repair. People need to be shown more than just a tool. How things are written, the website is set up, problems are fixed, and teachers talk to their students are also important. Open testing shouldn't be an extra step; it should be a part of how tests are given.

5.4 Implications for ICT System Design

The people who make ICT systems need to make sure that the test tools are simple to use, compatible with assistive technology, and easy to get back to after failing. Before you can use a mouse, you should be able to get to everything and know where to click to log in, ask questions, look over, save, and send. Readers on screens should be able to read more than just the question text. They should also be able to read messages, timers, warnings, and marks that show when a state has been saved. To show who you are, you should do more than just look at something or move your body.

The test engine, the proctoring layer, and the submission system all need to be able to change the time and agree on it. Auto-save should always work, be clear, and be easy for people to use. The letter should say what went wrong, what action or field it affects, and how to fix it. When you have to think a lot on a test, small problems that are helpful can feel unfair. That's why apps should be simple to use. Screen readers, magnifiers, speech-to-text systems, and other input devices should be used to test secure websites and proctoring tools before they are made available to everyone.

5.5 Limitations

There are still some problems with the study, though. The first thing that could have changed the results is the pick of test, school, and setting. Another thing is that practice tests might not fully make up for the stress, changes to the course, and high academic stakes of real tests. Third, disabled students are not all the same. Depending on how they need to learn, the way they talk to each other may change. Fourth, you should be careful and honest with system-log signs because looking at the data can show private actions. Last but not least, results from one school might not work

with all digital testing systems if they aren't tested more on more platforms and in more places.

5. Conclusion

This study says that making it easier to get to digital tests is more than just making it easier to get to class. Also, it means making sure that the IT systems in higher education are fair, dependable, and of a high scientific level. More and more, schools use tests that run in the LMS, browsers, online proctoring, login tools, and systems that report results automatically. These types of tests are hard for students with special needs because they are shaped by both the site and the course subject. If the test is hard to use, doesn't let you use help tools, doesn't let you set your own time limits, doesn't let you see error messages, or doesn't make it clear how to show proof, it might measure more than just academic success. Tests aren't as helpful in this case because possible system issues cause problems that aren't related to the idea.
This type of expert study using a mix of methods is a good way to look at these risks. It asks students if they think the system is easy to use and finds out where and why there are tech issues during the test. To do this, it combines data from staff notes, task-based tests, and polls of disabled students. Seeing happiness can hide problems, so this needs to be done. Students may not always say that they have trouble moving around, but if they do, it can still limit their freedom, trust, time use, and sense of what's fair. They might have to start over with pages several times, pause for a long time, go backwards, fix mistakes, ask for help, and then fail to.

The study also shows that the amount of living should be seen as a basic need for adoption. Something doesn't mean a place is good just because a group liked it. Not only does it need to be set up correctly, but it also needs to be stable during the whole assessment process and work with assistive technologies. It also needs to be in sync with test security and time limits. If universities want to make sure exams are accessible, they should try the platforms before the exams, train both academic and ICT staff, and make sure that accessibility standards are followed when platforms are bought and exams are run.
After being used, new test tools shouldn't need to be changed so that they can be used by one student at a time. After they have been tried and tested and shown to work, everyone should be able to use ICT systems right away. Every school needs to make sure that everyone can get to their online tests. Kids who need more help can then show what they know in a way that is honest, fair, and on their own.

References

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). The effect of Universal Design for Learning application on e-learning acceptance: A structural equation model. *The International Review of Research in Open and Distributed Learning, 18*(6), 54–87. https://doi.org/10.19173/irrodl.v18i6.2880

Ball, S. (2009). Accessibility in e-assessment. *Assessment & Evaluation in Higher Education, 34*(3), 293–303. https://doi.org/10.1080/02602930801956000

Bong, W. K., & Chen, W. (2024). Increasing faculty's competence in digital accessibility for inclusive education: A systematic literature review. *International Journal of Inclusive Education, 28*(2), 197–213. https://doi.org/10.1080/13603116.2021.1937344

Burgstahler, S. (2015). Opening doors or slamming them shut? Online learning practices and students with disabilities. *Social Inclusion, 3*(6), 69–79. https://doi.org/10.17645/si.v3i6.420

Cumming, T. M., & Rose, M. C. (2022). Exploring universal design for learning as an accessibility tool in higher education: A review of the current literature. *The Australian Educational Researcher, 49*(5), 1025–1043. https://doi.org/10.1007/s1635-654-0635-654

Fernández-Batanero, J. M., Montenegro-Rueda, M., Fernández-Cerero, J., & García-Martínez, I. (2022). Assistive technology for the inclusion of students with disabilities: A systematic review. *Educational Technology Research and Development, 70*(5), 1911–1930. https://doi.org/10.1007/s1635-654-1635-654

Fichten, C. S., Asuncion, J. V., Wolforth, J., Barile, M., Budd, J., Martiniello, N., & Amsel, R. (2012). Information and communication technology related needs of college and university students with disabilities. *Research in Learning Technology, 20*, Article 18646. https://doi.org/10.3402/rlt.v20i0.18646

Griful-Freixenet, J., Struyven, K., Verstichele, M., & Andries, C. (2017). Higher education students with disabilities speaking out: Perceived barriers and opportunities of the Universal Design for Learning framework. *Disability & Society, 32*(10), 1627–1649. https://doi.org/10.1080/09687599.2017.1365695

Kent, M., Ellis, K., & Giles, M. (2018). Students with disabilities and eLearning in Australia: Experiences of accessibility and disclosure at Curtin University. *TechTrends, 62*(6), 654–663. https://doi.org/10.1007/s1635-654-0337-y

Konur, O. (2007). Computer-assisted teaching and assessment of disabled students in higher education: The interface between academic standards and disability rights. *Journal of Computer Assisted Learning, 23*(3), 207–219. https://doi.org/10.1111/j.635-654.2006.00208.x

Laamanen, M., Ladonlahti, T., Uotinen, S., Okada, A., Bañeres, D., & Koçdar, S. (2021). Acceptability of the e-authentication in higher education studies: Views of students with special educational needs and disabilities. *International Journal of Educational Technology in Higher Education, 18*, Article 4. https://doi.org/10.1186/s4635-654-0635-654

Lee, K. (2017). Rethinking the accessibility of online higher education: A historical review. *The Internet and Higher Education, 33*, 15–23. https://doi.org/10.1016/j.iheduc.2017.01.001

Lee, O. E., & Kim, S. Y. (2024). Exploring the impact of disabilities and accommodation on students' online learning experiences. *Journal of Special Education Technology, 39*(3), 378–389. https://doi.org/10.1177/01626434241232118

Lomellini, A., Lowenthal, P. R., Snelson, C., & Trespalacios, J. H. (2025). Accessible and inclusive online learning in higher education: A review of the literature. *Journal of Computing in Higher Education, 37*(3), 1306–1329. https://doi.org/10.1007/s1635-654-0635-654

McNicholl, A., Casey, H., Desmond, D., & Gallagher, P. (2021). The impact of assistive technology use for students with disabilities in higher education: A systematic review. *Disability and Rehabilitation: Assistive Technology, 16*(2), 130–143. https://doi.org/10.1080/17483107.2019.1642395

Moriña, A., Carballo, R., & Castellano-Beltran, A. (2024). A systematic review of the benefits and challenges of technologies for the learning of university students with disabilities. *Journal of Special Education Technology, 39*(1), 41–50. https://doi.org/10.1177/01626434231175357

Nieminen, J. H. (2024). Assessment for inclusion: Rethinking inclusive assessment in higher education. *Teaching in Higher Education, 29*(4), 841–859. https://doi.org/10.1080/13562517.2021.2021395

Okada, A., Whitelock, D., Holmes, W., & Edwards, C. (2019). e-authentication for online assessment: A mixed-method study. *British Journal of Educational Technology, 50*(2), 861–875. https://doi.org/10.1111/bjet.12608

Reyes, J. I., Meneses, J., & Xavier, M. (2023). Suitability of online higher education for learners with disabilities: The students' voices. *Journal of Special Education Technology, 38*(2), 253–266. https://doi.org/10.1177/01626434221131772

Roberts, J. B., Crittenden, L. A., & Crittenden, J. C. (2011). Students with disabilities and online learning: A cross-institutional study of perceived satisfaction with accessibility compliance and services. *The Internet and Higher Education, 14*(4), 242–250. https://doi.org/10.1016/j.iheduc.2011.05.004

She, L., & Martin, F. (2022). Systematic review (2000 to 2021) of online accessibility research in higher education. *American Journal of Distance Education, 36*(4), 327–346. https://doi.org/10.1080/08923647.2022.2081438

Sireci, S. G., Scarpati, S. E., & Li, S. (2005). Test accommodations for students with disabilities: An analysis of the interaction hypothesis. *Review of Educational Research, 75*(4), 457–490. https://doi.org/10.3102/00346543075004457

Tai, J., Mahoney, P., Ajjawi, R., Bearman, M., Dargusch, J., Dracup, M., & Harris, L. (2023). How are examinations inclusive for students with disabilities in higher education? A sociomaterial analysis. *Assessment & Evaluation in Higher Education, 48*(3), 390–402. https://doi.org/10.1080/02602938.2022.2077910

Weis, R., & Beauchemin, E. L. (2020). Are separate room test accommodations effective for college students with disabilities? *Assessment & Evaluation in Higher Education, 45*(5), 794–809. https://doi.org/10.1080/02602938.2019.1702922

Acknowledgements

This research project was supported by the University of Technology and Applied Sciences-Suhar, Oman, through the Internal Research Funding Program 2026 (Grant No. IRFP-635-654). The authors would like to thank the university for its commitment to advancing research in educational technology.

Author Declaration

The author(s) declare that this manuscript is an original work and has not been published previously, nor is it under consideration for publication elsewhere. All sources used in the preparation of this manuscript have been appropriately acknowledged and cited.

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.