

Enhancing Digital Learning: The Effect of an LMS Accessibility Tool in Higher Education

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Abstract

In May 2023, the U.S. Department of Education Office of Civil Rights released a *Dear Colleague* letter reminding colleges and universities of their legal obligation to provide accessible digital content to students. Despite these legal obligations, research indicates that much digital content remains inaccessible. To help improve digital accessibility, a medium sized state college in the southeast United States adopted a digital accessibility tool and integrated it into its learning management system. The goal of this study was to investigate how accessibility scores were affected during the first semester of adopting this learning management system accessibility tool. Accessibility scores ($n = 515$) were analyzed to determine if there was a difference in the mean accessibility scores before and after adopting the learning management system accessibility tool. The findings showed statistically significant results ($p < .001$) with accessibility scores increasing by five percentage points in the first semester of adoption. These improved scores indicate an improvement in the accessibility of digital content that can benefit all students, but especially students with disabilities.

Keywords: digital accessibility, LMS accessibility, accessibility tools, accessibility detection, accessibility remediation

Digital accessibility is a growing concern in higher education. On April 24, 2024, the U.S. Department of Justice, published in the Federal Register the final rule updating the American with Disabilities Act (ADA) with specific requirements for web and mobile content accessibility. Title II of the ADA prohibits discrimination based on disability. States and local governments are required to make services accessible to people with disabilities, including services offered online or through mobile applications (apps). Web Content Accessibility Guidelines (WCAG) 2.1, Level AA are the new technical standards required for web content and mobile apps (U.S. Department of Justice, 2024). The new rule applies to password protected content inside an institution's learning management system (LMS), which would need to be accessible to students with disabilities. These changes to the ADA have moved concerns about accessibility in higher education to the forefront. Historically, progress to improve accessibility in digital content has been slow (McKeown & McKeown, 2019; Sieben-Schneider & Hamilton-Brodie, 2016; Straumsheim, 2017). The lack of progress should be a source of concern for higher education institutions.

Digital accessibility is a subset of accessibility focused on making digital products and environments available to all users, including those with disabilities. This includes websites, web or mobile applications, software, electronic documents, multimedia, LMS, or any other digital tool or product (W3C, 2024a). Accessibility includes access for people with permanent or temporary disabilities. It includes conditions that are physical like mobility impairments, visual impairments, or hearing impairments. It also includes unseen conditions like cognitive impairments, learning disabilities, and neurological impairments (U.S. Department of Justice, n.d.). Accessible designs accommodate the needs of individuals, so their disability is not a barrier to successful participation in everyday life.

Digital accessibility tools inside an LMS can help solve some of the problems by helping course designers—both instructors and instructional designers—remediate inaccessible digital content (Adebesin & Pillay, 2022; Francis et al., 2021; MacDonald, 2021; Nash et al., 2023; Walters, 2022). LMS accessibility tools flag inaccessible digital content so instructors or course designers can remediate the content. These tools provide directions to make the task of remedia-

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tion easier. For example, an inaccessible PDF might be flagged for missing tags, headings, titles, or alternative text. A PowerPoint file might be flagged for incorrect or missing reading order. Videos would be flagged if they were missing captions. LMS accessibility tools benefit students by allowing them to download course content in a variety of alternative formats, like audio or braille, to better suit their learning needs. LMS accessibility tools use WCAG to develop their tools.

WCAG were developed by the Web Accessibility Initiative (WAI), a division of the World Wide Web Consortium (W3C). WCAG are a set of technical guidelines that must be followed to make digital content and products accessible. WCAG 1.0 was first introduced in 1999 and was updated in 2008 (WCAG 2.0), 2018 (WCAG 2.1), and in 2023 (WCAG 2.2). Each version of WCAG has evolved so it is more inclusive of the needs of people with different abilities and disabilities. These guidelines include specific guidance on how software and web developers need to program their digital products, so they are accessible to all users (W3C, 2024c).

WCAG are based on four principles for accessibility, usually referred to by the acronym POUR: Perceivable, operable, understandable, and robust. Interfaces and information must be perceivable by people's senses. For example, if a person is visually impaired, they must be able to operate the interface using a different sense. Interfaces must be operable to everyone, regardless of ability or disability. Interfaces and information must be understandable to the user. Content and tools must be robust so they can be interpreted by assistive technologies that a disabled person might need to use. Robust also refers to content that must remain operable and compatible as technologies advance (W3C, 2024b).

On May 19, 2023, U.S. Department of Justice, Civil Rights Division released a *Dear Colleague* letter specifically referencing digital accessibility. The letter mentioned a lawsuit against The University of California at Berkeley as an example of the consequences that higher education institutions face when the law is not followed. As a result of the lawsuit, The University of California at Berkeley agreed to make all its web content accessible including content on third party websites, train personnel, change internal processes to consider accessibility, assign a digital accessibility coordinator, and perform accessibility audits. The letter ends with a reminder that, "Online accessibility for people with disabilities cannot be an afterthought" (U.S. Department of Justice, 2023).

To meet the new ADA requirements, digital content inside an institution's LMS must be accessible to students with disabilities. For example, deaf stu-

dents need videos and audio files with accurate captions or transcripts (McKeown & McKeown, 2019). Students who have visual impairments need course materials in alternative formats like braille (Beyene et al., 2023). The following study examines data from one state college's quest to provide accessible digital content to students through an LMS.

Literature Review

Students' Online Learning Needs

Online learning can be beneficial to students with disabilities when digital platforms and content are accessible. A blind student, for example, does not have to navigate public transportation or have someone drive them to class to gain an education. Course content delivered through digital platforms are great equalizers for students with disabilities because access empowers them to learn independently (Beyene et al., 2023; Marghalani & York, 2021).

Moreover, some course materials are easier and more affordable to make accessible online. For example, captioning videos for a deaf student is less expensive than paying for a sign language interpreter. A screen reader can be more affordable than a human reader for students who are visually impaired. Conversely, students with disabilities face barriers when digital content is not accessible (Beyene et al., 2023; Francis et al., 2021; Wilkens et al., 2021). For example, if a PDF is not accessible, the text cannot be read accurately by a screen reader. Accessibility barriers can be overcome by using LMS accessibility tools like *Anthology Ally* (Ally), *Brickfield Accessibility Toolkit*, *Universal Design Online Content Inspection Tool* (UDOIT) *Advantage*, and *YuJa Panorama* (Panorama), which make identifying and remediating inaccessible course materials easier for instructors (Anthology, n.d.; Brickfield Education Labs, n.d.; Cidi Labs, n.d.; YuJa Inc., n.d.).

Higher Education and Accessibility

While digital content and online learning can help improve access for students with disabilities, the lack of accessible digital content presents a learning barrier (Beyene et al., 2023). The COVID-19 pandemic presented additional challenges for students with disabilities due to the hurried nature of putting content online (Chen, 2021). However, accessibility tools, especially those that integrate with an LMS, were found to help improve digital accessibility, even during the COVID-19 pandemic (MacDonald, 2021; Walters, 2022).

Accessibility detection tools can help instructors remediate accessibility errors in their digital content and improve learning conditions for all students

(Francis et al., 2021) by flagging inaccessible content and helping instructors remediate the inaccessibility. In a study of one accessibility tool, Adebessin and Pillay (2022) found inconsistencies in how the tool created accessibility scores but found that its strength was the different alternative formats it created for students. Students with low vision found alternative formats or accessible versions of Word documents, rich text files (RTF), and PDFs the most useful content in their LMS (Marghalani & York, 2021). Another study recommended that an LMS should have built in accessibility tools to flag inaccessible content and help instructors and designers improve accessibility as they create course content (Baldwin & Ching, 2021). Baldwin and Ching (2021) provide examples of two LMS tools that support accessibility as they look for similar errors that do not meet WCAG.

Instructors and Digital Accessibility

Training instructors on digital accessibility is an important component to any successful digital accessibility initiative (Bong & Chen, 2021). Studies show that instructors do not feel confident in their level of knowledge or ability to digitally remediate their courses to be accessible (Guilbaud et al., 2021). Instructors lack knowledge of how assistive technologies work and training is needed to increase knowledge (Sanderson et al., 2022). Training instructors on how to make digital content accessible was necessary to help improve learning conditions for students with disabilities (Chen, 2021; Lazar, 2022). Guilbaud et al., (2021) found that training in online learning can help improve instructor knowledge and accessibility practices. Likewise, Walters (2022) found a statistically significant difference between accessibility scores for instructors who attended training on accessibility and those who did not. However, lack of training negatively impacted instructors' attitudes about accessibility because they did not understand why accommodations are required (Black et al., 2014).

The concept of designing with accessibility in mind from the beginning is called "born accessible" (Lazar, 2023). Instructors who are trained on accessibility can use this concept in their course design, which is more cost effective and less time consuming than remediating for accessibility after the course has been designed. If instructors are not being adequately trained on accessibility, then other solutions are necessary to help them remediate courses that have already been designed without accessibility in mind. This is where LMS accessibility tools can benefit and help instructors.

A qualitative study about what instructors know about digital accessibility and Universal Design for

Learning (UDL) suggested that a quantitative study should be conducted in which instructors are asked to demonstrate their practical knowledge of how to make digital content accessible (Sanderson et al., 2022). For these reasons, the present study investigated Sanderson's et al. (2022) call for quantitative research. Since the LMS accessibility tool used in this study gives each course an overall accessibility score, these scores can be used as a measure of instructors' digital accessibility knowledge.

Theoretical Framework

UDL and Universal Design for Instruction (UDI) were used as a theoretical framework for this study (Baldwin & Ching, 2021; Beyene et al., 2023; Marghalani & York, 2021). UDL and UDI provide guiding principles so that instruction is designed to meet the diverse learning needs of all students, including students with disabilities, and attempt to provide solutions and suggestions that can help meet accessibility requirements (Black et al., 2014; Olivier & Potvin, 2021).

UDL is an educational framework that provides guiding principles, so instruction is flexible for students with different learning needs, backgrounds, and abilities to benefit from the instruction (Black et al., 2014; Olivier & Potvin, 2021). The framework is based on Universal Design (UD) principles which originated in the field of architecture (Meyer et al., 2014). These principles were applied to the field of education by Meyer and Rose, who cofounded the Center for Applied Special Technology (CAST) (CAST, 2018). Since the late 1990s and early 2000s the researchers at CAST helped establish the three core principles of UDL which are multiple means of: (a) engagement, or why people learn; (b) representation, or what people learn; and (c) action and expression, or how people learn (CAST, 2018).

Within each of the core principles of UDL are recommendations for how these principles can be met (CAST, 2018). To provide multiple means of engagement, instructors should give students options for (a) recruiting interest by optimizing choice and autonomy and minimizing distractions, (b) sustaining effort and persistence by varying resources and optimizing challenges, and (c) self-regulation by promoting motivation. Meeting these recommendations will encourage learners to be purposeful and motivated. To provide multiple means of representation, instructors should give students choices for (a) perception by offering ways to customize how information is displayed and offering alternatives for auditory or visual information; (b) language and symbols by clarifying vocabu-

lary, symbols, syntax, and mathematical notations and promoting comprehension across languages; and (c) comprehension by activating background knowledge and guiding information processing. These recommendations will encourage learners to be resourceful and knowledgeable. To provide multiple means of action and expression, instructors should give learners options for (a) physical action by optimizing navigation and access to assistive technology; (b) expression and communication by using multiple tools for communication and knowledge construction; and (c) executive functioning by supporting the management of goals, information, and resources. Applying these suggestions encourage learners to be strategic, and goal directed (Capp, 2017; Olivier & Potvin, 2021; Rose, 2000; Sanderson et al., 2022; Tarconish et al., 2023).

UDI is based on UDL principles but focuses on the design of instruction (Burgstahler, 2009). UDI supports WCAG since both provide guidance on how to design with accessibility in mind. When designing using UDI, instruction should be (a) equitably designed so that it is accessible to all learners regardless of disability; (b) flexible so that learners can choose methods that best suit their learning needs; (c) intuitive, simple, and straightforward so learners are not confused; (d) perceptible so information is communicated regardless of students' sensory abilities or ambient conditions; (e) tolerant of error where instruction leaves room for mistakes that could be caused by learner's lack of prerequisite skills or varied pace for learning; (f) designed with low physical effort so that learning is maximized by eliminating unnecessary physical exertion; (g) designed with size and space in mind so that learners can complete learning tasks comfortably regardless of their mobility or physical limitations. Students should be able to represent themselves in multiple ways and should have the opportunity to engage with students and instructors in various ways (Black et al., 2014; Burgstahler et al., 2020; Olivier & Potvin, 2021; Sanderson et al., 2022; Tarconish et al., 2023).

Tools for Assessing Accessibility

LMS accessibility tools help instructors make content accessible to all learners. By meeting WCAG standards, the digital content that instructors provide their students can be read and interpreted by assistive technologies, allowing students with disabilities to learn. This accessibility meets the UDL principle of multiple means of action and expression by providing options for physical action and by optimizing content. It works with assistive tools and thereby removing barriers for students with disabilities.

The LMS accessibility tool used in this study helps instructors achieve UDL/UDI because it allows students to download content in alternative formats, giving them agency over their learning. LMS pages can be converted to plain text, audio, braille, electronic publication (ePUB), PDF, or optical character reader (OCR). Students can use a gradient reader or an immersive reader, which reads text out loud and includes a dictionary with images and written definitions and identifies parts of speech. Content can be translated into over 100 different languages. Students can choose to have their LMS content displayed in ways that can optimize their learning. Students can select from a menu of preset formats for different disabilities like dyslexia, motor impairments, color blindness, seizure disorders, or other cognitive disorders. If students do not like the preset formats, they can customize the LMS to display in a different way. These features allow students to access course content in a way that meets their preferred method of learning. The accessibility tool's alternative format output is affected by the quality of the original content. The closer a file or page is to meeting WCAG, the better the quality of the alternative formats output (YuJa Inc., n.d.). The accessibility tool can help instructors meet WCAG and legal accessibility while advancing UDL/UDI principles (multiple means of engagement, representation, and action/expression) to meet the diverse learning needs of students. Figure 1 demonstrates a customized LMS page using the accessibility tool for color blindness (with color contrast and saturation adjusted), dyslexia (with readable, larger fonts), and cognitive learning (with titles and links outlined and a solid bar that serves as a reading guide so learners can focus while they read).

Purpose and Research Question

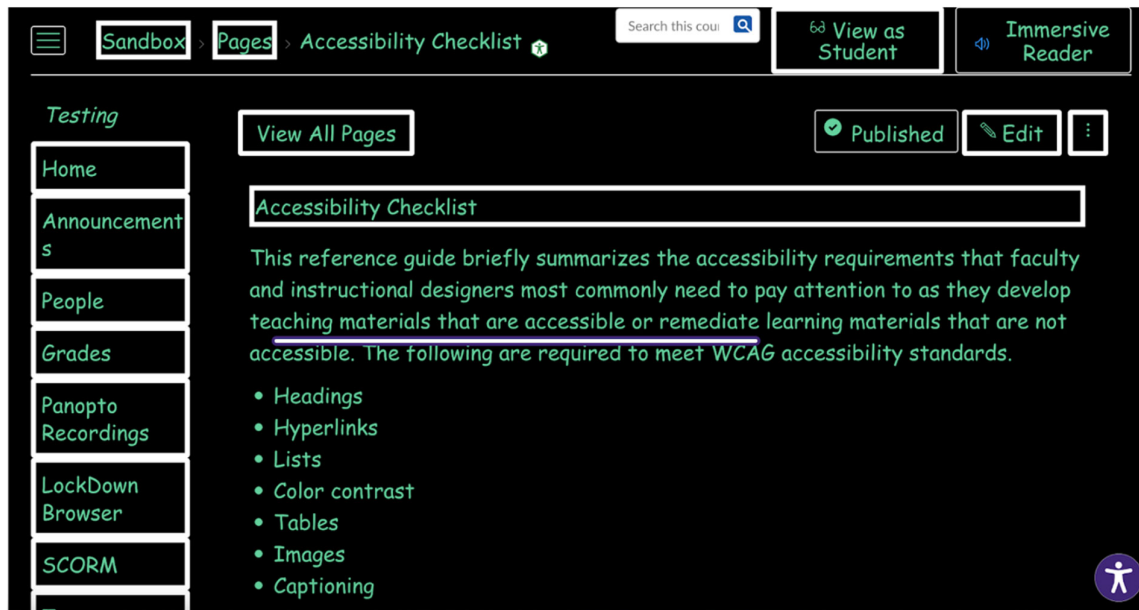
The purpose of this study was to investigate how accessibility scores changed during the first semester of a state college adopting an LMS accessibility tool. Providing students with accessible digital materials aligned with WCAG meets UDL/UDI principles by designing with accessibility in mind. The research question was as follows: What is the mean difference, if any, between the pre- and post-accessibility scores after the first semester of adoption?

Method

To investigate LMS accessibility, a quantitative study was conducted. A paired sample t test was selected as the most appropriate statistical test since it could be used to compare accessibility scores in the

Figure 1

Customization for Color Blindness, Dyslexia, and Cognitive Learning



LMS pre- and post-adoption of the accessibility tool and to determine if there was a statistically significant difference between the mean scores. The Institutional Review Boards (IRB) of two institutions approved the study; the institution whose data were used and the institution where the study was conducted.

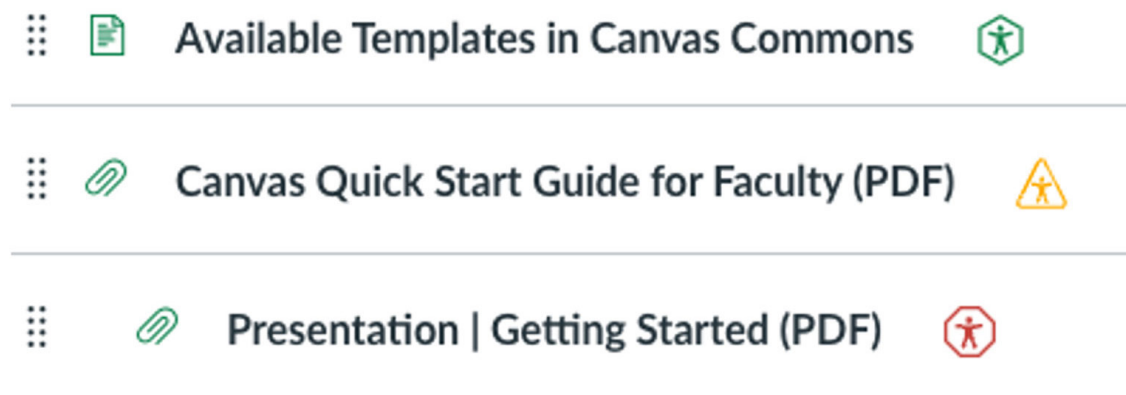
Participants and Setting

The participants were the instructors at this medium sized state college in the southeast United States who create and deliver content to students via the LMS. The institution is a Hispanic Serving Institution in a small suburban county. In fall 2022, the number of full-time instructors reported on The Integrated Postsecondary Education Data System (IPEDS) was 202 while the number of part-time instructors was 360 (NCES, 2023). The racial makeup of the full-time instructors was 6.44% Asian, 7.43% African American/Black, 9.41% Hispanic/Latino, 0.50% Hawaiian/Pacific Islander, 75.74% White, and 0.50% two or more races.

The fall 2022 enrollment of the institution was 14,323 (NCES, 2023). The college recognized its legal obligation and began undertaking an initiative to make online courses and digital content accessible to all students. The college provided mandatory training on digital accessibility for all instructors in late fall 2022, which was supposed to be completed by sum-

mer 2023. The training course was developed in-house by the college's eLearning department. The training included instruction on how to check for and remediate accessibility errors for headings, hyperlinks, lists, color contrast, tables, alt text for images, and captions for audio and video files. Instructors had to score 100% on a 10-question quiz to demonstrate that they completed the training. The training was delivered via the college's LMS. Even though the training was mandatory, not all adjunct instructors completed it. All full-time instructors completed the training.

While the college provided training for instructors on digital accessibility, the accessibility tools that instructors could use to help them remediate inaccessible content were lacking. Instructors were relying on multiple tools that sometimes provided contradictory information. The college decided to adopt one tool that would replace the disparate tools. A committee of instructors chose the accessibility tool after evaluating various tools that could be integrated with the college's LMS. Although the LMS has its own built-in accessibility checker, it was found to be insufficient since it only checks pages via the rich content editor and not files like Microsoft Office documents or PDFs (Instructure, n.d.). The accessibility checker indicates the number of errors on each page and provides directions on how to fix the errors. The accessibility tool that was selected checks all content in the

Figure 2*Accessibility Indicators for Instructors*

LMS and provides accessibility scores for each page, file, and for the course overall. The accessibility tool provides instructors written and video directions on how to fix each accessibility error.

Mandatory training on how to use the selected accessibility tool was not provided. Resources like training videos created by the company that developed the accessibility tool were added to a resource course in the LMS for instructors. Some in person training was offered at a professional learning day for full time instructors at the start of fall 2023. In person voluntary open labs were offered to all instructors, but no adjunct instructors attended. After integrating the accessibility tool in the college's LMS and deploying it in all courses in fall 2023, it was important to understand how accessibility scores were affected during the first semester of adoption.

The Accessibility Scoring Tool

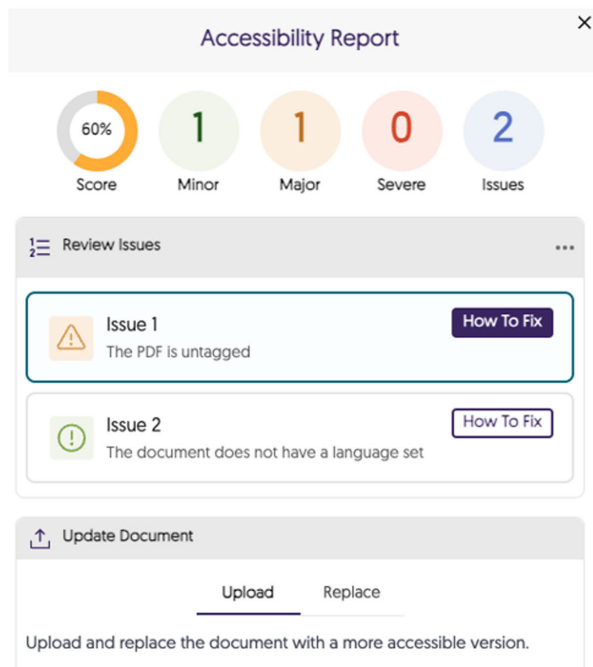
The accessibility tool assigns an accessibility score for each course based on the level of accessibility of the digital content. Once integrated inside the LMS, the accessibility tool assigned an accessibility score for all past courses. When content is added to new courses, the accessibility tool assigns an accessibility score to those courses. The accessibility tool is responsive; scores change daily as instructors add, remove, or remediate course content for accessibility.

As the accessibility tool checks course content for accessibility, indicators appear as red, yellow, and green symbols throughout every course. The colors indicate the level of accessibility or level of severity of the inaccessible content—green for minor, yellow

for major, and red for severe (see Figure 2). When instructors hover over the red, yellow, and green symbols, they can see the accessibility score for that item. The accessibility tool assigns an accessibility score between 0 to 100% for each page or file based on WCAG standards. The software relies on artificial intelligence (AI) technology to find and determine the severity of the accessibility errors and uses that information to generate a score. The scores for the different pages and files are used to generate an accessibility score for the course. Together all the accessibility scores for individual courses at one institution are used to generate an institutional accessibility score.

To remediate accessibility errors on pages or documents, instructors can open the accessibility report for that file or page. They are presented with a list of errors and a “How to Fix” button that provides written and video directions for each error. For simple errors, the accessibility tool will provide a solution, and the instructor can simply accept the change, and the accessibility tool will fix the error for them (see Figure 3).

The state college examined in this study adopted the accessibility tool Panorama in summer 2023 and deployed it in all college courses in fall 2023. The college was relying on the accessibility tool to help guide and encourage instructors to remediate their own courses. Institutional data were downloaded in April 2024, for the fall 2022, and fall 2023 terms. The goal was to compare accessibility scores in courses before and after adopting the selected accessibility tool.

Figure 3*Accessibility Report for a PDF File***Data Analysis**

Utilizing SPSS 29, a paired sample *t*-test measured the accessibility scores pre- and post-tool adoption. Accessibility scores were downloaded for all courses for fall 2022 and fall 2023 as a .csv file. The data from both semesters were combined into one Excel spreadsheet so the data could be prepared for analysis. To clean the data, some course shells were removed. For example, courses with no content are assigned an accessibility score of 0% by the accessibility tool. At this state college when course sections are merged, a new course shell is created in the LMS, and the old shells are not deleted. Additionally, when courses are canceled each semester, those course shells are not deleted from the LMS. These are the reasons why the institutional data included blank courses with 0% accessibility. The data in the Excel spreadsheet was sorted by accessibility score. To avoid skewing the data, courses with 0% accessibility scores were deleted from the Excel spreadsheet.

Next, the following assumptions were used to pair the courses. While these assumptions may not be the same at every institution of higher education, these assumptions are true at the state college examined in this study: (a) Every instructor creates their own course content so, therefore, courses must be paired

by instructor; (b) course content in online, in person, and hybrid courses is generally not the same so these modalities were considered separately when pairing the data; (c) for most instructors, course content does not change significantly from one year to the next, which is why comparing accessibility scores from fall 2022 and fall 2023 was appropriate. The goal was to compare courses with similar content pre- and post-adoption of the accessibility tool. Using these assumptions, courses were paired by course, instructor, and modality (online, in person, and hybrid).

The Excel spreadsheet was sorted by instructor, by name of the course, and by term. After the data were sorted, it became possible to examine all the courses taught by the same instructor at the same time to determine if there were valid pairs using the pairing criteria. Courses with no pairs were deleted from the file. Instructors were deidentified. The .csv file from the accessibility tool labeled each instructor by their LMS ID number and not by their name. The LMS ID number is unique to each user. These numbers were used to pair the courses by instructor. Courses taught by multiple instructors were only paired if the course was taught by the same group of instructors. The LMS course naming conventions were used to determine course and modality—online, campus, or

hybrid. The state college examined in this study has standard naming conventions for LMS courses that identify course modality.

In some instances, there were multiple course sections in the same modality taught by the same instructor in the same semester. In this instance, if the accessibility score for the different sections was different, the average accessibility score of the sections was used. If the accessibility scores for the multiple sections were the same, only one course section was used to create a pair, and the other sections were deleted from the data file.

There were 2,725 individual courses for the two terms fall 2022 and fall 2023. After applying the criteria to pair the courses, 1,030 individual courses or 515 pairs remained. Once the data were cleaned, they were converted to SPSS to run a paired sample *t*-test. A paired sample *t*-test was deemed appropriate for these data because it examines the difference between two means and determines whether there is a statistically significant difference between them.

Results

To answer the research question—What is the mean difference, if any, between the pre- and post-accessibility scores after the first semester of adoption?—a paired sample *t*-test was conducted to assess if the mean differences in accessibility scores for fall 2022 pre-tool adoption and fall 2023 post-tool adoption were statistically significant. An alpha of .05 was used with $n = 515$.

The mean accessibility score for fall 2022 was 87.32 with a standard deviation of 10.50. The mean accessibility score for fall 2023 was 92.33 with a standard deviation of 7.74. This result shows that accessibility scores increased by 5.01 points post-adoption of the accessibility tool. The results of the paired sample *t*-test showed a *p* value of $<.001$ and $t = 14.28$, which indicate statistically significant results. *Cohen's d* was 0.63 with a confidence interval between 0.53 and 0.72. Using Cohen's guidelines (1998), this result reflects a medium effect size. The practical implications of these results are that the accessibility tool had a medium impact on accessibility scores. This finding further supports the conclusion that there is a statistically significant difference between the mean accessibility scores in fall 2022 pre-tool adoption and fall 2023 post-tool adoption.

Discussion

The current study was conducted to determine if an LMS accessibility tool improved course digital ac-

cessibility scores with the goal of meeting ADA requirements and UDL/UDI. The institution where this study was conducted adopted the accessibility tool in the summer of 2023 and wanted to understand the effect that this tool had on the accessibility of digital materials in their LMS after the first semester of adoption. The statistically significant results of this study show that an accessibility tool integrated into an LMS can improve digital accessibility. Improved accessibility meets UDL principles of multiple means of engagement by providing all students learning materials that meet their learning needs. To improve accessibility scores in each course, instructors had to voluntarily remediate, replace, or remove documents or pages from their course. Instructors at this state college had to complete mandatory training on digital accessibility, and while there is an expectation that instructors should be remediating their inaccessible course content, this expectation has not been enforced. The findings from this study confirm the results of other studies that found that accessibility scores increased more with an LMS accessibility tool than by just training instructors on digital accessibility (MacDonald, 2021).

Sanderson et al. (2022) conclude that training instructors on digital accessibility is necessary, future research should provide quantitative methods, and that more objective measures could be used to demonstrate instructor knowledge of digital accessibility. The present study addresses these suggestions and takes them a step further by providing quantitative evidence of what happens after instructors are trained and institutions provide tools to help make accessibility detection and remediation easier for instructors.

The statistically significant results could be attributed to a combination of the accessibility tool and the mandatory accessibility training that the instructors of this college in the southeast United States were required to complete. Training instructors on digital accessibility and UDL can increase awareness of the barriers students with disabilities face and can positively impact instructor knowledge on digital accessibility (Bong & Chen, 2021; Chen, 2021; Lazar, 2022; Olivier & Potvin, 2021; Walters, 2022). However, the LMS accessibility tool used in this study makes it easier for instructors to meet UDL/UDI principles by flagging inaccessible content and providing directions or one click solutions to resolve accessibility errors. This tool helps remove barriers students with disabilities may face if they need to use assistive technologies, thereby meeting UDL principles of action/expression.

Upon investigation of some courses, accessibility scores were lower post-tool adoption because instructors added new content to the courses but did

not take accessibility into consideration. This finding would seem to show that even though instructors had to complete simple training, it did not change the behavior of all instructors. Providing additional training on creating “born accessible” digital content could help convince some of these instructors since designing with accessibility in mind from the beginning is less time consuming than fixing accessibility after the content has been designed (Lazar, 2023).

The practical implication of this study is that higher education institutions should invest in an LMS accessibility tool, which can be installed in the most popular LMSs, including Canvas, Blackboard, Moodle, and D2L Brightspace. Tight budgets are always a limitation in higher education. However, the cost of one of these tools is less expensive than hiring a team of employees to manually check all courses for accessibility. For higher education institutions that have departments or staff dedicated to remediating digital content for accessibility, LMS accessibility tools can help speed up the work by easily identifying content that needs remediation.

Limitations and Future Research

The current study has limitations that leave room for future research. There could be some mistakes in the accessibility tool’s ability to detect or assign accessibility scores for some courses. Errors have been reported by two instructors at the institution where this study was conducted. In these cases, the accessibility tool mistakenly assigned accessibility scores of 0% to corrupt files. A mistake in scoring one file would not impact the accessibility score for the course and would not impact the results reported here. Therefore, these types of errors are negligible.

A limitation of LMS tools is that they rely on AI technology which cannot correctly identify all accessibility errors. For example, AI technology cannot determine if the content on a page requires headings or how the headings should be nested and organized. The tools can only determine if headings are nested correctly—heading 1 is followed by heading 2, for example. In addition, AI technology can only determine if alt text has been added to an image; it cannot determine if the alt text is appropriate for the image. LMS accessibility tools make remediation work easier, but they cannot accurately check for all accessibility errors and cannot entirely replace the manual work of humans checking accessibility errors. Accessibility professionals are, therefore, still needed to check for errors that the LMS accessibility checkers fail to flag and to fix errors that checkers cannot remediate correctly.

One limitation of this study is that the courses at this state college were not designed “born accessible” in that they did not take accessibility in mind when the courses were being created (Lazar, 2023). Instead, instructors are being asked to remediate accessibility at the back end after the course has been designed, which is a much more time-consuming process. Accessibility scores might be higher if instructors were mandated to fix their accessibility errors or if classes were designed “born accessible” (Lazar, 2023). Another limitation is that this study is exploratory. There are no other published research studies that use this specific accessibility tool. More studies are needed to compare accessibility scores and results at different institutions to better understand this tool and a variety of other tools, and their impacts on digital accessibility.

While statistically significant results between fall 2022 pre-tool adoption and fall 2023 post-tool adoption were found, there are no details about what instructors did to improve their scores. A survey could be used to determine the impact that mandatory training on accessibility had on accessibility scores. Additionally, a survey or interviews could gather additional information to understand how seeing their accessibility scores changed instructor attitudes or behaviors regarding accessibility.

Future research could examine what impact LMS accessibility tools have on students with disabilities. Quantitative data from the accessibility tool could examine how students are using this tool and what alternative formats are most popular and beneficial to students with disabilities. Quantitative data like success rates for students with disabilities could be tracked to see if students’ achievement improves with more accessible content. Students could be surveyed or interviewed to understand how they used the LMS accessibility tool and how or if it helped them learn.

Conclusion

The present study confirms that digital accessibility tools embedded in an LMS can have a positive impact on the accessibility of digital content that institutions deliver to their students via an LMS. The increase in accessibility scores at this institution indicates that the college is closer to meeting its legal obligation of offering students content that is accessible and helps achieve UDL/UDI by providing learning materials designed with accessibility in mind. Ultimately, the more important consideration is that students with disabilities will have course materials that are accessible and will meet their learning needs.

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