

Major Paper

**Analysis of the Integration of Universal Design for Learning (UDL) in  
PowerPoint Artifacts in an Ontario College Trades Course**

by

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# PROJECT REVIEW INFORMATION

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The Project was approved on December 8, 2020 by the following review committee:

**Review Committee:**

Research Supervisor                      Dr. Joseph Stokes

Co-supervisor                              Dr. Wendy Barber

Second Reader                            Dr. Bill Hunter

The above review committee determined that the Project is acceptable in form and content and that a satisfactory knowledge of the field was covered by the work submitted. A copy of the Certificate of Approval is available from the School of Graduate and Postdoctoral Studies.

# ABSTRACT

Through a quantitative case study analysis of learning artifacts used in a skilled trades course at an Ontario community college, this research project examined PowerPoint presentation artifacts designed by a college instructor and assessed how they aligned with principles of UDL and the tenets of UDL curriculum design. Specifically, the artifacts were examined using the overarching three principles of the Center for Applied Special Technology's UDL framework: (a) multiple means of representation (b) multiple means of action & expression and (c) multiple means of engagement, and within each of these then examined the four tenets of curriculum design (i) goals (ii) methods (iii) materials (iv) assessments.

**Keywords:** Universal Design for Learning; UDL; skilled trades; PowerPoint; disability

## AUTHOR'S DECLARATION

I hereby declare that this project consists of original work of which I have authored. This is a true copy of the work, including any required final revisions, as accepted by my committee.

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## **Introduction**

Skills Canada estimates that 40% of all new jobs created within the next decade will be in the skilled trades and technology industries, and in line with this projection, technology and skilled trades college programs have grown significantly (Ontario Colleges, 2020). The unique blend of academic learning and practical skills training has made Ontario public colleges a popular choice for individuals pursuing post-secondary education. Ontario colleges' skilled trades programs combine apprenticeship training or co-ops with hands-on training and classroom theory (Ontario Colleges, 2020). Trades and apprenticeship programs are growing as a career direction for many students who may struggle academically, and Mooney & Scholl (2004) highlight a substantial increase in students with disabilities participating in work-based learning programs.

The typical college student's demographic profile has changed over the years since more students with disabilities are attending post-secondary institutions. The Higher Education Quality Council of Ontario (HEQCO) reports that the number of students registering with disability offices on campuses has increased by 63% between 2003-2004 and 2010-2011 (McCloy, 2013). Although data suggests that challenges exist in classification rates of disabilities, 'hidden' disabilities are the most prominent disability type among higher education students (McCloy, 2013). Visible disabilities include cerebral palsy and disabilities that affect mobility whereas hidden disabilities such as a learning disability or mental health related disabilities (e.g., anxiety) are not as identifiable amongst students. Additionally, it is estimated that 73% of college students do not attend directly from high school, 33% are the first generation in their families to attend post-secondary studies, 15% use disability support services, and many are mature students (Ontario Colleges, 2020).

### **The Current Accommodation Model and Impact on Student Achievement**

Despite the growing number of students registered with disability support services, many post-secondary institutions continue to adopt a medical model to support students with disabilities. This disability service model is a by-product of the “medical or individual model of disability, which situates the disability within the individual and sees them as the root of the problem to be cured or treated and normalized” (Griful-Freixenet, Struyven, Verstichele & Andries, 2017, p. 1628). Griful-Freixenet et al. (2017) emphasize that a significant barrier to identified students’ academic success relates to the current medical accommodation model. This approach assumes that students have sufficient knowledge about their disabilities to communicate their needs properly. However, many students may not completely understand their disability's impact on academic success, as many receive their diagnosis after transitioning to post-secondary studies. The majority of post-secondary institutions support this traditional special education model based on a process of assigning a label, a tutor, and a specific accommodation (Griful-Freixenet et al. 2017). Campus disability professionals determine a student's eligibility for accommodations. Accommodations are often designed to support students across two settings. First, support is offered in the classroom which includes notetaking supports, clarification of content, accessing presentation handouts in advance and recording lectures. Second, supports for testing are offered, which include extended test time and access to technology. In turn, this support requires documentation provided by a medical professional.

Trades and apprenticeships are designed for hands-on learning. Despite college apprenticeship programs continuing to expand, they sometimes do not fit the prescribed testing accommodation model. Notably, the skilled trades programs teach practical hands-on skills in a shop by a skilled trade professional, and students are evaluated based on demonstration

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assessments (Sochowski, 2013). The hands-on design of college programs can be a barrier to students with disabilities and can affect their ability to access, and successfully take advantage of, accessible accommodations. This can include college programs that integrate labs (e.g., veterinary nursing labs) and shop classes (e.g., plumbing classes) where students need to perform hands-on tasks to meet course outcomes. Moriña (2017) states that the accommodation process is insufficient in ensuring that all students have access to quality education, without fostering discrimination, as certain programs are not designed to support accommodations.

As more students with disabilities are enrolling in the skilled trades programs, literature is emerging indicating that this population of students is at greater risk for academic failure due to challenges with accommodations extending beyond the classroom to work placement settings (Mooney & Scholl, 2004). Students with learning disabilities can face barriers with reading texts, writing, concentration, organization and time management (Cotton, 2010), as well as the impact of previous negative experiences in education and fear of stigma in trades professions (Johnston & Castine, 2019). Despite being at great risk of academic failure, this demographic of students enrolled in trades programs may not access resources from disability support services at the same rate as the general college student population. Students in skilled trades may be underreporting their need for disability supports. Further to this, some students enrolled in skilled trades programs may require additional support or a different instructional approach. Findings from a study on students with learning disabilities participating in apprenticeships revealed a need for instructional strategies that build on students' strengths, as well as curricula that focus on students' interests to improve their motivation (Cotton, 2010). Similarly, Mooney & Scholl (2004) advocate for more diverse curricula design following an analysis of accommodation and support for students in apprenticeship programs.

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Further to this, most curricula promote the traditional instruction model and adopt a 'one-size-fits-all' approach, which assumes all students learn in the same way creating “unintentional barriers to learning” (CAST, 2011). Consequently, students with disabilities and those with different learning experiences may face challenges accessing curricula and participating in classes. The current educational climate in colleges reveals growing numbers of students with visible and hidden disabilities who have an increased risk for academic failure, as well as a more diverse student demographic attending college (Ontario Colleges, 2020). As a result, post-secondary institutions require new approaches to providing accessible and practical instruction. Griful-Freixenet et al. (2017) agree that this increase in student diversity brings pedagogical challenges, and accessible learning opportunities need to go beyond mere accommodations. To meet the wide variety of learning needs and abilities in the classroom, teachers must find innovative methods for reaching this diverse student population (Boothe, Lohmann, Donnell & Hall, 2018).

### **Universal Design Learning (UDL) Framework**

Universal Design for Learning (UDL) is an instructional approach designed to improve and optimize teaching and learning for all people based on scientific insights into how humans learn (Center for Applied Special Technology (CAST), 2016). UDL was influenced by Universal Design (UD), which originated from the 1970s by Ronald Mace to refer to the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (Center for Universal Design, 2015). The Center for Applied Special Technology (CAST) defines UDL as a framework that addresses the primary barrier to fostering expert learners within instructional environments by addressing inflexible, "one-size-fits-all" curricula (CAST, 2011). It proactively builds in features to support the range of human

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diversity (Scott, McGuire & Foley, et al., 2003). One of UDL's founders, David Rose, advocated that UDL puts the tag “disabled” on the curriculum, not the learner. The curriculum is disabled when it does not meet the needs of diverse learners (Council for Exceptional Children, 2011). This framework is in direct opposition to the medical model that traditionally defines disability accommodations as a process of identifying the functional limitations and accommodating. Conversely, it pushes instructors to pursue a more socially inclusive model that celebrates differences rather than excludes or labels students with a negative connotation (Kumar & Wideman, 2014). The social model of disability in the context of education contends that students have varying abilities, and if they are not able to access course materials, then it is the course that must be altered, rather than the student (Rose, Harbour, Johnston, Daley, & Abarbanell, 2006). Furthermore, the social model of disability aligns with the critical premise of UDL, which is to shift the burden of adaptability from the shoulders of the students to the learning environment (Kumar & Wideman, 2014).

The UDL framework helps address learner variability by suggesting four curriculum tenets: flexible goals, methods, materials, and assessments, which can empower educators to meet students' varied needs (CAST, 2011). Within the UDL framework, learning goals address learner variability by offering more options and alternatives for students to achieve mastery (CAST, 2011). Goals are described as the learning expectations, specifically, the knowledge, concepts, and skills students should master (CAST, 2011). Materials are referred to as the media used to present learning content and the means through which learners demonstrate their knowledge; through the UDL framework, materials offer variability and flexibility through multi-media and embedded supports (CAST, 2020). For the purposes of this research, the author considers that assessment is the gathering of information about student performance, and through

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the UDL lens, this information and evidence of learning is designed to improve the accuracy and timeliness of assessments (CAST, 2011).

A UDL approach to instruction is based on three principles: multiple means of representation, multiple means of action & expression and multiple means of engagement (CAST, 2016). The first principle, multiple means of representation is a principle based on the brain's recognition networks and addresses the "what" of learning by targeting how learners gather and categorize information (Boothe et al., 2018). The principle of multiple means of engagement addresses the affective network, the "why" of learning and is related to learner motivation and engagement (Boothe et al., 2018). Finally, multiple means of action and expression, is related to the brain's strategic networks, which speaks to the "how" of learning, including how students perform tasks and communicate their understanding of ideas (CAST, 2011).

### **Promise of UDL in Meeting the Needs of Diverse Students**

With increased pressures to address the problems inherent in a one-size-fits-all model and the need to reduce barriers to learning, UDL as an instructional strategy is gaining attention from researchers, administrators, and faculty members (Izzo, Murray & Novak, 2008). The support for UDL as a universal instructional design applied to the teaching and planning framework was explored in several studies (Rao & Tanners 2011; Parker, Robinson & Hannafin 2008; Navarro Zervas, Gesa & Sampson, 2016). Importantly, UDL was found to provide a more inclusive alternative to the traditional accommodations process (Izzo et al., 2008).

There is a distinct connection between UDL and disability accommodations, specifically the argument that adopting a UDL framework in teaching practices may reduce the need for accommodations (Lombardi & Murray, 2010). Conceptually, universally designed lessons

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attempt to meet all learners' needs at the onset of instruction rather than retrofitting accommodations into lesson plans (Capp, 2016). UDL can reduce the need for individual accommodations, while incorporating instructional strategies making learning accessible to a broader range of students.

The principles of UDL integrated into college instruction may provide tools for addressing accommodation access in a more proactive way that preserves the integrity of the course, while promoting learning for a broader range of students (McGuire, Scott & Foley, 2006). The UDL framework targets curriculum design systematically from the beginning to address individual differences and support the needs of students with disabilities (CAST, 2011). Furthermore, the difficulties of "retrofitting" accommodations and adapting curricula could be reduced or eliminated, creating a more fully inclusive learning environment (CAST, 2011).

### **Purpose of the Study**

UDL as an instructional framework to support diverse students is promising as it adopts a social model of disability, as well as equity, and targets intentional instructional strategies that adjust the curriculum and not the student. Faculty knowledge and experience with UDL instructional methods can be a contributing factor to the likelihood of adopting the framework into curricula. Notably, the UDL framework is not universally applied in higher education and the literature primarily focuses on university settings. The community college setting is uniquely different from universities and research on UDL is limited in the college setting, therefore the examples and challenges in current literature may not necessarily be representative of, or applicable to, the needs of faculty and students in the college setting. The following overarching research question guided this inquiry: How has UDL been applied in a specific set of PowerPoint artifacts used in a skilled trades classroom setting in a large Ontario community college?

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Through a quantitative case study analysis of learning artifacts used in a skilled trades course at an Ontario community college, the author examined a total of seven PowerPoint presentation artifacts designed by a college instructor and assessed how they aligned with principles of UDL and the tenets of UDL curriculum design. Specifically, the author examined the course artifacts using the overarching three principles of the Center for Applied Special Technology's UDL framework: (a) multiple means of representation (b) multiple means of action & expression and (c) multiple means of engagement, and within each of these then examined the four tenets of curriculum design (i) goals (ii) methods (iii) materials (iv) assessments.

### **Literature Review**

#### **Integration of UDL in Higher Education**

Universal Design for Learning (UDL) in education has become increasingly popular in the past decade and is referenced as an instructional framework for educators; however, the research base supporting its efficacy is limited (Rao, Ok & Bryant, 2014). UDL in higher education is primarily focused on how universal design could be integrated into professional development training rather than on implementing UDL principles for instruction (Smith, 2012). Limited research has examined the impact on student outcomes and only a handful of studies have examined instructor UDL training (Davies, Schelly & Spooner, 2008). More importantly, most of the research on UDL has been conducted in a university post-secondary setting (Smith, 2012; Griful-Freixenet et al., 2017; Schelly, Davis & Spooner, 2011; Boothe et al., 2018; Izzo, Murray & Novak, 2008; Kumar & Wideman, 2014). There is a significant gap in research literature related to college setting.

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### **Role of Faculty in UDL Integration**

University faculty attitudes and practices can largely contribute to students' success or failure in post-secondary education (Lombardi & Murray, 2010). Because Apprenticeships and Skilled Trades require certification by qualified and licensed practitioners, faculty knowledge and skills in these specialized content areas are often the primary factors to being hired at the college level (Scott et al., 2003). Many post-secondary faculty will therefore have expertise in specialized content areas rather than pedagogical instructional methods (Lombardi, 2011). Additionally, some faculty may lack knowledge about the general characteristics of students with disabilities, thus limiting their ability to design supportive, inclusive or responsive instruction (Lombardi & Murray, 2010). Students with disabilities and those without documented disabilities are often dependent on the faculty to respond to accommodation requests and provide instructional practices that can enhance the learning environment for all students (Lombardi, 2010).

LaRocco & Wilken (2013) conducted an action research project to identify faculty members' stages of concern about, and use of, nine UDL guidelines and reviewed how to serve students with disabilities. Results from the study revealed that faculty were primarily concerned about how UDL strategies would impact them personally with respect to the level of effort, time commitment, knowledge and skill development required. Participants were not actively applying any of the principles to their practice, while others noted no campus-wide training. These findings highlight the significance of professional development on broadening faculty perspectives of UDL and addressing faculty concerns related to implementation of UDL.

A study by Izzo et al. (2008) also analyzed faculty attitudes on UDL; however, the authors created training based on UDL concerns and evaluated the training results. In the initial

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study, the researchers assessed faculty and teaching associates' instructional practices and comfort with supporting students with disabilities, and participants indicated that UDL was the most needed training topic. As a result of participant feedback in the study, the authors created a web-based, self-paced professional development tool, then piloted, and revised it in response to the request for UDL training. Participant feedback indicated support for the value of on-demand, multimodal professional development in universal design, and ninety-two percent of respondents reported increased comfort in meeting the instructional needs of students with disabilities as a result of using this curriculum (Izzo et al., 2008). These two studies highlight the important role examining faculty attitudes can have on designing UDL professional development.

### **The Implications of UDL on the Student Learning Experience**

The literature highlights the critical role faculty attitudes can have on a student's learning experience, along with the impact of pedagogy, its influence on the student voice, and its relationship to the student learning experience (Griful-Freixenet, Struyven, Verstichele, & Andries, 2017). Students with disabilities have historically reported that negative faculty attitudes and perceptions of disability, specifically in response to accommodation requests, have adversely affected their experience in post-secondary classrooms (Lombardi & Murray, 2010). Additionally, the retrofitting accommodations model based on disability type has been perceived as inefficient. A qualitative study conducted by Griful-Freixenet et al. (2017) evaluated whether UDL met the learning needs of students with disabilities effectively by examining their learning experiences. Findings suggested that students' perceptions aligned well with UDL's principles. Specifically, the principle of multiple means of engagement, aligned with students' perceptions while providing a means for instructors to implement strategies more flexibly. The authors advocated for counteracting the prescribed model of accommodations and stated that

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incorporating a high number of accommodations at the beginning of the course design can be beneficial for all students, not only students who were identified with disabilities (Griful-Freixenet et al., 2017).

Building on the value of exploring student learning experiences through UDL, He (2014) conducted a case study to help teacher candidates better understand the UDL framework in an online university course. The findings of this study highlighted the role reflection had on participants' confidence and self-efficacy in learning, as well as positive experiences reported by participants. Through the UDL experience, teachers challenged their pedagogy and were encouraged to think differently and explore different instructional pedagogies. Researchers have found that those who engage in inquiry opportunities about their teaching practice invite opportunities to alter and adjust their instruction, consider the impact on their students, and continuously monitor their effectiveness (Boothe et al., 2018).

A qualitative study sought to explore students' viewpoints in relation to the Three-Block Model (TBM) of UDL. The TBM framework is an expanded focus of UDL which also includes social-emotional learning needs and strategies (Katz & Sokal, 2016). The results supported the TBM's ability to uphold the principles of UDL. Furthermore, researchers found students progressed toward a more sophisticated conception of learning as students moved away from teacher-dependent learning and began to perceive their role as agents in their learning (Katz & Sokal, 2016).

Examining how students' perceptions of a course can be changed by UDL integration was analyzed by Schelly, Davis & Spooner (2011). The results of this study indicated that teachers who had UDL training changed students' perceptions about how their instructors presented ideas and information, they engaged students, and allowed students to express their comprehension of

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course content (Schelly et al., 2011). Since no control group was used in the research, Davies et al. (2013) conducted a follow-up study. They replicated the Schelly et al. (2011) research with the addition of a control group where students took the same course in a different section with instructors who did not receive UDL training. Students in both the intervention and control groups reported a positive change in engagement. Students enrolled in the course in which their instructors received training reported more effective use of UDL strategies, especially those related to the principle of multiple means of representation (Schelly et al., 2013).

Findings from a redesigned university health course using UDL strategies yielded positive feedback from undergraduate students; they felt the course delivered more flexibility, reduced learning stress, and enhanced success and social presence (Kumar & Wideman, 2014). The authors designed the course to address three principles of UDL by (a) increasing maximum flexibility in how course material was displayed, (b) offering choice in how students expressed their understanding and (c) integrating multiple opportunities for face to face and online engagement (Kumar & Wideman, 2014). Although the authors emphasized that significant course planning time was required to address the multiple modalities, they were satisfied with the course design implementation because it reduced barriers for students with disabilities and the need to access support from the university disability office.

Parker, Robinson & Hannafin (2008) highlighted the benefits of integrating a UDL and Adult Learning framework in an online learning environment. The study results yielded positive feedback from students with the new delivery approach. This course design allowed the authors to overcome challenges associated with the traditional lecture-only methodology (Parker et al., 2008). In another post-secondary study, Rao, Tanners & Mano (2011) used the principles of UDL and Universal Instructional Design (UID) in a university course that was delivered through

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an online mode. The results indicated that students preferred universal design-based strategies within the course, such as multimodal resources and short assignments. This case study emphasized the value of digital features of UDL as the most valued strategy indicated by students. The authors found that instructional approaches that integrate digital tools and resources, such as those embraced by UDL, are essential to effectively engage college students (Rao et al., 2011).

Although most of the literature reviewed are based on university settings, the collective findings shed light on students' post-secondary experiences. Specifically, the student feedback gathered from the research reiterates the benefits of UDL on instructional strategies, on professors' teaching, and how that can improve overall student learning.

### **UDL Training and its Impact on Faculty**

Redesigning curricula to reflect UDL strategies and evaluating the effectiveness of these changes is another approach highlighted in the literature. McGhie-Richmond & Sung (2012) conducted qualitative and quantitative research on teacher candidates to evaluate the impact of UDL principles on revising lesson plans. The quantitative findings demonstrated that after receiving an introduction on UDL training, teachers made significant changes to their original lesson plans, and the feedback from their own students highlighted the benefits. A similar study by Navarro Zervas, Gesa & Sampson (2016) with first year teacher candidates evaluated first-year development for lesson planning and its impact on improving participants' competencies. Participants were moved through several phases of UDL learning from analysis and design phases to implementation and evaluation phases, where they were able to review and apply UDL principles in depth (Navarro et al., 2016). The study results showed that participants demonstrated a considerable amount of growth in UDL strategies between pre-test and post-test

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when designing an inclusive lesson plan. Based on the findings, the authors argued for the importance of equipping teachers with appropriate competencies and resources to address the learning needs of all students (Navarro et al., 2016).

Research by Courey, Tappe, Siker & LePage (2013) compared lesson plans by teacher candidates before and after UDL training. The results of this study indicated similar positive findings after a 3-hour UDL training session. Researchers highlighted that teachers incorporated more differentiated options and varied teaching strategies into their lesson plans based on the three UDL principles. These strategies illustrated that teachers had a better understanding of the framework after receiving UDL training (Courey et al., 2013). As a result of the findings, the authors emphasized that teachers need to have more experience implementing the UDL principles in their classrooms.

Finally, Spooner, Baker, Harris, Ahlgrim-Delzell & Browder (2007) used an experimental and control group to examine the effects of a one-hour teacher training on UDL on lesson plan development on special education and generalist educators. The findings illustrated that teachers in the experimental group showed more improvements in designing more diverse lesson plans based on UDL between pre and post-test assessments compared to the control group.

The results of the above studies emphasized that any amount of professional development or training can positively impact teachers' instructional practices, increase teachers' understanding of the UDL framework, and increase the likelihood of an instructor using UDL in designing lessons and accessible curricula.

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### **UDL Framework Impact on Instructional Material**

Two studies by Naik (2016) and Fenrich, Carson & Overgaard (2018) focused on changing PowerPoint presentations to support students with disabilities. Naik (2016) developed a dual presentation approach to help students with special education needs (SEN) and accompanying note-takers. The author utilized the UDL framework to develop his SEN PowerPoint presentations, resulting in the creation of two versions of PowerPoints: (a) handouts for teaching/summarising and (b) comprehensive lecture notes used as a guide to SEN students/note-takers. The lecture handout used graphics, tables and charts that were enhanced. Additionally, mathematics was simplified using pictures and real-life examples. The comprehensive PowerPoint lecture notes covered the subject topic in detail, including all terminology, definitions, explanations, as well as the various features mentioned above. The findings demonstrated three significant successes; increased motivation and independence of students with SEN, more accurate note-takers, and better instructional approaches that aligned with learning objectives and content.

Fenrich, Carson & Overgaard (2018) analyzed how instructional design and UDL principles could be designed into instructional materials to teach trades students how to solder and braze copper pipe. The researchers conducted a quantitative and qualitative analysis to determine whether the students felt that the new materials had more instructional design and UDL attributes than the original materials. The findings showed that there were significant differences in the instructional design and UDL attributes of the new PowerPoint materials, which included being well organized, having an easy learning path, including supportive video clips, aligning content with learning objectives, addressing practical components and meeting

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diverse learning preferences. Notably, there were no significant differences between some of the attributes.

Both studies illustrated how PowerPoints can incorporate UDL strategies and teachers can easily re-structure course content in a way that can be clearer and more in-depth for students, resulting in an overall improvement to the student learning experience.

### **The Need for Diverse Pedagogy in Skilled Trades**

The need for more diverse instructional practices is a theme that has emerged in the limited research on skilled trades and apprenticeships (Mooney & Scholl 2004; Cotton 2010; Sochowski 2013; Miesera & Gebhardt, 2018). Findings from a three-year study on students with disabilities and their experience with accessing accommodation supports indicated several student challenges including (a) limited accommodations and support that students received on work placement compared to the school setting and (b) students choosing not to disclose their accommodation needs (Mooney & Scholl, 2004). As a result of these challenges, the authors suggested the need for more diverse accommodations for students that could be integrated into the curriculum. Similarly, a study conducted by Cotton (2010) identified students with disabilities faced barriers in apprenticeships. The author determined that despite barriers and potential difficulties in reading and writing, anxiety, or low self-esteem, instructional strategies that build on strengths and interests could restore students' motivation and engagement.

Although trades are considered an application-focused program, preliminary research is starting to emerge around technology integration and its potential benefits. Technology is a resource that can facilitate UDL in apprenticeships, specifically electrical training courses as one study showed (Sochowski, 2013). The results of a case study reviewing Online Distance Learning (ODL) in electrical apprenticeship activities highlighted that ODL could meet the

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physical hands-on requirements for assimilating skill-oriented knowledge in blended learning environments (Sochowski, 2013). This research provided a concrete example of blended learning environments and presented core elements of UDL in practice. Technology can make learning more easily and readily accessible to students for anytime, anywhere learning. It can increase productivity and provide a way to stay connected with others. Smith (2012) attests that infusing digital media into classroom instruction, supported through a UDL lens, can optimize students' learning experiences and preferences. The author states that emerging research on technology integrated curriculum benefits learning in trades programs.

UDL can further be utilized as an approach to improve the instructional design of career training programs for youth with disabilities and those with previous academic challenges. An analysis by Johnston & Castine (2019) illustrated how the four curricular components of UDL (goals, methods, materials and assessments) could be applied to career training programs, particularly apprenticeships in the United States. Several recommendations for UDL integration were outlined based on the four curriculum components. First, encouraging students to have a voice in the goal setting process creates opportunities for learners to recognize their own needs, advocate for themselves and address systemic barriers to training and employment. Second, learn/teach one another accordingly. Third, resources for students should be culturally relevant and provide a variety of content from diverse backgrounds. Finally, assessments in career training programs should provide multiple means of representation, multiple means for action and expression that align with a learner's interests and goals (Johnston & Castine, 2019). The YouthBuild USA program, a pre-apprenticeship career training program for young men from low-income backgrounds, adopted this program's recommendations and examined the student outcomes (Johnston & Castine, 2019). Interim findings from a randomized controlled trial of the

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YouthBuild USA program found that participants that completed high school, enrolled in college, engaged in vocational training, and volunteered, had a small increase in earnings more than two years following program enrollment.

The literature review presented key themes that provide context about UDL being integrated into higher education, and most of the research is focused in a university setting. However, the UDL framework application in community college settings, specifically skilled trades, is practically non-existent. Notably, the limited research based on a college setting indicates a gap in the literature and a need for the development of diverse teaching practices in community college settings. The strategies and best practices that were reviewed in university environments could be also applied to a community college. The review of current literature highlights Universal Design Learning as a promising pedagogical framework that, when supplemented with instructor training, can positively impact teaching, increase flexibility in course design, and improve the student learning experience in higher education.

### **Methodology**

A case study is defined “by an interest in an individual case, not by methods of inquiry used” (Stake, 1995 p.44). This particular research is based on a descriptive case study framework, also noted as an "atheoretical" case study, because it is not guided by established hypothesized generalizations (Merriam, 1998). Moreover, this framework looks to present information about a specific area of education where little research has been previously conducted (Merriam, 1998). This quantitative case study was conducted with a skilled trades course at a large Ontario community college, specifically, a second-year welding and fabrication technician diploma course was chosen. The Structural Layout & Fabrication course was a course that ran during Winter 2020 term (January to April 2020). It encompassed two-hour

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lectures and six hours of laboratory instruction weekly. The class size of students enrolled in the course was 18 students; however, it is important to note that on average, no more than 25 students are often registered in a skilled trades course at this particular Ontario community college.

The research was designed to examine the course presentation artifacts designed by a college instructor and specifically assess how those materials (e.g., PowerPoint presentations) aligned with UDL and the key tenets of curriculum design principles, (i) goals (ii) methods (iii) materials (iv) assessments.

The student sample for this case study is based on convenience sampling, which is a specific type of non-probability sampling method that relies on data collection from members of the population who are conveniently available to participate in the study (Dudovskiy, 2019). Based on the author's role within the college, access to research and relationship to faculty, the student population was based on convenience sampling.

### **Phase I: Literature Review**

The purpose of the literature review was to investigate research related to UDL and its impact on student learning in higher education settings, professional development and/or training, and instructional materials. The section concluded with a discussion on skilled trades and the need for new instructional approaches. The literature review was conducted using Google Scholar and OMNI databases to conduct searches using the following primary keywords: universal design learning, universal design, universal instructional design, universal design of instruction and universal design; and the following secondary keywords: post-secondary, college, university, higher education, skilled trades, apprenticeship, undergraduate, students, accommodations, vocational, disabilities. Boolean search terms (AND, OR) and wildcards (such

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as the asterisk) were also used to double-check results and ensure that combinations and alternative forms of the keywords were searched. The search results were filtered by publication date and articles published prior to 2001 were removed. Additionally, articles not published in peer-reviewed journals were also excluded from the search. The initial search yielded 40 articles based on the criteria, but after reviewing the abstracts and titles, twenty-one articles met the inclusion criteria based on the noted key words and publication dates.

### **Phase II: Consultation**

After consultation with research supervisors, a series of PowerPoint lectures designed by one instructor was chosen as the group of artifacts to address the research question. As highlighted by Forrest (2020), PowerPoint artifacts are common and important teaching tools used by professors to guide their curriculum delivery. PowerPoints have been considered to be a useful teaching tool based on three factors: they can be a means for communicating the structure of a lesson, a prompt for instructors to guide them through topics to be discussed and a note-taking aid for students (Forrest, 2020). A total of seven PowerPoint artifacts were gathered and used for the research analysis. These artifacts were evaluated on how the specific principles of UDL instructional strategies were, or were not successfully incorporated. The abstracts and titles, of twenty-one articles met the inclusion criteria.

### **Phase III: UDL Tool, Codification & Data Collection Process**

To address the research question, the author triangulated ideas with two other researchers to create a “UDL Artifacts Checklist”. After reviewing several other adapted assessment tools, an instrument was created based on the Center for Applied Special Technology (CAST) universal design for learning guidelines, which is based on CAST's 2.2 version of the UDL guidelines. The UDL guidelines, an articulation of the UDL framework, were developed to assist

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lessons of study and/or develop curricula (using the tenets of goals, methods, materials, and assessments). CAST's guidelines are based on extensive research from learning theories, neuroscience and teaching approaches to support the three principles of UDL (CAST, 2011). The framework of this tool is structured based on three main principles: multiple means of representation, multiple means of engagement and multiple means of action & expression. From those principles, the framework further breaks down into nine categories with additional checkpoints to guide the educator when customizing instructional environments (Smith, 2012). These checkpoints of the UDL framework are designed to be used when integrating the UDL principles in creating PowerPoint artifacts for lessons.

The final instrument used in the research project was a breakdown of the UDL framework in a table format that formed an adapted tool for assessing the CAST components of the course PowerPoint artifacts. This tool's design used a binary method of assessment that interpreted the artifacts based on one of two categories. The data was coded based on 'meeting principles' with a checkmark or 'not meeting principles' noted with an X, and is displayed in Table 1. The data gathered from the analysis of the artifacts were analyzed using the adapted tool and further categorized based on the UDL framework, including three principles, nine guidelines and corresponding checkpoints.

Data were gathered using this adapted UDL artifact assessment tool. This was achieved by the researcher analyzing each of the seven artifacts individually, specifically by reviewing the content and design of each individual PowerPoint artifact. The researcher supplemented the tool by reviewing the CAST's UDL guidelines and reviewing each guideline in-depth when coding. Along with the artifact assessment tool, the UDL guideline website which provided concrete examples of strategies that were also used when reviewing each artifact. Once each artifact was

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analyzed, the researcher indicated on the tool whether the presentation slides met, or did not meet, the different UDL principles and checkpoints. Table 1 presents the Universal Design for Learning guidelines version 2.0 visual organizer based on CAST (2011) guidelines. The raw data from the UDL tool is outlined in Appendix 1.

**Table 1**

### *Universal Design for Learning Guidelines 2.0 Version*

<b>Universal Design for Learning (UDL) Guidelines</b>		
<p><b>III. Provide Multiple Means of Engagement</b></p> <p>7: Provide options for recruiting interest</p> <p>7.1 Optimize individual choice and autonomy 7.2 Optimize relevance, value, and authenticity 7.3 Minimize threats and distractions</p> <p>8: Provide options for sustaining effort and persistence</p> <p>8.1 Heighten salience of goals and objectives 8.2 Vary demands and resources to optimize challenge 8.3 Foster collaboration and community 8.4 Increase mastery-oriented feedback</p> <p>9: Provide options for self-regulation</p> <p>9.1 Promote expectations and beliefs that optimize motivation 9.2 Facilitate personal coping skills and strategies 9.3 Develop self-assessment and reflection</p> <p><b>Resourceful, knowledgeable learners</b></p>	<p><b>I. Provide Multiple Means of Representation</b></p> <p>1: Provide options for perception</p> <p>1.1 Offer ways of customizing the display of information 1.2 Offer alternatives for auditory information 1.3 Offer alternatives for visual information</p> <p>2: Provide options for language, mathematical expressions, and symbols</p> <p>2.1 Clarify vocabulary and symbols 2.2 Clarify syntax and structure 2.3 Support decoding of text, mathematical notation, and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media</p> <p>3: Provide options for comprehension</p> <p>3.1 Activate or supply background knowledge 3.2. Highlight patterns, critical features, big ideas, and relationships 3.3 Guide information processing, visualization, and manipulation 3.4 Maximize transfer and generalization</p> <p><b>Strategic, goal-directed learners</b></p>	<p><b>II. Provide Multiple Means of Action and Expression</b></p> <p>4: Provide options for physical action</p> <p>4.1 Vary the methods for response and navigation 4.2 Optimize access to tools and assistive technologies</p> <p>5: Provide options for expression and communication</p> <p>5.1 Use multiple media for communication 5.2 Use multiple tools for construction and composition 5.3 Build fluencies with graduated levels of support for practice and performance</p> <p>6: Provide options for executive functions</p> <p>6.1 Guide appropriate goal-setting 6.2 Support planning and strategy development 6.3 Facilitate managing information and resources 6.4 Enhance capacity for monitoring progress</p> <p><b>Purposeful, motivated learners</b></p>

Adapted from CAST (2011). Universal design for learning guidelines version 2.0.

Wakefield, MA: Author

## Findings & Results

This section reviews the quantitative data collected from analyzing the presentation artifacts and the results were broken down based on the 3 principles and 9 guidelines of

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### **Components of Universal Design for Learning (UDL) Curricula**

Initially the results section examined the components of the UDL curricula: goals, methods, materials, and assessments and how the artifacts attempted to integrate the four tenets of UDL curricula.

The data demonstrated how artifacts addressed the goals tenet and the results indicated that 53% of all the seven presentation artifacts analyzed contained outlines and strategies to develop executive functioning and goal setting skills, while 71% of the total slides articulated the goals and requirements for achieving learning expectations for each class. In addition, the study found that 57% of PowerPoints encouraged students to reflect and share their personal goals.

Addressing the tenet of methods, the results found that 42% of the presentation slides used scaffolds and prompts to supplement the lecture material. All of the artifacts presented information using adjustable visual content that could be adapted and 85% of the artifacts broke down ideas into small parts.

In reference to the UDL curricula, 85% of the artifacts failed to provide opportunities for alternative media expression, while 28% of the PowerPoint slides supplemented learning with online video media. None of the artifacts utilized media as an alternative option for students to demonstrate their learning.

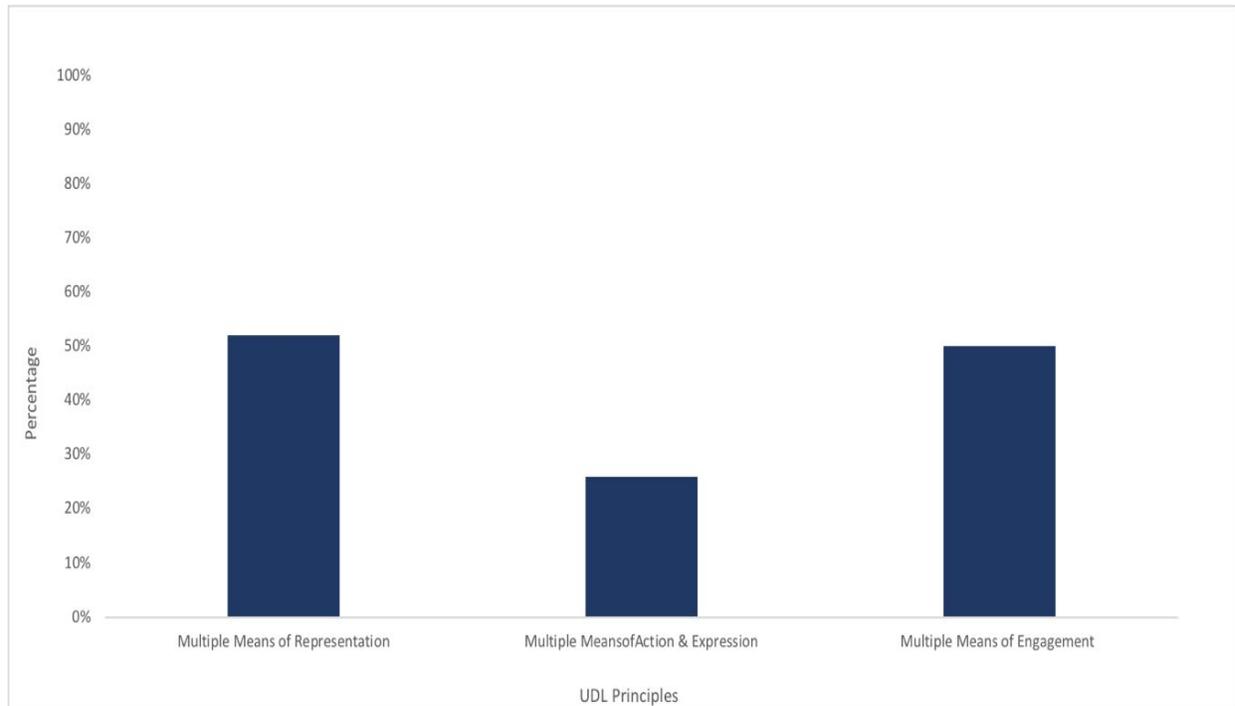
In terms of the assessment tenet, findings indicated that 71% of the artifacts presented prompts and scaffolds outlining the level of effort and difficulty required to complete test and project evaluations. Of the PowerPoint presentations, 42% outlined differentiated self-assessment models to facilitate self-evaluation, which included assessment checklists and examples of student work.

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The results and frequency of UDL integration are summarized based on the three principles; figure 1 presents the percentage of artifacts that utilized UDL principles in this research.

**Figure 1**

*Utilization of Artifacts that Met UDL Principles*



### **Multiple Means of Engagement**

This principle supports the different ways in which learners can be engaged or motivated to learn. Of the artifacts reviewed, only 50% met this principle. Half of the artifacts met guideline seven which states that artifacts provide options for recruiting interest. Those that did, presented content through colour prompts and video links that could engage students. Similar to this, six of the PowerPoints highlighted the importance of learning specific content and bridged the material to practical activities. For example, one of the artifacts outlined the course learning outcomes, expectations and deliverables for the term. As a second example, an artifact discussed

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the relevance of understanding the "Title Block concept" and highlighted how the course content related to the industry could be applied in a job. Both examples meet the guideline of optimizing relevance, value and authenticity. Two artifacts presented opportunities to encourage personal reflection on content and activities by posing questions to the students (e.g., what are some things we found interesting, what are some things needing improvement). One of the artifacts conveyed an example of reducing threats and distractions by using visuals and charts to increase predictability, involving students in the class discussions (e.g., creating class discussions and lab projects) and providing warning cues to remind students when to seek support.

Guideline eight which addresses providing options for sustaining effort and persistence was observed in over half of the artifacts, five out of seven presentation slides noted goals and a rationale for achieving them; for example, one artifact illustrated multiple ways to scale drawings correctly. Three artifacts presented scaffolds and prompts among the slides to explain how to complete specific tasks (e.g., determining the layout of bolt holes and tacking parts together). However, only two of the artifacts presented opportunities for feedback that guided learners toward mastery. In one of the PowerPoints, content encouraged reflection on lab projects by highlighting feedback on what students executed well (e.g., worked well together, completed project), but also noted areas for improvement (e.g., "tacking" improvements, reducing distractions).

This research determined that 38% of the artifacts presented opportunities for self-assessment and reflection and optimized motivation, meeting guideline nine. In one of the artifacts, self-reflection and identification of personal goals were observed in four of the slides. It suggested a reflection activity designed to encourage students to identify and share their goals for

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the rest of the term. The first PowerPoint slide outlined comprehensive college supports and resources (e.g., Accessible Learning) for students.

### **Multiple Means of Representation**

The principle of Multiple Means of Representation addresses the different ways that students perceive and comprehend information presented to them (CAST, 2011). The data indicated that 52% of the PowerPoint artifacts evaluated met this principle. Moreover, all of the slides met the criteria for presenting information using flexible course content that could be adjusted; examples included the size of text, images, graphs, tables, and other visuals. In one of the artifacts, bright colored squares were used to prompt the reader to pause and reflect, identify if they were meeting the requirements of a drawing and the artifact provided instructions if students' responses were incorrect. Additionally, visual representation of tools and materials related to concepts were paired throughout many of the artifacts. None of the PowerPoint slides provided alternative visual or auditory information options, and less than half (42 %) presented content using language and symbols. However, clarification of vocabulary and symbols and the integration of multiple media were the most frequently used strategies in five out of seven artifacts. Among those artifacts, two of them highlighted different teaching tools, such as YouTube videos to supplement PowerPoint content.

This research found that 71% of the artifacts demonstrated multiple options for comprehension as the most widely adopted guideline. All of the slides presented patterns, critical features, big ideas and relationships. Given the many terms taught in the course, three artifacts used cues such as charts and numbered steps to draw attention to critical features. Through the use of text prompts, the artifacts highlighted key elements such as "remember" slides to indicate important information (e.g., artifact 4 used "remember" cue to inform students of the importance

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of stretching a tack). Five of the artifacts built connections between prior understandings and experiences. In one example, the content bridged students' previous experiences and observations from lab projects to the course content (e.g., pictures of completed projects and students from the lab) when reviewing content and discussing concepts such as "tacking." It was discovered that 85% of the artifacts presented information by chunking concepts into smaller elements, and explicit prompts were outlined at each step in the sequential process, for example, one presentation slide explained specific steps, tips and reminders when welding in the lab.

### **Multiple Means of Expression & Action**

The principle of Multiple Means of Expression and Action targets how students navigate a learning environment and express what they know (CAST, 2011). Only 30% of the PowerPoint artifacts had content that met this principle. Although the artifacts failed to meet most of the guidelines and corresponding checkpoints, one of the artifacts illustrated an example of providing alternatives for physically interacting with materials through a group activity that encouraged students to apply their skills and create a layout flange with bolt holes. Similar to the previous results, 85% of the artifacts failed to meet the criteria for guideline five except one example that presented information to students on how to demonstrate knowledge of a concept using drawings as a multimedia source.

Of the artifacts, 53% integrated information that outlined how to develop executive functioning skills and, therefore, met guideline six. Five of the artifacts presented content that encouraged setting challenging and authentic goals. Many of the PowerPoints embedded prompts and scaffolds to estimate the amount of effort, resources, and difficulty required to meet this criterion. One of the artifacts outlined steps to create a 'title block' by outlining steps and prompting reflection to encourage students to examine their work and adjust if needed, some

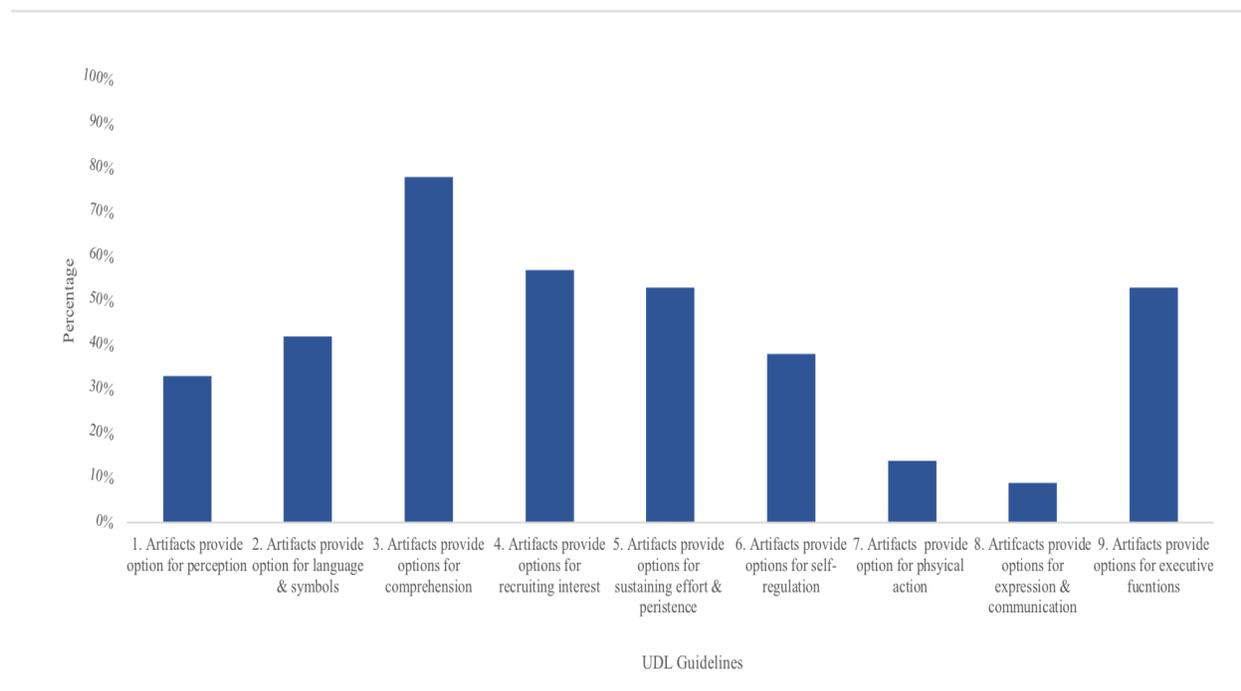
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examples included embedding prompts to encourage ‘stop and think’ before acting and integrating prompts to ‘show and explain your work.’ Additionally, two of the artifacts' content illustrated student performance examples using student photos, and integrated questions for students to guide self-monitoring and reflection.

Overall, based on the results, the collection of artifacts integrated two of the principles, multiple means of representation and multiple means of engagement at least 50% of the time. Comparatively, only 30% of the artifacts embedded multiple means of action and expression strategies. The findings from the seven artifacts revealed that the UDL guidelines were integrated at different rates. Figure 2 presents a bar graph that breaks down how much of the artifacts met each UDL guideline.

**Figure 2**

*Percentage of Artifacts Meeting each UDL Guideline*



### **Discussion**

This quantitative case study focused on the analysis of seven PowerPoint artifacts to assess whether they met the criteria of the principles and tenets of UDL and curriculum design. This study analyzed these existing PowerPoint artifacts in a trades course at an Ontario college utilizing a UDL framework adopted from the CAST (2011) model. The importance of this research is twofold. First, Ontario colleges are expanding, with trades and apprenticeship programs growing and attracting learners who would normally struggle academically (Cotton, 2010). Second, many colleges often continue to utilize a medical model in accommodations - something that cannot always be adapted seamlessly and can create barriers to learning for students with a wide variety of learning needs. PowerPoint is a tool that many educators currently use, and with the appropriate skills and instructor training, it can be effectively utilized to design innovative UDL based lessons to reach the diverse population found at Ontario colleges.

This research analyzed the PowerPoint artifacts' current level of integration of the UDL principles and instructional strategies. The results indicated that some UDL strategies were observed in the sample of artifacts. For example, half of the artifacts embedded both multiple means of representation and multiple means of engagement strategies. Yet, since these instructional strategies were not found in every artifact, these findings illustrate that the artifacts inconsistently adopted the UDL principles. It can be speculated that the instructional materials were designed based on other factors such as the teaching style and/or previous teaching experience of the instructor (Naik, 2017), and not the UDL principles themselves. As a result, the instructor may have limited experience, training and skills to provide supportive instructional

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materials to students with diverse learning needs, or those who may require alternative formats of presentation.

As PowerPoint is one of the most common teaching aids used to concisely summarize information for students by instructors (Naik, 2016), UDL training could positively influence the design of PowerPoint presentations and enhance the student learning experience. This research found an inconsistent application of UDL strategies in the artifacts examined, affirming the need for potential opportunities for professional development and/or teacher training on UDL for college instructors who wish to use inclusive design in their curriculum development. Any amount of professional development or training has been identified as having a positive impact on teachers' instructional practices, resulting in an increase in their understanding of UDL and likelihood of designing lessons and accessible curricula (Spooner et al. 2007; Tappe et al. 2013; Courey et al. 2013; Navarro et al. 2016; Izzo et al. 2008; Rao & Tanners 2011). This research analyzed the application of some UDL strategies in PowerPoint artifacts. Literature suggests that expanding instructors' current knowledge with UDL training could potentially have a positive impact on the likelihood of teachers integrating the framework into course material. This researcher suggests that with the appropriate training, instructors could create intentional curricula, aimed at including students at all levels.

Findings from this case study revealed that the UDL guideline multiple means of engagement was observed amongst half of the PowerPoint artifacts. Through the inclusion of students' work and bridging concepts to working in the industry, many of the PowerPoints presented UDL strategies that encouraged student opportunities to apply theory to practice. The PowerPoint artifacts incorporated UDL strategies that prompted students to critically evaluate their work in labs, their progress in the course, and their knowledge of when to seek assistance

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and how to adjust skills when necessary. These particular strategies can enable students to become more independent learners. The self-assessment skills demonstrated in these slides are transferable to trade students when they are working on projects in the lab, but perhaps more importantly, when they move on to working in the field. The PowerPoint artifacts that were successful in incorporating UDL strategies created opportunities for students to share their voice, specifically their goals for the term and their lab projects. PowerPoint content such as this, fosters students' voices and works towards playing a role in student engagement and investment in the course. These UDL intentional instructional design strategies have been noted as one factor in helping student apprentices develop knowledge and metacognitive abilities (Cotton, 2010).

Given that many students will likely work collaboratively in their respective trades field upon graduation (Scott, Temple & Marshall, 2015) fostering collaboration through the use of group investigation and discussions was a missed opportunity in these artifacts that might build engagement and understanding among students. An activity example highlighted by Boothe (2018), is the “ask 3 method” where students ask their peers three questions before asking the professor. This activity, or one similar to it, could be easily incorporated into PowerPoint materials to foster collaboration, encourage engagement and develop a deeper understanding of course material.

The multiple means of representation principle and its corresponding instructional guidelines was the most widely observed principle. UDL guidelines 2.0 advocate that there is no one representation method that is optimal for student learning, but providing options for representation is essential in meeting student learning needs (UDL, 2011). Multiple means of representation is a UDL principle that encourages multiple ways of presenting information and

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strongly correlates with the characteristics of PowerPoints. PowerPoints can be designed to be a visual learning aid, and through use of graphs, charts and images, these tools can support the instructor in relaying information (Forrest, 2020). The results of this case study highlighted several of Naik (2017) UDL PowerPoint best practices, which included the use of images, audios, videos and multimedia content, as well as readable font size, colour and brightness contrast, emphasising text. Most of the artifacts incorporated visuals and graphics throughout to supplement course content. Due to the instructor's ability to easily manipulate visuals and add graphics to PowerPoints, these noted examples can be considered more common PowerPoint characteristics and could be a factor to why they were more frequently observed in the artifacts studied.

Building on multiple means of representation, the guideline of providing options for comprehension was captured in almost all of the artifacts as the content was organized and broken down into sections and provided a clear path. Video clips supported key concepts and content outlined key skills required to complete lab projects. These examples illustrate that content in the artifacts went beyond just incorporating visuals, but effectively used them to build connections to, and expand understanding of, course material. These particular instructional strategies have been reported as being helpful means of supporting students with processing challenges. Findings from Smith (2010) affirm that strategies such as simplifying terms and concepts, exploring concepts, and use of visual representations were beneficial in aiding students with learning disabilities to succeed in an apprenticeship course. The findings highlight the potential benefit of this instructional approach on building student comprehension and processing.

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The results indicated that multiple means of action and expression was the least integrated principle. The findings illustrated that the PowerPoint artifacts presented content that built on executive functioning skills and was the most widely adopted guideline of this principle. Specifically, goal setting and supporting plan development were observed in just over half of the artifacts. Multiple examples of how incorporating goals in PowerPoint content could help inform students about expectations and requirements of completing tasks were found. This type of information can potentially help develop the applied skills students require in skilled trade courses as students develop greater expectations of achieving success. However, integrating flexible opportunities for students to demonstrate skills and knowledge was the least observed guidelines amongst the results. The artifacts missed opportunities to incorporate activities or prompts that could have facilitated students' demonstrating their knowledge in diverse ways.

This research study further observed the use of scaffolding as a UDL tool within the PowerPoint artifacts. Scaffolding is an effective UDL strategy for students to develop their independence (Griful-Freixenet et al., 2017). An innovative approach on how to use equipment digitally and through scaffolding was presented by Sochowski (2013). Scaffolding was facilitated by teaching through animations and simulation. This instructional approach could provide a formalized and simplified model of teaching that can be changed based on learners' skills and needs (Sochowski, 2013). More importantly, these strategies provided scaffolding opportunities that could be used digitally to allow students to build on their learning of operating equipment, and to have opportunities to get feedback from their instructors (Sochowski, 2013). The findings presented several examples of scaffolding strategies using technology and this can provide an innovative approach to creating practice based learning opportunities that could be embedded into PowerPoints.

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The findings in this study demonstrated that there were missed opportunities to integrate technology into PowerPoints in the context of UDL. Smith (2012) highlighted several examples of how technology-based tools could be integrated into instructional materials (e.g., use of spell checkers or graphic organizers). In contrast to easily adding visuals into PowerPoints, integrating technology-based tools could be perceived as a steeper learning curve for instructors, which could explain why this was the least observed guideline. Tools such as a graphic organizer would require instructors to have knowledge of how to use the platform and explain its value to students. Without prior experience or training this could become a greater challenge to incorporate such tools. This research reiterates the value of UDL training, but also illustrates the importance of instructors being able to test and apply the tools in practice in order to be confident with adopting these tools. Within the context of a trades course, Tobin (2014) highlighted the benefit of strategies that could support learning instructional content by visually demonstrating how to complete tasks in a trades course. An example of this could include providing students with video recorded task demonstrations with voice-over outlining steps and prompts.

The findings from this quantitative case study highlighted concrete UDL strategies that were meaningfully integrated into PowerPoint artifacts of a college trades course. The examples illustrated that some of the UDL guidelines were consistently adopted. The strategies that were identified could be a helpful resource for educators teaching similar applied courses at a community college. The researcher has outlined a visual graphic in Figure 3 that highlights UDL strategies that were observed in the PowerPoints. Figure 3 illustrates that there is a need for more concrete strategies that demonstrate the application of the multiple means of expression and

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action principle. The graphic breaks down examples of strategies found within the PowerPoint artifacts based on each of the nine guidelines, see Figure 3 for review.

**Figure 3**

### *UDL Examples Identified in the Research Findings*

<b>UDL Examples that can be Incorporated into PowerPoints</b>		
<b>III. Provide Multiple Means of Engagement</b>	<b>I. Provide Multiple Means of Representation</b>	<b>II. Provide Multiple Means of Action and Expression</b>
<p>7: Provide options for recruiting interest</p> <ul style="list-style-type: none"><li>Outline course learning outcomes, expectations and deliverables for the term</li><li>Explain relevance to learning content</li><li>Encourage personal reflection on content and activities by posing questions to the students (i.e., what are some things we found interesting or did well)</li><li>Breakdown of both short and long-term goals</li><li>Use charts</li><li>Provide cues to remind students when to seek support</li><li>Prompt class discussion through guiding questions</li></ul> <p>8: Provide options for sustaining effort and persistence</p> <ul style="list-style-type: none"><li>Include scaffolds and prompts within PPT to explain how to complete specific tasks</li><li>Use reflection to encourage student to identify their goals</li><li>Use activities to encourage collaboration (example, "ask 3 method" where students ask their peers three questions before asking the professor is an activity)</li></ul> <p>9: Provide options for self-regulation</p> <ul style="list-style-type: none"><li>Integrate reflection that prompt student connect back to their goals for projects</li><li>Use activities detailed visuals and graphics as alternative scaffolds (e.g., charts, templates, feedback displays) that support understanding</li></ul>	<p>1: Provide options for perception</p> <ul style="list-style-type: none"><li>Use content that can be flexible tin size of text, images, graphs, tables, and other visuals(i.e., bright square as a prompt students to reflect to determine if on right path of project)</li><li>Pairing visuals and graphics of tools/materials to concepts 1.3 Offer alternatives for visual information</li><li>Alternative audio information (visual/charts diagrams, captions)</li><li>Alternative visual information (text description for images, use of physical objects to convey concepts)</li></ul> <p>2: Provide options for language, mathematical expressions, and symbols</p> <ul style="list-style-type: none"><li>Used cues such as charts and numbered steps to draw attention to critical features</li><li>Embed support for learning vocabulary and symbols within the text by using definitions or illustrations</li><li>Explain concepts or ideas through media</li></ul> <p>3: Provide options for comprehension</p> <ul style="list-style-type: none"><li>Used cues such as charts and numbered steps to draw attention to critical features</li><li>Use of text prompts to highlighted key elements such as "remember" cues important information</li><li>Bridge students' previous experiences and observations from lab projects to the course content (i.e., pictures of completed projects and students from the lab),</li><li>Chunk concepts into smaller elements i.e., explaining specific steps to complete tasks or review a process</li></ul>	<p>4: Provide options for physical action</p> <ul style="list-style-type: none"><li>Create opportunities for students to physically engage with materials or activities to apply knowledge</li><li>Allow students demonstrate knowledge using media (i.e., drawings)</li></ul> <p>5: Provide options for expression and communication</p> <ul style="list-style-type: none"><li>Provide models that demonstrate the same outcomes but use differing approaches (i.e., graphic,, video, physical demonstration, analogy)</li></ul> <p>6: Provide options for executive functions</p> <ul style="list-style-type: none"><li>Incorporate steps and prompt reflection to encourage students to examine their work and adjust if needed</li><li>Embed student performance examples to h</li><li>Integrate questions to guide self-monitoring and reflection.</li><li>practice and performance</li></ul>

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### **Future Research**

Within the last ten years, the UDL framework is a more recent instructional strategy that is being applied in some post-secondary institutions, however there is not as large of body of knowledge related specifically to community colleges. As such, continued research is needed, particularly in applied education settings such as community colleges where literature is most absent. Future research could be conducted to determine the effectiveness of this framework on different student populations and within different settings, for example with students with disabilities and students in a college setting. Expanding on the work in this case study, further studies could analyze which UDL strategies in PowerPoints are most effective amongst students by gathering student perspectives. Examining this research approach across multiple or different trades courses could provide a better understanding and applicability of this approach.

Developing research projects to determine if PowerPoints with incorporated UDL strategies meet accessibility needs for students with disabilities is another important area of work to examine.

### **Limitations**

The findings of this study cannot be generalized as the course selected was based on convenience sampling. Factors such as student demographics (e.g., gender, students registered with accessible learning services) were unknown, as such, generalizations about impact of the instructional material was unknown. There were no opportunities to capture student perspectives on which UDL strategies were most beneficial, thus the student voice was not highlighted.

Another significant limitation is the small sample size of artifacts, only 7 PowerPoints were analyzed, other instructional materials such as assessments (e.g., projects and tests) were not reviewed, thus generalizations about the instructor's integration of UDL into a full course is limited. Accessibility of the PowerPoints was also not analyzed, thus, generalization about

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accessibility could not be explicitly determined. Notably, PowerPoint slides are not the only aspect within the learning environment, as the slides themselves are accompanied by a presentation by the instructor. As a result, some UDL principles might have been addressed in the lecture presentation.

### **Conclusion**

This research demonstrated that some principles of UDL were being applied in PowerPoint artifacts in a community college trades course. The gap identified in the literature reinforces the need for more research on the application of UDL, specifically in a community college setting. Instructional materials, specifically PowerPoints were designed to incorporate some UDL instructional strategies. Through this research, the author designed a modified tool to assess these PowerPoint artifacts, and used the tool to analyse one instructor's course materials, identifying several concrete strategies that could be integrated by educators. The graphic displayed in Figure 3 provided examples that can be replicated by other educators to make their artifacts more inclusive and compliant with UDL principles. The findings also suggested that there is a gap in educator awareness and skills, thus identifying a critical need for training on the UDL framework for educators in post-secondary environments. More importantly, the examples observed indicated that PowerPoints that integrated UDL may address students' needs who often require accommodations such as clarification and breaking down content.

This research project was completed during the global pandemic of 2020 where all lectures in community college setting were moved to online format. Courses that previously were designed to be hands on in an in-person environment were re-designed for a virtual delivery mode and used as one of the primary learning materials. The timeliness and relevance of this case study may be used to build tools and resources to support faculty to integrate UDL in their

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PowerPoints to create a better learning experience for students with diverse learning needs, including those with disabilities.

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## Appendix 1

Universal Design Learning (UDL) Artifact Assessment Checklist									
	Artifact 1	Artifact 2	Artifact 3	Artifact 4	Artifact 5	Artifact 6	Artifact 7	Meets UDL criteria	Does not meet UDL criteria
<b>MULTIPLE MEANS OF ENGAGEMENT "WHY" -</b>									
Artifacts Provide Multiple Ways To Engage									
<b>Artifacts provide options for recruiting interest</b>									
Optimize individual choice and autonomy	✓	X	✓	X	X	X	✓	3	4
Optimize relevance, value and authenticity	✓	✓	✓	✓	✓	✓	X	6	1
Minimize threats and distractions	✓	X	✓	✓	X	X	X	3	4
<b>Category subtotal</b>								12	9
<b>Artifacts provide options for sustaining effort &amp; persistence</b>									
Heighten salience of goals and objectives	✓	✓	✓	✓	X	X	✓	5	2
Vary demands and resources to optimize challenge	X	✓	✓	✓	X	X	✓	4	3
Foster collaboration and community	X	X	✓	✓	✓	X	✓	4	3
Increased mastery-oriented feedback	X	X	✓	✓	X	X	X	2	5
<b>Category subtotal</b>								15	13
<b>Artifacts provide options for self-regulation</b>									
Promote expectations and beliefs that optimize motivation	✓	✓	✓	✓	X	X	X	4	3
Facilitate personal coping skills and strategies	X	X	X	X	X	X	X	0	7
Develop self-assessment and reflection	X	✓	✓	✓	✓	X	X	4	3
<b>Category subtotal</b>								8	13
<b>MULTIPLE MEANS OF REPRESENTATION OF "WHAT" -</b>									
Artifacts presented in multiple formats									
<b>Artifacts provide option for perception</b>									
Offer ways of customizing the display of information	✓	✓	✓	✓	✓	✓	✓	7	0
Offer alternatives for auditory information	X	X	X	X	X	X	X	0	7
Offer alternatives for visual information	X	X	X	X	X	X	X	0	7
<b>Category subtotal</b>								7	14
<b>Artifacts provide option for language &amp; symbols</b>									
Clarify vocabulary and symbols	X	✓	X	✓	✓	✓	✓	5	2
Clarify syntax and structure	X	X	X	✓	✓	X	X	2	5
Support Decoding of text, mathematical notation and symbols	X	X	X	✓	X	X	X	1	6
Promote understanding across languages	X	✓	X	✓	X	X	X	2	5
Illustrate through multiple media	X	✓	✓	✓	✓	✓	X	5	2
<b>Category subtotal</b>								15	20
<b>Artifacts provide options for comprehension</b>									
Activate or supply background knowledge	✓	X	✓	✓	✓	X	✓	5	2
Highlight patterns, critical features, big ideas and relationships	✓	✓	✓	✓	✓	✓	✓	7	0
Guide information processing and visualization	✓	✓	X	✓	✓	✓	✓	6	1
Maximize transfer and generalization	X	X	X	✓	✓	X	✓	4	3
<b>Category subtotal</b>								22	6
<b>MULTIPLE MEANS OF EXPRESSION "HOW" -</b>									
Artifacts presented in multiple pathways for									
<b>Artifacts provide option for physical action</b>									
Vary the methods for response and navigation	X	X	✓	X	✓	X	X	2	5
Optimize access to tools and assistive technology	X	X	X	X	X	X	X	0	7
<b>Category subtotal</b>								2	12
<b>Artifacts provide options for expression &amp; communication</b>									
Use multiple media for communication	X	✓	X	X	X	X	X	1	6
Use multiple tools for construction and composition	X	X	X	X	X	X	X	0	7
Build fluencies with graduated levels of support for practice and performance	X	X	X	✓	X	X	X	1	6
<b>Category subtotal</b>								2	19
<b>Artifacts provide options for executive functions</b>									
Guide appropriate goal-setting	✓	✓	✓	✓	X	X	✓	5	2
Support planning and strategy development	X	✓	✓	✓	✓	X	X	4	3
Facilitate managing information and resources	X	X	X	✓	X	✓	✓	3	4
Enhance capacity for monitoring progress	X	✓	✓	✓	X	X	X	3	4
<b>Category subtotal</b>								15	13