

Evaluating the impact of visual course outlines in the Faculty of Science at McMaster University (2 April 2022)

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Abstract

Introduction Course outlines are instrumental to a student's success in post-secondary education. We argue that there are fundamental issues with the current state of course outlines at McMaster University. As a result, students often miss important information. To address these issues, we created scannable visual course outlines using UI/UX design principles that aimed to reduce the time students spend finding specific information and to increase comprehension for each specific component of the course outline.

Methods Through a single-blind interventional randomised control trial, we explored differences between the standard and visual course outline in terms of speed and comprehension among McMaster students. We also captured key perceptions of each course outline as described by the students through a thematic analysis.

Results Participants in the intervention group ($n = 84$) found that the visual course outline was quicker to locate all components, easier to understand, and quicker to understand than the control group ($n = 91$) that received the standard course outline (all $p < 0.05$). The intervention group found the visual course outline more appealing and expressed they were more likely to refer back to it during a semester (all $p < 0.05$). The intervention group also had more positive sentiments toward the visual course outline than the control group had toward the standard.

Conclusions Visual course outlines help increase knowledge synthesis, understanding, and perceptions of the course content. We recommend that other faculties at McMaster University and other universities adopt visual course outlines to further support student learning.

Introduction

Course outlines (also known as syllabi) play a critical role in setting student expectations and supporting student success in higher education. These documents are given to students at the start of a school term for them to use throughout. They include key pieces of information, such as points of contact for course instructors and teaching assistants, the course schedule and format, assessment descriptions and deadlines, and policies about late work, academic dishonesty and more. The 'syllabus' has traditionally served as a legally binding document, providing contractual, record-keeping, and communication functions (Fink, 2012; Neaderhiser, 2016).

There are fundamental issues with current course outlines in post-secondary academic institutions including McMaster University, a public university in Hamilton, ON. We have identified key pain points (problems that customers face when using a product) pertaining to course outlines at McMaster University. The first pain point is the overwhelming length of the course outline. The outlines at McMaster University span about 10 pages that consist of mostly text. For example, the LIFESCI 2AA3, boilerplate language that is standard across outlines makes up 54.7% of the text (visuals nowhere to be found). Another pain point is the lack of concision within the document. This lends itself to the boilerplate language that spans more than half of the document and the overall length of the document, making it confusing to follow. The other pain point in

existing infrastructure is the word choice and tone of writing. Course outlines tend to not be written with a student audience in mind. They are often littered with punitive language (for example, “You must adhere to these guidelines or you will receive a grade of 0) that can often cause students to shy away from the outline. With these three pain points in mind, it is no surprise that students sometimes miss key information or not even check the document at all. Students rely on and benefit from quick guides that are both accessible and engaging.

The pain points of the current course outline framework opened up opportunities for improvement. To address these issues, we developed new and revised course outlines (coined as ‘visual course outlines’) that are visually engaging, concise, and friendly by integrating User Experience and User Interface (UI/UX) design best practices for two McMaster undergraduate courses LIFESCI 2AA3 and LIFESCI 3P03. These two courses teach science communication skills. The visual course outlines will supplement the standard ones and will be made available to all students over ‘Avenue to Learn’—an online platform where McMaster University students can access course content. We predict that exposure to visual course outlines will allow students to more quickly access and understand information.

This review examines the existing pedagogical research that explores the impact that different types of course outlines have on student learning and academic outcomes. Research on this subject is limited and so we will draw on other relevant articles to help form our argument. We will first discuss how the digital age has caused a paradigm shift in the way we access and consume information online, best practices in online interface design, and how UI/UX design strategies can help engage readers on an online platform.

The Digital Age and Information Processing

The Digital Age has caused a paradigm shift in the way that we consume and digest visual and textual information. Nielson (1997) conducted several studies and found some emerging themes: users usually do not ‘read’ pages on the web, but instead ‘scan’ pages to find the information they want, users prefer pages that do not involve excessive scrolling and text that is factual and straight to the point, and users prefer language that is not ‘overhyped’ or embellished. Designers are now searching for ways to optimise readership by integrating ‘scannability’ into online webpages.

Scannability

Scannability is a term coined by UI/UX designers that describes how easily we, the target audience, can read and understand a body of text (Fanguy, 2020). Readers want to arrive at the main point as fast as possible and writers and designers should keep this in mind when creating content. There are several reasons why we may choose to scan online documents rather than fully read them. Neilson (1997) developed the following reasons:

- Reading on the internet is about 25% slower than reading on physical paper
- Users feel driven to click, share, follow on the internet, reading seems too passive
- There are other websites competing for user’s attention and attention spans are short
- Users do not want to expend too much energy finding out information on the internet

Eye-tracking Experiments

Results from several eye-tracking and heat map experiments have revealed patterns where the reader’s eyes gaze when reading webpages. Nielson Norman (2006) notes that the most common and efficient way readers scan web pages is in an ‘F-shaped’ pattern, resembling the capital letter ‘F’ in the English alphabet

(Shrestha et al., 2007). This eye-tracking pattern informs web designers about where to put the most relevant information to optimise user experience.

Inverted Pyramid for Comprehension

Schade (2018) explains the informational hierarchy order that web designers and writers may use to organise their information based on the degree of importance. This is much different from the pyramids used to illustrate plot structure in fictional stories, where the climax (i.e., the most intriguing point) is at the tip of the pyramid. They developed an inverted pyramid shown in Figure 2 to best illustrate the notion that readers prefer to read efficiently and effectively on the internet rather than for longer times for pleasure. The pyramid illustrates the importance of conveying the most important message the author wants to convey first and then any add-on details after, ensuring that users get their information quickly and efficiently to support ‘scannability’ (Schade, 2018).

Interface in Web Design

User Interface (UI) is a type of design that focuses on how we interact with a system in terms of functionality and ease (Joo, 2017). While UI is often applied on company websites (such as Apple, Khan Academy, Aritzia, et cetera) similar methods can be applied to learning too. How a student in academia interacts with a document (e.g., a textbook or a handout) is important for their learning process (e.g., putting information into long term memory). There are several best practises noted in the literature that can be applied by designers to optimise user experience (UX) and learning.

Typeface and Legibility

Fonts play a key role in determining whether the text is legible or not. A common way to assess legibility is using eye-tracking experiments to measure reading time and observe eye movement behaviour, such as saccades, fixations, and sweeps. One component of typeface is whether the font is serif or sans serif. Eye-tracking studies that explored the differences between serif and sans serif fonts on reading time and behaviour are limited and do not derive any significant findings due to too small sample sizes (Josephson, 2008; Dogusoy et al., 2016). Hojjati & Mundiandy (2014) found significant differences between a serif versus a sans serif font on reading speed and recall. They noted that participants ($n = 30$) tended to read sans serif text faster and could recall the information more in that font type.

Columns and Cognitive Processing

Over the last three decades, researchers have been studying the effects of the number of columns on reading speed, comprehension, and cognitive load. Some studies have tested whether the number of columns affects reading time, but many of them were inconclusive (Neal & Darnell, 1984; Tinker, 1963).

Dyson & Kippling (1997) conducted a study to explore whether reading in three columns was faster compared to a single one. The researchers recruited 18 subjects ($n = 18$). Ten of them were between the ages of 18 and 24, six of which were between the ages of 25 and 34, and two of which were between the ages of 35 and 44. The subjects read three separate passages in a 12 point Arial font. Two passages were single-columned, scrolled and paged and the other was 3 columns, paged. (A paged passage divides the content into different pages whereas scrolling takes all of the information on one page and allows users to use their trackpad or mouse to scroll through the content.) After running their experiment, they derived two main findings: paging is faster than scrolling and a single wide column is faster when paged. Dyson

& Kipping (1997) also found differences among age groups. When the text was paged in both the single column and three-column passage, subjects only in the 18-24 age group read the passage faster. While this study has implications for the behaviour of online readers, its sample size alone is too small to derive any significant conclusions. It is also outdated, published about 24 years ago, and may not be as relevant today as online reader behaviours have changed with social media platforms, like Twitter and Instagram. They also did not consider measuring differences in cognitive load, which describes the amount of working memory expended in order to complete a task, among the readers across groups.

A more recent study by Al-Samarraie et al. (2019) studied the effects of column number and cognitive load while reading. To measure cognitive load, they performed electroencephalography (EEG; a method that measures brain activity during a task). The researchers recruited 27 postgraduate students to participate in the study. The participants silently read each of the three passages in a single column, two columns, and three columns. Al-Samarraie et al. (2019) found that less energy was used up in participants reading passages in a two-column format compared to the single and three-column format. The study informs designers on how to minimise cognitive load and maximise a learner's cognitive performance when designing textual documents. There are several limitations to the study, again like in the study by Dyson & Kipping (1997), the smaller sample size could have affected the generalisability of the results but the researchers argued that a sample size of 27 was appropriate for an EEG study.

Existing Literature: Course Outlines

The 'syllabus' has traditionally served as a legally binding document, providing contractual, record-keeping, and communication functions (Fink, 2012; Neaderhiser, 2016). The traditional syllabi are more content-driven, coined as a content-focused syllabus (CFS). Harrington & Thomas (2018); O'brien et al. (2008) have argued that syllabi should adopt a learning-focused approach. These learning-focussed syllabi (LFS) aim to create an engaging, question-driven course description, multi-faceted learning goals, concise and measurable learning objectives, strong assessment and activity descriptions, detailed course schedules, an inviting, approachable, motivating tone and a focus on student success (Schunk et al. 2007). Baecker (1998) examined how the use of pronouns plays a role in the power dynamics between the instructor and student. They suggest that addressing pronouns such as 'I' versus 'You' causes a power imbalance between them, resulting in a negative impact on the students' learning outcomes. A paper from Ludy et al. (2016) discussed how students express more engagement in a course and the instructor when the syllabus with graphics is presented to them when compared to a text-rich syllabus.

Wheeler et al. (2019) conducted a quasi-experimental mixed study, randomly assigning participants to either a CFS or an LFS for the same history course. They assessed their perceptions of the syllabus, the instructor, the course as described by the syllabus assigned to them, and their motivation toward the course using the Likert scale. The motivational component of LFS was built upon the expectancy-value theory (EVT) of motivation framework which assumes that a student's individual choices, persistence, and performance inform their beliefs about how well they will do on an assignment (expectancy) and how much value they place on it (value). For perceptions of the syllabus, the researchers found that LFS participants had more positive perceptions of the course schedule, course materials, learning objectives, assignment activities, tips for success and the overall tone of the document. The LFS participants reported that they would revisit the course materials and learning objectives more often than the CFS participants. For perceptions of the course the LFS participants generally expressed a more positive perception of learning goals in the course, interest in the course and workload of the course than the CSF participants. The LFS participants understood how the instructor will teach the course, what type of learning they would be engaging in and what it will take to succeed in the course. The study suggests that addressing the course with an LFS may reduce hesitancy before students actually begin the course. For perceptions of the instructor, the LFS participants had significantly more positive perceptions of the instructor being supportive, encouraging, and engaging compared to the CFS participants (Wheeler et al., 2019). This recent study has sweeping

implications for making a better course outline to gain more student traction, engagement and motivation. Wheeler et al. (2019) concluded the paper with several suggestions to help instructors build a comprehensive learning-focussed syllabus: Use a tone that is friendly and approachable, and ensure that the undertones reflect the instructor's dreams and aspirations for their students; be explicit about the purpose of the syllabus, explaining the importance of each course component; emphasise course objectives, tips for success and a structured schedule; and put less of an emphasis on course policies and expectation (Wheeler et al., 2019). In *Liberal Education* 94(4), Singham (2007) describes the traditional content-focused course syllabi as "rule infested," "punitive" and "controlling." They argue that the syllabi are text-heavy documents, solely laying out rules, expectations, and penalties for missing deadlines. The liberal use of bolded, underlined and italicised typeface insinuates a 'stern' or 'angry' undertone to the document and Singham goes as far as to analogize the traditional content-focused syllabus as something that would be "handed to a prisoner on the first day of incarceration." They also mention that while course syllabi /do/state what content students will be covering, there is no justification as to /why/they are learning it in-depth, its worldly relevance and its associated learning strategies to get the most out of the content. Echoing Wheeler et al. (2019)'s point, traditional content-focused syllabi have little to no indication of fostering a harmonious learning experience between the instructor and students (Singham, 2007). While the arguments made by Singham have more sweeping implications of power imbalance between the instructor and student in educational delivery, the course syllabus reflects that notion and should not be ignored.

As pedagogical research continues to grow, there has also been increasing empirical research on the implications of visuals and infographics on reading comprehension and retention; this has been a research focus in pedagogical practices. Dunlap & Lowenthal (2016) state that infographics present complex and dense information in a way that supports cognitive processing, learning, and recollection and that they quickly tell a story. Infographics satisfy people's innate dual-coding tendencies, where verbal and visual cues help us retain information. They also mention that infographics promote 'resonance'. Viewing an infographic can invoke images, emotions and memories, forming long-lasting connections with information (Dunlap & Lowenthal, 2016). A study by Al Honsi (2016) administered a study that spanned a full school semester. They measured the impact of infographics in education on comprehension and retention. The researcher collected a sample of 27 ($n = 27$) undergraduate students at the College of Economics and Political Science at Sultan Qaboos University who would be taking a course. Al Honsi randomly assigned the participants to an experimental group and a control group. The experimental group received a document summarising the material in the form of an infographic whereas the control group received a document summarising the content with only text. Immediately after both teachers of each group finished explaining the document to the groups, the participants were given a 15-minute quiz to test their comprehension. One week later both groups took a 15-minute retention quiz. The results show that the experimental group performed better on both quizzes than the control group. The experimental group performed significantly better on the retention quiz than the control group. These findings indicate that the use of infographics in learning has a greater impact on comprehension and retention than text alone.

The literature described suggests that there are fundamental issues with the traditional content-focused syllabus that is still often used by universities and colleges today (McMaster University included). Content-focused syllabi contain little to no visuals to support a student's comprehension and retention. Through empirical evidence supporting the effectiveness of learning-focused syllabi and the importance of visuals and infographics in pedagogy, we argue that implementing these components in our revised course outline will have many benefits to support and enhance learning. By creating a modern learning-focussed syllabus, integrating the components developed by (Schunk et al., 2007) and paying close attention to how certain visuals enhance a student's perception of course outlines backed by pre-existing research, we expect to see higher rates of student engagement and success.

Materials and Methods

Ethical Protocol

The survey was reviewed and cleared by the McMaster Research Ethics Board (MREB # 5642) with the final approval date on 31 January 2022. Data were only analysed from participants if they (A) agreed to participate in the survey, (B) consented to have their results used for research purposes and (C) if they fully completed the survey.

Materials

Adobe InDesign and Adobe Illustrator were used to create the visual course outlines for LIFESCI 2AA3. LimeSurvey, an online survey software, was used to create and code the survey. GraphPad Prism 9, an online statistical software service, was used to run statistical analyses to explore the differences between the control and treatment groups. NVivo was used to run a thematic analysis to identify patterns and themes in the comments section of the survey.

Participants and Eligibility

McMaster University students enrolled in LIFESCI 2AA3 and LIFESCI 3P03 for the Winter 2022 term were eligible to participate as the new visual course outlines were designed specifically for them.

Recruitment

A recruitment script and the attached Letter of Information and Consent form were sent out to 2AA3 and 3P03 students via Avenue2Learn (an online learning platform where 2AA3 and 3P03 courses are hosted) on the day the survey was made available.

Intervention

Based on the UI/UX design best practices described in the literature review, we created a new and visual course outline to support reading on the web (course outlines for 2AA3 and 3P03 are posted on Avenue2Learn as digital .pdf files). The visual course outline for both LIFESCI 2AA3 and 3P03 was reduced from 10 pages (from the standard course outline) to 1 page. We added an illustration banner at the top, icons, donut charts to visualise the assignment weight breakdown, inclusive language, Helvetica Neue font, used multi-columns, and included course and mental health resources at the bottom. The visual outlines for both courses are found in **Appendix A**. The standard course outlines for both courses are found in **Appendix B**.

Study Design

A single-blind randomised control trial was used to explore differences in perceptions between the control and intervention groups. The survey evenly split participants into control and treatment groups based on the tutorial section for LIFESCI 2AA3 and last name for LIFESCI 3P03. In LIFESCI 2AA3, students in Tutorial 1 to Tutorial 6 (inclusive) were designated as the control group where they would only receive and answer questions based on the standard LIFESCI 2AA3 course outline. Students enrolled in Tutorial 7 to Tutorial 12 (inclusive) were designated as the intervention group where they received the visual LIFESCI

2AA3 course outline. In LIFESCI 3P03, students with the last name A to Mah were designated as the control group where they would only receive and answer questions based on the standard LIFESCI 3P03 course outline. Students with the last name Mal to Z were designated as the intervention group where they would only receive and answer questions based on the visual LIFESCI 3P03 course outline.

Survey Design

The survey was designed to automatically split students into the control or intervention group based on the aforementioned criteria through preliminary survey screening questions (e.g. What tutorial section are you in?) The survey was split into three distinct sections: (1) questions pertaining to any course outline that they receive at McMaster University, (2) questions about the specific course outline they received based on the group they were assigned (standard or visual), and (3) feedback about the specific course outline they received based on the group they were assigned (standard or visual). A detailed account of the survey design is found in **Appendix C**.

Section 1: Questions regarding any course outline

Section 1 of the survey was designed to gauge participants' perceptions of any course outline at McMaster University. The first question prompted students to rate how likely they were to refer back to a course outline at any given point of the semester using a 5-point Likert scale (1 being 'Very unlikely' to 5 being 'Very likely'). Then students were asked to select which course outline components they were most likely to check including 'Evaluation scheme', 'Assignment descriptions', 'Course description/Learning objectives', 'Instructor/TA contact information', 'Lecture time slots', 'MSAF policy', 'Plagiarism policy', and 'Other'. (MSAF stands for McMaster Student Absence Form which is a self-reporting tool for undergraduates to document absences that last up to 5 days and provides the ability to request accommodation for any missed academic work.) Participants could select one or as many options as they would like. Based on what the participants selected, they were then asked to rate how quickly it usually takes them to locate the components they had previously selected using multiple choice using a 3-point Likert scale (1 being 'Less than a minute', 2 being 'About a minute', and 3 being 'Several minutes'), how easy each component was to understand using a 5-point Likert scale (1 being 'Very difficult' to 5 being 'Very easy'), and finally how long it took them to understand each component using the same 3-point Likert scale. The last question prompted participants to rate whether the course outline was visually appealing or not with the option to select "Yes" or "No", after they selected their answer, an open-ended comment box appeared for them to type out their justification.

Section 2: Questions regarding the specific course outline assigned

Section 2 of the survey uses the exact same questions as Section 1 but the participants assigned to the control group received the standard course outline as a reference and the treatment group received the visual course outline as reference.

Section 3: Feedback regarding the visual course outline

This section was only for the intervention group who received the visual course outline. They were prompted to select which course outline features either interfered with or enhanced their ability to use and access the course outline. The features we included were: Spatial Layout, Donut Chart (used to breakdown the assignment weightings), Illustrations, Icons, Word Choice, and Tone of Writing. After selecting their

preferences, the participants were then prompted to write how the visual course outline could be improved in the future.

Thematic Analysis

The parts of our survey where students were asked to use an open-ended response box were analysed using NVivo 12, following methods proposed by Braun & Clark (2006) to identify patterns and themes in the textual data. Our method followed a semantic realist approach meaning we did not look beyond the surface level of the participants written comments. This also allowed us to avoid any misinterpretations. We performed a thematic analysis whenever the survey prompted participants to write in an open-ended comment box.

Statistical Analysis

We pooled data from both LIFESCI 2AA3 and LIFESCI 3P03 in our analysis. After collecting and tabulating the survey data, we took it into Prism 9 (GraphPad), a statistical software application that allows us to perform statistical tests for Sections 2 and 3 of the survey (i.e., data that was directly comparing the control and intervention groups). For these sections, we performed an unpaired, nonparametric Mann-Whitney U test to explore whether there were any statistically significant differences between the control and treatment group. We then used Prism to visualise our data and added mean lines where appropriate. We accepted a p-value < 0.05 as statistically significant. For **Section 1** (i.e., data that was not comparing the control and intervention groups), we created non-statistical data visualisations.

Results

Enrolment Sample Size

A total of 470 students were eligible to participate in the study, as they were enrolled in either LIFESCI 2AA3 or LIFESCI 3P03 for the Winter 2022 semester. A total of 324 students were enrolled in LIFESCI 2AA3 and a total of 146 students were enrolled in LIFESCI 3P03. After the survey was administered, there were a total of 304 records identified in the system. After the screening process (which excluded those who did not fully complete the survey and those who did not consent to having their results included for research purposes) a total of survey responses from 136 students from LIFESCI 2AA3 (return rate of 41.98% in LIFESCI 2AA3) and a total 39 students (return rate of 26.71% from LIFESCI 3P03) were included for analysis. There was a combined return rate of 37.23 %. Participant screening is illustrated in **Figure 1**.

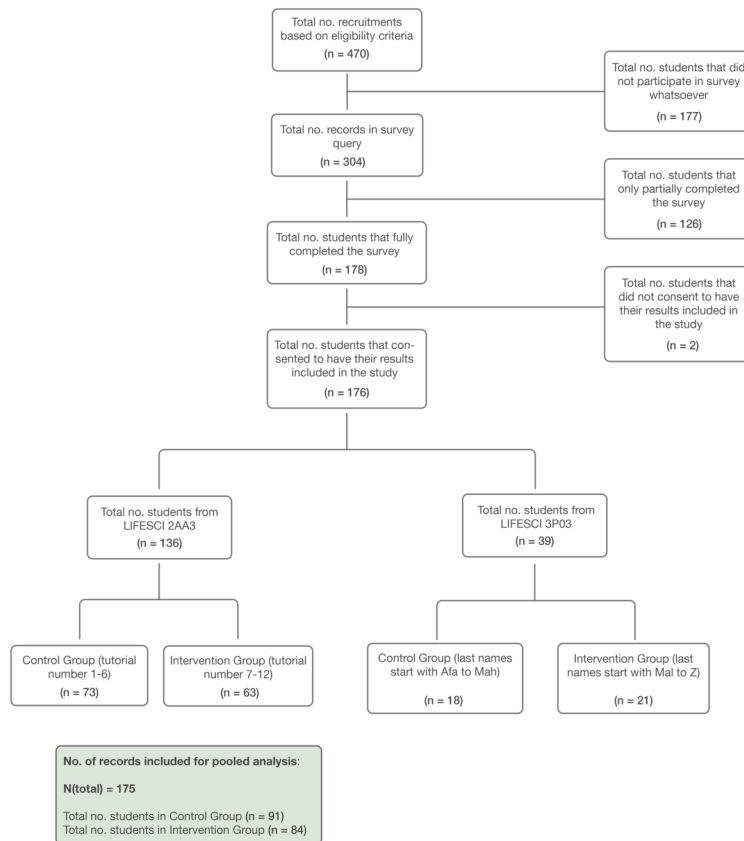


Figure 1: Screening of participants. A flow diagram illustrating the screening process of the data used in the survey. A total of 470 participants were eligible to participate. After screening, a total of 175 students were included in the study ($N = 175$). There were a total 91 students in the Control Group ($n = 91$) and a total of 84 students in the Intervention Group ($n = 84$).

Results from Section 1 of Survey

There were no students who expressed that they were ‘very unlikely’ to refer back to a course outline at any given point in the semester. There were a total of 2 students who expressed that they were “unlikely” to refer back to a course outline ($n = 2$). There were a total of 3 students who expressed that they were “neutral” about their likelihood of checking a course outline ($n = 3$). 59 students expressed that they were “likely” to refer back to a course outline ($n = 59$). On the other hand, the majority of students expressed that they were “very likely” to refer back to a course outline at any given point during a semester ($n = 104$). The results are illustrated in **Figure 2**.

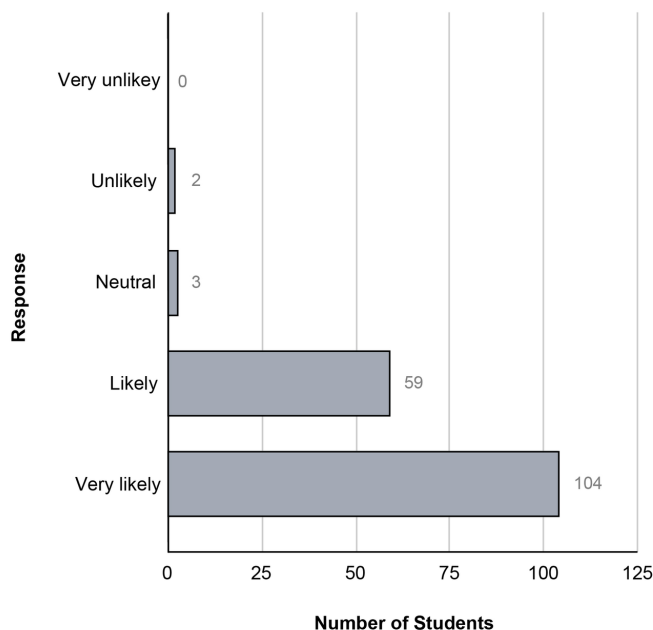


Figure 2: Participants were asked to indicate how likely they are to refer back to a course outline. N = 175.

The ‘Evaluation scheme’ was the most popular course outline component that participants indicated they would check (n = 168). A total of 133 participants expressed that they would check the ‘Assignment description’ (n = 133), 51 expressed that they would check the ‘Course description/Learning objectives’ (n = 51), 98 expressed that they would check the ‘Instructor/TA contact information’ (n = 98), 67 expressed that they would check the ‘Lecture time slots’ (n = 67), 73 expressed that they would check the ‘MSAF policy’ (n = 73), and a total of 9 participants expressed that they would check the ‘Plagiarism policy’ (n = 9). Those who selected “Other” (n = 12) indicated they were looking for “Assignment due dates” (n = 9), “Course calendar/schedule” (n = 2), and “Alternative marking schemes” (n = 1). Results are illustrated in **Figure 3**. **Figure 4** illustrates how quickly it took participants to locate the components they had selected, how easy each component they selected was to understand, and how quickly it took them to understand.

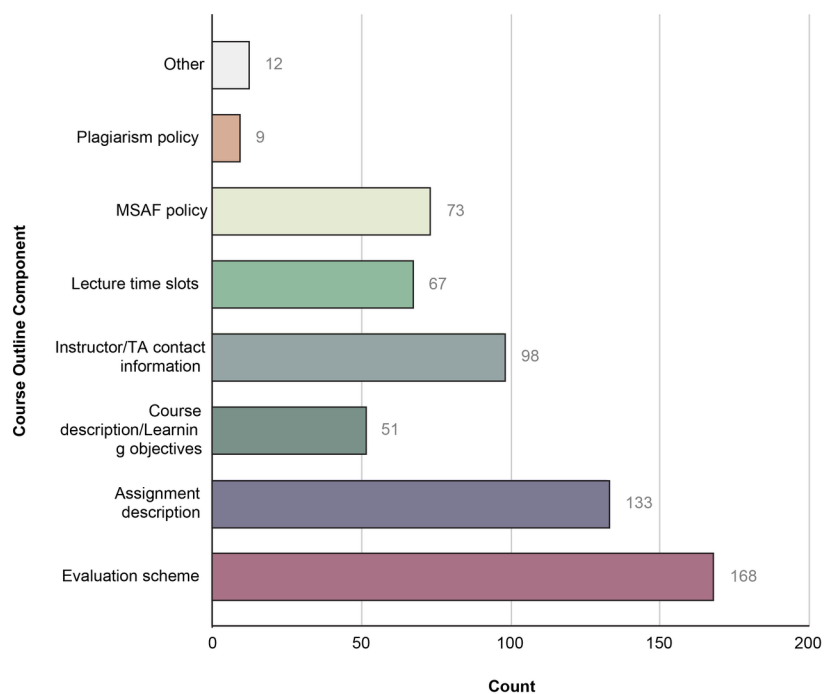


Figure 3: All participants in the intervention group were asked to select which course outline component(s) they are usually checking for. $N = 175$.

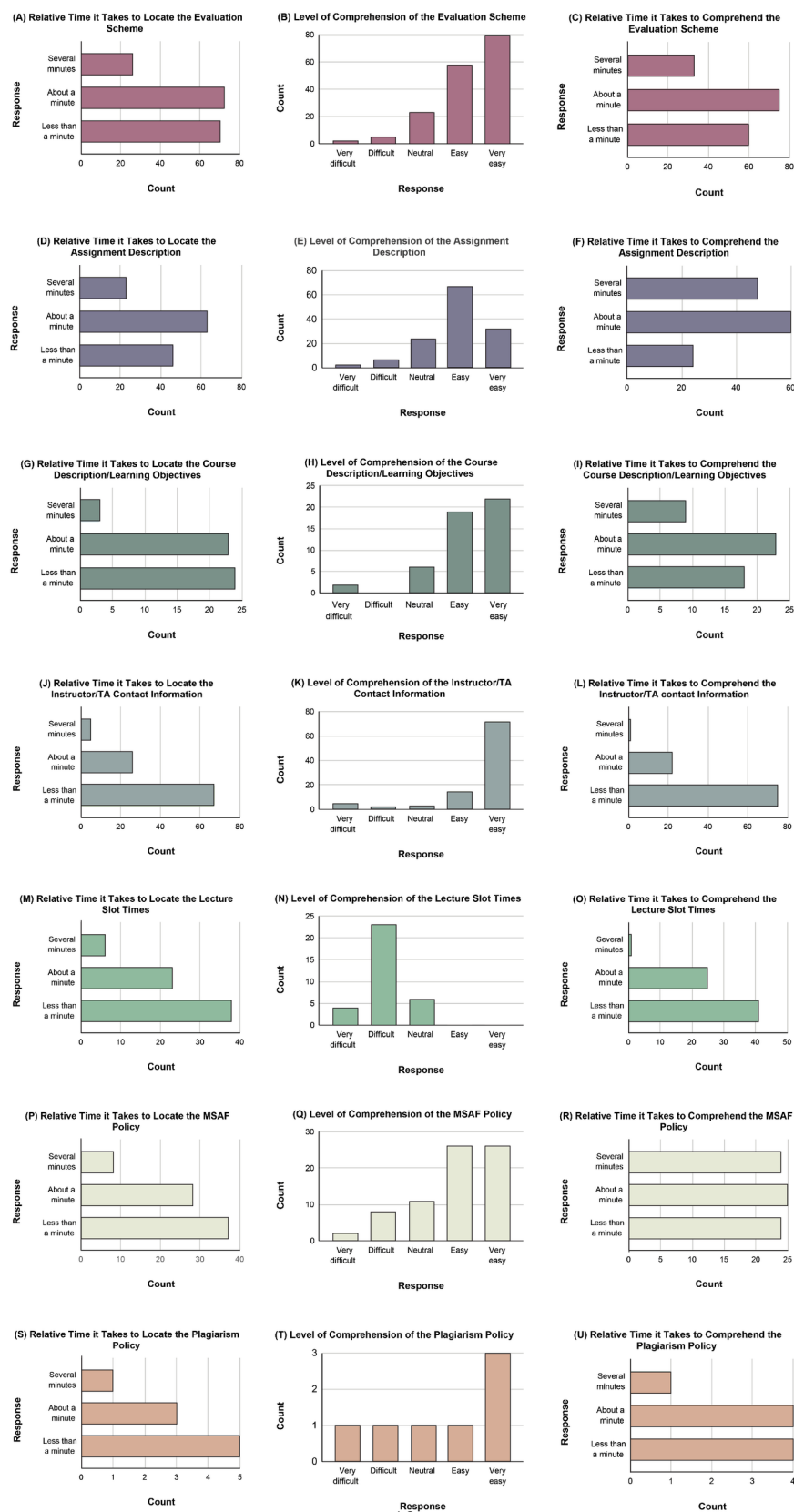


Figure 4: Relative time to locate each component, level of comprehension of each component, and time to comprehend each component from left to right. N = 175. Graphs A-C represent the measurements for ‘Evaluation scheme’, D-F represent ‘Assignment description’, G-I represent the ‘Course description/Learning objectives’, J-L represent the ‘Instructor/TA contact information’, and M-O represent

104 students ($n = 104$, 59.77%) stated that they found the standard course outline visually appealing while 70 students stated that they did not find the standard course outline visually appealing ($n = 70$, 40.23%). Results are illustrated in **Figure 5**.

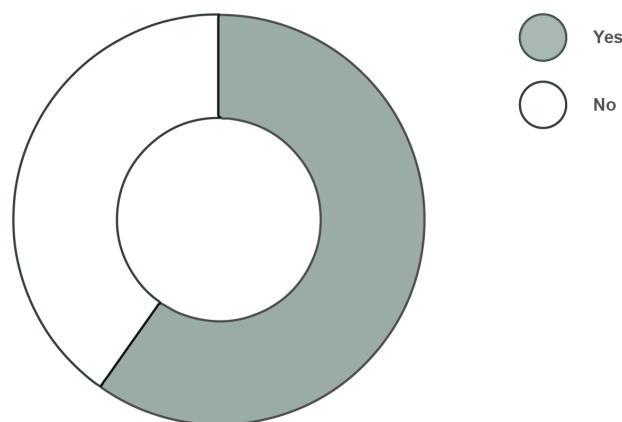


Figure 5: **Participants were asked to rate whether they found the course visually appealing or not.** $N = 174$). 104 participants responded “Yes” ($n = 104$, 59.77%) and 70 participants responded “No” ($n = 70$, 40.23%).

Students were given an open comment box to justify whether they thought the course outline was visually appealing or not. After reading, reviewing, and analysing the comments section, we found six key themes that captured its essence: (1) Visual Appeal, (2) Conciseness, (3) Organisation/Format, (4) Usability/Approachability, (5) Navigation, and (6) Cohesion between Documents. We highlighted singular codes based on singular clauses (i.e., if a string of text had one singular idea). We coded ‘Visual Appeal’ as a theme if the participants mentioned anything about how the course outline ‘looked’, including references about its colour, graphics, typeface, and fonts. We coded ‘Conciseness’ as a theme if the participants mentioned anything about whether the document was able to portray a lot of information in a few words in a brief, yet comprehensive way, without redundancies. We coded ‘Organisation/Format’ as a theme if the participants mentioned anything about whether the document’s components were laid out in an intuitive and/or clean way. We coded ‘Usability/Approachability’ as a theme if the participants mentioned anything about how easy it was to use the document and whether it was inviting to the participants at first glance. We coded ‘Navigation’ as a theme if participants mentioned anything about how easy/efficient it was to find certain components in the document. We coded ‘Cohesion between Documents’ as a theme if participants mentioned anything about whether there was any similarity between course outlines in other courses at McMaster University.

After identifying and defining the themes, we created two sub-codes that allowed us to identify whether each theme was portrayed in either a negative or positive light. The quotes are located in **Table I**. There were 34 negative and 11 positive comments made about ‘Visual Appeal’, 30 negative and 13 positive comments made about ‘Conciseness’, 5 negative and 29 positive comments made about ‘Organisation/Format’, 16 negative and 15 positive comments made about ‘Usability/Approachability’, 6 negative and 20 positive comments made about ‘Navigation’, and 3 negative and 14 positive comments made about ‘Cohesion between documents’. The results are illustrated in **Figure 6**.

Code	Men-Neg-	tions a-	Example Quotes (Negative)	Pos-	Example Quotes (Positive)
		tive		i-	
Visual Appeal	45	34	"They are ugly..." "Pretty bland."	11	*No explicit justifications or mentions
Concise-ness	43	30	"Jumbled with a lot of information that is not concise and clear." "Too much text that could be summarised in [a] few bullet points"	13	"[The course outline] offer[s] clear/concise descriptions". "They keep it simple and concise."
Organization/Format	34	5	"Mostly, the course outlines are messy and disorganized." "[They are] not organized visually."	29	"They are very well organized!" "[They are] organized in a user-friendly way."
Usability/Approachability	31	16	"Hard to read." "[They] look daunting."	15	"Organized in a user-friendly way." "I find them to very useful."
Navigation	26	6	"I feel like the lack of headings and subheadings makes it hard to find information in the course outline." "Can be overwhelming to navigate."	20	"I find it very easy to navigate to find certain specific details relating to the course." "[They are] very easy to navigate."
Cohesion between Documents	17	3	"Sometimes, some profs have different course outlines. I believe that they should all follow the same format, and separate sections accordingly." "MSAF policies as they are very wordy [and] different for each class."	14	"I really like the way that they are organized and all follow the same [...] format." "They are all in the same logical order and contain relatively the same information making it easy to find."

Table 1: Thematic analysis of the comments section regarding the standard course outline.

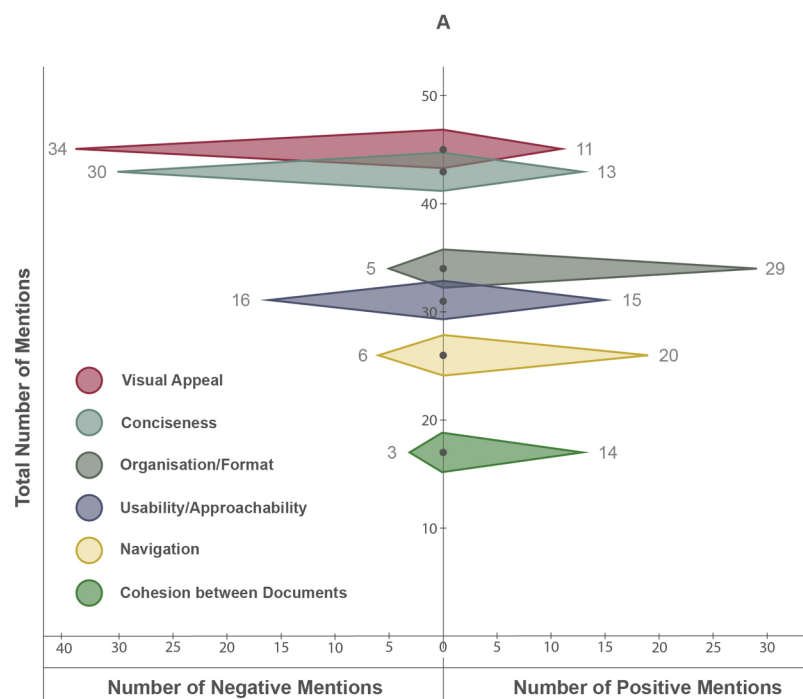


Figure 6: **Textual justifications as to whether participants thought the standard course outline was visually appealing or not.** Y-axis represents the number of mentions in comments section per theme and the X-axis represents and quantifies how many times each theme was expressed in a positive or negative light.

Results from Section 2 of Survey

There was a significant difference between the likeliness of referring back to the course outline between the groups ($p = 0.0167$). The intervention group who received the visual course outline were more likely to refer back to it compared to the control group. The results are illustrated in **Figure 7**.

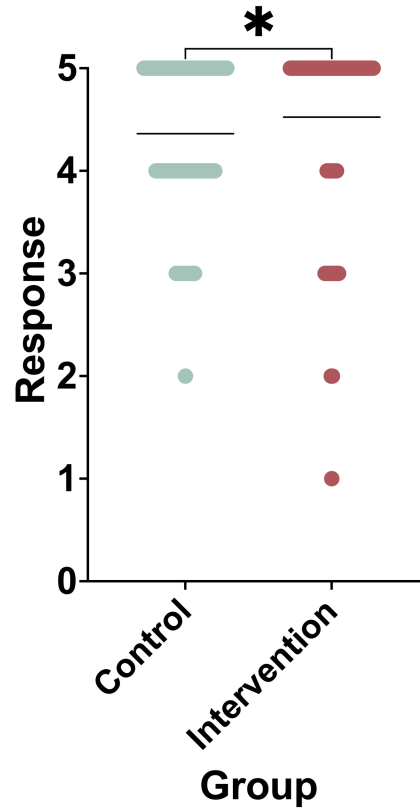


Figure 7: Participants were asked to express how likely they were to refer back to the course outline assigned using a 5-point Likert scale with 5 being 'Very likely' to 1 being 'Very unlikely'. $p =$

The components 'MSAF Policy' and 'Plagiarism Policy' were not included in the visual outline and were not included in the analysis. The majority of participants selected 'Evaluation scheme' ($n = 61$). 49 participants selected 'Assignment description' ($n = 49$), 26 participants selected 'Course description/Learning objectives' ($n = 26$), 32 students selected 'Instructor/TA contact information' ($n = 32$), and 19 participants selected 'Lecture time slots' ($n = 19$). The results are illustrated in **Figure 8**.

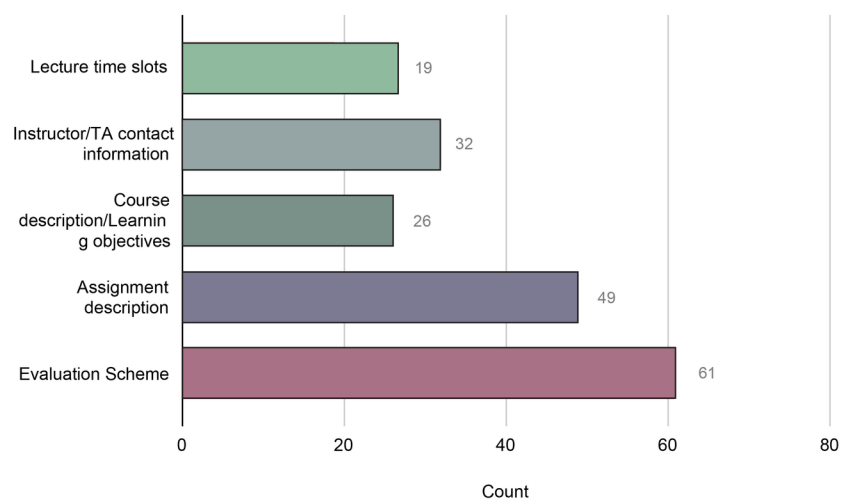


Figure 8: **Participants in the intervention group were asked to select which course outline component(s) they are usually checking for. (n = 84).**

Between the control and intervention groups, there was a significant improvement (all $p < 0.05$) in the time it took to locate a course outline component, to comprehend the component, and the time it took to comprehend the component. The results are summarised in **Figure 9**. The p-values for each graph (A-O) are summarised in **Table II**.

Left Column

When checking X how long, on average, do you spend time finding it?

- 3 Several minutes
- 2 About a minute
- 1 Less than a minute

Middle Column

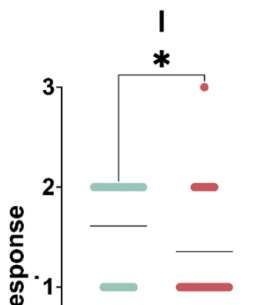
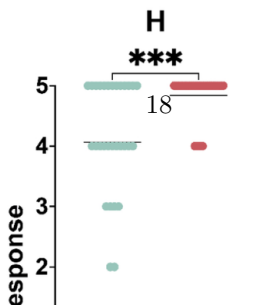
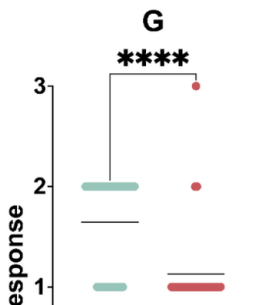
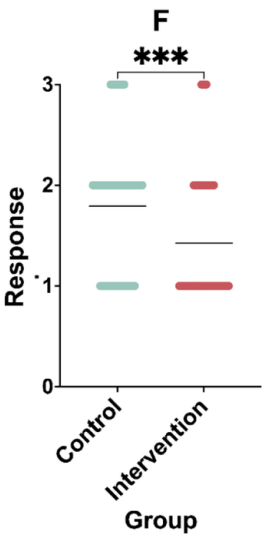
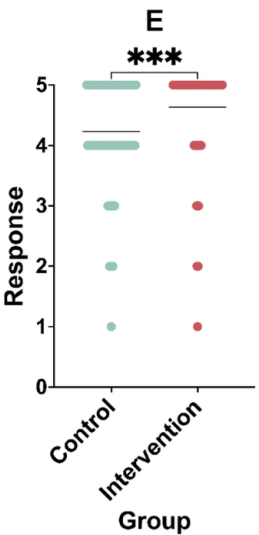
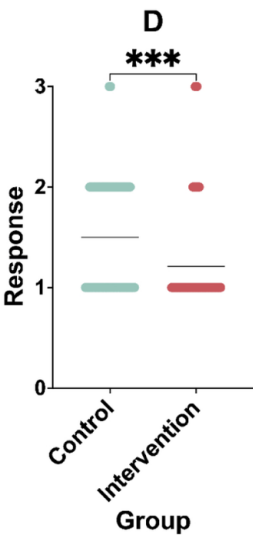
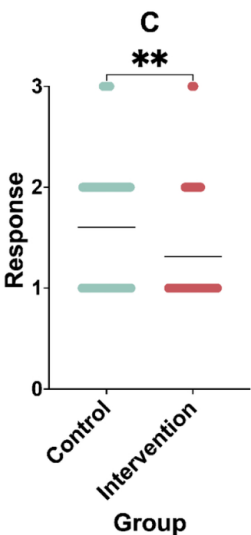
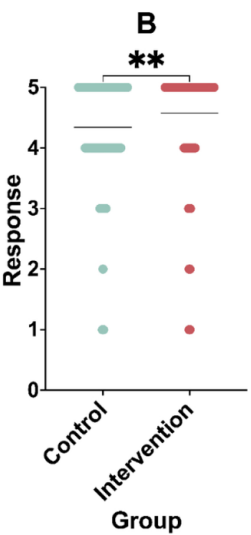
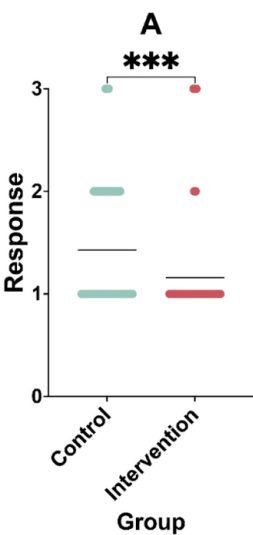
When you have found X how easy is it to understand?

- 5 Very easy
- 4 Easy
- 3 Neutral
- 2 Difficult
- 1 Very difficult

Right Column

How long, approx., did you take to understand X?

- 3 Several minutes
- 2 About a minute
- 1 Less than a minute



Component	Relative Time to Locate	Comprehension Level	Relative Comprehension Time
Evaluation Scheme	$p = 0.0$	$p = 0.01$	$p = 0.0$
Assignment description	$p = 0.0$	$p = 0.0$	$p = 0.0$
Course description/Learning objectives	$p = 0.0$	$p = 0.0$	$p = 0.04$
Instructor/TA contact information	$p = 0.0$	$p = 0.04$	$p = 0.01$
Lecture time slots	$p = 0.02$	$p = 0.03$	$p = 0.02$

Table 2: **Summary of p-values in Figure 9.**

There was a significant difference between the control and intervention groups in reporting whether they thought the new course outline was visually appealing ($p < 0.0001$). The participants in the intervention group, on average, expressed that the new course outline was more visually appealing than the participants in the control group. The results are illustrated in **Figure 10**.

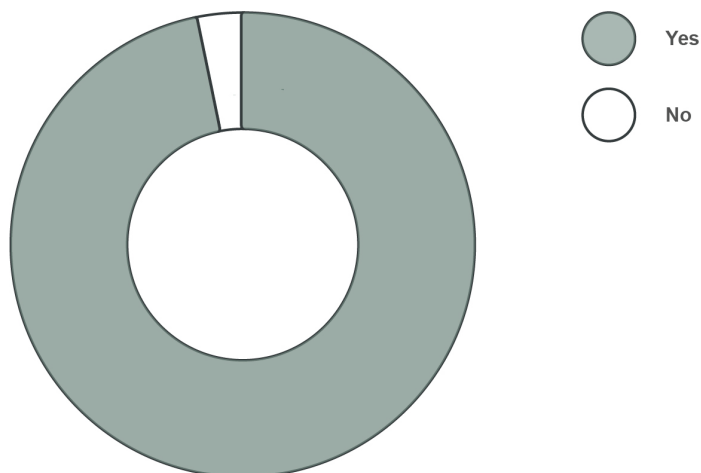


Figure 10: **Participants were asked to rate whether they found the visual course outline visually appealing or not.** $N = 62$. 60 participants responded “Yes” ($n = 60$; 96.77%) and 2 participants responded “No” ($n = 2$; 3.23%).

When the interventional group justified their selection, there were 2 negative and 37 positive comments about ‘Visual Appeal’, 0 negative and 22 positive comments about ‘Conciseness’, 2 negative and 22 positive comments about ‘Organisation/Format’, 1 negative and 13 positive comments about ‘Usability/Approachability’, and 0 negative and 13 positive comments about ‘Navigation’. The results are illustrated in **Figure 11**. Quotes about each theme are found in **Table III**.

Code	Men-	Neg-	Example	Pos-	Example Quotes (Positive)
tions a-	tive	Quotes	i-		
		(Negative)	tive		
Visual	39	2	"Dull	37	"It just seems aesthetically pleasing."
Appeal			colours		"I find this course outline extremely visually appealing."
			make it kind		
			of hard to		
			see."		
Con-	22	0	N/A	22	"It is short and easy to understand with small amounts of text
ciseness					and more visuals then the standard course outline."
					"Graphs make things easier to understand."
Usabil-	15	3	"I found the	12	"Very easy to skim."
ity/Approachability			style to be		"Information is easily accessible."
			harder to		
			follow."		
Organi-	14	1	*No explicit	13	"The information is organized easily."
sa-			justifications		"As someone who is a visual learner, I find the layout perfect!"
tion/Format			or mentions		
Naviga-	13	0	N/A	13	"The idea of setting a course outline as an infographic is
tion					amazing as it ensures that students don't miss important
					information and know exactly where to find what they're
					looking for."
					"It condensed all the information onto one page which I found
					very convenient because course outlines require one to scroll
					alot to find what they're looking for."

Table 3: Thematic analysis of the comments section regarding the visual course outline.

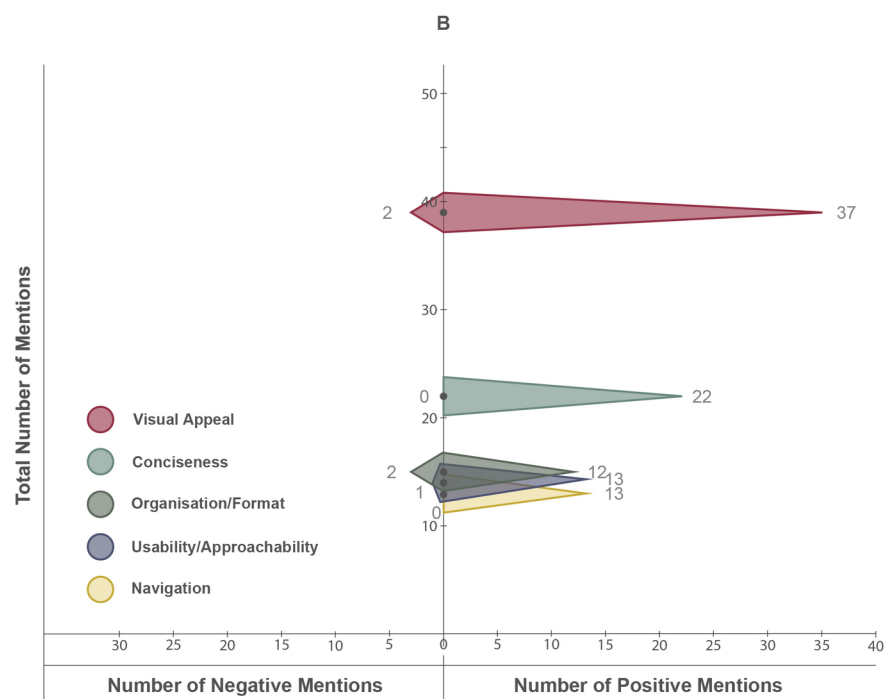


Figure 11: **Textual justifications as to whether participants thought the visual course outline was visually appealing or not.** Y-axis represents the number of mentions in comments section per theme and the X-axis represents and quantifies how many times each theme was expressed in a positive or negative light.

Results from Section 3 of Survey

Most participants reported that the ‘Spatial Layout’ and the ‘Illustrations’ enhanced their ability to access the information . The specific results are summarised in **Figure 12**.

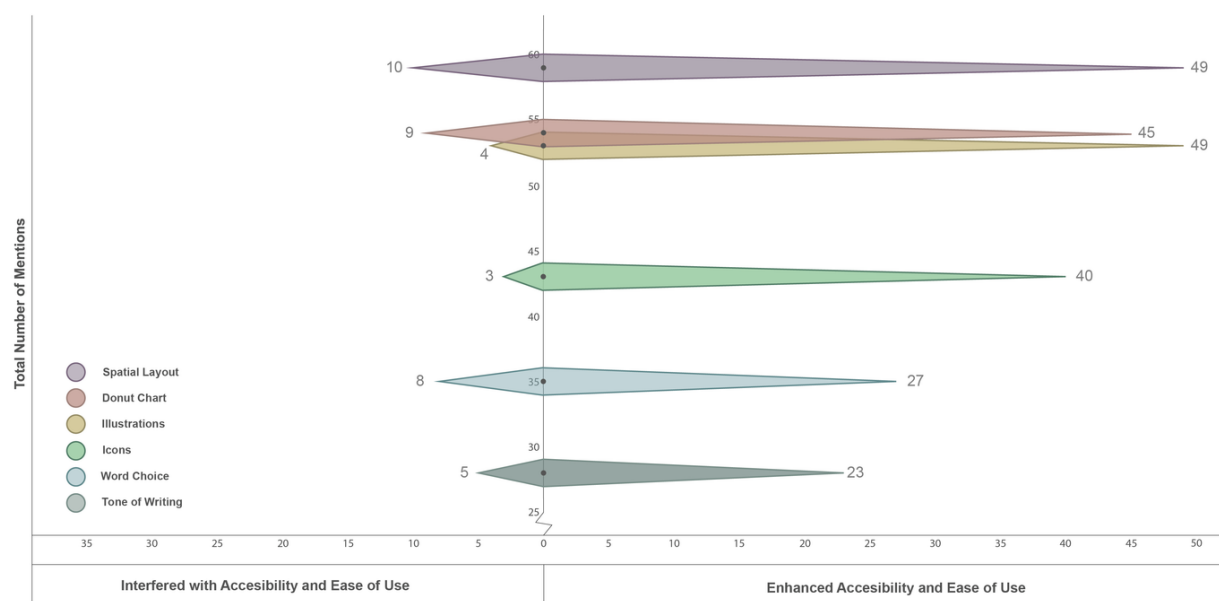


Figure 12: Students were asked to identify which features either interfered with (left) or enhanced (right) usability and accessibility.

38 participants who received the visual outline indicated some areas where the it could be improved. 5 participants said that the outline should have brighter colours, 4 participants asked for a bigger font size, 5 participants said the flow from one heading to the next could have been improved. A few other notable suggestions include making the lecture times more visual, and to include assignment due dates and information about the MSAF policy.

Discussion

Key findings

Students often refer back to course outlines during any given time of the semester but some found the standard outlines long, confusing, and/or hard to navigate. We found that the visual course outlines had a relatively positive effect on how participants interacted with them. We found significant differences between the control and intervention groups across all metrics we tested for. Participants that received the visual course outlines expressed that they were more likely to refer back to it. They found the visual course outline quicker to locate all components, easier to understand, and quicker to understand. They also rated the visual outlines more visually appealing than the standard and indicated that they were likelier to refer back to them during the semester.

Interpretations

Participants in the intervention group, receiving the visual course outline, found that all components were quicker to locate than in the control group. This indicates that the visual course outline was correlated with

faster location times. The theme of ‘Navigation’ in our thematic analysis could be related to this metric (we did not test for its correlation). Participants in the control group that received the standard course outline made 6 negative comments about the ease of navigation whereas students in the intervention group that received the visual course outline made 0. This, in part, suggests that the visual course outline had a positive effect on location time. There are a few reasons why the time to locate was faster for those using the visual course outline. One possible reason is that the visual course outline was physically shorter than the standard course outline. The visual course outline was only one page whereas the standard course outline was 10 pages. Participants in the intervention group only needed to look at one page to find things while those in the control group had to scroll through 10 pages to find certain components like the evaluation scheme or the assignment descriptions. Another possible reason is the overall design of the visual course outline where headings and subheadings were easier to isolate through bold typefaces, font size, colours, and graphics.

We found that the experimental group had a deeper understanding of the visual course outline for all components compared to the control group. This indicates that the way the visual course outline was written is correlated with better comprehension. Conciseness, another core theme of our thematic analysis, could be related to this metric. Participants in the control group that received the standard course outline made 5 negative comments about conciseness whereas students in the intervention group that received the visual course outline made 0. Perhaps the concision writing in the visual course outline allowed for a clearer and quicker understanding of the material. For example, for the Commentary/Op-Ed assignment description, the standard course outline describes it in 84 words whereas the visual course outline describes it in 27 words, while still maintaining the necessary information. Another possible reason for the higher comprehension levels is the simple but effective language used in the visual course outline. Some participants in the control group noted that the standard course outline has “jargon” in it, interfering with their ability to understand the information. One noted that they “are filled with unnecessary jargon.”

The experimental group expressed that they were more likely to refer back to the visual course outline and that it was more visually appealing compared to the control group receiving the standard outline. This indicates that the visual course outline was more visually appealing than the standard and that it was more approachable than the standard course outline respectively. With the change of course outline from standard to visual, there is also a shift in the positivity in feedback. From **Figure 6** to **Figure 11**, we see a shift in positivity of each theme coded. We

Implications

Students have more positive interactions with course outlines when they are concise, visually engaging, and written in a friendly and inclusive tone. This helps them gain a better understanding of course content, better supports learning in the classroom and allows them to feel more empowered in a course.

Limitations

There are a few notable limitations to this study. One of which is that we pooled participants from LIFESCI 2AA3 and LIFESCI 3P03 together in our data analysis. If we separated the groups, the sample sizes for each would have been too small to make any important inferences about our data. Pooling these participant groups together may have affected the data because students in LIFESCI 3P03 have the advantage of one extra academic year on the LIFESCI 2AA3 group. The course content was also different between the two outlines and so the results cannot be directly translational between courses. Another limitation is that, while LimeSurvey filtered out all incomplete survey responses, there was one response missing to the question “Do you find that the standard course outlines at McMaster are visually appealing?” While one missing response is relatively insignificant, it is still important to note. Not every participant justified why they thought the

course outlines were visually appealing or not. This resulted in fewer comments for our thematic analysis and could have skewed our results for the section. Another potential limitation is the inclination to feel pressured into rating the ‘visual course outline’ (as it was named) as visually appealing. We named it visually appealing to keep track of our survey questions but could have led to a bias.

Recommendations and Future Scope

Course outlines are an important tool for students. They should be quick and helpful resources for students to find important and relevant information about a course. They should also be designed to empower students with the confidence to succeed in a course and set the tone for a positive learning environment. We urge universities to adapt to students’ needs by focusing on creating supplementary (i.e., in addition to the original course outline that the school issues that includes all contractual information) learning-focused course outlines that are visually engaging, concise, and written in an inclusive and friendly tone. In the future, researchers who continue the scope of this project should use eye-tracking experiments to gauge how long students are looking at a course outline component and questionnaires to more rigorously measure comprehension.

Acknowledgements

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