A SCOPING REVIEW: WHAT IS KNOWN ABOUT THE REASONING BEHIND USING PAPER VERSUS SCREEN RESOURCES AND ITS IMPACT ON ENGAGEMENT AND COMPREHENSION?

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Abstract

This project identifies factors and examines the use of screens or paper to assist health professionals’ reasoning when developing and providing educational resources for clients who have had a concussion. Many educational resources are now provided in traditional formats as well as more contemporary formats such as webpages and apps. The development of contextually relevant evidence-based multimedia client resources is inherently challenging, due to the fast-paced changes in technology that are now an integral part of how we live and learn.

This study employed a scoping review methodology and reviewed the current research and knowledge on the use of screen versus paper to inform occupational therapy practice. The search strategy of two research databases narrowed the analysed research down to 13 articles published within the last five years. The key themes were extracted from the articles and displayed in mind map format, with the results presented as a visual map.

The three key areas which emerged from this research were cognitive maps, comprehension, and preferences. Although there needs to be an awareness of cognitive maps and comprehension, the findings show no significant difference between reading from screen or paper resources. Therefore, consideration of an individual’s preferences is relevant and prioritised. A visual map was used to summarise the ideas from the findings and could potentially guide a therapist’s client-centred practice by demonstrating the complex factors which impact the client’s preference for screen or paper resources. Health professionals can utilise both screen and paper resources for clients’ education; however, clients’ concussion symptoms and preferences need consideration.

Keywords: Concussion, Occupational therapy, Cognitive maps, Comprehension, Preferences.
Acknowledgements

I want to thank my supervisors, Rita Robinson and Alexa Andrew, for their invaluable support and understanding during my master's project.

Additionally, I want to thank my sister Chelsea Sellars for her unwavering support through the ups and downs of my postgraduate study; without her, this thesis would not have been possible.
Declaration of authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.
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In this fast-paced modern world, technology quickly changes how people live their lives (Gilbert, 2019). It was no so long ago that access to information was limited to those of upper-class education status and was stored away in large libraries. This has meant that access to health information has been limited to health professionals and clients relied on those professional to share the information verbally. Today, there is an abundance of information available in most places in the world, including in Aotearoa/ New Zealand. At the same time, there is still a level of health literacy needed by the individual in order to access and interpret that information (Adams, 2019); however, there are no longer the same widespread knowledge inequalities. New Zealanders have access to free education through Aotearoa/ New Zealand schools and an education system that focuses on reading and writing skills (Ministry of Education, 2020). This increased access to early learning means the Aotearoa/ New Zealand population is now growing up with the ability to read and write and improved health literacy skills (Ministry of Education, 2020).

Over the past three decades, accelerating advancements in technology have permitted access to and use of devices such as computers, tablets, e-books and mobile phones (Foroughi, 2015; Gilbert, 2019). In this thesis the term computer includes both laptops and desktops. The term tablet includes the brands Apple iPads and Microsoft surface pros. An e-book is a small form of a tablet with no backlighting and is used to read eBooks from Amazon. Lastly, mobile phones include all the brands including the most well-known Apple and Samsung. With these technologies, information is no longer restricted to the printed page in handheld books. It is now accessible through the technologies mentioned above (Muttappallymyalil et al., 2016). These changes highlight the importance of understanding the impact of these various forms of technology on individuals and, particularly, when health professionals are looking to provide information to clients to assist with their health education needs.

**OCCUPATIONAL THERAPIST CONNECTION**

A concussion is an injury to an individual’s head due to an accident. It is understood that concussion results in several symptoms that can vary significantly between individuals; however, one symptom frequently reported as the most severe is fatigue (Mollayeva et al., 2013; Wylie & Flashman, 2017). While I was working alongside clients on the ACC program, I noticed that fatigue was often a considerable concern for individuals. Fatigue impacted on their
activities of daily living, which in turn affects how they engage in and benefit from the education and guidance given by a health professional.

As an Occupational Therapist working in the concussion services contracted by Accident Compensation Corporation (ACC, 2018), I provide education and guidance for ACC clients who need additional support following their injury. ACC program’s purpose is to support the individual’s recovery from concussion and help them return to their activities of daily living. An ACC program provides approximately 11 hours of face-to-face support with an occupational therapist and a physiotherapist (ACC, 2018). The ACC program and its support is essential to individuals' recovery.

In New Zealand, there are around 14,000 reported concussions every year and data shows Māori are at greater risk of a concussion by 23% compared to other New Zealanders (ACC, 2017). Most individuals find their concussions symptoms relatively mild, and thus have a high recovery rate. Consequently, ACC data shows that only 10-12% of individuals with concussion require additional support from health professionals (ACC, 2017). However, the resulting cost to ACC is over $80 million a year (ACC, 2017).

Recently concussions and traumatic brain injuries have been thoroughly investigated in New Zealand due to their prevalence and impact on society ("Our research - TBI Network - AUT", 2022). This topic spotlight has led to a significant increase in knowledge of concussion symptoms and the appropriate treatment of these symptoms ("Our research - TBI Network - AUT", 2022).

THE PRACTICE PROBLEM

While working as an Occupational Therapist with clients on the ACC’s concussion program, I concluded that the ACC-suggested one hour session intended for providing information and education to the client verbally is not long enough. Information relayed to clients can often be rushed by the Occupational Therapist. In the case of a head injury, such as concussion, the information presented to clients might not be retained or understood.

I initially used multiple written resources printed on A4 paper in my practice. Resources printed in black and white were provided to the client in a plastic sleeve at the end of the initial assessment. I advised the client to read through all the information provided. I often found that on my return to see the client a week later, not only had the client not read the resource provided, but they had lost the papers. The initial conclusion I drew from experiences with various clients was that they did not prioritise the value of the resources given and did not engage with them. As a result, clients were not benefiting from the information provided, particularly when the
Occupational Therapist was not present. A lack of engagement with the written information meant I had to repeat the same information over multiple in-person sessions. I wondered if this lack of engagement was due to the clients not retaining or referring to the information and, consequently, not being able to apply the knowledge in their day-to-day lives. Providing education is a vital aspect of occupational therapy practice, as is understanding the contractual guidelines for ACC’s concussion service (ACC, 2018). I contemplated the need for a better way of providing for and supporting individuals’ education and recovery following a concussion.

These contemplations encouraged me to develop a written resource that clients would value and, thus, increase their engagement. Clients would more likely value a well-formatted paper-based book they could engage with, read, and return to multiple times between sessions. The book would allow the client to reflect on the written material and verbal information provided during face-to-face contacts. This reflection would enable clients to implement appropriate daily actions towards recovery. By providing agency of information, I intended to empower a sense of self in the recovery process.

CONCUSSION WORKBOOK

The developed concussion workbook is intended to provide clients with an in-depth resource with helpful, easy-to-read information that would support their recovery. As well as containing the necessary educational information, the workbook provides a place for clients to write notes and work through their personal recovery experiences.

The first stage in developing the workbook was to take the information I was using on the A4 pages and transform it into easy-to-understand sections. I designed the book around the key topics that would benefit a client in their recovery. As shown in figure 1, these are concussion, fatigue, sleep, movement, memory, attention, mood, and emotions.
The workbook is divided into the key topics listed above, and each of the topics was assigned a colour. Based on my knowledge, understanding and experience, I concluded this would help the visual part of the brain make connections and memories. These colours are used to highlight each area on the contents page and are present on the side of the corresponding information page. Each section has a clear title at the top of the page related to the information in that area. Figure 2 shows the layout of each topic.
Firstly, a general overview of the subject is presented. This is followed by what symptoms to expect, what the information means (for example, what is sleep, ways of improving the symptoms associated with sleep) and different ideas that clients can immediately apply. Each section includes a space to make notes. It is important to note that all the key points are written as bullet points. Each topic has app suggestions and a page in a mind map format consisting of ideas that clients can try. A space was included for client to record their experiences as shown in Figure 3. Additionally, there is a page where they can write notes about that section.
After reflecting on my professional understanding of presenting information to support a client's education, I made deliberate formatting choices. The font type, size and colours remain consistent throughout all the sections. The book breaks down the information into short sentences with clear titles. In addition, it includes appropriate lists with bullet points to divide the information into smaller more understandable parts and diagrams to support comprehension of the information.

The information sections contain only the most relevant information and are designed to use alongside the one-on-one sessions. The purpose is to enhance my practice (and other occupational therapists' if this book is published) by using the workbook to support the face-to-face sessions with a client, and to make these sessions more meaningful and productive for the individual.

A section on health professionals is at the end of the information on the topics, this provides clients information on the different roles of the health professionals in their team.

The second section of the workbook contains an activity tracker, as shown in figure 4; this section allows the client to note down information about their day, symptoms and how they felt. It is designed to provide short, easy-to-answer questions and emojis to show how the client is feeling. Emojis were chosen alongside numbers in order to appeal to a wide range of individuals and to provide clear visual signals for what answers could be selected. This section allows the client to plan their day and later reflect on what happened and how it affected them. There is a deliberate use of positive language to ensure the focus is not on what the individual cannot do.
The third section is a sleep tracker tablet; this is optional, but the Occupational Therapist could suggest it for clients with concerns about their sleep.

Lastly, there is a section on additional resources, exercises, activities, and trackers. In my practice as an occupational therapist working with clients with a concussion, these resources have been beneficial. This section was placed last to ensure it did not bombard the clients with too much information. The intention is to allow those who wish to try additional techniques or to gain further knowledge about their condition and to be proactive in their recovery without having to do additional research themselves. The Occupational Therapist could suggest the use of various activities in this section depending on the clients’ individual needs.

The last few pages in the workbook are where the client can take notes during their appointments with all the health professionals involved in their care. These notes allow all information to be kept together, and referred to, reflected on, and shared with others.

Furthermore, all the information in the workbook is linked to current concussion research written up to and including 2021. These references to the literature have been included
in the back of the workbook for individuals who wish to look further into the research or those who want reassurance that the information provided is coming from relevant, trustworthy sources. The number referencing system is used in this workbook as there is limited space available on the education pages, and to ensure that the client is not overwhelmed by the inclusion of additional names and dates.

After considering the impact of a concussion on a client, and through my prior occupational therapy knowledge and experience, I decided to create a paper-based workbook rather than a website or app. When considering a topic to further my education via a scoping review, I became intrigued to understand why these were my initial thoughts and actions. Before I move forward with publishing this Concussion Workbook, further research into how it works and benefits the intended population is essential. In addition, I want to better understand my perception that a workbook in paper format is the most appropriate resource for clients with concussion, particularly those experiencing fatigue, compared to the alternative, which would be a digital version. This led to the development of the following research questions.

What factors can be identified within paper verse screen research that may support occupational therapists and health professionals’ reasoning when they develop and provide educational resources for clients who have experienced concussions?

- What is known about the reasoning behind using paper versus screen resources and its impact on engagement and comprehension?

PROJECT OUTLINE

The following research project is structured into six chapters. Following the introduction, the second chapter discusses a brief background of the topic stemming from the initial literature review. The third chapter describes the methodology and the process followed by this project. The fourth chapter showcases the findings from the research. The fifth chapter is the discussion, which explores practice implications, limitations, and future research directions. Lastly, the conclusion summarises the key learnings from engaging in this research project.
Chapter 2: Background

OCCUPATIONAL THERAPY AND CLIENT EDUCATION.

The central underlying theory of occupational therapy is to provide client-centred support and education that allows the client to engage in activities following illness, disability, or an accident. Client-centred practice is where an occupational therapist’s practice is informed by the client’s life, values, and priorities, and it aims to minimise the power inequalities between the client and professional (Hammell, 2012).

A core aspect of the practice of occupational therapists working with clients following a concussion is to provide clients with accessible education and information. This education and information provision is recommended as part of best practice for the ACC concussion service (ACC, 2018).

Furthermore, beyond the education and information being provided, personal reflection by a client and homework tasks can support their recovery following a concussion. Spending time engaging in reading and reflection outside of the time spent with the occupational therapist is thought to promote an individual’s occupational engagement, which in turn increases meaning, choice, control, and self-worth. These all assist in developing the client’s insight and progression towards recovery (Hammell, 2004).

Therefore, when developing and providing client education as an intervention tool, occupational therapists need to consider and incorporate the client’s perspectives, interests and goals, past experiences, and knowledge of concussion symptoms. This is a core aspect of occupational therapy practice. Additionally, there needs to be an examination of how occupational therapists provide these educational tools and resources, particularly an exploration of the advantage and disadvantages of using paper or screen resources for clients.

SCREEN VERSUS PAPER

Research considering the effectiveness of screens versus paper for reading and education dates to the initial invention of computers, with the earliest studies comparing the two mediums being published in the 1980s (Hou et al., 2017a). Since the creation of the computer, an ongoing debate has been around which medium is more effective for reading and learning. This debate has become even more critical as the years have passed, as the ever-expanding world of technology has become an integral part of everyday life (Nichols, 2016).
Computers were once seen as only applicable in larger organisations as part of one's job, whereas now individuals may own numerous computing devices used for a variety of purposes. These computers no longer resemble their ancestors; rather than one computer taking up a large room, they have evolved into devices such as desktop computer, laptops, tablets, e-books, cell phones and watches. This means that these devices are more readily accessible to a broader range of individuals, and several community programs have been set up to assist with getting computers into schools and homes around New Zealand (Computers in Homes, 2022). However, opinions regarding computers and devices for reading and learning are both positive and negative. While devices increase access to information, there is a general consensus that individuals should decrease their exposure to screens in order to lower the potential of visual information overload. Research shows that excessive screen use increases fatigue and interferes with sleep (Myrberg & Wiberg, 2015). These conflicts need to be taken into consideration when developing occupational therapy interventions.

AGE

Children use computers and devices as part of their everyday lives in the digital age, making them digital natives (Myrberg & Wiberg, 2015). A digital native is an individual who was born into and grew up with technology; in contrast, a digital immigrant is someone who grew up before significant technology advancements (Wang et al., 2013). Children now routinely interact with devices as part of how they learn and interact with the world. As a result, their experiences and knowledge will significantly differ from the older generations who started to use technology at an older age. Although many of today's adults have not grown up with technology, they are often introduced to technology through their work and their families. However, there is still inequality in digital fluency between age groups (Ryd et al., 2018; Wang et al., 2013). Although digital fluency is a term used to describe an individual's ability, competence, and skill in using technology, it suggests that those with digital fluency can better engage with technology and are more likely to be more productive using technology (Wang et al., 2013).

Compared to those with high levels of comfort with technology use, Hou et al. (2017b) found that adults with high levels of technophobia require more time reading text on a device; however, their comprehension from reading on the screen is as effective as those with no or lower levels of technophobia. Hou et al. (2017b) describe technophobia as a psychological condition where individuals experience anxiety around using technology. These individuals with high levels of technophobia did report more feelings of discomfort and fatigue following
technology use. This idea of technophobia and its consequences is a crucial aspect to consider when occupational therapists provide resources for their clients. Occupational therapists must ensure that the use of technology with clients is conducive to their values, experiences and needs. (Hou et al., 2017b, p. 7).

**CONCUSSION**

A concussion refers to the symptoms that an individual experiences after receiving a knock to the head or experiences a sudden stopping of the body. Concussion results from the acceleration or deceleration of the head or body, which can cause the brain to move inside the skull, which then results in the stretching of neurons in the brain (Saigal & Berger, 2014).

The concussion may temporarily disrupt the way the neurons in the brain function, which results in short-term and long-term symptoms. Short-term symptoms last for a few minutes to a few hours and include loss of consciousness, confusion, and short-term memory alterations. Long-term symptoms include changes in energy levels, disrupted sleep, changes in coordination, alterations in mood and changes in memory and attention (Leddy et al., 2016; Makdissi et al., 2013; McCrory et al., 2013). Many individuals find that concussion symptoms are temporary and last from a few minutes to a few days or weeks before resolving themselves completely (Leddy et al., 2016). However, some individuals may have ongoing symptoms that affect how they function in their activities (Craton et al., 2017; Kontos et al., 2019). One of the most significant ongoing symptoms following a concussion is fatigue, and a review by Mollayeva et al. (2013) showed it affects between 21% and 73% of individuals.

The last publicly available statistics from ACC were produced in 2017 these show that around 14,000 people are treated for a traumatic brain injury each year in New Zealand (ACC, 2017). Moreover, according to ACC (2017), approximately 10 to 12% of individuals who experience a mild traumatic brain injury require extra support beyond what they receive from their general practitioner. In 2015 these services came at a cost to society of 83.5 million dollars (ACC, 2017).

**WELL-BEING AND SLEEP**

The well-being of individuals needs to be considered when looking at screen versus paper resources. Myrberg and Wiberg (2015) and Hue et al. (2012) discussed ‘computer vision syndrome’, which they described as a temporary condition where individuals may experience headaches, fatigue, and dry eyes during and after screen use. Furthermore, they discussed how screen use might affect the body's melatonin production and negatively affect users’ sleep. In
addition to this, Brayton-Chung et al. (2016) found that screen use is especially relevant for clients with a concussion, as sleep disturbances are a common symptom following this type of injury. Grima et al. (2018) discussed that sleep disturbances might negatively affect recovery from a concussion as decreased sleep is associated with decreased cognitive ability, reduced productivity, and worse rehabilitation outcomes. Grima et al. (2018) observed that individuals may have reduced evening and overnight melatonin production following a concussion, which in combination with the effects of screen use decreasing melatonin production, individuals may see slower recovery from concussion due to reduced or poor-quality sleep. Wylie and Flashman (2017) additionally discussed the implications of sleep disturbances in concussions, with these symptoms affecting 30 to 70% of individuals. Therefore, consideration needs to be given to whether the use of screens during the day or night will further exacerbate the sleep disturbances, which are known to increase fatigue. Furthermore, the general advice from health professionals working with clients with a concussion is for these clients to decrease their exposure to screens because of the potential of over stimulus of visual information (“Just a Thought”, 2022), which may create a greater risk of fatigue which in turn could affect comprehension, motivation, and engagement (He et al., 2020).

NEW ZEALAND HEALTH LITERACY

New Zealand is a country in the southwest Pacific Ocean. StatsNZ (2022) estimates there are 5,127200 residents living in New Zealand, most of whom come from six major heritage groups: European, Māori, Pacific peoples, Asian, Middle Eastern/Latin American / African and other ethnicities. This combination results in a unique Aotearoa/ New Zealand culture. Aotearoa/New Zealand has specific guidelines developed through collaboration between Māori and New Zealand government to have a health and disability system that meets the needs of all New Zealanders. This is known as the Ministry of Health’s Te Tiriti o Waitangi framework. It guides health professionals in working with all New Zealanders especially Māori in a culturally sensitively manner ("Te Tiriti o Waitangi", 2022).

Clients’ health literacy needs to be considered to ensure occupational therapy practice meets the guidelines of Te Tiriti o Waitangi. Health literacy is the skill and knowledge individuals must have to ensure they are able to assess their health, their family’s health, and the community’s health, as well as to be able to understand what affects their health, how to take responsibility for health and what steps are needed to address health issues (Adams, 2019; Ministry of Health, 2015). Individuals who have low levels of health literacy are more likely to have worse health outcomes. (Adams, 2019; Ministry of Health, 2015)
The last recorded data on health literacy in New Zealand is from the 2006 Adult Literacy and Life Skills Survey. From the survey data, the “The Korero Marama Health literacy and Māori report” found that, in general, New Zealanders have lower than average health literacy skills. Across all cultures the score was less than 275, which is described as the minimum score that individuals need to be able to understand the complex demands of everyday life (including health) and work (Māori Health Research Team, 2010).

The repercussions for individuals with low health literacy are experiences of shame and embarrassment when interacting with the medical system. These individuals may use well practiced strategies to hide that they cannot read or understand the information provided. (Adams, 2019). These difficulties experienced by individuals lead to worse health outcomes. Adams (2019) discussed the mismatch between individuals and the health system, that the health system has the responsibility to meet the needs of all individuals. This means reducing medical jargon, avoiding assumptions, and making sure written material can be easily read and understood. Health professionals should take a universal precautions approach and provide support for individuals without requiring self-disclose to health professionals or high health literacy skills. (Adams, 2019) This is means health professionals should offer the same level of support to all individuals, and this includes simplifying information, confirming the information has been understood and making systems easy to use and understand (Adams, 2019).

SUMMARY

The research question asks what is known about the reasoning behind using paper vs screen resources and its impact on engagement and comprehension there are several factors to consider when reviewing the literature on this topic. Technology has evolved significantly over the past 40 years, with more mediums and greater access than has ever been seen (Muttappallymyalil et al., 2016). The youngest generation is now being exposed to technology early, so this generation of digital natives will have different knowledge and experience with technology not currently seen in the adult population (Myrberg & Wiberg, 2015). This scoping review will consider the question proposed against the unique population of Aotearoa/New Zealand and how these fits into the Te Tiriti o Waitangi framework and clients' health literacy. Furthermore, there needs to be a consideration for concussion; this can be a significant injury that has widespread effects on the individual, their family, and the wider community. These changes in technology and New Zealand unique demographics and culture, need to be taken into account when considering occupational therapy resources for clients with concussion.
Chapter 3: Methodology

RESEARCH QUESTIONS
What is known about the reasoning behind using paper versus screen resources and its impact on engagement and comprehension? The aim is to identify what factors within paper versus screen research that may support occupational therapists and health professionals' reasoning when they develop and provide educational resources for clients who have experienced concussions?

DESCRIPTION OF RESEARCH METHODOLOGY AND RESEARCH DESIGN
This section covers the definition of a scoping review, why it was chosen, and explains the scoping review process and how it was applied to these research questions. Peters et al. (2015a) and Peters et al. (2015b) defines a scoping review as a process of mapping the critical areas derived from a research topic, filtering out definitions, and finding a topic's theoretical outlines.

This study utilised the scoping review methodology to examine the broad area of screen versus paper research in order to clarify key topics and report what evidence can be used to inform practice (Peters et al., 2015b). Within this research, a scoping review was used to look at the research in other industry sectors to provide an overview of the critical topics to consider.

This scoping review establishes a range of findings and discussions that has implications for occupational therapy practice. Furthermore, it reviews the recent research and provide practice recommendations, particularly where occupational therapists develop and offer resources to clients following a concussion.

RESEARCH DESIGN
The purpose of this scoping review methodology is to understand the current research and knowledge. The methodological framework used for this project is informed by Peters et al. (2015a) guidelines and Peters et al. (2015b). This framework involves five key steps in the review process:

1. Identifying the research question
2. Identifying relevant studies
3. Selecting studies
4. Charting the Data
5. Collating, summarising, and reporting the results

**Identifying the research question**

The overarching research question that has been identified is: ‘What factors are identified within paper versus screen research that may support occupational therapists and health professionals' reasoning when developing and providing educational resources for their clients who have experienced concussions?’ A sub research question is: ‘What is known about the reasoning behind using paper versus screen resources and it impact on engagement and comprehension?’

The development of research questions was guided by the Population, Concept, Context (PCC) framework, as recommended by The Joanna Briggs Institute (Peters et al., 2015a), to identify the main concepts within the primary review question. As part of this framework, the population refers to the qualifying criteria of the participants in the research. For this research, the initial background search ruled out focusing on the intended population group of people with concussions because there was a limited amount of research comparing screen versus paper. Therefore, this scoping review focuses on the population group of adults. As part of the framework, the concept refers to the overarching topic and understanding of inquiry. For this scoping review, the focus on paper versus screen resources was identified as the concept. For the final aspect of the framework, the context is the environmental, cultural, and situational setting that frames the research. The context depends on the objective of the research questions and the specific settings being researched. The context of this scoping review focuses on occupational therapist and health professionals. The context of the literature reviewed in this scoping review is from the education sectors. Initial reviews of the available articles from the databases revealed no research completed from the health sector.

**Identifying relevant studies**

The next phase of scoping review was to identify the relevant databases for searching (Peters et al., 2015a). This phase can involve refinement of the source of information by creating limits and criteria by considering the relevance of information required (Peters et al., 2015a).

This scoping review initially proposed searches of four database: ProQuest, Cochrane Library, Cinahl Complete and Google Scholar.
An initial database search of each of the selected databases gave a range of results. Google Scholar was rejected early because of the limitations of the small size of this scoping review. Cochrane library was initially thought to be a suitable database to search due to its link with health research; however, initial searches using the keywords identified articles not relevant to the research questions. Therefore, Cochrane library was discarded. ProQuest and Cinahl Complete brought up several relevant articles and included an appropriate size search. Therefore, ProQuest and Cinahl Complete databases were selected for the next phase of the scoping review process.

ProQuest is an online research platform that gives students and researchers access to new and historic scholarly journals, books, newspapers, and many other mediums of information. Cinahl complete is a full-text database of open access academic journals. Both databases cover a range of disciplines and require payment for access. Both databases were accessed through Otago Polytechnic's Robertson library membership.

Selecting Studies

The next phase of the scoping review includes selecting studies through a literature search. The literature search is a three-step method Peters et al., 2015b):

- Initial search of two database and analysis of key words in title and abstract
- Second search using key words across all included databases.
- Third search of reference lists of previously identified articles.

Table 1: Key word inclusion criteria

<table>
<thead>
<tr>
<th>Search One - Title Level</th>
<th>Search Two - Abstract Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOT Children</td>
<td>NOT Children</td>
</tr>
<tr>
<td>Screen and/or device and/or computer and/or digital and/or pixel and/or online</td>
<td>Reading</td>
</tr>
<tr>
<td>Paper and/or print and/or newspaper Text</td>
<td>Cogniti*</td>
</tr>
<tr>
<td></td>
<td>Cognitive map</td>
</tr>
<tr>
<td></td>
<td>Comprehension</td>
</tr>
<tr>
<td></td>
<td>Fatigue</td>
</tr>
</tbody>
</table>

This research utilised an Excel sheet (Appendix A) to record the search results. An initial search of the databases using the key word inclusion criteria (Table 1) found relevant articles based on the defined ‘Search One – Title Level’ search (Appendix A). ‘Search One’
utilises the keywords in the titles of journal articles to identify relevant studies. ‘Search One’ search was completed on August 30th and 31st, 2021. ‘Search Two – Abstract Level’ search (Appendix A) included a more detailed search of the databases and examined the keywords in the title and abstract.

Following both search one and two initial searches, all articles’ abstracts were read. This initial search (Table 2) from both databases highlighted 48 articles relevant to the research question. Several articles were discarded based on the relevance to the research question, including articles discussing assessments of reading and children’s reading. This process refined the number of relevant articles to 20.

The next stage involved a detailed read of the 20 refined articles. Due to the size requirements of the scoping review, the search needed to be restricted to the five years prior to 2021. Therefore, the dates of the included articles were narrowed to include articles from 2016 to 2021, which resulted in 13 articles being included. The search restriction to the last five years reflects the evolving nature of technology. Due to the size and scope of this research project, a third level search of references was not required.

The computer program ‘Zotero’ was used to store and organise the included articles for this scoping review. Zotero is a computer reference management system that stores, organises, and processes academic literature and references.
Figure 5: Study selection

Table 2: Inclusion and limits/ exclusion criteria

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Inclusion criteria</th>
<th>Limiters / Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time specifications</td>
<td>2016 to 2021</td>
<td>Articles written outside of this date</td>
</tr>
<tr>
<td>Language</td>
<td>English</td>
<td>Articles in other languages</td>
</tr>
<tr>
<td>Types of literature</td>
<td>Articles published in peer reviewed journals</td>
<td>Articles that are not peer-reviewed</td>
</tr>
<tr>
<td>Study context</td>
<td>Articles that studies adults use of screen and paper.</td>
<td>Articles that involved children</td>
</tr>
<tr>
<td>Methodology</td>
<td>All methodologies were included</td>
<td></td>
</tr>
</tbody>
</table>

Charting the data

The data extraction process was guided by the scoping review framework. The scoping review framework describes the data extraction process as charting the data and involves extracting key information from the selected articles and charting it in a table structure (Peters et al., 2015a, 2015b).

An Excel database (Appendix B) was formed to manage this information. The following details were charted for each article (Peters et al., 2015b):

A. Title
CHAPTER 3: METHODOLOGY

B. Author(s)
C. Year of publication
D. Country of origin
E. Aim/purpose
F. Study population and sample size
G. Methodology
H. Intervention type, comparator, and details of these
I. Duration of the intervention
J. Outcome and details of these
K. Key findings that relate to the scoping review question

Collating, summarizing information

For the next phase of the scoping review, Peters et al. (2015b) emphasise a full read of the included articles and an analysis in detail of data, ideas, themes, and information. This analysis includes the collating and summarising of the key information in the identified articles. The analysis can be presented in a range of forms including, diagrammatic, tabular or descriptive forms (Peters et al., 2015b).

For this research project, the data from each article were extracted and mapped in a diagrammatic form. The diagrammatic form used for this project was mind maps. These three mind maps are included below as evidence of the thought process and to assist with the understanding of the overall aim of the research. These three mind maps were developed, as detailed below, to represent keywords, key ideas, and key themes. The mind maps are a collection of the ideas, words, themes related to the research question and research methodology. These mind maps create visualise representations of the data extracted in the charting process, and they allow connections to be formed between the ideas in each article and enable development of the relationship between ideas, words and themes. Colour was used to represent an article and links between the bubbles represent the connections between ideas and data.

Mind Map of Key Ideas

The mind map in figure 6 presents the data from each article and map the key ideas from each article individually. This first mind map includes all articles between 2011-2021 and was completed before the criteria date range was narrowed to include fewer articles to match the size and scope of this project.
Figure 6: Mind map of key ideas
**Mind Map of Keywords**

The second mind map as shown in figure 7 was completed following the exclusion of the articles over five years old. This mind map narrowed the approach by specifically selecting and highlighting keywords and statements from each article. The process was to pull the key words from each of the article to form the mind map. The purpose of this mind map is to see the key points from all the articles collectively to draw themes from and analyse similarities and differences.
Figure 7: Mind map of keywords
Mind Map of Key Themes

The mind map as shown in figure 8 utilises the previous two mind maps to build a greater understanding and connection of the themes between the articles. Further to this, the themes in this mind map were explored for connections to each other, which are characterised on the mind map by dotted lines. This mind map focuses on the key ideas and themes and links these to the articles. Through this process, the research identified the similarities and differences between the articles to develop trends and patterns in the data.
Figure 8: Mind map of key themes
Reporting of the results

The final stage of the scoping review process as per the scoping review guidelines is reporting of the results. The results of a scoping review may be displayed as a data map, including diagrams or tables, but it may also be described in a manner that represents the research question (Peters et al., 2015a).

The results of this scoping review are presented in the chapter four: Findings which will detail the key themes extracted from the data. Further to this, chapter five: Discussion involves an in-depth discussion of the findings detailed in chapter four and supports this discourse with a visual map.

ETHICAL CONSIDERATION

The scoping review did not require human participants as part of the data collection methods; therefore, ethics approval was not required.

SUMMARY

This scoping review followed The Joanna Briggs Methodology for scoping reviews as informed by Peters et al. (2015a) and Peters et al. (2015b). This scoping review completed the five steps of the scoping review framework: identifying the research question, identifying relevant studies, selecting studies, charting the data, collating, summarising, and reporting the results.

For this scoping review the research question was identified in relation to the key literature:

- What is known about the reasoning behind using paper versus screen resources and its impact on engagement and comprehension? What factors can be identified within paper versus screen research that may support occupational therapists and health professionals' reasoning when they develop and provide educational resources for clients who have experienced concussions?

The study selection process found 13 articles across two databases that met the scoping review inclusion criteria. The data was extracted and charted in a table and three mind maps to illustrate key themes, ideas and words that compared and contrasted the selected articles. Appendix B shows the complete data set of charted material from this scoping review arranged in chronological order.
Chapter 4: Findings

The Findings chapter explores the extracted and analysed data from the 13 selected articles. It discusses and highlights key areas in the articles and provides comparisons, links, and connections between the studies. There are three key areas: cognitive maps, comprehension, and preferences.

COGNITIVE MAPS

In this scoping review, cognitive maps emerged as a critical factor. The reviewed research shows that cognitive maps influence individuals’ engagement and comprehension of information.

The concept of cognitive maps stems from spatial cognition concepts, which originate from psychology research. Cognitive maps are the mental representation of environmental information produced by the brain by collecting visual and environmental cues and connecting them to form a map (Hou et al., 2017a). Cognitive maps explain the brain’s process of connecting a variety of information about an object and how the object fits in space. The cognitive map mechanism proposes that the human brain has evolved with distinct mechanisms that guide specific behaviour (Hou et al., 2017a). Cognitive maps are recognised as an essential element involved in the learning process. By having the brain convert information into a cognitive map, an individual can understand, retain, and recall information and learning more efficiently (Hou et al., 2017a).

Reading comprehension is a fundamental aspect of learning and involves the use of cognitive maps to form representations of the information being read. This brain process of connecting the words and how they fit in space is the cognitive map of reading. In reading, both the words and the physical location of the words on the page assist the brain in processing the information. Because reading is a recent adaptation in humans, the brain relies on existing mechanism which were developed for other purposes. Consequently, the brain reacts to reading text as being part of the physical world and takes information from the visual system of the text and its surroundings and constructs a mental map of the environment (Hou et al., 2017a).
Medium materiality mechanism

In the last three decades, advances in technology have produced a change in how we view and access text information. Hou et al. (2017a) highlight that there is a difference between reading on paper versus reading from a screen. This difference can be explained through the medium materiality mechanism. The medium materiality mechanism considers paper being tangible and screens being not tangible. The tangibility of paper increases an individual’s ability to encode the information being read. Medium materiality was also seen in Neijens and Voorveld (2018) study where evidence for a preference for paper-based reading was found due to individuals valuing the “physical contact and scent of paper” (p. 771).

Hou et al. (2017a) used the medium materiality mechanism to explain that reading from a screen uses an individuals’ mental resources faster than when reading from paper. Additionally, the medium materiality mechanism shows that individuals found screens more fatiguing because the lack of sensorimotor engagement decreased information encoding (Hou et al., 2017a). These authors ‘further explained that fatigue also happens when the text hinders the reader’s ability to form a cognitive map, thus causing the reader to become disoriented, leading to an increased load on the cognitive processing systems. The reader needs to continuously process the spatial placement of the text they are reading. A solution discussed by Hou et al. (2017a) was to use a fixed layout on the screen that simulated a paper book in order to assist the reader’s construction of cognitive maps.

The research completed by Mangen et al. (2019) identifies that the physical nature of paper increases an individual’s comprehension of the information. The mental representation (cognitive maps) of the text on physical paper provides placeholders and supports the cognitive processes, thus allowing for the formation of cognitive maps. Mangen et al. (2019) suggested that the lack of kinaesthetic and tactile feedback from digital text had adverse effects on individuals' formation of cognitive maps. The study concluded that reading from paper helps individuals develop more robust cognitive maps than when reading digital text (Mangen et al., 2019). The difference may have been because the paper provides more significant placeholders which allows individuals to off-load cognitive processes.

Text signalling

Furthermore, as highlighted by Hou et al. (2017a) and Shi et al. (2020), it was identified in their research that text signalling is an essential aspect of the cognitive map construction. Text signalling, as described by Shi et al. (2020), is a reading strategy where words, phrases and sentences are used within the text; however, instead of adding new content, they emphasise
specific content. Shi et al. (2020) examined the construction of cognitive maps and how they improve reading performance when using text signalling. The two-way mixed experiment looked at two mediums: paper and digital text and three types of signalling: plain text, physical signalling, and verbal signalling. They found that signalling gives the reader navigational clues that assist in constructing their cognitive maps, which improve their reading performance of digital text.

Summary

Cognitive map construction is an essential consideration to the research question of this scoping review. Cognitive maps are the mental representation of an environment they are interacting with (Hou et al., 2017a). This mental representation is a fundamental aspect of reading and learning. The medium materiality mechanism considers the impact the medium has on an individual, with research showing that reading from physical paper better supports the development of cognitive maps (Mangen et al., 2019). Lastly, text signalling impacts on how well cognitive maps were constructed (Shi et al., 2020).

COMPREHENSION

Alongside cognitive maps, the reviewed research demonstrates that comprehension should be considered when looking at educational resources, as it reflects an individual's ability to understand presented information (Sage et al., 2019). Comprehension is an individual’s ability to understand, process and use information (Mangen et al., 2019), and as such comprehension is a point of concern for health professionals. There is an expectation from health professionals that clients are able to process and retain information in order to be proactive with their recovery.

Comprehension can be considered from the viewpoint from two different mediums: paper or screen. A variety of studies have examined the difference between paper and screen mediums. Paper or print medium was defined as the reading of written information from a physical material, for example, singular paper, books or comics. Screen or digital medium was defined as the reading of written information from a digital source, for example, a computer, tablet or e-book. All studies analysed in this scoping review utilised both mediums and provided printed materials, compared to handwritten materials.

The studies examined in this scoping review utilised a variety of participants, methods, texts. The majority of the studies analysed concluded that there was no significant difference in an individuals’ reading comprehension between reading on paper or screen (Haddock et al.,
2020; Hou et al., 2017b; Mangen et al., 2019; Sage et al., 2019;). One study concluded that participant’s overall comprehension was improved when reading from a print book (Haddock et al., 2020). Although most of the studies had a similar conclusion that there are no difference between paper and screen, each had a significant point of difference that will be discussed below.

**Population focus**

Most of the studies explored undergraduate students’ comprehension of text presented on paper or screen (Haddock et al., 2020; Mangen et al., 2019; Sage et al., 2019), whereas Hou et al. (2017b) mixed-method study focused on a different participant group. This study used older adult participants to look at the impact of technophobia on comprehension and concluded no difference in comprehension between screen and paper.

**Purpose of Reading**

It is well recognised that people read for a range of purposes—for organisation, education, and entertainment. Several studies have explored reading comprehension within the context of education and entertainment. Different to the other research analysed, a study by Sage et al. (2017) used flashcards. This study compared college students’ vocabulary learning from paper flashcards and two forms of digital flashcards. Although Sage et al. (2017) concluded there was no difference in comprehension between paper and digital cards, the physical act of moving and bringing the cards closer provided the students with a feeling of control over what they were learning. Therefore, both paper and tablet-based cards resulted in a clear preference by students, compared to computer-based cards.

In another study, Hou et al. (2017a) completed a timed experiment with comic books: softcover comic books, digital format comics and digital comics in disrupted mode. This is different to previous studies due to the focus being on disrupting the textual structure of the writing and page layout. Hou et al. (2017a) found that a fixed layout of text on either paper or screen provided effective structural cues (text signalling) that increased individuals' comprehension. Hou et al. (2017a) concluded that if the text format was presented identically on both mediums, there was no difference in comprehension levels between paper and digital text. However, a decrease in comprehension was found when structural cues were disrupted.

Although this study found no difference between comprehension on paper or screen, it implies that text that lacks strong structural cues may hinder comprehension.

Mangen et al. (2019) used a mixed-methods procedure to study undergraduate students reading a long text (10,800 words) for a period of one hour. It is notable that this study was
different to the other studies analysed, which mainly used short text. Mangen et al. (2019) utilised long text, as they proposed that comprehension is different when reading long text because, they argued, reading comprehension relies on both short and long-term memory skills. Mangen et al. (2019) found no difference in comprehension between screen and paper long form text. By engaging with long-text, Mangen et al. (2019) utilised a quantitative methodology to test participants’ long-term memory when reading from paper and screen.

In contrast, Haddock et al. (2020) found that overall comprehension was better when participants read from a print book. The study concluded that participants were more confident with their responses when reading from print; however, the authors noted the type of content impacted on comprehension. The study utilised two different content-based non-fiction stories and compared comprehension after participants read on both paper and screen. The classical content was a story about the use of pen and paper and the modern content focused on a story about using technology and screens. Haddock et al. (2020) found that the classical content had increased comprehension when read in a printed book.

**Environmental Disadvantages**

It is important to highlight the relevance of when research was conducted; the more recent the research, the more relevant it is to the research question. Singer and Alexander (2017) noted initial reviews of the literature show during early computer development that there were environmental disadvantages when reading from a screen. These early disadvantages were due to the types of screens initially in use and individuals who were not familiar with the technology. As technology and familiarity has improvement so has comprehension when reading from a screen (Singer & Alexander, 2017). The environmental disadvantages were due to the type and quality of early computers and how they displayed text. These disadvantages negatively impacted on individuals’ reading comprehension.

In addition, a systematic review conducted by Çetin and Kılıçkaya (2019) raised concerns that digital texts may negatively affect learners because of the increased cognitive demands. These negative effects were especially pronounced when the screen optimisation and font size were not optimal, and the individuals experienced increased visual fatigue.

Comparatively, Ross et al. (2017), in a systematic review, concluded that students’ comprehension and recall were similar; however, they further discussed that hypertext may negatively influence comprehension due to distraction from the core information. Hypertext are the links embedded in digital text that direct individuals to external information when they are
clicked on. Although no difference was found in either study, both sets of authors believe environment could affect comprehension.

**Summary**

The majority of the research reviewed in this scoping review concluded that there was little difference between participants’ comprehension of paper or print versus screen or digital text. One study explored a specific population group and the impacts on comprehension. Some of the studies identified several environmental disadvantages which could impact on comprehension. Other studies highlighted the purpose of the material is important. The conclusions remained the same that comprehension was not statistically different.

**PREFERENCES**

In contrast to the limited differences in the medium’s effects on comprehension, there are some differences in the research reviewed conclusions regarding preference for paper or screen. Preferences are an individual’s expression of what they like or dislike. The research examined in this scoping review shows that the individuals/participants in the research reviewed showed mixed preferences for paper or printed text (Çetin & Kılıçkaya, 2019; Haddock et al., 2020; Hou et al., 2017b; Krishen et al., 2016; Neijens & Voorveld., 2018; Ross et al., 2017; Sage et al., 2019) Çetin and Kılıçkaya, (2019), in a systematic review, concluded that in some studies the students preferred reading digital text but in other studies the students preferred reading paper. The studies highlighted the importance of recognising additional factors that influence an individual's preferences. It is important to note preferences may be influenced by the participants age, experiences, and familiarity with the medium. Despite the mixed result of the analysed research for preference, it is beneficial to utilise both mediums when providing educational materials.

**Familiarity**

Several of the studies analysed considered how familiarity with technology impacts on preferences. In a systematic critical review, Ross et al. (2017) found students preferred printed text for the best learning outcomes. The preferences were determined by several factors including the students’ prior experiences, familiarity, and comfort levels. Sage et al. (2019) considered how students’ familiarity with a medium effected their learning. The study examined the perceived usefulness of assessing whether a student’s positive view of the medium effected their comprehension. The students who found using a computer or tablet helpful for their education believed they had gained greater knowledge and had a positive view
of their reading (Sage et al., 2019). Similarly, the study completed by Haddock et al. (2020) found that individuals who had previous experience with tablet devices had increased engagement with the information presented on a tablet. These studies concluded that the students were more likely to use and benefit from mediums they were already familiar with. (Haddock et al., 2020; Ross et al., 2017; Sage et al., 2019).

In addition, the matching effect was explored by Haddock et al. (2020) and Sage et al. (2019). The matching effect is where there are positive or negative impacts on the individual depending on whether the medium used matches or mismatches their preferences. The Sage et al. (2019) study established that if students were provided with their preferred medium of information, the students had better comprehension scores. In contrast, if students provided with a medium, they did not prefer, they reported that reading was more difficult, and it was harder to engage with.

Similar to the matching effect, Krishen et al. (2016) used cognitive lock-in to explain an individual’s preference for either screen or paper. Cognitive lock-in refers to when an individual practices a task and with repetition, they become more efficient. The more efficient they are with the task, the more familiar they are, which leads to them becoming locked into that environment (Krishen et al., 2016). Cognitive lock-in means the individual is more likely to return to the task and environment because the more repetitions lead to less mental effort being required to engage in that task.

Hou et al. (2017b), focused on unfamiliar mediums and technophobia. The study found that individuals with high anxiety towards an unfamiliar medium demonstrated lower beliefs in their ability to complete the reading task (Hou et al., 2017b). Additionally, Hou et al. (2017b), noted that when participants engaged with a medium, they felt anxious and experienced increased discomfort and fatigue.

In contrast to the previous studies, Neijens and Voorveld (2018) concluded that reading from paper was the preferred medium despite familiarity of digital technology. The study found that among college students, who are perceived as being digital natives, there was a preference for reading from paper.

With the gap between preferences for paper and digital decreasing, research by Neijens and Voorveld (2018), Ross et al. (2107) and Sage et al. (2019) concluded that preference is an individual’s choice. These studies recommended that information should be provided to individuals in both digital text and print form. Furthermore, Çetin and Kılıçkaya (2019), Hou et al. (2017b) and Krishen et al. (2016), suggested that individuals need to practice reading both paper and digital text to increase their confidence.
Changes over time

The findings of Neijens and Voorveld (2018) and Sage et al. (2019), showed that while paper is a familiar format for learning knowledge and has been used successfully worldwide for millennia, there are current changes in learning processes as technology evolves. Ross et al. (2017) discussed that there needs to be consideration for the future of education and learning. Students are now engaging with digital text at earlier ages; as these students age, the difference in learning outcomes between paper and digital text will become smaller. Çetin and Kılıçkaya (2019) state that individuals who grow up reading from paper may prefer reading from paper.

In addition, Sage et al. (2019) stated that more electronic technology is being used in early education, as it is convenient and cost-effective. These early experiences of individuals learning from digital text, will see preferences evolving over time (Sage et al., 2019). As Ross et al. (2017) and Sage et al. (2019) discussed, the digital natives who are now emerging through the education system have increased experience with computers and tablets, and, alongside the fact that technology is becoming more common place, there will most likely be changes in what medium is preferred over the coming years.

Summary

The research reviewed in this scoping review highlights how individuals’ age, experiences and familiarity strongly influence their preferences for a medium. Familiarity was discussed by Haddock et al., (2020), Ross et al. (2017) and Sage et al. (2019) all of whom concluded that those with more experience and familiarity with a medium had positive attitudes and experiences using the medium. Additionally, Hou et al. (2017b) looked at technophobia and individuals' anxiety towards using an unfamiliar medium. Çetin and Kılıçkaya (2019) suggested that individuals need to practice reading from both paper and screen to increase their confidence with both mediums. The studies by Ross et al. (2017), and Sage et al. (2019), view that preferences of the medium will change over time, as a new generation of digital natives come through the education system, which is now putting increased focus on technology use within education.

SUMMARY

This scoping review found three key areas from the 13 articles reviewed: cognitive maps, comprehension, preferences. Cognitive maps are how the brain collects, cues, and connects information to form a mental representation of the environment; this process has implications for individuals' comprehension and preferences (Hou et al., 2017a). The medium
materiality mechanism considers the impact of the medium, with benefits arising from the tactile nature of paper supporting the development of cognitive maps (Mangen et al., 2019). In addition, the use of text signalling supported the development and strength of cognitive maps. (Shi et al., 2020).

The conclusion of the analysed research regarding comprehension was that there was no significant difference between individuals reading from paper versus reading from a screen (Hou et al., 2017a, 2017b; Mangen et al., 2019). One study discussed an older adult population and the impacts of technophobia on comprehension. Some of the studies identified several environmental disadvantages around digital text which could impact on comprehension. Furthermore, several studies highlighted that the purpose of the material is important.

Lastly, the research reviewed concluded that preferences for a medium were a personal choice, and this personal choice could be influenced by an individual’s familiarity with technology. Positive experiences increased positive attitudes, whereas technophobia increased anxiety (Haddock et al., 2020; Hou et al., 2017b; Ross et al., 2017; Sage et al., 2019). Furthermore, several studies concluded with a view that preferences will change over time.

These findings have implications for the research question of this scoping review and will be addressed in the following chapter.
This scoping review has analysed and charted the data from 13 research articles to address the research question. The three key findings in the research: cognitive maps, comprehension and preferences will be discussed within the bigger research question:

What is known about the reasoning behind using paper versus screen resources and its impact on engagement and comprehension? What factors can be identified within paper versus screen research that may support occupational therapists and health professionals' reasoning when they develop and provide educational resources for clients who have experienced concussions? The findings and research question are discussed through the application to practice. The discussion covers the application of findings for occupational therapy, health and concussion and implications to the original concussion workbook which was the catalyst of this research project. Furthermore, this chapter discusses research limitations and future research directions.

RELEVANCE OF FINDINGS TO OCCUPATIONAL THERAPY AND PERSON, OCCUPATION AND ENVIRONMENT

A key aspect of occupational therapy is the application of the Person, Occupation and Environment (POE) client-centred model, which focuses on occupational performance. The POE model is an occupational therapy model developed by Law et al. (1993) that demonstrates both the theoretical and the clinical applications of the interactions between three key areas: the person, their environment, and their occupations. The person is defined as a dynamic composition of mind, body, and spirit. The environment encompasses the psychological, social, cultural, and socio-economic aspects and defines them as unique to the individual. Lastly, occupation includes the activity or task individuals engage in to meet their needs (Law et al., 1993; Zoltan, 2007). This discussion explores the scoping review findings: cognitive maps, comprehension, and preferences and how they can be applied to occupational therapy through the POE model.

Cognitive maps

Occupational therapists need to be aware of the significance of cognitive maps when providing resources for clients. Cognitive maps are vital for taking information external to the
individual and converting it into a mental representation in short and then long-term memory. An understanding of cognitive maps is fundamental to the support that occupational therapists provide for their clients. Without an individual’s ability to convert information into memory, the individual will find limited benefit in engaging with an occupational therapist.

With a strong link to the comprehension of information, the creation of cognitive maps relies on the environment providing strong text signalling (Hou et al., 2017a; Shi et al., 2020). The research shows that individuals can form strong cognitive maps when there is effectively used text signalling (Hou et al., 2017a). Text signalling assumes even greater importance when individuals are provided with resources on a screen, because of the possible unfamiliarity of the medium. For individuals to benefit from the information provided on a screen, there needs to be significant support in text signalling to ensure the information can be processed and understood (Hou et al., 2017a). Providing information with suitable text signalling can further assist in reducing a client’s fatigue as they engage with the information, thus ensuring they can comprehend the information, retain it and act on it (Hou et al., 2017a).

Relating to the POE model (Law et al., 1993), the aspect of cognitive maps needs to be considered by an occupational therapist. Cognitive maps can be referred to as the internal mental process within the person, which considers their attributes and experiences. The activity of reading that an individual is engaging in, needs to be considered because this activity enables the formation of the cognitive maps. Text signalling positively influences the internal process of developing a cognitive map of the information being read. Furthermore, other external factors such as culture, socio-economic and physical factors likewise influence the developmental skill of building cognitive maps. Cultural factors represent an individuals’ family and community background and includes that community’s shared beliefs and values. For example, is reading considered valuable to the community, or on the other hand is technology valued? Socio–economic factors include the individual’s education history, income, savings, and occupations they engage in. The physical factors consider where the individual lives, what access to amenities and services, such as power and internet facilities, is provided by their local government agencies and their reliability. This reinforces and builds on the idea that the person’s occupational engagement is supported or discouraged by their environment.

**Comprehension**

When occupational therapists work with clients, the client’s comprehension needs to be considered. Comprehension is essential for an occupational therapist to consider as it is a vital part of the client’s understanding of the information they are being provided. A client's
comprehension of information is part of their level of health literacy. Without a sufficiently high level of health literacy, a client will have difficulty converting the information they are receiving through the resources into knowledge that they can apply to dealing with their symptoms. As highlighted by the “The Korero Marama Health literacy and Māori report” New Zealand has low health literacy levels, which negatively impacts client outcomes (Ministry of Health, 2015). Health literacy for Māori is a literature-rich area that is applicable of this review; however, due to the size and scope of this research, Māori health literacy is not discussed in depth.

An occupational therapist needs to consider the individual clients’ education and reading levels, cognitive ability, and prior knowledge and experience to ensure that the information presented can be comprehended. Occupational therapists need to have a strong understanding of competent text signalling and an awareness of health literacy to ensure the resources provided will support the client’s comprehension.

According to the POE model (Law et al., 1993), comprehension results from an individual engaging in the task of reading. Considering the POE model, there needs to be an understanding that the reading environment can support or hinder comprehension. An environment with supportive text signalling will support the individual's formation of cognitive maps, thus allowing them to process and retain the information. This will lead to increased comprehension, and therefore an increased ability to utilise strategies taught within client education.

Preferences

While the reviewed research demonstrates an overall preference for paper-based resources, occupational therapists need to consider not only their personal preferences, but what the client's preferences are. Clients’ preferences will be continually evolving within and between individuals and across individuals’ ages, and stages and experiences of life (Krishen et al., 2016).

In occupational therapy practice and Occupational Therapist uses a client-centred practice philosophy which puts the client first and foremost during interventions (World Federation of Occupational Therapists, 2010). A preference will be individual and depends on the client’s age and stage of life, background, knowledge, and motivation. There needs to be understanding and awareness that this preference will evolve and may change significantly over an individual's lifetime. These constant changes may result in individuals changing their preferences as new options become available (Sage et al., 2019). There is currently an evolution
from mainly text-based information to significant amounts of video and audio resources. While the text-based method is traditional, there are now new ways of presenting information that individuals may prefer such as YouTube videos and TikTok. (Ross et al., 2017). Furthermore, as the digital natives progress through the education system, they are learning how to engage with technology, and this may lead to a generation that prefers technology over paper resources based on their previous experiences and knowledge developed early in their education.

The client’s preferences will determine how they engage with the resources and information provided by the occupational therapist, which will affect their recovery. (Ross et al., 2017). Suppose the client is provided with a resource in a medium with which they do not have previous experience or knowledge of using. If technology is provided to a client with technophobia, they will have difficulty engaging with the information. Similarly, a digital native provided with a written book may not be motivated to engage with the medium. However, as Ross et al. (2017) discussed, an individual's preference for a medium does not necessarily mean increased comprehension of the information, although it may increase motivation and engagement.

This research analysed in this scoping review shows that engaging the client with their preferred medium makes them more likely to be motivated, engaged and experience benefit from the information. Additionally, the occupational therapist needs to consider whether the information presented in either medium matches or mismatches the client’s skill level (Haddock et al., 2020; Sage et al., 2019).

Considering the POE model (Law et al., 1993), the medium of information which the individual prefers is part of their environment and is influenced by the environment around them. How often a person engages with the device is influenced by their past experiences. The more a person engages with a medium, the more that person will prefer to engage in that medium (Krishen et al., 2016).

**SUMMARY**

This section looked at the nature of the POE model, specifically, why cognitive maps must be considered by an occupational therapist when working with clients and how cognitive maps fit within the POE model. Furthermore, how a client’s comprehension influences what an occupational therapist provides for a client alongside how comprehension fits in the POE model. Finally, this section considered preferences, the implications for occupational therapists and the POE model.
VISUAL MAP RELEVANCE TO OCCUPATIONAL THERAPY

The overarching research question was developed to identify factors that would support occupational therapists’ reasoning when developing and providing educational resources for their clients who have experienced concussions. The following visual map identifies these factors and links them back to the core three findings from the research: comprehension, preferences, and cognitive maps. This section discusses these factors through the lens of the visual map shown in figure 9.

Figure 9: Visual map

This visual map was developed from the scoping review methodology process and reflects the findings of the review. The map represents the processes and influences both internal and external that impact upon an individual. The individual is illustrated in blue and placed in the centre of the visual map, which represents the underlying philosophy of client-centred practice in occupational therapy. The internal circles show the overlapping connection between an individual’s comprehension, preferences, and motivations. At the heart of the visual map displayed in white is the individual’s engagement with the occupation. The green circles represent the internal context of what the individual experiences; this includes previous experiences, knowledge, physical health, mental health, and intrapersonal factors. The yellow circles represent the external context, which is the environment around the individual; this includes environmental signalling, cultural factors, economic factors, social factors and
interpersonal factors. The yellow and green arrows which encompass the external and internal contexts show the interactions between the factors. The visual map represents how an individual interacts with their surroundings through how they respond, internalise, process, and ultimately engage with the environment.

**Cognitive Maps**

Cognitive maps are the mental representation of information from both the internal and external contexts. Each of the external and internal contexts will positively or negatively impact an individuals' formations of cognitive maps. In the context of this paper, cognitive maps refer to the mental representation of written or digital text.

Cognitive maps can impact personal preferences for written information in digital or paper form. Cognitive maps make the information easier to engage with and increase a person’s likelihood to seek out that medium. The stronger the cognitive map constructed by an individual for that preference, the more likely the individual will engage with that medium of choice. The process is self-reinforcing as engagement with the preferred medium consequently strengthens the formation of the cognitive maps. Additionally, the same concepts and ideas apply to comprehension and motivations, which consequently reinforce and impact engagement.

Therefore, when developing resources, using similar text signalling throughout the information will support the development and utilisation of internal cognitive maps. Direct teaching of the layout and text signalling is another factor that may support the client's engagement with client education resources. If an individual has well-formed cognitive maps, there will be a positive impact on their comprehension, preferences, and motivations, which will increase their engagement with the information.

**Comprehension**

Comprehension is the person’s understanding of the information they are presented with. When reading the information provided by an occupational therapist, the client needs to understand what they have read. Comprehension relates to the individuals short- and long-term memory processes (Mangen et al., 2019). Short term memory is the retention of the information they have read to build an understanding across the texts. A key aspect of comprehension is the ability to retain and recall information read (Mangen et al., 2019).

A key aspect of the research by Mangen et al. (2019) is that participants were made aware they would be tested on the information via a comprehension test. Consequently, one of the limitations of this study was that the participants were aware they would be tested on the information, which could have impacted their comprehension of the information. The
information the participants were given may also have impacted their motivation to engage with the texts. However, this concept could be used to an advantage. A therapist could structure their intervention by providing quizzes or tests and recording outcomes from the assessment, which could promote increased comprehension by the client.

For the health professional, there is an underlying assumption that the resources and information provided to the client will be engaged with through the individual’s comprehension, motivation, and preference. Furthermore, the client would assume that the resource provided by the health professional would match their level of comprehension and be relevant to their motivations and preferences. Therefore, the health professional needs to ensure the resources being provided are at a level that can be understood by the majority of clients and/or can be adjusted to meet the client at their level of need. As advised by Adams (2019) a universal precautions approach should be taken to ensure that all resources provided by the health professional are accessible to all individuals.

Preferences

Preferences are one of the blue centre circles of a person’s internal processes. It represents the person’s individual needs and wants regarding how and what they interact with. When relating to the context of reading client education material, preferences can refer to the individual’s choice of medium to engage with when reading e.g., screen or printed.

If individuals have a strong preference for a medium, they will generally find that medium or method of reading more beneficial (Sage et al., 2019). They gain more knowledge and intrinsic benefit when using a medium that matches their preferences, compared to one that does not (Sage et al., 2019).

The visual map shows the preference overlapping motivation; individuals are more motivated to engage with information provided in their medium of choice (Krishen et al., 2016; Sage et al., 2019). If individuals prefer working with paper, they will be more motivated to engage with a paper resource. Alternatively, if an individual prefers digital, they will be more motivated to engage with an e-book, website, or app.

However, there is a potential for mismatch between health professionals who are digital immigrants’ and clients who are digital natives. The digital native preferences may misalign with the health professionals if the latter’s educational recommendations come in a medium that mismatches the digital natives’ preferences. Therefore, to ensure a suitable match when providing education, it is imperative the therapist asks and understands the clients' preferences in the background information gathering stage.
Motivation

Motivation was not explicitly discussed in the reviewed research as part of this scoping review. Most of the participants in the studies discussed were undergraduate students who held a range of external and internal motivations for contributing to and completing the research.

Motivation is critical for engaging in information (Haddock et al., 2020; Sage et al., 2019). If the person does not have the motivation to engage with the information, they will not see the information as being beneficial, and this could result in skim reading or not reading the information at all. Furthermore, without motivation they are less likely to retain and retrieve the information to convert it to long term memory (Sage et al., 2017).

The health professional needs to be aware of both intrinsic and extrinsic motivational factors when looking at the reading of educational resources. Extrinsic motivation is drawn externally and provides a reason for engaging in the information. Extrinsic motivation could include positive or negative accountability to another person. Intrinsic is internal to the person, which means the information they are reading has a purpose just for them. Intrinsic motivation could include the personal desire to better themselves. Extrinsic and intrinsic motivation have varying levels of impact on a person's engagement when reading educational resources. If no extrinsic or intrinsic motivation is present, the individual does not begin to engage with the information. If an individual prefers a medium, they are more likely to engage with it, and if they are motivated by the content, they are more likely to engage with it (Haddock et al., 2020; Ross et al. 2017; Sage et al., 2019). Therefore, a clear link between the resources provided and the goals and motivations of the client needs to be made, which links back to the core concept of client-centred practice. Further to this if the information is provided so that the individual can easily comprehend it, they will be more likely to be motivated to engage with it.

The following external and internal contexts were not explicitly stated in the literature reviewed; however, looking at it from an occupational therapist's perspective and the POE model, the following are identified as key influencing factors in the formation of cognitive maps and consequently individual engagement with occupations such as reading material provided by the Occupational Therapist. The visual map flows in both directions with the internal and external contexts affecting everything on the way into the middle of the circle and engagement affecting everything on the way out of the circle. These effects can be positive or negative depending on the circumstances involved.
Internal Contexts

Well-formed cognitive maps are beneficial to an individual. There are several key internal contexts and factors that influence and impact an individuals' formation of cognitive maps, including previous experiences, knowledge, concussion symptoms, health & well-being and intrapersonal factors. These factors can structure and support a therapist’s reasoning when considering the development and provision of client education resources.

Previous experiences build a person’s sense of self and reflect environmental experiences. Previous experiences relate to a person’s life events and shape who an individual becomes and consequently form part of that person's internal context. A person's experiences of their environment impact what knowledge is built and the cognitive maps that are formed. For example, prior experience with a topic or resource strengthens the formation of cognitive maps in that area.

Knowledge is an internal context that is closely linked to experiences. A person’s experiences within an environment help form their knowledge. Knowledge is “The condition of knowing something with familiarity gained through experience” (“Dictionary by Merriam-Webster”, 2022). Knowledge is individual to the person; even with shared experiences, personal knowledge will be different. The stored knowledge and understanding of the world support the formation of cognitive maps.

Physical Health is the balance of the internal processes of the individual's physical body. Physical health and well-being will positively or negatively impact an individual’s ability to form cognitive maps. A negative effect on an individual’s physical health is because of a disruption within the internal body's processing systems that decreases the brain's ability to process information. For example, low blood sugar negatively impacts clear thought processes. Alternatively strong physical health will have positive effects by allowing increased brain function with clear thoughts and cognitive abilities.

Mental health is the mental wellbeing of the individual. As with the physical health of an individual mental health plays an important role. Unstable mental health of the individual will disrupt the brain’s ability to process information. Ouellet et al. (2018) studied depression in the first year following a concussion found that 42% of their participants were diagnosed with a depressive event. The consequences for individuals with concussion are that depression will further diminish their cognitive processing, which will inhibit the formation of cognitive maps. This implies that when an individual has positive mental health the cognitive process is working well and can support the formation of cognitive maps.
**Intrapersonal factors** are an individuals' internal self-awareness, including reflection and critical analysis skills that enable an individual to function and make decisions within their environment. Self-awareness is a higher-level cognitive skill and an essential factor in an individual’s health literacy (Adams, 2019). Critical to cognitive map formation is an individual’s self-management skills, position, and approach to their environment. These factors can have positive and negative influences that, respectively, strengthen or interfere with cognitive map formation.

**External Contexts**

**Environmental signalling** is how the external environment supports and promotes the internal formation of cognitive maps. When considering occupational therapy, modification of the environment as part of the therapeutic process helps to support an individual's engagement in a task (E.g. reading educational information). This environment modification includes the specific use of text signalling in educational resources provided to individuals.

**Economic factors** influence an individual's ability to engage in the medium, which will link to their previous experiences and knowledge. If the individual is unable to afford to engage in the medium because of economic factors, this inability will negatively affect their experiences and knowledge of that medium, which will inhibit the formation of cognitive maps. Alternately, if the individual has a range of mediums they can easily access and purposely engage with, there will be positive benefits from their previous experiences and knowledge, prompting strong cognitive map formations. Access has implications for occupational therapy and the equity of health outcome. Individuals who are unable to access health services because of economic factors will have decreased health outcomes. Through their no-fault system, ACC in New Zealand aims to address these inequalities by providing equal access to health services following any injury (Oliphant, 2009). The no-fault system means that no matter how the injury was sustained, all individuals can get the same level of medical and social support. However, it should be noted that the ACC system has flaws and inequalities that will not be addressed in this scoping review.

**Cultural factors** in the New Zealand context are highly recognised and valued. The Ministry of health provides guidelines for health professionals through the Te Tiriti o Waitangi framework for working with Māori clients (“Te Tiriti o Waitangi”, 2022). Cultural factors are the collective experiences, and collective values and beliefs of a group of people; in Aotearoa/New Zealand these refer primarily, but not exclusively, to the Māori population. These collective beliefs may have positive or negative for engagement with mediums. Individuals’
values and beliefs needs to be considered when introducing new concepts of mediums such as computers and tablets into cultures that value traditional forms of information transfer such as verbal storytelling and song.

Societal factors are the community and the community’s expectations that surround an individual, and this can have both negative and positive impacts on that individual, for example the valuing of literacy or technology (Zeng et al., 2016). Health literacy is also a shared societal factor where low levels of health literacy will have negative impacts on health outcomes for the community (Adams, 2019).

Interpersonal factors relate to the people that an individual has close interactions with. They can have both positive and negative influences on the individual (Adams, 2019; Zeng et al., 2016). If individuals see those familiar to them engaging positively with a particular medium, then their observations and perceptions of that medium will more likely be positive in relation to that medium. However, if an individual sees and experiences their friends and family having and verbalising negative associations with a medium; they will be negatively influenced (Ryd et al., 2018; Sikora et al., 2019).

SUMMARY

This section introduced the visual map and how it aligns with occupational therapy. It covered the key topics from this scoping review including cognitive maps, comprehension, and preferences. It expanded to include the more implicit ideas of motivation and engagement then examined the internal context of previous experiences, knowledge, physical health, mental health, and intrapersonal factors. This was followed by a discussion of the external context including environmental signalling, cultural factors, economic factors, society factors and interpersonal factors. These combined factors need to be considered when developing, personalising, and providing client education resources.

RELEVANCE OF FINDINGS TO HEALTH, CONCUSSION AND OCCUPATIONAL THERAPY

This section discusses how concussion sits within the POE model and how the key topics of cognitive maps, comprehension and preference influence and affect treatment of and recovery from concussion.

Relevance of Concussion to POE

The POE model is relevant to concussion as it considers the client as an individual, the persons occupations they wish to engage in, and the environment they live and work in (Law et
al., 1993). Concussion symptoms are highly individual and are specific to that person. The concussion symptoms draw on the personal factors including their previous health and well-being, and previous experiences and knowledge.

Concussion symptoms negatively influence a person’s engagement in occupation as they interrupt the person’s basic occupational needs due to the intensity of symptoms. For example, individuals may experience significant fatigue that interferes with basic self-care requirements. Concussion symptoms can interfere with the individual’s perception of themselves and their abilities. The change in perception and loss of identity following a concussion can disrupt the core self, and consequently their engagement in occupations. Concussion symptoms directly impact on an individual’s environment, through their relationships with others and loss of occupation, which affects socio-economic circumstances. These changes disrupt an individual’s place and space within the community resulting in loss of identity and sense of self (Losoi et al., 2015; Zeng et al., 2016).

**Cognitive maps**

Cognitive maps should be considered when presenting educational information to individuals who have suffered a concussion. Due to these individuals already experiencing fatigue from the injury, there is a need for the occupational therapist to reduce the impact the information has on the individuals. Suppose the individual is struggling with processing the educational information in the way it is presented. In this case, they will experience increased symptoms, resulting in decreased engagement with the information. In this situation, the occupational therapist needs to have a strong understanding of text signalling to ensure that the educational information being provided is set up in a way that supports the individual's understanding and retention. When the information provided contains unsuitable text signalling, the resource will hinder the reader’s cognitive process resulting in them becoming more fatigued through the effort required to understand and retain the information.

**Comprehension**

Occupational therapists need to consider the individual’s symptoms. Concussion presents differently depending on the injury sustained and the individual’s pre-injury factors. The occupational therapist needs to consider these individual symptoms and the medium on which the resource is provided to the client. An individual with vision concerns, eye strain, headaches and light sensitivity may find that information provided on technology exacerbates their symptoms, resulting in decreased engagement with the information. However, individuals
experiencing fatigue, memory and concentration concerns may find paper harder to engage with and may benefit from a more interactive medium of information such as a website or app.

The research from this scoping review highlights that the medium used to present information to clients does not affect comprehension. However, as stated by Cetin and Kilickaya (2019), some factors that may increase visual fatigue in individuals need to be considered when using screens, such as unsuitable font size and screen optimisation. This is information that is important for an occupational therapist to understand when working individuals with a concussion who due to their injury may have increase susceptibility to visual fatigue. Consideration needs to be given to older individuals following a concussion who may experience technophobia to ensure they are comfortable with the medium provided in order to decrease possible anxiety (Hou et al., 2017b). An occupational therapist working with these individuals needs to consider how long the individual is advised to engage with the material on a screen.

The findings from the analysed research indicate that occupational therapists could adapt the information to a way that supports an individuals’ symptoms. This could include information being provided in a graded manner such as on day one the information is in a short paragraph or video, with longer versions as the days go by until all educational information is provided and the individual has increased their tolerance to the medium being employed. This process of providing gradual changes in the information warrant further research in the health setting.

When relating these concepts to the research in the scoping review, limitations need to be understood: the research reviewed looked at healthy populations and showed that there was no difference in participants’ comprehension when using screen or paper. As the populations were healthy, the research did not need to consider negative cognitive symptoms that may interrupt the development of cognitive maps into comprehension.

Preferences

An individual's preferences are especially important when considering the concussed clients occupational therapists work with. Consideration of preferences is particularly applicable when working with older adults who have sustained a concussion. When presented with educational information in a medium that goes against their preferences, there may be an increase in anxiety and fatigue in certain individuals which will negatively affect their comprehension and engagement. The advice of Sage et al. (2017) was to offer both paper and digital text.
SUMMARY

This section considered the POE model's impact on occupational therapists working with individuals suffering from concussion. It then further examined how the scoping review key topics impacted on concussion.

VISUAL MAP RELEVANCE TO CONCUSSION

This section builds on the previous section, which discussed the visual map in relation to occupational therapy. This section introduces the aspect of concussion and resources and applies the visual map to these two aspects.

Figure 10: Visual map with concussion and text signalling

From a trauma-induced perspective, this visual map provides a view for an occupational therapist to support an individual with resources following the impact of a concussion. The visual map remains as described above with the addition of concussion under internal context and text signalling under external context. This visual map could be considered in the context of any traumatic event with or without changes to the external context.

Concussion symptoms have been added to the internal context and are shown in relation to a red arrow signifying the trauma event. The circle of concussion intercepts both physical and mental health circles.
Concussion Symptoms are caused by a traumatic event to the head or body. Concussion impacts an individual’s physical, mental health and the internal context. A concussion may have minimal or widespread effects on both the physical and mental health of an individual as everyone will present differently. Concussion symptoms interrupt the physical and mental processes in the brain which are needed to form cognitive maps. How the brain forms and strengthens these cognitive maps are what concussion interrupts. For example, decreased concentration caused by concussion will negatively impact the formation of cognitive maps by interrupting the logical order of brain processing (Leddy et al., 2016; Makdissi et al., 2013; McCrory et al., 2013). Engagement in an occupation can positively affect concussion symptoms as engagement in the tasks strengthens preferences, motivation, and comprehension, which support the formation of cognitive maps, which, in turn, reinforces both the internal and external contexts.

This visual map includes an additional circle of text signalling intercepting environmental signalling. This additional circle represents this concept being explicitly used to explore the effects of educational resources.

Text signalling is one of the many forms of environment signalling and specifically relates to the process of reading and writing (Lemarié et al., 2008). Text signalling is the form of written information, produced by another person, given to an individual for reading. Written information made up of strong text signalling such as headings, bold, underlining and bullet points promotes the formation of strong cognitive maps (Lemarié et al., 2008). The opposite is true in that unsuitable text signalling inhibits the formation of cognitive maps. While text signalling is part of the external context, it needs to be considered alongside the internal context of both previous experiences and knowledge. Without the individual having been explicitly taught to understand and use text signalling, even strong text signalling will not be beneficial to their understanding of the information (Beker et al., 2016; Lemarié et al., 2008).

When considering its impact on an individual, a concussion can cause disruptions to that an individual’s memory, concentration, and processing abilities. This means that although prior to the injury the individual had no concerns around their reading comprehension, following the injury they may struggle to understand written information. There may also be concerns around their tolerance levels to reading, and the information they do read may not be comprehended and moved from short term memory into long term memory (Craton et al., 2017; Kontos et al., 2019). This is why it is important for the occupational therapist to understand text signalling, and how to include assessment of client's skills in this area, and if required teach
strategies and skills to access this environmental support for comprehension. As stated, explicit text signalling will support the formation of cognitive maps (Hou et al., 2017a).

**SUMMARY**

This section looked at the visual map in relation to concussion and resources, specifically looking at how the concussion impacts the internal context which in turn influences the key topics of this scoping review. It is important to consider the impact of text signalling on the external context, which affects the key topics discussed, and how text signalling is relevant to occupational therapists and concussion clients.

**RELEVANCE OF FINDING AND VISUAL MAP TO DESIGN OF CONCUSSION WORKBOOK.**

This scoping review has provided me with an increased understanding of the key ideas underpinning the use of paper versus screens, moreover, it has provided further information and ideas to include as I continue developing the concussion workbook.

The information and understanding developed will allow for updates to the workbook to ensure it is suitable and beneficial for use in practice by occupational therapists. This scoping review confirmed my initial thoughts on the development of a paper-based workbook and reaffirmed many of the formatting and layout decisions I originally included. I am reassured that the development of a workbook is justified.

The next stage of the workbook will be a review of how the text signalling used supports the reader’s development of cognitive maps. This will consider titles, bullet points, how information is presented in sections and the use of colours and visual maps. Further consideration will go into providing a supplementary paper-based resource that breaks the key information into smaller parts which then increases as the resource is worked through.

Time needs to be dedicated to completing a health literacy review as guided by the Ministry of health “Health literacy review: A guide” document. This will ensure that the concussion workbook meets the standards proposed for health resources in New Zealand (Ministry of Health, 2015).

As the research shows that comprehension is similar across the mediums, I will now consider adapting the workbook to include a screen version. Initially this will be a direct copy of the paper version in the form of a PDF / e-book, but the goal is to move it to an interactive web-based format.
Further research should be considered to examine the effectiveness of this workbook with its intended population.

LIMITATIONS AND FUTURE DIRECTIONS

This section discusses the limitations identified by the author of this scoping review and further research directions.

Limitations

This scoping review has several limitations. Due to this scoping review's restricted size and scope, only the last five years of research were included and examined across the two databases used. This restriction of dates was because there was a large amount of research available dating back to the development of computers in the 1970s and 1980s. This means that the included research focused on newer technology, such as the use of new screens, and the restricted timeframe did not allow for comparisons of where technology was and where is it now. Furthermore, the size and scope of the scoping review limited how in-depth the research analysis was able to go.

Another limitation was that research studies around children and teenagers were excluded. This was because the scoping review was drawn from the author’s work context with adults following concussion and the development of the workbook focused on the adult population. This affects the results of this scoping review as the population of children and teenagers is unique in terms of what technology they are exposed from a young age, which is different from the adult population being considered. Children and teenagers are now classed as digital natives because they have grown up with technology being a significant part of their lives. This means they engage and benefit from technology in a way that is different from adults and older people who are not digital natives. Therefore, the differences in previous experiences, education and knowledge conclusions from this scoping review cannot be directly applied to the population of children and teenagers.

Furthermore, this scoping review drew on research that came mainly from the education sector because no research was found that specifically came from a health-specific sector. Likewise, there was no research completed by health professionals or occupational therapists identified. This means that the conclusions drawn from this scoping review have been generalised and viewed through an occupational therapy lens and applied to a section of individuals who may have different needs and concerns from the populations in the research
reviewed. This meant that no specific research was found on how reading on paper or digital affects individuals who have experienced a concussion.

Additionally, there were limitations on the cultural diversity of the research reviewed in this scoping review. All the research reviewed was written in English and published in English journals. No research was identified that was completed in or discussed the unique context of cultural diversity in the Aotearoa/ New Zealand community. The research found in this scoping review may have limited implications that can be applied to Aotearoa/ New Zealand community as a culturally diverse and unique population. The education and health sectors must cater to a more diverse population than the populations that the research reviewed. Therefore, limited conclusions can be drawn from the research and directly applied to the Aotearoa/ New Zealand population.

Lastly, it needs to be considered that the research included in this scoping review was taken from the education sector and higher education. Within the education sectors these participants were self-selecting to be educated; therefore, there was an underlying understanding that they would be learning information and tested on it within this context. The population that is being provided with health information by the occupational therapist are not necessarily similar or in a position to learn, instead they are there to get assistance to solve a problem. From a patient perspective, gaining information and education may not be the purpose of engaging with a health professional. This is where it is important for the occupational therapist to consider the clients personal motivations and values, as this will impact clients’ engagement with the information provided.

**Future directions**

The purpose of this scoping review was to explore further the effects of paper or screen resources as used by health professionals. Because of the limited size and scope of this scoping review, there is scope for a more extensive study on the same topic as well as related topics that were found during this review.

One of the critical factors in undertaking this scoping review was to gain knowledge and insight into the effects of reading from a screen or paper in order to evaluate and update accordingly a concussion workbook which has been produced by the author and is currently presented in paper form. Of personal interest to the author would be to further research how effective this concussion workbook is for the intended population. This further study would investigate if the use of the workbook were linked to better outcomes and recovery from a concussion on the ACC concussion program. There would need to consider how well people
are engaging with and learning from the workbook. Further to this initial research there could be additional research to look at the paper version compared to the digital version in website or app format.

As highlighted above in the limitations of the current research, there is a clear gap in the research when considering the implications of paper versus screen in Aotearoa/ New Zealand context. Further research could look at the preferences for screen or paper by individuals in Aotearoa New Zealand with consideration of its unique social, economic and cultural factors and the influences of our specific education and health systems. This links to future opportunities to look at the accessibility to technology within the Aotearoa/ New Zealand population, and the preferences and benefits those individuals receive from using technology, as this may depend on their home, school and workplace circumstances.

Further research would be beneficial into the effects of concussion symptoms on individuals' ability to read and comprehend information from either paper or screen. Lastly, research could look more broadly at the health profession and the resources they are providing to clients. How do clients engage with the health professional resources and how health professionals provide their patients with the most effective information for their needs? An example for another health field would be a client going to the doctor with diabetes and being provided by the doctor with a written pamphlet versus an e-book, website, or app. This research could evaluate whether the medium used by the doctor to provide the information makes a difference in these clients' health outcomes.
Chapter 6: Conclusions

This research project considers the larger research question of What is known about the reasoning behind using paper versus screen resources and its impact on engagement and comprehension? Under this larger research question was a smaller question which specifically guided the scoping review aspect of this inquiry.

- hat factors can be identified within paper versus screen research that may support occupational therapists and health professionals' reasoning when they develop and provide educational resources for clients who have experienced concussions?

In summary, this research project report covered six chapters. The first introduces the connection of the topic to occupational therapy, the practice problem, and the author’s development of the concussion workbook as to how the practice problem evolved. The second chapter explores the background of the topic through an initial literature review and discusses key aspects of the research question by looking into concussion and New Zealand’s health literacy. The third chapter describes the methodology which the author followed to address the research questions. The fourth chapter outlines the findings from the selected articles. The fifth chapter includes a detailed discussion of how this research is relevant to occupational therapy practice with an in-depth discussion on the three key topics found: cognitive maps, comprehension, and preferences. A visual map is introduced to illustrate the information and ideas found through the research and are discussed further in relation to occupational therapy. Further to this, the research is discussed in relation to individuals’ health, concussion, and the occupational therapy model of POE. The visual map is then reintroduced with further details to explore how the concept fits into concussion focused practice. Reflection against the initial development of the workbook and the implications of the scoping review findings were briefly discussed. Finally, the limitations of this research project are discussed, and future directions are suggested.

To conclude, this research project suggests that the relationship between cognitive maps, the tool of text signalling and maximizing comprehension are essential factors to consider when developing educational resources. However, the medium of screen or paper resources
from the research reviewed does not significantly impact an individual’s ability to form cognitive maps or understand the information presented. This finding is taken cautiously due to the fact that none of the population groups included within the scoping review included people with concussion. However, the most important finding is the influence of an individual’s preferences. These findings align strongly with the core idea of client centred practice, ideas summarised within the visual map could potentially guide a therapist’s inquiry into gaining an understanding of the complex factors which influence a client’s screen or paper preference.
References


REFERENCES


StatsNZ. (2022). *Estimated population of NZ*. https://www.stats.govt.nz/indicators/population-of-nz?gclid=CjwKCAjwve2TbhByEiwAaktM1PsYgWDtQcInTedlzCNLuOxxgtLuTFvDawlCTcnsN15dEhIw99wBoC5vkQAyD_BwE


## Appendices

### Appendix A

#### Search results

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### Article summary

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<td>Krishan, A, Kachan, S, Kraussman, M, Harrell, Z.</td>
<td>2016</td>
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<td>Explore consumers motivations in the adoption of either print or digital forms of media.</td>
<td>1-53 qualifying non-student participants, 2-163 undergraduate students</td>
<td>Qualitative inquiry between subject groups. Focus group.</td>
<td>Mixed methods</td>
<td>Conceptualized the key ideas from the focus group data.</td>
<td>Benefits of digital resources. Hedonic utilitarian. &quot;Although we consider the digital medium cheaper and more convenient, we regard the print medium as more familiar, personal, and visual&quot; pg 494. &quot;Cognitive lock-in theory contributes to customer loyalty in the online environment&quot; pg 494.</td>
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<td>Cognitive map or medium malleability: Reading on paper and screen</td>
<td>Hsu, J, Rashad, J, Lee, K.</td>
<td>2016</td>
<td>USA, S Korea</td>
<td>&quot;Examined two common mechanisms that are used to explain why reading on an electronic screen versus paper results in different reading outcomes. The cognitive map mechanism and the medium malleability mechanism.&quot; p. 84</td>
<td>45 undergraduate students from a communication school</td>
<td>Timed experiment pen and paper, questionnaire assessing reading comprehension, separate pen and paper, questionnaire assessing fatigue and immersion.</td>
<td>Randomly assigned one of three reading conditions - Softcover comic book, apple iPad with comic pre-installed in full-page digital format, apple iPad with comic pre-installed in desktop view mode.</td>
<td>1 experiment</td>
<td>Reading time, Fatigue, comprehension (kristal-sally test) and immersion</td>
<td>Comprehension not significant. Reading time is not significant. Softcover and digital equivalent reported fatigue less than disrupted view. Immersion higher in paper comic than disrupted view. It was also higher in digital equivalent than disrupted condition. &quot;Key aspect for a reading device to simulate a book is a fixed layout of text presentation which supports the construction of an effective cognitive map&quot; p. 93</td>
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<td>Digital replica editions versus printed newspapers: Different reading styles? Different recall?</td>
<td>Neijens, P, Vervoort, H.</td>
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<td>Investigates reading styles and recall of the news from reading digital replicas of printed newspapers on tablets and compares them with the printed version.</td>
<td>60 college students</td>
<td>Experiment - questionnaire</td>
<td>Read that day, newspaper for 30 minutes on either paper or tablet. 3 days - come in anytime</td>
<td>Recall, Perceived fragment reading, perceived selective scanning, perceived elaboration, perceived disorientation, digital innovativeness, attitudes to printed newspaper, attitude to tablet newspaper, preference for reading from screen.</td>
<td>Preference for reading from paper - 83.5% reading digital replica editions of newspapers on tablet is comparable to reading traditional printed newspaper (pg 770). &quot;Readers still value the physical contact and scent of paper&quot; pg 771. Reading behaviour - Reading styles, digital innovativeness, Preferences.</td>
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<td>Australia</td>
<td>&quot;reviews current literature on the advantages and disadvantages of electronic and paper media for academic reading.&quot; p. 160</td>
<td>Literature review - last 6 years</td>
<td>Literature review</td>
<td>N/A</td>
<td>N/A</td>
<td>Preference for reading long documents on paper pg 179. &quot;Moss and Garland propose that reading from paper led to better information knowledge and retention&quot; pg 190.</td>
<td>Preference.</td>
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<td><strong>Reading on Paper and screen among senior adults: Cognitive map and technology</strong></td>
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| Napoli, A., Wu, Y., 
| Hanani, E. |
| 2017 |
| USA |
| "Documents the impact of technology on reading. Investigated how different reading methods might result in different reading outcomes among older adults due to both cognitive and psychological factors." | *p. 1* |
| | |
| 61 participants aged 57 to 85 years |
| *Lab experiment - reading condition: completing questionnaires* |
| *Reading test presented on a paper-based or computer-based format \( \text{with text and line spacing.} \) |
| *15 pages in a length total of 3150 words* |
| *Comprehension - 20 comprehension questions for each text. Time - the length of time the participant spent reading each text. Fatigue - self-reported.* |
| "...general constructability - post test questionnaire enjoyment - self-reported reading experience - 10-point scale, perceptions of the technology innovation in the computer-based computer and mobile technology based experience on a 10-point scale, characteristics - the tension personality inventory scale." |
| "The utility of cognitive maps construction influences readers feasibility of fatigue" |
| *"Reading a text influences readers fatigue"* |
| "...the reading process of the text is in relation to the test's use on the page" |
| pg 5 |
| *Did not show significant difference between reading on screen versus print paper. Impact of reading type on reading performance is likely to be an artifact due to user's attitudes and screen towards computer based as well as the computer screen towards." |
| Cognitive mixed |
| technology. |

| Print versus digital text: understanding the experimental research and challenging the dichotomy "flane" |
| Ross, B., \( \text{Frederiksen, E., Mosslow, L.,} \) Cheung, A. |
| 2017 |
| Australia |
| Systematic review of interdisciplinary literature concerned with digital text use in education and propose recommendations for how text can be implemented for impactful learning. | Systematic review |
| N/A |
| N/A |
| N/A |
| "Students prefer digital print tests" |
| *pg 9* |
| "Students' comprehension and recall may be similar to the reading print and test." |
| *pg 9* |
| Preferences, |

| Flip, Click, or Snipe: Learning Outcomes from Paper, Computer, and Tablet Flashcards |
| Sage, K., Kincaid, B., Grove, R. |
| 2017 |
| USA |
| Compared the effectiveness of paper and digital flashcards. | Experimental |
| *89 undergraduate students* |
| *50 minutes in all conditions* |
| "Neural recall learners perceptions. Background questionnaires, pre and post tests, and a demographic questionnaire." |
| "Students can be trained to move from table and paper cards to computerized cards. The act of flipping cards and ability to safely bring cards down might have contributed to feelings of control when compared to sitting at desktop computer." |
| Preferences - bling the best of both. |

| Reading on paper and digitally: the past decades of empirical research revisited |
| Singer, L., Alexander, P. |
| 2017 |
| USA |
| "To examine the role that print and digital media play in text comprehension."
<p>| Literature review |
| N/A |
| N/A |
| N/A |
| &quot;We have a responsibility to try to understand how our surroundings may also offer readers when high-stakes reading assessments are not only delivered digitally but also includes features such as animation or video.&quot; |
| pg 103 |</p>
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| **A systematic review of research on reading in English as a second language**

2019, Turkey

"Aims of the study: To identify the major findings and trends in reading research by describing the current state of knowledge and practice in the field of reading comprehension and its relationship to academic achievement."

Study design: Systematic review

Research gap: N/A

**Reading comprehension of a long text read in print book and on Kindle: Differences in the story?**

2019, France and Norway

"Comparison of reading a long text on Kindle and in print.

- 10 participants - mean age: 24 years old
- Experimental
- Reading 20 pages of a story as kindle or in a print pocket book. The session took place in a quiet room.
- 16800 words - 1 hour of reading
- Actual reading time, comprehension, and engagement levels were measured.

**Reading from print, computer and tablet: Equivalent learning in the digital age?**

2019, USA

"Learning from and perceptions of print and digital reading to present recommendations for readers and educators regarding best approaches for reading assignments.

- 100 undergraduate students
- Mixed methods
- Three reading platforms - print, computer and tablet
- Reading education articles
- 10-page articles on common core standards
- Measures include reading, elements of digital reading, and preference of digital reading and print materials.

**The medium can influence the message: How does reading influence how people process different types of written information?**

2020, UK

"Tested whether comprehension is maximized when the context of the material matches the medium.

- Study 1: 128 undergraduate students
- Study 2: 60 undergraduate students
- Experimental
- Randomly assigned to read one of two short stories. Study 2 had pop culture magazine style articles.

**Construction of cognitive maps to improve reading performance by text signaling: Reading text on paper compared to an screen.**

2020, China

"Reading text from a screen has been shown to be less effective compared with reading text from paper."

- 15 college students
- Experimental
- Reading performance measured via reading comprehension scores, and navigation performance measured via navigation test scores.

The use of digital media can provide background information and supplementary data for increased reading performance, promoting the understanding of readers' cognitive maps and ultimately improving their overall reading performance."