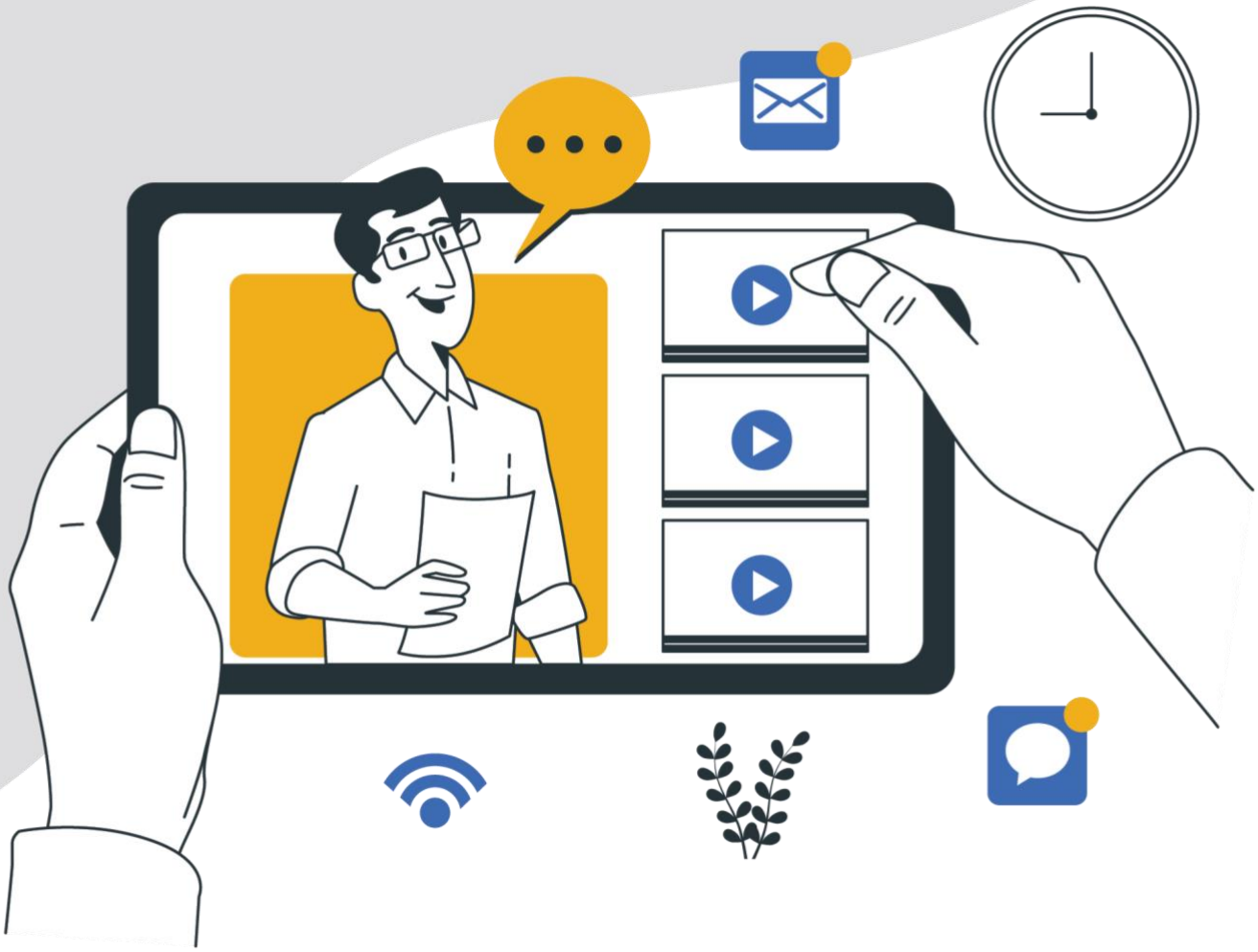

MISSION FOCUS:

Supporting executive functions in VLEs and the design of inclusive user interfaces.

By Nidhi Treesa Paul

Submitted to OCAD University in partial fulfilment of the requirements for the degree of Master of Design in Inclusive Design

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Abstract

Virtual learning environments (VLEs) use educational technologies to facilitate remote online learning in the absence of synchronous supervision and support. Most VLEs offer inclusive options for learners to access content at any time and to adapt content into a form suiting their interaction modes. They also facilitate online collaboration and peer communication. However, they do not fully consider the needs of pre-literate adolescents with developing executive functioning for engaging in asynchronous learning, resulting in barriers. Through an exploratory-cum-participatory research approach combined with a collaborative and iterative co-design process with the participants, this study explored and examined barriers to independent and asynchronous functions that pre-literate adolescent learners face when learning in a VLE, such as planning, focus, and setting and achieving goals (executive functions). Building on principles for user interface design, guidelines were developed to help enhance the design of VLEs to make them more inclusive of diverse executive functioning needs.

Keywords: Executive function support, pre-literate, adolescent learners, user interface design, virtual learning environment, participatory action research

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I want to express sincere gratitude to The Trillium Demonstration School for providing a conducive environment for this research and its students' invaluable contributions, without which this research would not have been possible. I hope that the findings of this research will contribute to the body of knowledge in making education in virtual settings more inclusive.

I thank the Graduate Program Director, Michelle Wyndham-West and the Graduate Office for facilitating my graduation process. I am grateful for the support from my classmates who sailed the rough seas with me.

And to my family who always stood by me — thanks from the bottom of my heart!

Note: In this MRP, I have attempted to use language that is easy to understand for individuals who are unfamiliar with academic or technical language. Through this, I hope to reach as many people as possible, particularly those who may find the information in this work useful.

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Introduction

Virtual learning environments (VLE) are designed information spaces where educational interactions occur (Dillenbourg, 2000). Teachers use **Learning management systems (LMS),** a form of virtual learning environment (VLE), to support learners' academic progress through personalised learning contents, enhance their learning through discussions, and collaboration among peers (Mosharraf et al., 2013). While remote online learning seeks to be inclusive, it often presents barriers for pre-literate adolescents with developing executive functioning to engage asynchronously. **Pre-literate** refers to individuals who have not developed the use of a written version of their language but may speak and communicate perfectly well("Preliterate," n.d.). This umbrella term includes critical skills like oral language and the awareness of sounds (phonological and phonemic awareness) as well as knowledge of the alphabet and an understanding of common print concepts (print goes from left to right and from up to down on a page) (*The Meaning of Preliteracy*, 2019). The nature of digital information technologies requires learners not only to be able to read—one of the most cognitively demanding challenges we take on as a species (Hinton, 2020)—but also understand networked information such as navigating through linked rather than sequential pages, and interpret multi-sensory content such as visual, aural and verbal information all at the same time (Hopkins et al., 2013). Equally essential are **executive function and self-regulation** skills—the mental processes enabling planning, focusing attention, remembering instructions, and juggling multiple tasks successfully (Harvard

University, 2015)—supporting goal setting and assess progress in planned goals. The development of executive function skills can be disrupted by neurodevelopmental disorders such as ADHD and often have co-occurring disabilities that impact cognitive, social, communicative, motor, behavioural, and emotional spheres of the person, affecting how they learn(Cibrian et al., 2020; Kumaresan et al., 2022; Sonne et al., 2016). Neurodevelopmental disorders can affect how a learner sustains routine, and interacts with distractions, how they interpret assignments, and navigate technology (Averett, 2021). This, along with still developing language skills, compounds barriers to successful asynchronous use of the VLE. Children continue to develop their ability to keep relevant information and plans related to the tasks at hand (working memory) and their literacy skills as they mature, hence it is essential to design interfaces that don't present barriers in their use because these skills are in development (Mosharraf et al., 2013). Parents, guardians, and circle of care are often actively supporting their children's learning experience, including organizing and monitoring schoolwork, and occasionally adding supplemental instruction (Averett, 2021). During the COVID-19 pandemic, working parents, unable to support as such(Timmons et al., 2021), identified the "unmet need for educational assistance has been staggering and challenging for families to navigate" (Houtrow et al., 2020, p. 417). There is, therefore, an urgent need to:

a) better understand available assistive technology which may be hardware or software designed to enable pre-literate adolescents perform executive functions.

b) gain insights from pre-literate adolescents through co-design about their use of assistive technology in VLEs and
c) the possibilities for improving accessibility of VLEs using analog and digital assistive technologies.

Space, Scope, and Context

VLEs are essential not only because so much learning has moved to online formats amid the COVID-19 pandemic but also because it offers accessibility through options for learners to learn from anywhere and at any time, access content that is adaptable for different modes of interaction (e.g. speech-to-text, text-to-speech, changing font size and contrast, translating into another language and more), and the opportunity for learners to discover, express and explore their interests in learning (Watkins et al., 2020). VLEs can facilitate an inclusive learning environment through structures that encourage online collaborative groups, discussion, and peer communication. This can be a productive approach to help learners retain their autonomy, enthusiasm, and motivation while providing the opportunity to personalise learning. As learners with varying needs for learning use VLEs, it is important to continuously consider: who's needs are unmet? Who is being left out?

While VLEs have reached a high level of adoption in many countries, they are most prevalent in higher education contexts (Edmunds & Hartnett, 2014) and pre-literate adolescent learners who are developing EF skills are not included in the conversation as much. Of the school-related research that is available, most focus on developing

assistive devices to support particular EF skills such as planning, focusing attention and working memory or emotional self-regulation; whereas in a VLE learners' EF skills are challenged simultaneously, Adolescent learners are expected to manage their own school and extracurricular assignments, communicate effectively in multiple contexts, and successfully complete more abstract and complicated projects independently, (Cibrian et al., 2020; Tavakoulnia et al., 2019). There would seem, therefore, to be an urgent need for those involved in educational policy and practice to understand better the experience of pre-literate adolescents with VLEs and to investigate their engagement with various types of assistive technology for learning and EF support.

Design Challenge

Hardware and software technological tools have the potential to revolutionize the way education is delivered and accessed. These tools, collectively known as EdTech (Lathan, 2019), can improve access to education by assisting in the communication of knowledge, its development and exchange. For example, online learning platforms, video conferencing tools, and mobile applications can enable students and teachers to connect and engage in educational activities regardless of their physical location.

However, to make learning environments inclusive, we must also ensure that EdTech is accessible to everyone. This means that we must design EdTech tools that are user-friendly, adaptable, and customizable to meet the needs of all learners. The design challenge undertaken in this Major Research Project explores and examines barriers pre-literate adolescent learners face when in a VLE. Specific barriers looked at included

independent and asynchronous functions such as planning, focus, and, setting and achieving goals (executive functions) with the intention of adding to user interface guidelines making it more inclusive for diverse learner's needs.

Research Approach

The research approach of this study is both exploratory and participatory. The study includes a literature review, environmental scan, expert interviews, and co-design sessions with lived experience experts.

The review, scan and interviews included the following parameters:

Literature Survey

Literature Survey of databases like Early Childhood Education Journal, International Journal of Technology and Inclusive Education, Journal of Early Childhood Literacy, Journal of Open, Flexible, and Distance Learning, OCAD university's open research repository (Thesis and Major Research Papers/Projects) using keywords like Executive function support, pre-literate learners, user interface design, Virtual Learning Environments(VLE), participatory action research. Articles featuring qualitative review and individual lived experiences of key stakeholders were included.

Environmental Scan

Environmental scan using the Google search engine with search terms such as education technology, technology accessibility, K-12 education, VLE, assistive technologies, and more.

Expert interviews

a) UX designer at D2L Brightspace LMS used in Ontario, Canada
    i) 30 to 45 minutes,
    ii) seeded by the following open-ended questions:
    - What are the educational technologies used to support executive functioning?
    - What research tools are used by the company to design the virtual learning environment?
    - What are the challenges related to accessibility and inclusion for neurodiverse users in VLEs?

b) Expert interviews at the 2022 CEC (Council for Exceptional Children) conference with
    i) A Teacher
    ii) An assistive technology advocate.
    iii) A researcher who previously trained other teachers to support EF skills with students.

    seeded by the following open-ended questions:

- What barriers do children with weak Executive Function skills face while learning?
- How do you support Executive Function skills with children who need help with executive function and self-regulation? Are assistive technologies used?

Conceptual Framework

To guide the research, a conceptual framework was designed as a way to collect interrelated concepts. Chandrashekar and Wang's (2019) Platform-Process-Content framework and Kumaresan et al's Technology-Content-Pedagogy (TCP) framework, refer to a full-stack accessibility. Meaning each layer of the framework is necessary, must be used together and ensuring accessibility in each layer is necessary for an optimally inclusive online learning experience. For full-stack accessibility to happen, designers in EdTech who build VLEs must make sure that their products are accessible(Chandrashekar & Wang, 2019).

Inspired by these frameworks, we built the Assistive Tools, Learner Needs and Learning Interfaces framework. Three components were broadly conceptualized as influencing the design of a good learning experience in a VLE (Image 1).

a) Assistive Tools relating to facilitating multimodal methods for consuming accessible learning and supporting executive function needs.

b) Learner Needs, relating to the unique needs of each learner that accesses and interacts with online learning platforms and all associated tools.

c) Learning Interfaces relating to child-friendly interfaces based on human-computer interaction (HCI) and Universal Design for Learning (UDL) principles. UDL is a framework to improve and optimize teaching and learning for everyone based on scientific insights into how humans learn(CAST, n.d.).

This framework helped organize and interpret the findings in the following sections.

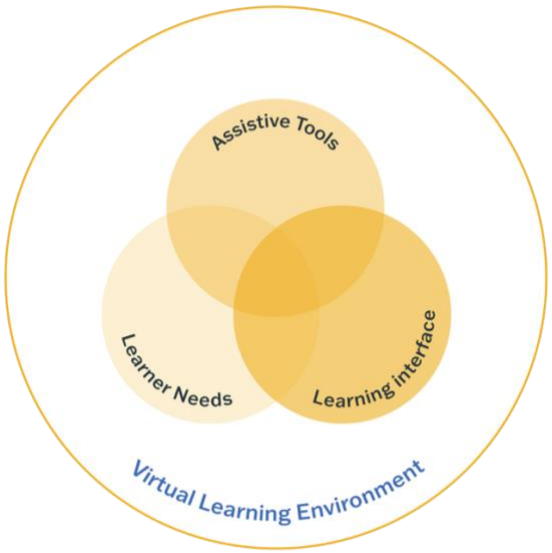

Figure 1: Conceptual Framework for inclusive Virtual Learning Environments

Literature Review

Neurodiversity refers to the diversity of neurological makeups across populations, emphasizing that our brain differences affect how our brain works (Spiel et al., 2022). In a survey of self-identified accessibility research papers published between 1994 and 2019, Mack et al. note that only about 5% of papers consider neurodiversity in populations (Mack et al., 2021). This literature review aims to add to existing investigations on technology design and its development and how it affects people with diverse needs. This analysis is dedicated to the context of supporting executive function skills (EF skills) of pre-literate adolescents in virtual learning environments. The readings were analyzed with focus on Assistive Tools (i.e., existing analog and digital design solutions to support EF), Learner Needs (i.e., how each learner is unique and how pre-literate individuals needing EF support were included or addressed in the research and how did potential participants act), and Learning Interfaces (i.e., the relation between learning environments, neurodivergence and adolescents).

Assistive Tools

This section considers analog and digital technologies that were developed and utilized for supporting EF skills classified into four broad categories–Smartphone, Wearables, Tangible Objects and EEG & Virtual Reality.

Smart Phone: used as either a general-purpose technology like setting an alarm or as a platform for time structuring applications like in MOBERO.

Wearables: interventions ranged from wristbands combined with smartphones (e.g., ParentGuardian, WRISTWIT), belts that measure inhalation or acceleration (e.g. Blurtline) to smartwatches

Tangible Objects: used in combination with a dashboard device (e.g., TangiPlan, ChillFish), or a countdown timer that visually shows time elapse (e.g., TimeTimer), or the use of tangible user interface in the form of a portable companion creature (e.g., KITA)

EEG and Virtual Reality: One of the devices used eight worn accelerometers, an EEG headset, and a smartphone to assist the child in regaining attention (CASTT) while another uses an EEG headband in a VR game to sustain concentration (Cogoland)

These interventions aimed to support executive functions for children in the following specific areas: *Social difficulty, Academic and Occupational Challenges, Behavioural challenges, Organizational and Planning skills, Emotional regulation, Impulsive Behaviour and Movement, Attention and Time Management, Working Memory.*

EF challenge	Social Difficulty	Academic & Occupational challenge	Behavioural Challenge, Organization & planning skills	Emotional Regulation	Impulsive Behaviour and Movement	Attention and Time Management	Working Memory
For Preschool Children		*TimeTimer*			*KITA*		
For Elementary and Middle School Children	*MOBERO*		*TangiPlan*	*ChillFish*	*BlurtLine*	*WRISTWIT* *CASTT* *Cogoland*	*CogMed*
For Adolescents							
Parents of Children	*ParentGuardian*	*TimeTimer*					

Table 1: Classification of current technologies to support executive functions for children shows that there is unmet need to support adolescents.

Upon studying these interventions in detail (See Table 2) to understand the principles used to design them, the following observations were made:

Name of Intervention	Solution description	Observations
MOBERO	• Used a smartphone system and novel timer devices. • Assists children with ADHD and their families in establishing healthy morning and bedtime routines, by providing structure and rewards.	• Many participants responded positively, but devices caused some participants stress and frustration. • Parents were responsible for defining the routine that the children were then guided through by the app. • System focuses on a reward system for completing tasks set by adults. • It is not mentioned if children were consulted about their preferences and experiences.

Name of Intervention	Solution description	Observations
TimeTimer	• Commercial product available in wristband, mobile phone app and physical device versions. • The clock visualizes time elapse in an analog form assisting to stay focused. • The face of the clock has the minutes marked on it and as time passes, a red disk decreases, showing the decrease of set time.	• Provides an option to view the passage of time in an analogous form rather normative pattern of portraying time. • Red colour and loud ticking may be intrusive to individuals with visual and auditory sensitivities.
TangiPlan	• Assists in completing morning routines using tangible connected objects to represent the morning activities the child must complete. • Children can define their own routines, set their own goals, and decide where to put the tangible reminders. • When starting the task, the child activates the physical reminder by pressing a button on it, starting a countdown of green lights (which turns red in case of delay) and after completing the task, presses the button again to record completion.	• Actively involved ADHD children and their parents in the design process • The system of only green and red lights to signify passage of time made it difficult for children to know how much time they had left for completing a task just by looking at the lights. • Unclear if this system and the interface will work for children with learning disabilities since an app needs to be used to set goals .
ChillFish	• A calming biofeedback game, whereby breathing through a tangible LEGO fish, the child controls a virtual puffer fish in a virtual underwater world. • The goal of ChillFish is to collect as many starfish as possible, which is achieved by performing a calming breathing exercise.	• Was designed in collaboration with medical/therapeutic professionals only involving children for the testing phase which revealed that it did not work well for them. • A chest strap during an emotional outburst may not be feasible.
Blurtline	• wearable prototype system initially designed for adults and later tested with children with ADHD to be used in school contexts. • Interactive chest strap monitors the wearer's breathing pattern (deep inhalation) to predict and prevent a child with ADHD from blurting (impulsive speaking behaviour). When a forthcoming blurt is detected, an alert is sent through tactile feedback.	• Risk of false alarms, e.g., if a child attempts to do breathing exercises in order to calm down. • Equipping children with wearable devices can be intrusive, and stigmatizing.
KITA	• A Kinesio-feedback Toy with a Tangible User Interface, designed as a 'portable companion creature'. • KITA measures and assesses children's activity and provides feedback to children through vibration. If a 'motor excess' is detected, it makes an unhappy face thus motivating children to make the toy smile by sitting still.	• Possibility for children to internalize their natural bodily movements make other people sad. • Ignores the role that movement might have for a child, e.g., supporting them in finding an outlet for their activity impulse or to calm down, and thereby enabling them to focus

Name of Intervention	Solution description	Observations
WRISTWIT	• A wearable device (similar to a watch) designed to support the sense of time and attention. • Watch displays time progress using LED lights and monitors body movement by means of an accelerometer alerting the child of inattentiveness. • The performance of the child is shown at the end of each class by LEDs in the timer presenting a green, yellow, and orange color-coding. • The drop-shaped LEDs symbolize water and can be translated to nurture a digital plant on a computer.	• Children expressed feeling proud of collecting the drops, eager to get more and knowing what to do to improve. • Such interventions depend on extrinsic motivation and children may internalize that their efforts are good only if they are rewarded. • Ignores the role that movement might have for a child, e.g., supporting them in finding an outlet for their activity impulse or to calm down, and thereby enabling them to focus
CASTT **(Child Activity Sensing and Training Tool)**	• Uses worn accelerometers, EEG headset and a smartphone to infer loss of attention and assist a child to regain attention in critical school situations. • Assistive component of CASTT is implemented through a smartphone-based quiz application that triggers simple mathematical quizzes, with the purpose of breaking the child's inattention and encouraging a return to focus on the task at hand. • Correctly answered questions are rewarded	• Risks further fuelling already prevalent stigma when children are in class with peers. • Intends to use a machine learning algorithm to efficiently recognize characteristic ADHD off-task lower body excessive motoric behaviours which can lead to biases regarding ADHD traits or potentially risk over diagnosis. • Methods for notification needs to be customizable to be inclusive of children with tactile sensitivity.
Cogoland	• Neurofeedback game based on an avatar in a 3D world, which has to complete a race as fast as possible. The speed of the avatar is controlled by the child's level of concentration, which is measured using an electroencephalography (EEG) headband on child	• the effect of these studies are inconsistent. • EEG headbands may feel intrusive for the child
Cogmed	• PC application that trains the child's working memory. A professional coach tailors the program and guides the user through five weeks of cognitive exercises, accessed on a computer	• based on research showing that WM capacity can be increased through training. • the effect of these studies are inconsistent and often based on small populations making definitive conclusions hard to draw (Sonne et al., 2016)

Table 2: An overview of existing research specifically for children, the tools designed and its implications to build more inclusive research.

Children need agency in the design process.

It is important to understand what the needs, expectations and personal goals of the child are otherwise designed interventions may not work well for them (e.g., ChillFish). The aim for many of the devices were to lower the parents' frustration levels by helping children build independence and healthy routines. Involving various stakeholders in the learning journey such as learners, parents, teachers, and caregivers is important but considering only adult perspectives in the design of devices and not explicitly attending to learner's specific perspectives, amplifies the power structures enacting on them in their daily lives. (e.g. MOBERO)(Spiel et al., 2022). As in the case of TangiPlan, the researchers chose to support individual strategies used by the children and parents to build a system that worked well for their home. Although institutional ethics review boards may place restrictions on researchers working directly with neurodiverse children due to their vulnerability, researchers can still strive to modify the activities and materials to facilitate the children's understanding and decision-making. This approach would provide the children with the ability to decide whether and how they wish to participate, thereby granting them agency.

Interventions need not reinforce neuro-normative patterns.

Neurodiversity affects how a person perceives time, interacts with information in their mind, uses language and more. Designs that try to mould children to view the world according to a set expectation reinforce neuro-normative patterns (e.g., TimeTimer, MOBERO). It is important to factor student variability and individual perception and thinking, helping to develop more flexible interventions.

In his book The End of Average, Todd Rose describes how the ‘average person’ is an artificial construct(Treviranus, 2021). Most individuals stray from the ‘average’ in some facet of their needs or goals and the needs of people at the margins of our society, become ever more diverse. This means that a mass solution would not work well. Appreciative engagement with participants having varying abilities and needs has the potential to benefit more people(Dalton, 2013) by triggering cycles of inclusion where diverse needs are met by the technology, inclusively designed solutions are made mainstream and more affordable (Treviranus, 2019).

Intrusive wearables

Wearables aim to provide meaningful information for researchers and can help users view personal data to support self-awareness and self-reflection. Yet, equipping children with wearable devices can be intrusive and risk further fuelling already prevalent stigma, especially when they are with their peers(Cibrian et al., 2020; Spiel et al., 2022). Notifications and feedback from the wearables in auditory, visual, or tactile form may become distracting or unfeasible during an emotional outburst (e.g., CASTT, Blurtline, ChillFish).

Employing stimuli-response conditioning approaches

Employing classical stimuli-response conditioning approaches, as training to suppress certain types of actions or to encourage others give a signal to children that impulsive behaviours are bad (e.g., Blurtline). Kinesio-feedback toys and wearables (e.g., KITA, WRISTWIT) that detect a motor excess in hyperactive children by making a sad face and encourage the child to sit still to make the toy happy again, ignore the role that

movement might have for a child. Movement supports them in finding an outlet for their activity impulse or to calm down, and thereby enabling them to focus. Such behaviourist conditioning strategy encourages behaviour modification(Hourcade, 2007; Sonne et al., 2016; Tavakoulnia et al., 2019), resulting in children internalizing that their natural bodily movements make other people sad or that sitting still will get them a reward.

Focus on certain behaviours by rewarding them.

Many of the devices use some sort of reward for successful completion of task or to stay on task (e.g.MOBERO, KITA, WRISTWIT, CASTT). For example, children testing WRISTWIT expressed feeling proud of collecting the rewards, eager to get more and curious of how to do it what to do to improve. This system encourages certain types of behaviours which adults deem positive such as sitting still and focusing during class and try to suppress other behaviours. How children focus can vary individually and at different times for the same person. According to research, such systems not only try to mould the child according to typical expectations of behaviour, but may also decrease any intrinsic motivation for learning as the children grow (Kohn, 1994).

Learner Needs

Disabilities need not be stigmatized.

Several studies conducted to develop technology to support executive functions focus on Autism or ADHD(Cibrian et al., 2021; Eriksson et al., 2017; Sonne et al., 2015; Tamm et al., 2020; Weisberg et al., 2014). However, most present these populations from a deficit perspective, portraying neurodiversity as disruptive and as having

undesirable behaviours that need to be suppressed (Garcia et al., 2013). Disabilities have been viewed through different lenses called ‘models of disability’ — as a deficit found within a person; a medical condition that should be cured or treated (medical model), as a mismatch between the users’ needs and the system or environment causing the disability (social model) and as a valuable, natural form of human diversity without categorizing differences as disability and normality(cultural model)(Collingwood et al., 2020; Retief & Letšosa, 2018). In large part, the reviewed literature is guided by a medical perspective, focusing on neuro-normative outcomes (Spiel et al., 2022; Tavakoulnia et al., 2019).

The Inclusive Design model recognizes unmet needs of the person in a product, system and/or environment as the disabling factor and introduces practices and design thinking methods to continuously engage those who are excluded in all levels of design (Collingwood et al., 2020; Treviranus, 2021). While research shows that providing early executive function training can prevent widening achievement gaps, particularly for children with learning disabilities or difficulties in attention management (Cibrian et al., 2021; Diamond & Lee, 2011; Payne & Swanson, 2022) it also conveys popular belief that ADHD or Autism is a condition one “grows out of” (Spiel et al., 2022) and thus requires intervention in childhood so it can be erased in adulthood.

The notion of neurodiversity, a term coined by Judy Singer, offers a non-deficit focused concept of understanding different neurotypes(Dalton, 2013; Gedye, 2020; Spiel et al., 2022). Without attributing a qualitative value to the difference in neurotypes, it is constructed as a mere difference. Ableism is a set of beliefs or practices that devalue

and discriminate against people with disabilities(Collingwood et al., 2020). This is often due to many assumptions and limiting beliefs about what disability does or does not mean. For example, some statistics share that those with attention deficit hyperactivity disorder (ADHD) are likely to be highly creative and strong multi-taskers with the ability to operate in stressful high input situations and given the right triggers they are able to hyper focus on tasks(Dalton, 2013). Although such data intends to address the needs of people who are viewed as different, it ignores variability between people who experience ADHD and propagates the notion that there is a one-size-fits-all version of accessibility for people who experience disability.

VLEs don't meet the needs of learners with developing EF skills.

Depending upon the theory of executive function, executive functions have been defined in different ways. Barkley (2005, p. 56) defined executive functions where the core concept was self-regulation. Stuss and Benson (1986) defined executive functions as:

> ''The planning and sequencing of complex behaviours, the ability to pay attention to several components at once, the capacity for grasping the gist of a complex situation, the resistance to distraction and interference, the inhibition of inappropriate response tendencies and the ability to sustain behavioural output for relatively prolonged periods'' (p. 158).

Gioia, Isquith, Kenworthy, and Barton (2002) defined executive functions as a general concept, encompassing all supervisory or self-regulatory functions, which organize and

direct cognitive activity, emotional response, and overt behaviour (p. 122). Even though there are significant differences in how executive function(s) is defined, there are several well-accepted concepts related to executive function.

Executive function and self-regulation skills are the mental processes that enable us to perform goal-directed tasks using organizational skills to plan, sustain attention, remember instructions, and control impulsivity(Center on the Developing Child at Harvard University, 2014; Kumaresan et al., 2022; Weisberg et al., 2014). VLEs require learners to independently analyze content on the interface, integrate it to form plans of action and modify those plans when necessary, posing barriers for children with developing EF skills to interact with the VLE. An inclusive education setting with a social and cultural model of disability may focus on progress by providing technology or other resources available for all students to use based on needs or preferences, individualized curriculum that is designed to be flexible, and welcomes all forms of difference, including disability. The system would be adapted to meet learners, rather than expecting learners to fit within the system. Through inclusive design, all stakeholders in the education setting would engage in building the system itself. In the context of VLEs, little research has been conducted on developing the learning interface to support learners in their own learning journey(Tamm et al., 2020; Weisberg et al., 2014). The interface needs to adapt to how the learner sustains routine, interacts with distractions, interpret assignments, and navigates technology.

Text based complex interfaces magnify navigational challenges.

Academic performance has been associated with learners' cognitive abilities (Tamm et al., 2020). In the Unites States, milestones set for children include that by kindergarten most children should identify and name letters, read their name, and a few simple common words. By third grade, most children should spell common words correctly and read primary-level fiction and nonfiction. By sixth grade, most children would read with confidence and can spell a majority of words correctly(Hourcade, 2007). The learning needs of children are highly variable and may not conform to developmental expectations related to age. Often, VLEs labelled "Appropriate for K-12 Use", rely on interactions using written mediums requiring complex typing and proper spelling for information transmission; reading for information retrieval(Hopkins et al., 2013), or necessitate an understanding of abstract concepts or content knowledge (Druin et al., 2001) with the expectation that the children would have acquired literacy skills by adolescence. This can affect the quality of the learner's interaction within the VLE leading to unexpected results for input commands and frustration.

To move past convention and toward a more inclusive perspective, research should involve learners who identify as pre-literate and require executive function support within VLEs to better understand their needs.

Research needs to address the unique needs of adolescents.

During adolescence, executive function skills are not yet at adult levels, but the demands placed on these skills often are(Center on the Developing Child at Harvard University, 2014; Payne & Swanson, 2022; Tamm et al., 2020). As teenagers look for independence(Cibrian et al., 2020; Tavakoulnia et al., 2019), they may need to

communicate effectively in multiple contexts, manage their own school and extracurricular assignments, and successfully complete more abstract and complicated projects.

Although a lot of previous research explores technologies to support executive functions in children, we know very little about the specific experiences of pre-literate learners in virtual learning environments, perhaps because remote learning at the K–12 level is relatively rare—a 2012 review, for example, identified only six empirical articles that examined online instruction for K–12 students with disabilities (Vasquez & Straub, 2012). Subsequent research has been conducted with older participants from post-secondary institutions and is sometimes used by policy makers and/or educators to generalize regarding K-12 education (Dixson, 2010; Hung & Zhang, 2008). Neither of those segments of the population learning in online environments encompasses the group of learners who attend school in full-time, K-12 online environments (Curtis & Werth, 2015).

Learning Interfaces

While learners with disabilities may find online courses to be particularly attractive because it offers accessibility through options for learners to learn from anywhere and anytime, access content that is adaptable for different modes of interaction (e.g. speech-to-text, text-to-speech, changing font size and contrast, translating into another language and more), and the opportunity for learners to discover, express and explore how they can optimize their own learning. These potential benefits are not always

realized due to the lack of organization& consistency, unmet need for educational assistance and lack of inclusion in the design process of learning environment. This section discusses barriers learner may face in VLEs due to the interface design.

Lack of organization, consistency, and inadequate instruction

An inclusive learning environment is an ongoing process–one where the learner experiences increasing presence, participation and achievements of all children and young people(Andersen & Sorensen, 2015). For learners to feel empowered in this way, Anderson and Sorensen (2015) identified some critical learning competences that the environment must facilitate: (i) to be heard & recognized, (ii) get experiences and opportunity to explicate these experiences (iii) courage and ability to join learning and life with an identity (iv) negotiating with other learners and learning to take the perspective of others (v) Learning must be scaffolded and take place in the zone of proximal development to create a state of flow for the learner.

Prior to the pandemic, learners had little interaction with a virtual learning environment since learning was synchronous and any asynchronous tasks were later shared in class. As schools began closing for in-person instruction in March of 2020 to mitigate the spread of COVID-19, schools across Canada varied widely in the type of remote learning they implemented. Teachers struggled to understand the implications of remote online instructions. Remote teaching in Ontario was delivered both synchronously and asynchronously although the delivery method varied greatly across teachers(Timmons et al., 2021). Synchronous delivery included connecting with students in real-time whereas asynchronous opportunities consisted of posting all required materials online

for students to work through without real-time interaction with their teacher or peers. Asynchronous learning allows more flexibility as students can complete learning activities on their own schedule (within parameters set out by the teacher). This variation also meant that many students with disabilities were also left without adequate instruction. This affected how they navigated the interface, if and what kind of accommodations they could receive, their social connection with peers and teachers, and sometimes their choice to disclose their disability to their instructors for fear of being stigmatized (Averett, 2021).

Teachers found that training parents and guardians to provide more specialized support (Schuck & Lambert, 2020; Tremmel et al., 2020) and often partnering with them to oversee and support learners in an online environment helped the learners(Curtis & Werth, 2015)

Parents identify an unmet need for educational assistance.

Parents and guardians of children with disabilities who are learning remotely often feel they need to take on a very active role in children's learning, acting as "co-educators," organizing and managing children's schoolwork, and, occasionally, providing instruction (Garbe et al., 2020; Waters & Leong, 2014). Parents discussed the extent to which they were able to support their children with remote learning, was often dependent on the amount of time that they could allocate based on their work requirements and educational supports available to them (Timmons, et. al, 2021). The shift to remote learning, has thus introduced new barriers to inclusion for both students and parents,

and the “unmet need for educational assistance has been staggering and challenging for families to navigate” (Houtrow et al., 2020, p. 417).

VLEs are being designed for children, without children.

Within HCI, there is a deficit regarding detailed studies of design and user experience that build on top of each other and in consequence, little accumulation of design knowledge of how to design VLEs that support young learners, more generally (Sonne et al., 2016; Spiel et al., 2022).

Several technologies intending to support executive functions for children were developed in recent years: many did not include children during development and were designed solely based on feedback from adults who interact with the children (parents, guardians, teachers, occupational therapists, psychologists) and later tested on children; some included children but do not take into consideration their inputs, therefore it is unclear how well suited for the children’s needs (Zuckerman et al., 2015). Natural human variance causes, us all to have different experiences in similar academic, behavioural, emotional, and social situations. For example, notifications and calendar systems used in VLEs may help some learners plan and remember tasks but for learners who are sensitive to light and auditory stimuli these notifications could become overwhelming, making it difficult for them to concentrate on the task they are performing. The technologies represented lack perspective on what children want from a virtual learning environment; interfaces that adequately account for neurodivergence as a mere difference, that attend to existing strengths, are adaptable and allow for self-determined engagement with technologies.

Research Methodology

Participatory Design and Inclusive Design

The current study was carried out using a co-design approach that is part led by researcher, drawing from the participatory design methodology and an inclusive design framework. Participatory design is based on the constructivism paradigm which states that “people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences” (Adom, 2016)

Further, Inclusive design is practiced in the current research process by working within the three Inclusive Design Dimensions(Treviranus, 2021)

1. Recognize, respect, and design with human uniqueness and variability.
2. Use inclusive, open, and transparent processes, and co-design with people who have a diversity of perspectives, including people that cannot use or have difficulty using the current designs.
3. Realize that you are designing in a complex adaptive system.

Co-design is the process of designing with people rather than for them(Introduction to Community-Led Co-Design, n.d.). It constitutes an approach and a vision that argues for involving people who are most impacted by the design of these technologies, especially those with needs least served by existing designs, are involved in the process from the beginning(Fails, 2012; Fekete & Lucero, 2019; Frauenberger et al., 2017). Participants

are not involved as research subjects or consultants, rather as designers engaged in active and sustained collaboration.

This design approach was selected for this research because it operates within an inclusive design framework by creating more engaged communities, recognizing community leadership, taking place in a familiar environment, and moving from design that is conducted for the community to design that is carried out by the community (Introduction to Community-Led Co-Design, n.d.)

The community-led co-design process inspired the activities created in later sections. There are three main stages described by the IDRC (Introduction to Community-Led Co-Design, n.d.) which include Discovery, Brainstorming and Refinement (Image 2) .

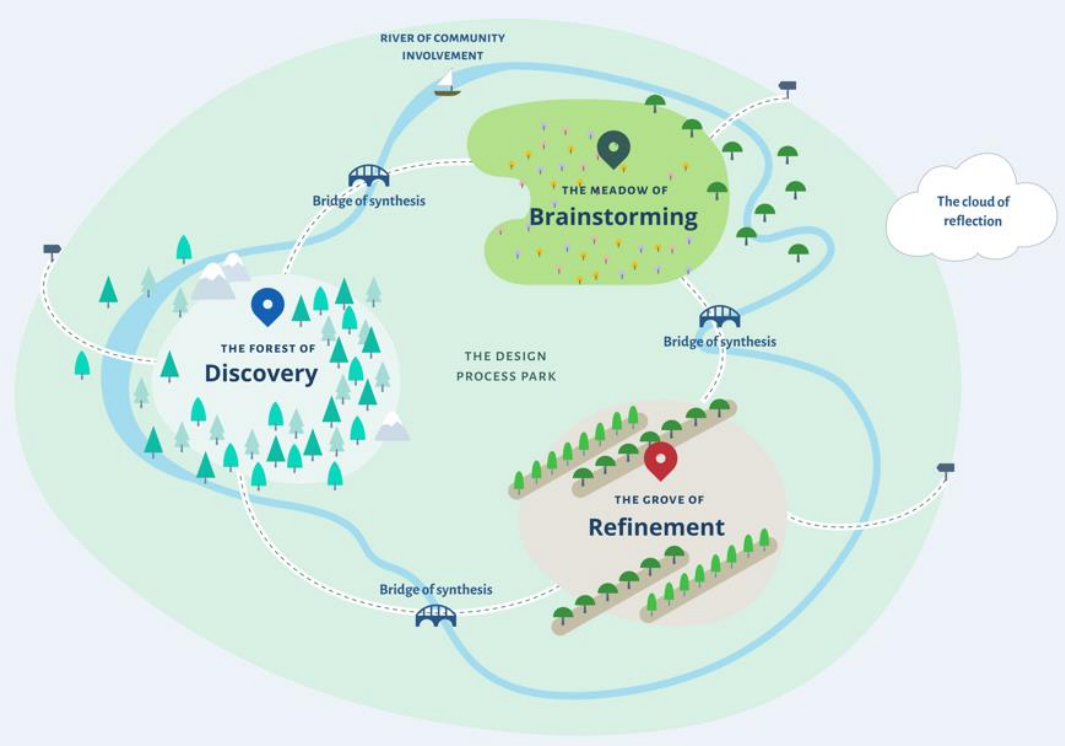

Image 1: Design process explained through a park metaphor illustrating how co-design can be used to make the process more inclusive (Source: Community Led Co-Design Kit).

Discovery

In this stage, researcher meet with community members to gain a deeper understanding of the topic or issue and how it affects different community members. Researchers then make sense of what they heard from community members to share it back with the group.

Brainstorming

In this stage, researchers create space for community members to come up with and explore lots of ideas.

Refinement

In this stage, community members pick the idea (or ideas) they would like to take further. A functional version of the idea (a prototype) may be created at this stage and community members will provide feedback on the prototype to see how well it works.

Children’s Participation in Design Process

Involving children in research can be a valuable way to gain insights into their perspectives, experiences, and needs. However, it's important to ensure that any research involving children is carried out in an ethical and responsible manner, with the welfare of the child as the top priority. Research should be meaningful and fun for children, recognizing the demands of time and focus, whilst promoting a move from ‘research on’ through ‘research with’ to ‘research by’ children (Fekete & Lucero, 2019).

There has been a significant amount of research focused on modeling the impact and extent of participation of children in research. In a depth style model proposed by Druin (as seen in Read et al., 2017), the emphasis is on the perceived increasing influence of the child as the circles expand in terms of the roles the children take on in research. The design partner is also, in this view, an informant and the informant a tester and so on (Image 2). In this body of literature, children typically participated as evaluators of a product, (**designed for them**– as in ChillFish, Blurtline, CASTT), and in a few cases as contributors to a research study (**designed with them**– as in TangiPlan, KITA) or as designers of ideas and products (**designed by them**– as in Smartwatch, Takt)

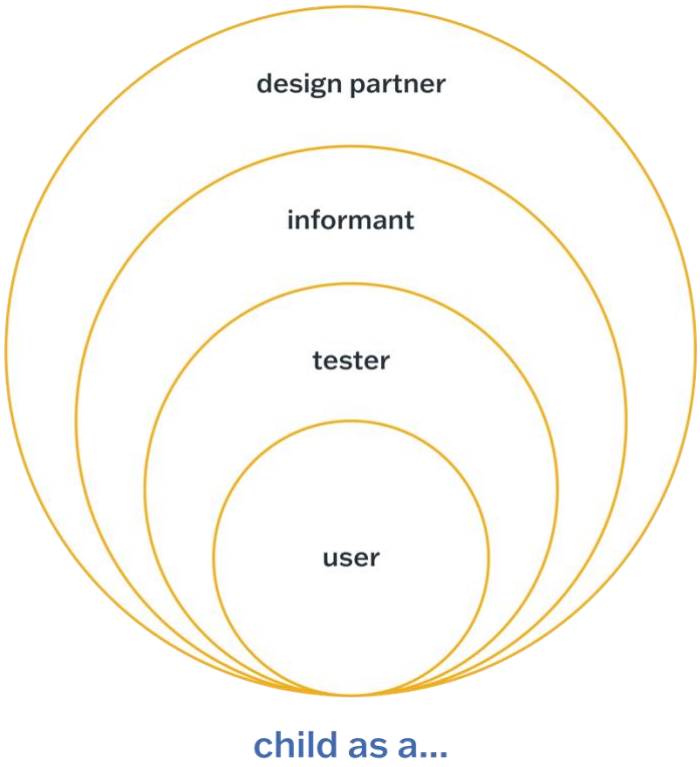

Figure 2: Participation according to role

Ethics in research for inclusion

The Research Ethics Board (REB) provides ethics guidance that applies to all research involving human participants. Within Inclusive design, practices such as co-design benefit from participants voluntarily and actively engaging in discussing their needs and collectively working with designers to build sustainable solutions. Initially this project faced some challenges in working directly with pre-literate adolescents who are developing EF skills due to the ethical concern of sensitive information regarding the children being discussed as a group. But the students and their circle of care are experts of their own needs with respect to their educational journey and hence it is important to have this conversation. While discussing varying needs of learners, it is essential to normalise how people differ from one another and that such difference is a beautiful thing. Such topics may be uncomfortable, but open discussion is one way to de-stigmatize our cultural assumptions around neurodivergence.

Another concern was regarding ‘informed consent’ and if the adolescent co-designers will understand maintaining confidentiality of discussions within co-design. Researchers sharing ize details of the participants without permission would be an ethical oversight, but making learners aware that their discussions within the co-design sessions need to remain confidential further fuels stigma related to their disabilities. Researchers can work adapt the process of inviting participants to actively contribute to research work in a way that they can best understand, thereby blurring the distinction between user and designer(IDRC, n.d.).

Research Ethics Review

This research was conducted collaboratively with a school for children with severe learning disabilities. After seeking authorized permission from the principal of the school in the form of permission letters and being reviewed by the Research Ethics Board at OCAD University, this research received ethics clearance on February 10th, 2023. As part of the process to obtain approval, an application outlining all the details regarding co-designers' recruitment, recruitment material, procedure, analysis methods were shared for review.

The study would benefit from a total of 6-9 co-designers comprising of 2-3 learners and their respective parents/caregivers. This is an appropriate size to gain insights into barriers through iterative co-design. The research did not aim to generalize conclusions or transfer findings but to discover unmet needs in current VLEs.

An in-person co-design session would benefit the study since it investigates executive functioning barriers children face specifically in an online environment. It would also facilitate observation of nuances in parent-child interactions related to online learning better as compared to a virtual co-design session. As a special consideration to mitigate catching viruses, masking was suggested, masks and hand sanitizers were made available for the session, along with flexible break times as required by co-designers. Co-designers were given the flexibility to engage in the session verbally, in written or through drawings to make them comfortable.

Co-designers

The Trillium Demonstration School gives enrolled learners with special learning needs, the opportunity to engage in a wholesome school experience. Recruitment was limited to learners at the Trillium Demonstration School as criteria for enrolment at the school matched the barriers to be addressed in the research. In this study, we wanted to work with children of grades 6-12 typically between ages 12 and 17. It is important to note that children with learning disabilities may not conform to developmental expectations of this age. To move past this convention of age, the research used the term pre-literate for children who identify as having difficulty reading and writing compared to typically developing children of the same age. These disabilities need not be stigmatized and open discussion about the learner's needs, can help support their learning better. The learners and their caregivers are experts of their own needs with respect to their educational journey and hence it is important to have this conversation.

Adaptations to the consent-to-research process

The recruitment poster and invite were shared with school and all parents to inform them about the research. A presentation of what's involved in this research(intent and process of the research along with the roles of the co-designers) was delivered at the school to all the students for their convenience. After the presentation, 12 interested students provided consent to take part. These students' parents were emailed the invitation letter and consent forms so that learners and parents could make an informed decision to participate. 8 Consenting students were recruited. While 3 parents were interested in taking part, they were not able to attend the session in person due to full time jobs and time constraints.

To protect the privacy of personal data of the participants' real name and family information (Identity), and contact information is kept confidential. Further, co-designers were informed that their participation is entirely voluntary and does not affect their relation academically or otherwise with the school to mitigate the risk of participants feeling obligated to participate due to the study being conducted through the Demonstration school. Co-designers were also informed that after joining the research, if they were uncomfortable answering certain questions or participating in activities, they were free to skip these or withdraw from the research entirely. Co-designers were offered the choice to be attributed for their contributions to the research.

Research Setting

The research consisted of a two-part creative session called Mission Focus. The sessions were conducted on Trillium school's campus in Milton, Ontario. Both sessions were held in the afternoon post morning classes on two consecutive days. Session 1 was 2 hours long with breaks in between to allow co-designers sufficient time to complete tasks and provide their thoughts. The sessions were designed as a mission, to try and engage the curiosity of the co-designers and to make them welcome as an active member in researching the topic. Activities included Affinity Mapping and Clustering, User Journey Mapping and Solution Sketching. The activities were planned in a way that will give agency to the participants to build the session based on needs they identify and want to solve for. Spiel et al., (2022) recognise potential in technologies supporting executive functioning on self-given tasks. In opposition to making people adhere to an externally defined task regime, they suggest identifying

opportunities for supporting and allowing people to figure out how to get those things done that they want to succeed at intrinsically. While Session 1 explored challenges and strategies to focus and organize learning goals, Session 2 aimed at creating a model of learning that the co-designers envisioned and may address challenges discovered in the previous session. During both sessions, participation was recorded through note taking, audio recording and photographs for documentation. Ideas collected through co-design were analyzed while backing them with user interface design principles and insights from the literature review to report guidelines and suggestions for further research in VLE design.

Design Activities

This chapter walks through the activities in detail performed throughout the five phases of the design process: understanding context through expert interviews, co-designing the mission focus sessions, the activities in discovery, brainstorming, and refinement stages.

Expert interviews

A total of 3 expert interviews were conducted between November 2022 and January 2023. Experts consisted of individuals who have professional backgrounds in UX design specifically in developing virtual learning platforms, in special education needs teaching and training. I recruited experts through my advisor’s network and through conversations at a conference on Assistive Technology.

Observations

In addition to comprehending a student's requirements on the virtual learning environment (VLE) for concentrating, it is crucial to consider the psychological aspects of children's learning. To assist in developing executive function in children, the researcher must recognize the delicate balance between dependence and augmentation that arises from utilizing technology. When collaborating with children to design research, smaller groups are preferable as they allow for individual input and facilitate a better understanding of the rationale behind their choices. Through the CEC conference, as I heard several teachers, researchers, and technology providers, it was

evident that there is a host of low-tech and high-tech assistive technology available for educational support but there is a need for these to be integrated into VLEs seamlessly. There is also a growing awareness for participatory and co-designed strategies with children for learning regulation.

Co-designing the ‘Mission Focus’ sessions.

Over the period of January and February 2023, I collaborated with the principal from Trillium; as they are most familiar with the context and culture of their community (IDRC, n.d.-c) and with my advisory committee to design important aspects of the co-design process. The principal’s contributions applied to both the design outcomes and the design process, providing guidance on alternative formats to support participation, accessible meeting spaces in the school campus, and plain language. She helped facilitate the session in planning the materials, schedule, and logistics for the sessions and coordinate with potential co-designers who were interested in participating from the school community.

The ‘Mission Focus’ activities

The activities planned were to navigate through the discovery, brainstorming and refinement phases as described previously but to also be amenable to the needs identified by the co-designers. Each student received a printed co-design kit that had easy to follow along steps to accompany verbal instruction given by the facilitator during the sessions (See Image 4).

Image 2: Co-design toolkit for Mission Focus

Sessions began by welcoming the co-designers and a brief explanation of the research followed by obtaining verbal consent from the co-designers to participate. To warm up for the session we had an icebreaker that aimed to establish codenames for the co-designers and to understand their expectations for the session. The **discovery phase** had two activities which helped children reflect upon the best learning scenario for themself and on their challenges and emotions in those optimal learning scenarios. The second activity helped participants take a deeper look into learning goals that co-designers identified as lacking in the virtual learning environment. The **brainstorming phase** had one activity aimed at creating as many ideas as possible to address participant identified objectives from the discovery phase. The final **refinement phase**

had one activity to investigate co-designers' wants and hopes, in the current system of learning and to understand their dreams for the future regarding learning followed by feedback and an open discussion about the ideas discussed during the session.

The following section discusses the activities and co-designer’s responses gathered during the sessions.

Findings

As the session began, co-designers were welcomed and informed of the audio and video recording of the session. Making clear that participation was voluntary, and they could opt out of answering certain questions or withdraw from the research, they were told about the different ways in which they could participate (verbally, by writing and drawing). After obtaining verbal consent, we proceeded with the activities of the session.

Image 3: 'Mission Focus' co-designers preparing for a generative co-design session.

Co-design session 1

The first co-design session was conducted on March 01, 2023, with 8 co-designers who consented and had parental consent to join the research. The objective was:

- To gather lived experience of co-designers engaging with a virtual learning environment as part of their school activities.
- To understand the needs of the student related to executive functions in a virtual learning environment.

During the ice breaker, co-designers created ‘superhero codenames’ for themselves and these names are used in this report as well.

Co-designer codename	Age	Gender
Croissant	11	Male
Apple Juice	14	Male
Agent Apple	14	Male
Salt	14	Male
Corneleas	14	Female
Big Pickles	14	Male
Big Mac	14	Male
Pepper	14	Male

Table 3: Co-designers’ Profile

One of the first activities we had was to create a ‘Learning Vision Board’ through Affinity Mapping. We engaged in discussion about an ideal environment for learning. From their lived experience, co-designers observed why that scenario helped in focusing on learning, how it made them feel, technological and human supports involved to help focus. The students clustered their findings based on similarity or relatedness of the findings to reveal themes. The three themes, according to the group, that defined a supportive learning scenario that helped them focus on learning were– (a) **building a positive mood to learn**, (b) **an environment that fosters active listening** and the ability for learners to easily follow along and (c) **A space that makes learning efficient** through the assistive technology it provides.

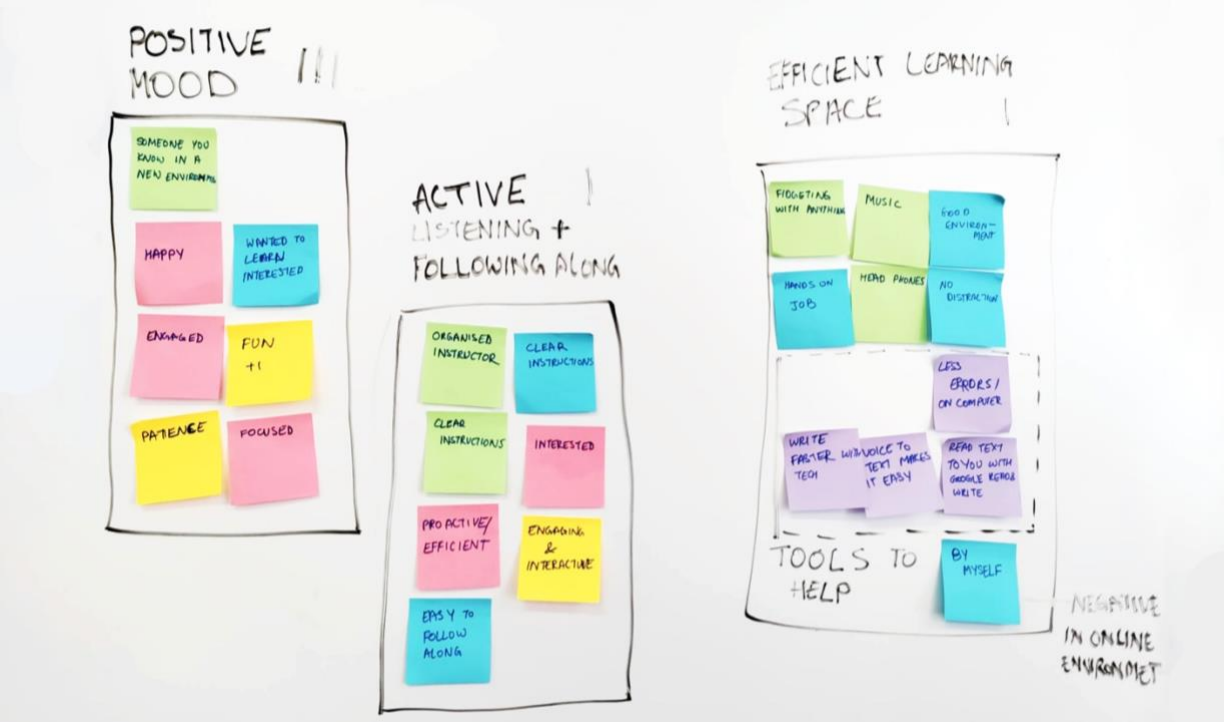

Image 4: The Learning Vision Board created by “Mission Focus” co-designers.

Positive Mood	Active Listening and Following Along	Efficient Learning Space
Learner feels happy	Organized instructor	No distractions in the space
Feeling Engaged	Clear instructions	Managing attention with fidgets
Having fun while learning	Occurs when learner is interested	Provides Hands-on learning experiences
Learner is interested and wants to learn	Makes learner proactive and efficient	Use music as a method to focus
The environment, teacher or guide is patient	Content is made engaging and interactive	Technology that helps decrease errors in work by keeping check
Helps stay focused	Content is designed to be easy to follow along	Affords tools or technology that: a. Help write faster. b. Dictate text. c. Read text aloud.
Familiar person in a new environment helps		Able to learn alone (without distractions). This can also be negative (loneliness)

Table 4: Responses captured in the Learning Vision Board, categorized into three themes.

Following this, we tried mapping the students' journey while trying to complete a task with focus. The task given was to complete homework independently while sustaining focus throughout. The map was divided into several phases as follows: gathering information, considering options, during the task, keeping check and after completing the task. At each phase, the co-designers were asked to respond to three questions:

a) What are they saying or thinking? This was to understand mental considerations taken before task initiation.
b) What are they doing? What actions are being performed or what decisions are being taken to move forward?
c) What are they feeling? What emotions are they feeling as they go through different thoughts and decisions?

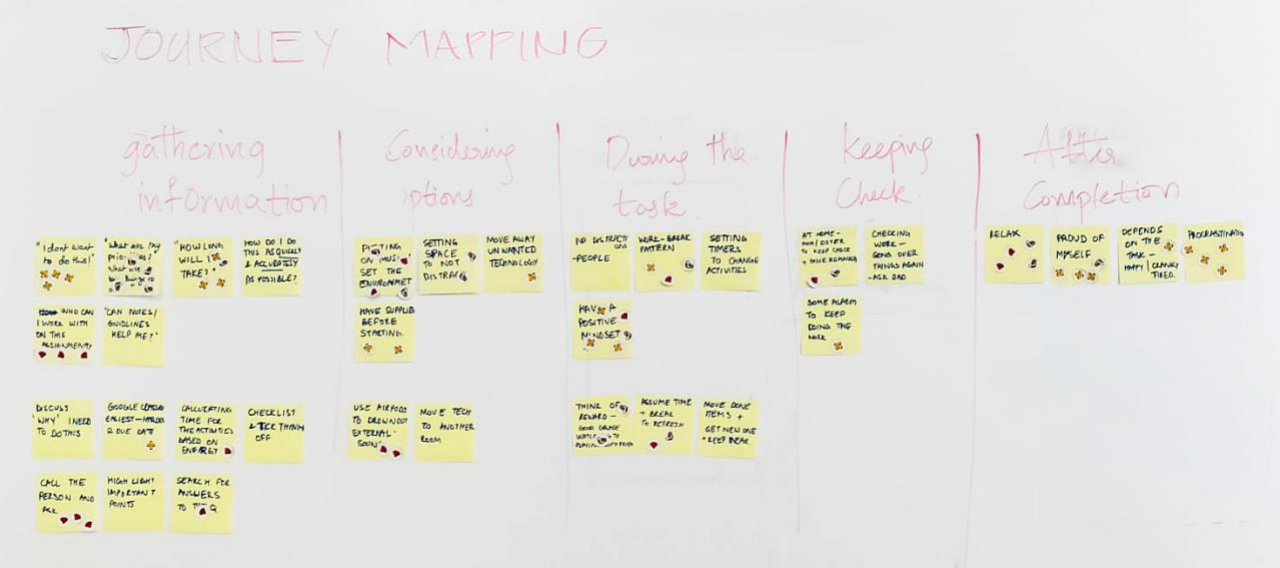

Image 5: The Project Journey Map for the task of completing homework with focus.

Prompting questions	Step 1 Gathering Information	Step 2 Considering options	Step 3 Doing the Task	Step 4 Keeping Check	Step 5 After completion
What would you say?	• I don't want to do this! • What are my priorities? • What are the 'big things' to do? • How long will this take? • How do I do this as quickly and accurately as possible? • Who can I work with on this assignment? • Can my notes/ guidelines help?	• Putting on music to set the environment. • Setting the space to not distract • Moving away unwanted technology • Have supplies before starting.	• Requesting other people to give space to avoid distractions. • Follow a work-break system such as Pomodoro method. • Setting timers and alarms to shift to next task. • Maintain a positive mindset	• Mom/ older sibling keep check and remind to be focused. • An alarm to stay focused.	• Relax
What would you do?	• Discuss why I need to do this with caregiver, parent, or guardian. • Check Google classroom and sort task based on hard-easy. • Sort task based on due dates- earlier dates first to later dates. • Plan tasks based on how much energy I have now.	• Make a check list and tick things off. • Call my classmates and work on the task together. • Use air pods and listen to music or white noise	• Highlight important points so I don't forget. • Think of the reward to motivate me. • Moving completed tasks and arranging items for next task near by	• Adults support re-checking homework.	• Procrastinate

Prompting questions	Step 1 Gathering Information	Step 2 Considering options	Step 3 Doing the Task	Step 4 Keeping Check	Step 5 After completion
What are you feeling?	• Not Motivated to do work. • Apprehensive				• Mood depends on the task completed. • Tired • Happy

Table 5: Ideas captured at each stage in the Journey Map by "Mission Focus" co-designers.

After gathering their ideas to each of the above questions, co-designers were given stickers of 'bandages', 'rubies' and 'hands'. These symbolized pain points, opportunities, and areas of adult support respectively.

Image 6: "Mission Focus" co-designers identify most important pain points, opportunities, and support areas in their learning experience by adding stickers on the Journey Map

In the following section, we describe the analysis of our journey mapping, in particular, we outline the need for children to have **learning environment that fosters a positive mood**, challenges related to **forming priorities and sustaining routines** faced by the child, the need to tackle loss of social connections through **accountability partners**.

A learning environment that fosters a positive mood.

It was interesting to note how the co-designers first concern about doing homework was related to inability to initiate tasks. In a school setting, task initiation, among others, fall under the EF framework of skills that students need to be successful(Payne & Swanson, 2022).

> **Croissant & Corneleas:** “I don’t want to do this!”

> **Salt:** “Usually, I’m getting told by either by a counselor or my parent, why I need to do the work. Or it’s like somebody just telling me that I have to do the work.”

The children are familiar with the use of a token-based economy where they are motivated to complete tasks in school and at home by being offered rewards for successful completion. This contrasts with Dewey, Montessori, and Vygotsky recommendation that motivation can be achieved by making learning activities relevant

to children's lives and interests(Hourcade, 2007). The children internalise that motivation to learn should be to achieve a reward and failure is something to be afraid of, as one of the students puts it:

> **Salt:** "I think if I put in effort, I think of the accomplishment. So, I think of the reward. It may be like someone saying good job or it might just be me thinking, if I do this, I will get a good grade. Or the idea of not failing."

Other ideas of rewards for completing tasks included time to watch TV and play with friends.

Techniques for Self-motivation also included a consequence system where the student allotted certain time to finish a task and then for break. If the task took longer, the time for break decreased hence motivating the student to work faster.

Building priorities and routines within a supportive learning environment.

Another idea that crossed the student's mind was to identify the 'big' tasks or their priorities and then plan to focus on the work accordingly. While all co-designers understood the need to plan and prioritize tasks, they also marked this activity as an area where adult support would help them through the 'hands' stickers.

> **Corneleas:** "I kind of like think of what my priorities are and the big stuff I need to do"

Salt: “I check my Google Classrooms. So, like, I figure out the due dates; which one [of the tasks] is the easiest to the hardest and the dues dates.”

Apple Juice: “Sometimes I plan them [the tasks] myself and sometimes I ask my parents, buts mostly myself. I ask my parents when I don’t know if I did it good enough, or proper.”

While discussing prioritizing tasks, the student’s way of approaching the tasks were different. This highlights variability in learners and how a particular student’s needs may vary according to the situation.

Salt: “Oh, I work hardest to easiest... Like I put [the tasks] in order the easiest to hardest, cos usually the harder ones take longer, so it’s about okay its hard but its due soon.. I have to do that one first. But if it’s easy and its due two weeks later, I’ll do it later or its due tomorrow I’ll do the harder one first cos I know I will finish the easy one fast.”

Salt: “say I have 10 easy assignments and 5 hard ones; I’d rather finish the 10 easy assignments today and do the 5 tomorrow cos the 5 hard ones take longer and more energy. This also makes me feel more efficient.”

Croissant: “The 5 hard assignments take as much time as the 10 easy ones”

Apple Juice: “So I kind of do the same thing, I do the harder first and then save the easier for last, either way whether its due tomorrow or later that’s what I do. Or if it’s too hard, I’ll do the easy one a little bit and quickly go back to the harder one. So, I prefer going harder to easiest cos then we get all the hard stuff out if the way cos as soon as the easy stuff is done, you’d want to get it over with already. And as soon as you see, for example this really hard essay, you feel like ‘I don’t want to do this’ and then you’re not gonna do it. And if you compare the hard assignment [you just finished] to the easy one, you feel like this one is so simple, and I can do this.”

To move from one task to the next, a student suggested that the next task be in sight or nearby so that mentally they would be prepared for it.

Having accountability partners

While most students thought of the phone as a distraction while studying, they suggested the timer or alarm feature to be helpful when trying track time and move through tasks efficiently. Having an adult check up on them regularly helped to ensure they weren’t getting distracted or could be pulled back to task if they did get distracted.

Having such accountability also extended to the peer group where students looked to work on assignments together and be able to discuss their concerns or answers.

Salt: “Who else is working on this assignment. I wonder if one of my pals is also working on this, so that I can work with them.”

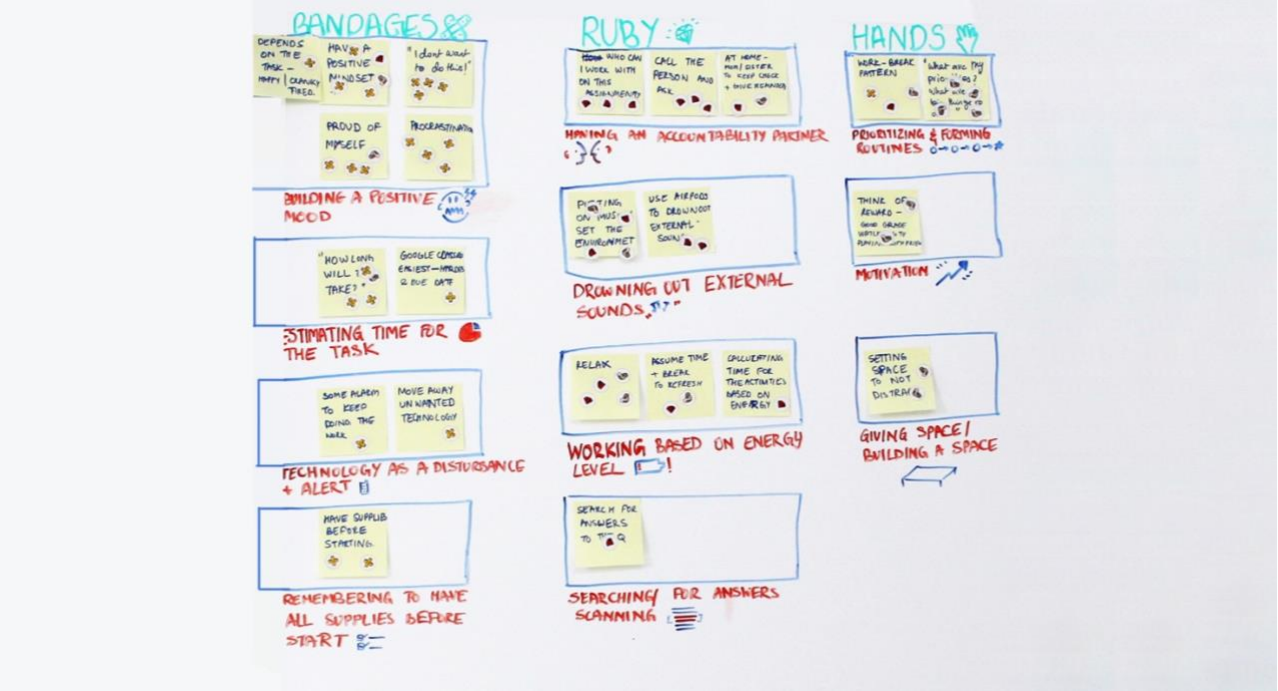

Image 7: Analyzing ideas from the Journey Mapping activity to form themes.

Bandages (Ideas that were identified as a pain point in completing homework with focus)	Rubies (Ideas that were identified as an opportunity to be developed to support all learners)	Hands (Ideas where adult support was preferred)
Building a positive mood	Having an 'Accountability Partner'	Forming routines, setting, and understanding priorities
Estimating time for the task	Shielding from external sounds	Motivation to complete tasks at hand
Technology as a tool to alert and as a disturbance	Working based on energy levels	Giving space and building a designated learning space
Being ready with all supplies before starting tasks	Searching or scanning content to find relevant information for learners	

Table 6: Ideas discussed in the Journey Map analyzed thematically.

After this the students tried to generate Ideas to address problem areas related to focus identified through Crazy 4 sketching. This activity involved co-designers choosing one touchpoint on the Journey Map that they would like to ideate on and address it in 4 different ways. Co-designers were given 2 minutes to doodle each idea. Following this, they had 10 minutes to pick a favourite idea from their sketches and detail it out further. The ideas co-designers shared with the group focused on addressing (a) Distracting Technology, (b) Avoid Procrastination and (c) Estimating time.

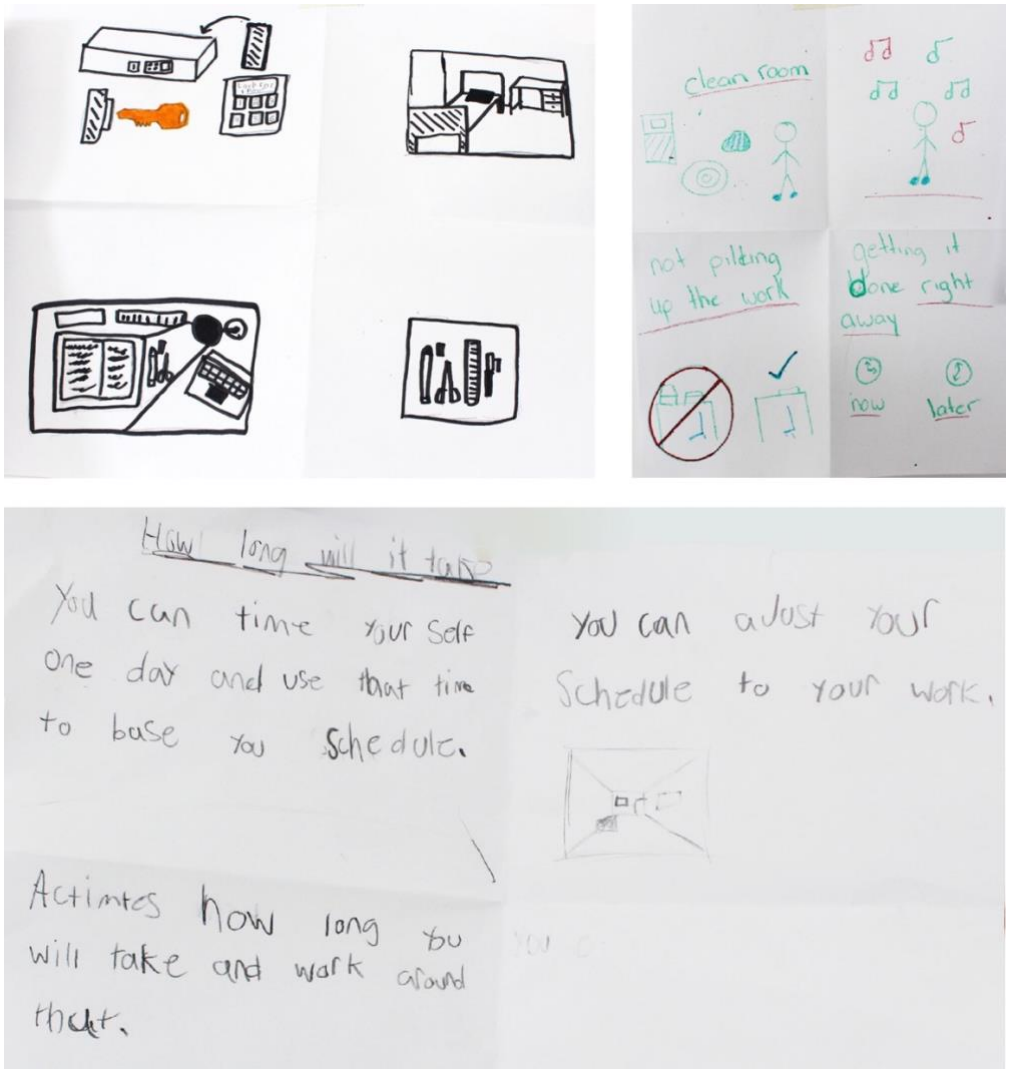

Image 8: Drawings by "Mission Focus" co-designers of how they would address a pain point they identified in the journey map

Moving distracting Technology away.

To avoid technology becoming a distraction, the child suggested having a dedicated working table with all required materials arranged neatly and sitting inside a dedicated learning space that is quiet. One of the ideas sketches, portrayed locking away technology for a certain amount of time and getting it back as a reward for completing a task as instructed. The problem-solving methods of children are shaped by the problem-solving techniques that they have been taught or observed, and the contribution of older

children and adults in this process is significant (Hourcade, 2007). Although the child considered this to be effective in keeping away distraction, it further fuels a behaviourist script and children link behaviour to consequences (Kohn, 1994; Spiel et al., 2022). While the child described the organization of their physical space as a support in being focused on a task, this could inform the visual design of a virtual learning space too in being clutter free and customizable with tools that the learner needs at a given time.

Motivation to avoid Procrastination.

Other ideas to stop procrastination for example included:

1. Keeping a clean environment, children associated a clean room, a tidy workspace and having only necessary items in reach a way of being free from distractions. They would deal with any external distractions which were out of their control, by listening to music using earphones. This method of ‘shielding’ and ‘focusing’ was also observed in previous research by Anderson and Sorenson (2015)

2. Children identified that to avoid procrastination, they must start working on a task immediately by being motivated rather than ‘pile it up’. In spite of identifying this, almost all the children identified building this ‘positive mindset’ to get started on a task as a problem. Motivational support in asynchronous learning, for children who prefer it can be provided through the learning environment through as affirmations, task summaries, or planning exercises with a mentor. Flexible and diverse learning opportunities are necessary to help every child find something that speaks to his or her interests (Hourcade, 2007)

Guiding time management

For estimating time for a particular task, the child suggested an iterative method, whereby they would time themselves using a phone and then calculate their schedule accordingly. Following this they would continue to iterate the schedule and until they could form a routine. While another student [Agent Apple, 14] agreed with this approach they felt that an adult should evaluate and let them know if they were doing well. Often cited in interaction design and children literature is the concept of scaffolding by Vygotsky referring to the help children require to complete a task before they can complete it on their own(Hourcade, 2007). Some research on children's technologies refers to the technologies providing the scaffolding, instead of teachers or parents. When children can complete a task with scaffolding, but cannot complete it on their own, they are in the zone of proximal development(Hourcade, 2007). This shows a need for adult support in motivation and evaluation of the plans that the student would create.

Co-design session 2

The second co-design session was conducted on March 02, 2023. The objective of this session was:

a) to investigate learner's wants and hopes, in the current system of learning and to understand their dreams for the future regarding learning.
b) to iterate on ideas collected during the previous session to form mockups of these ideas.

Learners formed two groups of 4 and were given the following scenario:

“You wake up to find that you can build a new way of learning. What would that learning system look like? Think of what you want to improve or change in your current way of learning and Make it Happen!”

The two groups were given papers, drawing material and clay and co-designers collaboratively explored a model of learning that they would like.

Image 9: “Mission Focus” co-designers working collaboratively, brainstorming to design a new way of learning.

Idea 1: An ambitions-based learning space instead of a fixed curriculum.

This group did not like the fact that currently schools have a lot of different subjects and most of them are mandatory when learners feel they may not use those skills in life later. They proposed the following system:

- The learner first thinks of a long-term goal e.g. What they want to be when they grow up/ A skill they want to master. Having such a goal in sight helped motivate them to learn. An adult (teacher/counsellor/parent) could help them define their goal help consider what might be required to achieve it.

- The classes and subjects would be only the ones that could help students continue to grow in the direction to achieve their goal.
- Co-designers agreed that certain subjects like language, math and finances were important subjects and should be mandatory.
- Each class sessions should be of smaller duration and any associated tasks should be broken down into easy-to-follow steps.
- Connecting concepts in different subjects and contextualizing the learning to their intended goal would also help understand the importance of what they were learning and motivate learners.

Idea 2: A personalised education focused on developing skills.

Inspired by their own learning experience of having to move to a specialised school for children with learning disabilities, this group's idea proposed the following system:

- The government should allocate more resources akin to the facilities they have at Trillium Demonstration School to all other neighbourhood schools. This would entail smaller class sizes, enabling teachers to offer personalised attention to students, emphasizing language acquisition and equipping them with the necessary workforce skills, and providing greater opportunities for practical learning.
- The audience feedback to this idea emphasized the importance of having a clear post-school vision. They believed that schools are presently failing to equip students with the ability to envision their future goals. Therefore, they suggested that the learning experience should incorporate counseling in addition to teaching skills.

Key take-aways for future co-design with children

While the session generated several interesting ideas and discussions, the co-designers' difficulties with language influenced their engagement with the activities. Upon reflecting on the sessions combined with co-designers' feedback, the following observations were recorded:

- Writing tasks proved to be challenging and distracting for the children, who preferred to express themselves verbally.
- Only one child enjoyed doodling their thoughts. Hands-on activities such as affinity clustering and using colorful sticky notes engaged the children.
- They particularly enjoyed using stickers to vote for pain points in the Journey mapping activity.
- Structured questions received quicker responses, but when trying to build a model, the children often became distracted.

Based on these findings, the research suggests the following key takeaways for designing co-design sessions with pre-literate children:

- Several shorter sessions that tackle one question at a time might help them engage better.
- Intuitive, easy, and more verbal means of exchanging ideas between all involved in the co-design will also make communication comfortable as the children face severe barriers with reading and written exchange.

Image 10: Co-designers of "Mission Focus"

The discussion below suggests guidelines to design VLEs that support executive functions for children based on the findings from the co-design and ideas developed by the co-designers.

Design Outcomes

Together, through a collaborative and iterative co-design process, we explored ways to support executive functions in a learning environment. The intention of these guidelines is not to provide an all-encompassing checklist, but rather to offer a set of principles for user interface design that can inspire thoughtful reflection when developing a virtual learning environment for children. Some of the implications of the children's ideas and needs discussed on the design of a VLE are:

Scaffolding content creation and consumption

Learners are currently exposed to a variety of technological interventions in online learning both directly as a modality-interchange tool and it emerged as a strong factor in providing behavioural interventions such (e.g., building a positive mood) for learners requiring executive function support. Previous research and the learners themselves recognize the importance of structure and routine as a key learning competency as well as benefits of scaffolding (Andersen & Sorensen, 2015; Hourcade, 2007). Numerous research studies indicate the benefits of using various hardware and software ICT tools to promote inclusion in education (ibid). A controversial topic in human–computer interaction has also made its way to the field of interaction design and children. That is providing interactions with computers or computing power through the use of "intelligent" or "smart" characters(Hourcade, 2007). They are most often found in the form of "pedagogical agents." These are characters that teach children about a topic. These agents often follow the idea that knowledge is something to be transferred to the

child, rather than constructed by the child. Most would thus fall under behaviorism. Although researchers claim that they actually are following socio-cultural approaches by providing a social dimension to learning through the characters, its use would need further research and reflection. The interface can thus become a vehicle for supporting content creation (with peers and teachers) and scaffold consumption using built in customizable templates (e.g., reusable note taking templates, co-created project management templates). Encouraging learners to share one-size-fits-one ideas and tools can start a virtuous cycle (Watkins, 2016).

Supporting Learner Variability

Virtual learning environments aim to be inclusive and welcome an incredibly diverse set of students. Every student brings a unique background, set of experiences, interests, strengths, and challenges. The interface needs to support this learner variability not just among different learners but also of a particular learner in different situations. Simply providing technology may not be sufficient to improve learning; rather, the power of edtech may be in the way that technology can be used to tailor learning environments and instruction(Tare & Shell, 2019). Considering a range of needs and abilities from novice user to expert user does not mean providing too many options since that can overwhelm the user causing more distraction.

Some suggested product features to that would support student access and engagement based on the conversation with co-designers include audio, visual, split screen, and article annotation.

Audio

Audio supports can benefit student engagement and learning for students with different needs. For students with reading disabilities, audio support during sustained silent reading is related to increased reading fluency and text-to-speech audio supports have also been shown to be particularly helpful for students who have poorer reading comprehension(Tare & Shell, 2019). The co-designers emphasized their use of headphones to ‘drown out’ external sounds helping them to shield and focus confirming findings in previous research by Anderson and Sorenson (2015) . Listening to content can help increase focus and make comprehension easy for them. The use of audio buttons and hover text-to-speech are also useful in interfaces to assist learning with dyslexia.

Visual

Visual means of interacting with user interfaces are crucial to the success of software for children who are pre-literate or are just beginning to read(Hourcade, 2007). Icons for children should be designed so they represent actions or objects in a recognizable manner, are easily distinguishable from each other, can be recognized as interactive and separate from the background, Icons should also be sized so that children can easily click on them. See under Pointing for more information on sizing guidelines. Being able to customize the screen with tools and content that they need.

Split Screen

One of the co-designers used scanning method to look for answers to assignment questions within the given content.

Corneleas: “When we have to answer questions based on a novel, I would look at the questions in the assignment and kind of like go back to the text [of the novel] to look for the answers and highlight it.”

To support students’ working memory and attention, we propose a split screen option which displays both the passage and comprehension questions simultaneously. Research suggests that the split screen format allows students to focus only on the relevant information and to more efficiently navigate content, thereby reducing cognitive load (Kumaresan et al., 2022; Tare & Shell, 2019).

Article Annotations

Online annotation tools, including highlighting and note taking, similarly allow students to keep track of important parts of the text and to take notes on their reading, boosting reading comprehension, which are critical for students with low attention (Kumaresan et al., 2022). Designing options to add notes as voice benefits learners who may be pre-literate and otherwise.

Learning environments as social spaces

Children’s learning may be seen as an active process where interactions with other people and tools are important and where children are not passive recipients of knowledge. Knowledge is not seen as constructed individually in the mind, but socially in the world. This is referred to as socio-cultural approaches to learning. One problem with the use of personal computers in education is that they often tend to isolate children and can get in the way of collaboration because they have been designed for

use by individuals. One of the disadvantages of asynchronous virtual learning spaces identified by the group was the loss of social connection with peers and teachers. The difference between other spaces and what virtual environments potentially offer can be described as making students not only active, but also actors, i.e., members and contributors of the social and information space. For instance, by enabling students to share informal notes thereby adding to the knowledge base, and work collaboratively even in asynchronous situations. The system thus embodies an open and inclusive learning environment.

Research as a nonlinear iterative process

Research need not be a linear process but an iterative one, involving individuals who are affected by the design of a product or service in the decision-making process may lead to eye-opening discoveries that are informed by the needs of the ‘user’. In this research apart from a focus on executive functions, the co-designers explored how a change in the foundation of the current education system could make learning more beneficial for them.

An interesting outcome of this process was the idea for a new learning system, a system that emphasized personal goals and motivations of each child which would then be supported by the learning space and teachers. There is a reversal of power here showing that children want to get more agency in the way they learn and what they learn.

One of the key components of user research is data analysis, which involves comparing and contrasting different sets of data to identify patterns, trends, and insights that can

inform the design process. But through inclusive research, we are not looking to find the ‘average needs’ of the user, rather, we are trying to explore various possibilities to support the range of human variance.

Conclusion

This research project presents the results from research with pre-literate adolescents in participatory design sessions regarding their experience and challenges faced in a virtual learning environment. Some of the ideas that developed from review of previous research as well as collaborative discussions with the learners who participated in the co-design sessions included:

a) Guidelines for user interface design that can help develop more inclusive virtual learning environments. This includes:
    i) Providing consistency in the learner's interactions through scaffolding their needs in content creation and content consumption. Examples could include reusable note taking templates, co-created project management templates that accept multiple modes of input like text, audio, video, drawings etc.
    ii) Supporting learner variability from novice user to expert user not by providing too many options, but by building technologies that adapt to the user's inputs.
    iii) Building learning environments that are social spaces encouraging co-creating knowledge through learner interactions and reflection of content rather than only consuming what is shared.

b) A system designed by the learners that helped them learn best. By giving agency to participants in the design process, they were able to collectively design an inclusive system where learning goals would be self-driven rather than based on a prescribed curriculum retrofitted to each learner's needs. They observed that focus and motivation may be intertwined elements of executive functions and hence having a goals-oriented approach to learning appealed to them.

Apart from these outcomes, this research aims to advance the field of inclusive design through co-design approaches discussed that de-stigmatize disabilities and provide agency in the design process to participants. Such approaches may lead to surprising outcomes but will reflect needs of the user.

In this research, as we try to make VLEs more inclusive by understanding the needs of pre-literate adolescents who are developing executive functions, we also make it better for anyone who has these needs, creating a Virtuous cycle (Huh & Ackerman, 2010, p. 7; Treviranus, 2019).

Limitations

This work is based on the perspectives and lived experiences of eight learners who are all from the same school. This school gives enrolled students with special learning needs, the opportunity to engage in a wholesome school experience. While each child was very different and made valuable contributions to this research, future research may try to engage learners from different schools, where such opportunities may not be accessible to understand their lived experiences.

Within the stipulated timeline of the Master's Program, co-designers and I worked to build initial concepts. It would have been beneficial to hold more sessions so co-designers and I could have gotten further with building and evaluating prototypes. In addition, although initially the co-design sessions hoped to involve parents, constraints with time availability resulted in parents being unable to attend the sessions in person. Future iterations could work toward hybrid codesign sessions providing participants with the choice to contribute how they prefer.

Future Work

For future research, it would be beneficial to explore the effectiveness of implementing the design outcomes produced from this work as a prototype in a VLE and re-engaging participants to improve the design. Furthermore, it may be worthwhile to investigate the attitudes and awareness of teachers who use VLEs, towards access and inclusion in online learning, as well as the potential barriers they face in building inclusive content and implementing inclusive practices in VLEs. Finally, research could also try to involve parents, guardians, teachers, and user experience designers for VLEs along with the learners to build on the learners' concept of what future learning systems could look like.

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Appendix

Appendix A: Invitation Script and Consent Form

This section contains the invitation script and consent forms used. The introduction poster shared with the school can be found here.

A presentation of the research purpose was given at the Trillium School, to which learners were invited and provided oral consent to join. The contents of this presentation are described below. Following learner consent, an interactive consent form was also sent to the parents for their consent. The interactive informed consent form can be found on Microsoft Forms. This consent document may also be physically printed and sent back through email or can be read to the participant via Immersive reader feature.

Section 1. INVITATION PRESENTATION

You are invited!

To be a part of 'Mission Focus' which is a research project to discover how virtual learning environments (VLEs), like the 'Google Classroom' you use in school, can be designed to help students focus while learning. This mission has two creative sessions (A.K.A co-design), in which I would like to work with you to:

1. Explore what challenges you face and strategies you use to focus and organize your learning goals.

2. Create a model to address challenges and strategies we discover from activities in Session 1 and how you think we can improve online learning.
Your input will help in developing better virtual learning environments and make organizing a learner's daily goals, easier.

Section 1.1 MISSION DETAILS

Research Project Title:

Mission Focus: supporting executive functions in Virtual Learning Environments to design an inclusive user interface.

Section 1.2 WHAT'S INVOLVED

When and where?

Co-design Session 1
Date: February 22nd , 2023

Venue: The Trillium School, Milton

Time: 12:30 PM – 2:30 PM

Duration: 2 hours (120 minutes)

Co-design Session 2
Date: February 23rd , 2023

Venue: The Trillium School, Milton

Time: 12:00 PM – 1:30 PM

Duration: 1.5 hours (90 minutes)

What happens in the co-design session?

Should you choose to accept this mission, I would like to talk to you about the best scenario to learn for you. I want to understand if there are certain things that stop you from learning well and how you overcome them. I would also like to take notes of our conversation and video/tape record it so that I do not miss any of your valuable inputs.

You may also write or draw your thoughts if you prefer. There are no right or wrong answers and it's your thoughts that matter. In the second session, I would like to explore with you how we can make virtual learning environments better by creating paper models that helps learners focus and organize their goals.

Do you have to join 'Mission Focus'?

You do not have to take part; it's up to you if you want to. If you choose to accept, I hope you will feel comfortable talking to me. But if you wish, you may decline to answer any questions or participate in any part of the Mission. You can choose to drop out of 'Mission Focus' at any time or request that your input be removed from it, and you may do so before February 28th, 2023. Details that expose your identity like your name or your own ideas will be removed before the next phase of this Mission. But ideas we discovered and created together as a group may not be possible to remove from the findings. We do not offer payment or incentives for participation in this Mission.

What are the benefits and risks of taking part in the Mission?

Somethings you could gain from taking part include:

- Identifying ways to help you focus and organize learning goals through discussion with others who have similar interests.
- Understanding your needs as a learner along with your parent
- Sharing your creative ideas to develop a Virtual Learning Environment that suits your needs.

There may also be certain concerns around participating as a group, such as:

- You or your fellow participants may feel uncomfortable sometimes talking about the challenges you face when learning in front of the group. Feel free to stop if you don't want to discuss. I will respect your decision and will not reveal your personal details to anyone else.

- Different people have different challenges and may require support in their day-to-day activities. Discussing these may be uncomfortable at times and if you would like to stop, we can stop.
- You may feel you need to participate since the Mission is being conducted through your school (Trillium Demonstration school, Milton) but, participation is up to you, and you may drop out from Mission Focus at any time, and it will not affect your studies or your connection with the school.

Who will know that you took part?

Any information I record from you will be stored on OCAD's secure SharePoint cloud and seen only by me and my research advisors from OCAD University. At the end of day on May 08, 2023, all the recordings will be deleted from the secure SharePoint drive and from deleted folders. Your name will not be used in the research but I would like to give you credit for your contributions so you may inform me if you wish to be given co-credit on the final research paper. This means that you may be identified within the paper by people who know you or your family. You can decide if you would like co-credit or not, up to April 30, 2023. I will ask you again during the editing phase of 'Mission Focus' if you'd like to change your mind.

How will you get to see the results of 'Mission Focus'?

Results of this research as part of 'Mission Focus' will be published in OCAD University's research repository and may also be published in reports and papers. In any publication, data will be presented without details that reveal your identity (except where you are given co-credit with your permission). Within 2 months after project completion, you will be emailed with information about co-design findings.

Contact details and Ethics approval details for this project:

If you have any questions about this research or require further information at any time, please contact me, Nidhi Treesa Paul, using the contact information provided below. This study has been reviewed and received ethics clearance through the Research

Ethics Board at OCAD University (File No. XXXX). If you have any comments or concerns, please contact the Research Ethics Office manager Christine Pineda, cpineda@ocadu.ca, 416-977-6000 x4368.

Email – nidhipaul@ocadu.ca

Phone – (647) 391-5584

Section 2. CONSENT FORMS

Dear Co-designer,

After reading about and understanding 'Mission Focus', if you would like to accept the mission, please indicate your consent below.

Section 2.1 CONSENT FORM FOR CHILD PARTICIPANT

Do you want to participate in this study? _____ Yes _____ No

Child's name: _____

Child's Signature: _____

Date: _____

Researcher Signature: _____

Date: _____

Parental Permission Form for Child:

Please indicate your consent below.

I have read and understood the above information.

I certify that I am 18 years or older and I am aware that my child will participate in the co-design if he/she/they agrees to participate, and I agree to his/her/their participation.

I agree to have my child being video/audio recorded in the co-design session to ensure an accurate recording of his/her responses. This is to ensure that my child's thoughts

are recorded accurately, and this material will be seen only by the researchers from OCAD University.

I acknowledge that all information gathered on this project will be used for research purposes only and will be considered confidential except where noted if there is a co-credit on the final research paper.

I am aware that permission may be withdrawn at any time (by either the parent and/or the child) without penalty by advising the researchers.

I understand that this project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at OCAD U.

Child's Name: _____

Name of Parent or Guardian: _____

Signature of Parent or Guardian: _____

Date: _____

Section 2.2 CONSENT FORM FOR PARENT PARTICIPANT

Dear Co-designer,

After reading about and understanding 'Mission Focus', if you would like to accept the mission, please indicate your consent below.

Do you want to participate in this study? _____ Yes _____ No

Parent's name: _____

Parent Signature: _____

Date: _____

Researcher’s Signature: _____

Date: _____

Thank you for your assistance in this project. You may keep a copy of this form for your records.

Thanks for your help,

Nidhi Treesa Paul

OCAD University

MISSION FOCUS:

Call for Participants

We're on a mission to improve online learning environments. Would you like to join this mission?

What is involved in this mission?

Since you know best about your learning needs, we want to include you in this research to create better online learning environments for you. Your mission, should you choose to accept it, is to help us improve the design of online learning.

Who can join the mission?

- Learners and parents from Trillium Demonstration school are invited to take part.
- Comfortable sharing how you organize your learning goals and if you face any difficulty while doing it.
- Willing to take part in creative activities through drawing or speaking or writing.

What can you gain from taking part?

Share your creativity as a group and work with researchers to make online learning better.

Have questions about this mission?

Contact Nidhi Treesa Paul at nidhipaul@ocadu.ca

MISSION FOCUS:

Invitation Letter & Consent Form

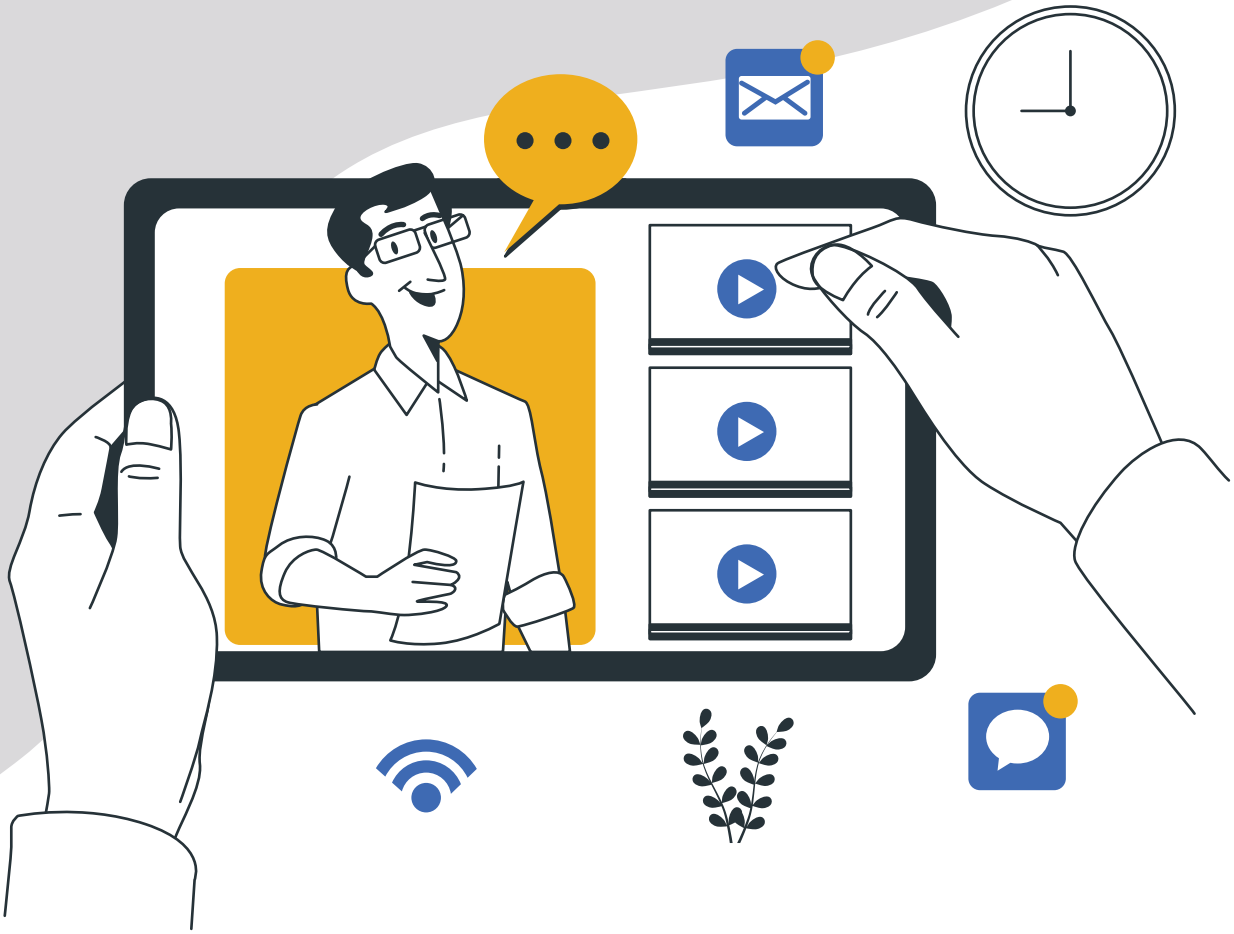
If you would like to join this mission, please scan the QR code below to read the invitation letter and indicate your consent to participate

Have questions about this mission?

Contact Nidhi Treesa Paul at nidhipaul@ocadu.ca

Appendix B: Co-design Kit

This section contains the co-design kit used for the research. This kit may be printed and used or can be adapted to be used digitally for virtual co-design sessions.



CO-DESIGN KIT FOR TRILLUM SCHOOL, MILTON

Mission Focus

How virtual learning environments (VLEs) can be designed to help children focus better while learning.

AGENT NAME: _____

AGE: _____

Nidhi Treesa Paul
MDES Inclusive Design,
OCAD University, Toronto
nidhipaul@ocadu.ca

MISSION FOCUS AT TRILLUM SCHOOL, MILTON

Co-design Session 1

Preference for sharing your contribution

Your name will not be used in the research but I would like to give you credit for your contributions so you may inform me if you wish to be given co-credit on the final research paper. This means that you may be identified within the paper by people who know you or your family or by other ways.

Would you like to be given co-credit?

(note: Whether you decide to be co-credited or not now, you can change your mind up to April 30, 2023. I will ask you again during that time if you'd like to change your mind.)

☐ **Yes** ☐ **No**

Please select your preference on quoting your ideas in the research below:

(You will be given the opportunity to confirm quoted material and specify what you wanted to be quoted about):

☐ **I do not want anything I say quoted in research materials directly**
(your exact words will not appear).

☐ **I may be quoted in research materials anonymously**
(a made-up name or code will appear with quoted material).

☐ **I may be quoted in project materials and my quotes should be attributed to me**
(your name will appear with the quoted material).

Welcome!

This is **Session 1** of the two-part co-design which involves identifying challenges and opportunities related to attention management and pursuing goals when children learn. Your input will help develop better virtual learning environments and make organizing, planning, and tracking learning goals for children easier.

In this session we will be going through the following activities:
(note: feel free to tick off activities as we complete them)

- [ ] **Get to know interview**
  A warm up activity where participants pair up and introduce themselves by answering some questions

- [ ] **Learning Vision Board**
  Reflect on the learning scenario that works best for you. Sort your findings into themes to form a vision board

- [ ] **Break- 5 minutes**
  Stand, stretch, hydrate

- [ ] **Project Journey Mapping**
  Using the template provided, describe in detail your process of planning and executing a given task

- [ ] **Break- 10 minutes**
  Stand, stretch, hydrate

- [ ] **Idea Lab**
  Using the template provided, quickly sketch different ideas to address your needs and wants related to online learning

Get to know interview

Step 1: Pair up with another participant.

Interview each other by asking each other their codename and three given questions. Each person has two minutes to ask the other.

Step 2: Present your partner to everyone in the group.

You may speak about your partner, make a drawing about what they shared with you or write it as notes. How ever you feel comfortable to share.

What is your partner's superhero codename ?

What is their favourite dish OR
What is a hobby they like and why?

What are they looking forward to today?

Learning Vision Board

Step 1: All participants reflect on questions

Think of a moment when you felt you were able to learn something well. Verbally, in written points or drawings on sticky notes respond to the following questions related to a good learning situation.

(note: Use the questions below as a guide to help you describe your experience)

Q.Why did you feel you have learnt well in that moment?

Q. How did you feel in that moment of learning well?

Q. What helped you to focus on learning in that moment?

Q. How can Technology support you in focusing on learning?

Q. Where can other people (parents/teachers/peers) support you in learning well?

Step 2: Everyone sorts the responses into themes

Three participants come to the board and sort the responses to form a 'Vision Board'. Stick similar or related responses nearby (Similar Theme). Stick unrelated responses apart (New Theme).

This is repeated by next 3 participants and so on until all responses are sorted on the Vision Board.

(note: A sample image of the vision board process is on the next page for reference)

Sample Learning Vision Board – How can I lead a healthier lifestyle?

01

Add words, phrases or drawings

Add words, phrases or drawings that answer the question here

- Balanced Diet
- Good Sleep everyday
- Active Life
- Regular check up with doctor
- Going to Gym
- Drink enough water
- Being consistent with diet plans
- Laugh a lot and be happy
- Eat greens even if i dont like it

02

Sort the answers to find patterns

Stick similar words, phrases or drawings together here

- Balanced Diet
- Eat greens even if i dont like it
- Drink enough water
- Going to Gym
- Active Life
- Good Sleep everyday
- Being consistent with diet plans
- Regular check up with doctor
- Laugh a lot and be happy

03

Give a theme to the patterns you found

Write a phrase for each theme you found

Eating Habits

- Balanced Diet
- Eat greens even if i dont like it
- Drink enough water

Physical Activity

- Going to Gym
- Active Life

Form Routine

- Good Sleep everyday
- Being consistent with diet plans
- Regular check up with doctor

- Laugh a lot and be happy

Project Journey Mapping

Step 1: Consider a given task

The facilitator presents a task related to learning.

(note: An Example template is given below)

Jamie is a school student and wants to be more_ _ _ _ _ _ _

Step 2: Walk a mile in Jamie's shoes

Put yourself in place of Jamie and think about how you would complete the given task.

a. Think of the doubts or concerns you may have when you start the task up until you complete the task.

b. What actions or decision would you make to address your doubts or concerns at each step.

c. What emotions are you feeling at each step.

Express your thought verbally. You may also write or draw on the post it notes and we stick them on the board.

(note: The template we are using is on the next page for your reference.)

Step 3: Recognize important points in the journey map

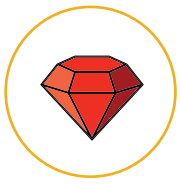
Use the 'bandage', 'ruby' and 'hand' stickers given in this file to mark the importance of points in the journey map.

Bandage

= pain points

Hand

= adult support



Ruby

= great impact

What would you say?

Describe your questions and thoughts at each stage to proceed further

What would you do?

Describe the action and decisions you take at each stage.

Gathering information → Considering Options → During the task → Keeping Check → After Completion

What are you feeling?

What emotions are running through your mind and why?

What can be improved?

How can we make it easier for you to complete the task? Are there any specific supports you need

Idea Lab

Step 1: Prepare paper for the activity

Fold a sheet of paper into half, twic. You should get 4 blocks on the paper.

Step 2: Pick a need you want to address

Choose from the ‘bandages’, ‘hands’ and ‘rubies’ you identified in the ‘Project Journey Map’. Quickly sketch 4 ways to solve the need you chose. You get 2 minutes for each idea

(note: these are rough sketches, they do not need to be perfect or beautiful, sketches just need to communicate the idea.)

Step 3: Pick a favourite Idea

Detail out your favourite idea further

Step 4: Present your Idea

Present your favourite idea to the group. Tell us the problem or need you worked on and how you intend to solve it.

MISSION FOCUS AT TRILLUM SCHOOL, MILTON

Co-design Session 2

Welcome!

This is **Session 2** of the two-part co-design which involves creating models to address challenges and strategies we discover from activities in Session 1 and how you think we can improve online learning.

In this session we will be going through the following activities:
(note: feel free to tick off activities as we complete them)

- [ ] **Doodle Agent**
  A warm up activity where participants doodle a portrait of another participant

- [ ] **Make it Happen!**
  Try out quick paper prototype ideas in groups and present it to the whole team

- [ ] **Break- 10 minutes**
  Stand, stretch, hydrate

- [ ] **Debrief & Reflect**
  Engage in feedback and discussions about prototypes presented

Doodle Agent

Step 1: Choose a co-participant. Shh! dont tell them

Each person picks up a random chit from a bowl containing superhero code names of the participants. Dont tell them or anyone else who you got. On the back write the code name of the person you got.

Dear _ _ _ _ _ _ _ _

Step 2: Doodle a portrait of them

Look around the room and find them. You get five minutes to doodle a portrait of the person. It doesn't have to be perfect; this is just a fun activity.

(note: feel free to write a nice message for them)

Step 3: You've got mail!

The facilitator will collect your art work. At the end of this session, we will give the portrait to the person it was drawn/written for.

Make it Happen

Step 1: You wake up tomorrow to find that you can build a new way of learning!

Participants are given papers, craft material and a computer/mobile screen template.

(note: you don't have to use all the materials. Use what works for the idea you are building)

Step 2: Form Teams

In teams of 3-4 participants, imagine a learning system of the future. Participants may sketch, make physical prototypes, or explain ideas in short notes on paper

Step 3: Take inspiration from the Idea Lab activity

Go 'feature shopping' to the Idea Lab and add ideas you like to the system you are building now. You may also remix ideas to form a new idea.

Debrief & Reflect

Step 1: Present your ideas

Each team presents their learning system and its features to the whole group.

Step 2: Engage in feedback and discussion

The audience may ask questions, point out things they like or suggest improvements.

(note: you may use the space below to write any thoughts you have related to the ideas you hear, or any general comments)