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Executive functioning, study skills, and dyslexia - Examining the effectiveness of an online programme for upper secondary and post-secondary students

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Abstract

As students transition to higher education, study skills, executive functioning skills, and life skills, are an important set of transferable skills in enabling them to learn and work more efficiently under more demanding conditions, thereby maximising their potential as well as the full benefit of their time and effort. Therefore, as dyslexia is a life-long learning difference, there is a need for specialist support even as individuals at risk or diagnosed with dyslexia transits into post-secondary education or tertiary education. Certainly, with the acquisition and competence in essential study skills and techniques, these students may become self-directed, independent and responsible learners, which are invaluable traits and characteristics for any tertiary learner. More importantly, these skills provide a strong foundation for them to be able to reach their goals and aspirations not only in school but also in their future workplace. The English Language and Literacy Division (ELL) at the Dyslexia Association of Singapore (DAS) developed the iStudySmart™ programme, which adopts an online learning approach that aims to empower students with learning differences in the areas of time management and prioritisation, planning and organisation, tertiary writing and presentation skills. The aims of iStudySmart™ were not only to bridge the gap in intervention and resources catered for students with learning challenges at the tertiary level but also to keep abreast with changing times, demands and expectations observed in the education sector. This paper evaluates the relevance and effectiveness of iStudySmart™ and also measures student self-confidence, motivation, and independence through the administration of pre- and post-questionnaires and a post-questionnaire or interview six months after. Further, qualitative data comprising testimonials from parents revealed high levels of satisfaction and recognition of the value of the online approach. Results from post-questionnaire and interview six months after indicate that all aspects of the iStudySmart™ intervention were effective, with moderate and large effect sizes for planning and organisation, tertiary writing and presentation. On the other hand, time management and prioritisation strategies learnt through the programme would need more time and practice before students can apply these in their daily lives.

Keywords: higher education, dyslexia, specific learning difficulty, study skills, motivation, executing functioning skills, independence, self-confidence, e-learning, online learning, flipped classroom, asynchronous learning, synchronous learning

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INTRODUCTION

Dyslexia is a life-long learning difference (Ramus et al., 2003). According to international prevalence rates, 10 percent of a population have dyslexia, of which four percent have dyslexia severe enough to warrant immediate intervention. Based on the European Dyslexia Association (n.d.), dyslexia occurs worldwide regardless of culture or language and it affects nine to 12 percent of the population whereby two to four percent of the population can be seriously affected by it. Further, as cognitive challenges associated with dyslexia persist into higher education and adulthood (Hatcher et al., 2002), awareness, specialist support and resources should ideally continue to be made available and accessible for students with dyslexia and other specific learning differences in the higher education environment.

In recent years, there has been a greater emphasis placed on awareness raising campaigns on dyslexia and other specific learning differences in Singapore. Hence, there are now more students with learning challenges being identified in pre-school, primary school or even secondary school. This enables them to access specialist programmes and services such as the school-based dyslexia remediation programme offered in Singapore government schools, or educational therapy at the Dyslexia Association of Singapore (DAS) to help them cope with their literacy challenges.

The Current Gaps in Higher Education

For students with learning differences, their literacy challenges that include reading, comprehension, spelling and writing may persist throughout their lifetime. For some students, they may be able to overcome their difficulties with compensatory strategies, but for others, the compensatory strategies may not be sufficient to help them cope with the more demanding and rigorous academic experience and expectations in higher education.

Unfortunately, as students transition to Institutes of Higher Learning (IHLs), academic demands do not only increase but specialist support, resources and awareness may not be as prevalent and accessible especially in supporting tertiary students with dyslexia and other specific learning differences (Dobson Waters & Torgerson, 2021; MacCullagh et al., 2017; Mortimore & Crozier, 2006; Olofsson et al., 2015; Pino & Mortari, 2014).

Singapore has continued to advocate and show its commitment in building a more inclusive society and education system, which includes supporting tertiary students with special educational needs (SEN) in IHLs. IHLs have SEN offices that coordinate support and provide guidance to students from pre-enrolment to graduation (Ministry of Education, Singapore, 2021).

A study conducted by Hewes (2020) revealed that participants who achieved a university education reported their tertiary learning experience to be a positive one as they have become matured. Hence, learning seems much easier and manageable. They also pursued subjects and specialisations of their interest and passion (West, 2014).

While Singapore is certainly on a path towards embracing diversity and inclusion in higher education settings, there are still gaps that need to be addressed and bridged in order to better support students with learning challenges and see them through their journey in completing their tertiary education. Therefore, it is vital for educational policies to be reviewed and implemented in ensuring that individuals with specific learning differences receive the necessary support and resources at all educational levels including higher education, to experience a more positive and fulfilling learning experience.

Taking into consideration the prevalence rate and that tertiary students with dyslexia are likely to continue to struggle with keeping up with the learning pace and academic rigour in IHLs, the iStudySmart™ programme was developed by the DAS primarily to support this population of students.

The iStudySmart™ Programme

The iStudySmart™, a two-term six months online learning programme, was developed at DAS to support tertiary students with learning differences, and upper secondary students transitioning to tertiary education to gain skills that extend beyond literacy intervention. The programme combines e-learning to allow students to access the content material at their own learning pace as well as online consultation sessions for more personalised support and guidance. As the e-learning and online consultation sessions are all online, the paper will use the term '**online learning'** throughout the paper.

The online learning pedagogy comprises different approaches such as multi-modalities and Orton-Gillingham teaching principles. These include being direct and explicit, diagnostic and prescriptive, structured, sequential and cumulative (Gillingham & Stillman, 1997). The pedagogical principles have been built into the design of the online content and execution to ensure that the students accessing the course materials are able to do so with greater independence and ease. iStudySmart™ also covers study skills, executive functioning skills and life skills that include time management and prioritisation, planning and organisation, tertiary writing and presentation skills.

The tertiary writing module, for instance, guides and teaches students how to effectively research for information (based on a research topic), evaluate the validity and reliability of sources as well as cite and reference the sources used in their research, which can be applied to their own assignments and research projects. Additionally, developing good public speaking/presentation skills i.e. being able to present confidently and coherently

has become an expectation at the tertiary level (Nash, Crimmins, and Oprescu 2016), as well as workplaces where making presentations is a commonplace. Good public speaking or presentation skills are critical communication skills which are part of the 21st century skill frameworks which will not only help students including those studying in IHLs cope better with the academic rigour but also stand them in good stead when they enter the workforce in the future (Hunt et al., 2019). The programme culminates in a final project presentation where students will present their research topic to an audience that includes fellow peers, teachers, and parents.

Since the inception of the programme in 2019 till the end of 2020, 41 students who have varied learning profiles and learning needs have received specialist intervention on iStudySmart™. The majority of the students were from Institutes of Technical Education (ITEs) and Polytechnics and all of them have a dyslexia diagnosis. For some of them, some of them also have other co-occurring challenges which include speech and language impairment (SLI), Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) in addition to their dyslexia diagnosis. Further, the common learning challenges observed in most students include:

- gaps in executive functioning skills i.e. poor time management, prioritisation and organisation skills
- difficulties in communication, tertiary writing and presentation skills

REVIEW OF LITERATURE

Dyslexia

DAS is guided in its definition of dyslexia by two important sources which includes the Rose Report from the United Kingdom - Rose (2009), the United State's Department of Education Report on the Individuals with disabilities education act (2011). The definition is as follows:

> "Dyslexia is a type of specific learning difficulty identifiable as a developmental difficulty of language learning and cognition. It is a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and processing speed. Co-occurring difficulties may be seen in aspects of language, motor co-ordination, mental calculation, concentration and personal organisation, but these are not, by themselves, markers of dyslexia."

Dyslexia in Higher Education

While a general understanding about dyslexia in higher education has increased, students with learning challenges appear to feel that they do not receive enough support (Dobson Waters & Torgerson, 2021; Griffin & Pollak, 2009). According to the Office for Students (2017), students would have to make the request for inclusive learning to help them in their academic studies rather than the inclusive practices being already in place and implemented. Students also reported inconsistency in support between the support staff and faculty staff (Higher Education Funding Council for England Report, 2015). The existing gaps prompted the need for specialist intervention programmes like iStudySmart™ to be developed and implemented to support students with dyslexia in higher education including Upper Secondary students to prepare and support them through their transition to tertiary education.

There is also little literature and research on students with learning disabilities (LD) despite their increasing number in higher education settings (Carlisle, 2022; Heiman & Precel, 2003; Sparks & Lovett, 2009). There is also little research to evaluate the effectiveness of the support and intervention rendered to the students at IHLs (Dobson Waters & Torgerson, 2021). The limited research and evidence-based practices for learners with dyslexia at IHLs conceivably disadvantages faculty staff who need more information to support students experiencing academic difficulties such as those with reading and writing gaps (Quick, 2013).

However, reading and writing skills continue to play an essential role in higher education studies (Quick, 2013). Although limited, some researchers have studied how learners with dyslexia cope in tertiary institutions (e.g. Carter & Sellman, 2013; Olofsson et al., 2015) and these studies have demonstrated a correlation between having dyslexia and academic difficulties. Consequently, due to the challenges experienced in reading, spelling and writing, students with dyslexia have reported to have lower self-confidence in their ability to learn (Olofsson et al., 2015).

Additionally, some students struggle with understanding course materials, journal articles, taking notes during lectures (Olofsson et al., 2012) as well as preparing for tests (Kirby et al., 2008). Therefore, being able to develop and possess essential compensatory strategies that includes study skills, time management skills and deep learning approaches (Kirby et al., 2008) may help them better manage their difficulties.

Moreover, the lack of appropriate support from the disability office as well as limited awareness of dyslexia among academic staff (MacCullagh et al., 2017; Mortimore & Crozier, 2006; Olofsson et al., 2015; Pino & Mortari, 2014) have also been identified as barriers by students.

Rowan (2014) also found that students with dyslexia may lack the knowledge and skills to

self-advocate. As a result, they may not adequately express their needs to request guidance and appropriate accommodations to support their university studies.

As students with dyslexia and other specific learning differences may continue to struggle and face academic difficulties in IHLs, having access to support, specialist services and resources as well as developing stronger advocacy skills are therefore critical in helping them navigate their challenges and overcome obstacles to experience success in their academic pursuit.

Dyslexia and Executive Functioning

The ability to perceive and estimate the duration of an interval, either retrospectively or prospectively, is vital in helping individuals organise their time more efficiently. In other words, having good time management optimises one's daily performance and productivity. It not only helps with meeting deadlines and schedules but also aids with organising tasks and assignments based on their level of importance and urgency.

According to Barkley (1997), time estimation is an executive ability that enables an individual to perform and deliver tasks optimally within a given time frame. It, therefore, has a bearing on how efficient and productive an individual is especially with higher expectations, limited amount of time and considerable assignments and projects (Rosenblum, 2012) that typically come with being in higher education institutions. Furthermore, there are deficits in explicit and implicit time estimation among the dyslexia population which might be due to specific impairments in their 'internal clock' (Casini et al., 2018; Nicolson et al., 1995). This means that students with dyslexia might overestimate the time they have to complete a complex task. In addition to difficulties with time estimation, language processing and short-term memory deficits associated with dyslexia further compound the difficulties learners with LD face when it comes to processing information the first time round, especially if the information comes at a high speed or if the task is complicated in nature.

Executive functions (EF) are higher-level cognitive functions which comprise two close but separate executive abilities: meta-cognitive ability and motivational-emotional ability (Ardila, 2008; Dawson & Guare, 2004). According to the literature, individuals with LD show gaps in EF (Compton et al., 2012; Horowitz-Kraus, 2014; Varvara et al., 2014) especially in areas related to time management, working memory, planning and organisation (Brosnan et al., 2002; Dahan et al., 2008; Fleming & McMahon, 2012; Trainin & Swanson, 2005).

In addition, activities and tasks that require more executive processes resulting in the need to allocate more attentional resources may also impact the efficacy of event-based prospective memory (Marsh & Hicks, 1998). Given reports that show how learners with dyslexia struggle with automatisation and attention (Nicolson & Fawcett, 1990), such

impairments are likely to affect naturalistic prospective memory settings (Smith-Spark et al., 2004).

Furthermore, deficits in EF may also affect educational success as EF has been linked to academic performance in learners of different age groups with and without specific learning differences (SpLD) (see Best et al., 2009, and Müller et al., 2008, for reviews).

Dyslexia and Study Skills

Study skills are essential for learning independently and effectively, including acquiring purposeful skills and knowledge at various levels of education (Jones et al., 1992). Study skills, a form of metacognitive processing, help students process and internalise information, retain and apply the acquired knowledge as well as produce new information in a meaningful way (Al-Hilawani, 2016).

The acquisition and application of study skills have therefore been positively associated with academic achievements (Hoover, 1989, Miranda et al., 2022). Some research also suggests that students who have inadequate study skill techniques with or without learning differences are likely to be at risk of underperforming (Proctor et al., 2006; Reaser et al., 2007) as they may be unprepared for a successful college education.

Dyslexia and Online Learning

Traditionally, before COVID-19, most learners and educators have a certain time to meet which means that synchronous learning takes place. However, with technology-enhanced learning techniques after the 1980s, there was an academic shift towards constructivist learning together with technology-enhanced learning techniques (Alpat, 2019). This was especially so after COVID-19. Such techniques that incorporate constructivist learning may include online learning which includes e-learning, or blended learning which is a combination of online learning and face-to-face learning.

E-learning, a subset of online learning, is a structured course of learning content delivered electronically and is usually managed and administered using a learning management system (LMS) usually accessed using a web browser (Foreman, 2017). Some common LMS might include Blackboard or Moodle. Learning on an LMS is asynchronous which means it is self-paced and the learners take the course on their own. On the other hand, synchronous online learning is educator-led and takes place at the same time across geographically dispersed areas. It might use web-conferencing or virtual classroom platforms such as Google Hangouts Meet or Zoom which uses the app features such as screenshare, chat, and annotation tools.

It is of utmost importance that the pedagogical approach adopted adheres to the learning styles of learners with dyslexia to better facilitate their learning. Here are some

pedagogical implications derived from studies investigating older learners with dyslexia and how they fared with an online learning approach.

- Learning modes or teaching approach should adapt to older students with SpLDs

Learning styles are commonly defined as "...characteristic cognitive, affective, and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (Ladd & Ruby, 1999, p. 363). They might also be defined as 'personal qualities that influence a student's ability to acquire information, to interact with peers and the teacher, and otherwise to participate in learning experiences' (Grasha, 1996, p. 41). There have been many studies which challenge the idea of learning styles, but most studies agree that learners have different learning preferences (e.g. Coffield et al., 2004; Mortimore, 2005). It was found that for students with dyslexia, they might benefit from instruction using multimodal learning (Andreou and Vlachos, 2013). Therefore, to accommodate all the different learning styles, it was important for delivery to be multimodal or multi-sensory. This would also mean using appropriate fonts and colours, organising text in slides and handouts, giving instructions, and the staging and scaffolding of videos, such as animations of tutorials and assignments, to be delivered in a multisensorial way.

Other than catering to the students' learning style, it was also important to focus on their profiles. These include focusing on strengths rather than weaknesses when giving feedback in order to build up self-confidence and reduce anxiety (Gallardo et al., 2015). As students with dyslexia also fall on a spectrum, it should not be assumed that students who are older will be able to do well on their own, and help should always be offered.

Learning for students with SpLD should be as authentic as possible to allow students to make sense of their own learning. This is in line with flipped classrooms, based on Piaget and Vygotsky's Cognitive constructivism which states that students should have an active role in the creation of their own reality so that students can make sense of it (Brown, 2001). Students should also be able to learn more effectively, because learning occurs when new experiences are integrated with their existing knowledge or context (Kaufman, 2004). This is especially true when it comes to teaching of life skills or study skills (Alpat, 2019; Durkin & Main, 2002). Therefore, by having flipped classrooms using e-learning as part of the online learning approach, students who are underachieving can help improve their motivation, learning attitude, and engagement which in turn allows them to learn more effectively (Al-Otaibi, 2017; Chou et al., 2021; Nouri, 2016; Cheng et al., 2020).

- The importance of teacher and peer interaction in the learning process

Other than having a good e-learning platform, it was also important that learners be

able to communicate and interact with their teachers online using different electronic devices such as tablets, laptops and smartphones to facilitate communication (Al-Otaibi, 2017; Moore, 2014; Nortvig et al., 2018; Rasskazova et al., 2017; Swan & Shih, 2005). This is so that students can still be motivated and engaged to access the LMS to learn (Rasskazova et al., 2017). This can be achieved through communicating with the students regularly, giving consistent feedback and getting students engaged in critical discussions modelled by the educator (Gray & DiLoreto, 2016).

Other than their teachers, students will need to feel connected not only to the educator but also to other students in the cohort, as well as the course content in order to achieve engagement and learning (Al-Otaibi, 2017; Martín-Rodríguez et al., 2015; Moore, 2014; Nortvig et al., 2018; Rasskazova et al., 2017; Swan & Shih, 2005; Southard et al., 2015). Therefore, in order to build and grow knowledge, teachers can foster feelings of mutual trust through a conscientious effort to build an online community (Cho & Tobias, 2015).

All in all, when interpersonal communication takes place between teachers and students, and their peers, meaning is formed and learning takes place (Tomlinson et al., 2003).

For the purposes of this study, the term **'online learning'** will be used to define the iStudySmart™ programme's mode of learning, which combines elements of e-learning and blended learning entirely through the use of online tools.

METHODOLOGY

Research Questions

What are the effects of an online executive functioning and study skills programme for upper secondary and tertiary-level students with learning differences?:

- **RQ1:** What is the effect of an online executive functioning and study skills programme on executive function, specifically in time management, planning and organisation of students with learning differences?

- **RQ2:** What is the effect of an online executive functioning and study skills programme on tertiary skills (writing and presentation) of students with learning differences?

- **RQ3:** What is the effect of an online executive functioning and study skills programme on the motivation and independence level of students with learning differences?

- **RQ4:** What is the effect of an online executive functioning and study skills programme on perceptions of online learning of students with learning differences?

Participants

Participants included upper secondary and tertiary students (n=28; see Table 1 for breakdown of numbers by school levels) enrolled in the iStudySmart™ programme in 2021. There were a total of 2 intakes and each intake took place for two terms (six months); from January to June and July to December. The students came from mainstream secondary schools, and IHLs which include private universities. 53% of the participants were students from upper secondary where their ages range from 15 years to 17 years old. The remaining 47% were students from higher education institutions with ages ranging from 17 years to 22 years old.

Table 1. Participants from different school levels for Intakes 1 and 2

Intake	School Levels	Number of Students at the beginning of the cycle	Number of Students in total at start of cycle	Number of Students at the end of the cycle	Number of students at the end of cycle
1	Secondary 3	4	15	4	14
	Secondary 4	3		3	
	Upper Secondary	**7**		**7**	
	Institute of Technical Education	5		4	
	Polytechnic	2		2	
	University	1		1	
	Tertiary	**8**		**7**	
2	Secondary 3	4	16	3	14
	Secondary 4	5		5	
	Upper Secondary	**9**		**8**	
	Institute of Technical Education	4		3	
	Polytechnic	2		2	
	University	1		1	
	Tertiary	**7**		**6**	

In Singapore, Students who go to Institute of Technical Education (ITEs) go through technical and vocational training in two or three year courses. Students who do well can apply to attend Polytechnic diploma courses. Students who go to Polytechnics focus more on project-based learning which spans approximately three to four years. They can then apply to attend university degree courses.

Three students exited the programme after one term of intervention. At the end of the programme, one student was not feeling well and did not complete the survey. Therefore, the total number of participants, which included upper secondary and tertiary students, is 27 (n=27).

Instrumentation

Pre- and Post- Intervention Surveys (Quantitative)

The pre and post intervention surveys used in this study was developed following a review of various questionnaires from different studies These include time management (Employability Skills, 2008), presentation skills (Higgins-Opitz & Tufts, 2010), areas of learning difficulties (Learning Disabilities Association of Minnesota., n.d.), and self-efficacy (Research Collaboration, 2015). The post-survey included an additional section to obtain feedback on participant students' overall perception of the programme as well as suggestions on how to further improve the learning experience and outcomes for subsequent intakes of students.

The pre- and post-surveys consisted of 3 main sections:

- Executive functioning skills
- Study skills
- Modes of learning

The pre-survey was administered to the students before the intervention commenced and the post-survey, on the last session. Each survey takes about five to eight minutes to complete.

Interviews- 6 months Post Intervention

As part of ascertaining the level of transference of skills acquired through the programme, a six months post interview was conducted. The interviews took place via Zoom due to the global COVID-19 pandemic. A total of eight students participated, of which two students transitioned to post-secondary right after the completion of the programme. The remaining six students have already embarked on their tertiary education at the point of enrolment. The interview questions provided insight on the

skills and techniques that helped students cope with the increased demands and expectations in their tertiary education.

Table 2. Experimental design

Activity	School Levels	Number of students
6 months Post-interview	Secondary to IHL	2
	IHL to IHL	6
Total number of students		**8**

Testimonials and Feedback (Qualitative)

As most of the participant students may have other co-occurring learning challenges in addition to their dyslexia diagnosis, their progress may be varied and gradual. Therefore, testimonials and feedback provided by parents and Educational Therapists also form an important qualitative aspect in the evaluation of the students' overall progress as well as to triangulate the data.

Intervention

The students received intervention for approximately 20 weeks, two terms in 2021. The first intake took place from January to June and the second intake was from July to December. The intervention combines both e-learning and online learning approaches. Extending beyond literacy intervention, the programme supports and equips students with critical skills to prepare and support them in higher education and future employment. It also aims to bridge the gaps in currently available resources and expertise in IHLs by providing older students access to a specialist programme that caters not only to their learning needs and challenges, but also enables them to become self-reliant, independent and empowered individuals.

Multi-modalities and key teaching principles have also been built into the design and content of the e-learning course materials to cater to learners with learning differences. Depending on the learners' needs and profiles, the online consultation session is another platform where the facilitators would provide differentiated instructions, scaffolding and guidance.

The e-learning elements were designed and developed with careful consideration for secondary school students with dyslexia in anticipation of them needing to adapt to tertiary education and for tertiary students to better cope and thrive in the higher education environment. The content was delivered online on any compatible devices

such as a desktop, laptop, tablet or phone. New content and assignments were uploaded on a weekly basis during the scheduled e-learning weeks. The students would then need to access the course materials at their convenience and pace within the week, spending about 1.5 hours to 2 hours weekly. Additionally, the students do not need to complete the week's course materials and assignments in one sitting. They can continue from where they left off on another day if they need to. Furthermore, they can also review the materials multiple times if they require over-learning and reinforcement in order to gain mastery in any of the skills and techniques taught.

The core modules covered include skills in the following areas:

Time Management and Prioritisation	Students will be taught how to manage their schedule and tasks based on the level of importance and urgency.
Planning and Organisation	Students will be guided on how to plan and organise ideas based on a chosen research topic.
Tertiary Writing	Students will learn how to gather, synthesise and organise relevant information.
Presentation	Students will grow and become a better and more confident speaker.

13 e-learning sets of materials were storyboarded by the two researcher-facilitators. Using Articulate 360, these learning materials were developed into Shareable Content Object Reference Model (SCORM) packages by an instructional designer who is also an Educational Therapist (EdT). All of the SCORM packages were uploaded on the e-learning platform for the students to access.

The SCORM packages consist of various multi-modal strategies including videos, interactive elements, closed captions, where possible, to increase engagement and sustained concentration among the students. Concept checking elements such as quizzes were also incorporated to further heighten students' understanding and hopefully, enable greater transference of skills across relevant domains. This is in line with Piaget's and Vygotsty's concept of cognitive constructivism which was discussed in the literature review earlier.

In addition to the e-learning content, there were a total of six stipulated face-to-face online consultation sessions scheduled over the course of twenty weeks. During these sessions, the facilitators would meet with their assigned students virtually to provide the necessary support and guidance. The students would also be able to clarify any questions they have regarding the course materials or assignments.

Should any of the students require extra help based on their varied learning profiles, the facilitators may arrange for additional sessions to support the student in order to help them to understand the e-learning content or assignment instructions. The facilitators also conduct weekly check-ins with the students and work closely with their parents via various communication channels such as emails and text messages.

Further, the intervention culminated in a live final presentation where the students not only presented the content of their research. but were also exposed to questions posed by the judges during the Question and Answer segment.

FINDINGS AND ANALYSIS

Students were asked to rate their responses across a Likert scale of 1 representing "never" and 5 which is "all the time". These are the findings from the pre- and post-questionnaires.

Overall Findings - Pre- and Post-Surveys: Tertiary and Upper Secondary School Students

Comparison between the students' pre-intervention and post-intervention scores were established in order to evaluate whether there have been any gains. T-scores and effect sizes were also calculated on selected questions from each module to have a better understanding of the level of progress i.e. significant, minimal or no improvement demonstrated by the students. Effect sizes are used where sample sizes are moderate, in order to compare between different questions, with an effect size of 0.2 representing a small effect size, 0.5 a moderate effect size, and 0.8 a large effect size (Cohen, 1988)

T-scores were calculated to show the difference between the student population before and after the intervention. Based on the t-scores calculated, the calculated t-score for the question, "I prioritise my tasks so that I do the most important and urgent ones first" was greater than the table value at an alpha significance level of .05 (which means it was non-significant. For the rest of the questions above, the t-scores generated were smaller than the alpha significance level of .05 (which means that answers before and after the intervention were significant and the null hypothesis (H0) is rejected.

After two terms of intervention, it was found that the effect sizes for the following modules, Planning and Organisation Skills, Tertiary Writing Skills and Presentation Skills were 'moderate' to 'large'. The effect size was small for Time Management and Prioritisation Skills.

Table 3. T-scores, P-value and Effect Sizes for various study skills

Study Skills	**Time Management and Prioritisation Skills**		**Planning and Organisation Skills**		**Tertiary Writing Skills**		**Presentation Skills**	
Question	I review my progress towards my goals every now and then and revise my plans accordingly.	I prioritise my tasks so that I do the most important and urgent ones first.	I break difficult tasks down into smaller components so that I can accomplish them one step at a time.	I am able to moderate my distractions and not affect the completion of my task.	I know how to find relevant information from various sources (e.g. internet, newspapers & books, etc.).	I know the structure and language features of a speech.	I feel confident presenting after a lot of practice.	I know how to create appealing visual aids (i.e. Google Slides) to help me in my presentation
T-scores	0.04*	0.15	0.01**	0.01**	0.04*	0.00***	0.03*	0.00***
P-value	*	nil	**	***	*	***	*	***
Effect Sizes	0.4 Small	0.3 Small	0.8 Large	0.7 Moderate	0.7 Moderate	0.82 Large	0.5 Moderate	0.9 Large

In table 3 above, * represents that the P-value is significant at <.05, ** significant at <.01 and *** significant at <.001.

RQ1: What is the effect of the iStudySmart™ online programme on executive function, specifically in time management, planning and organisation of students with learning differences?

- Time Management and Prioritisation skills

As the effect size score was low for both questions 'I review my progress towards my goals every now and then and revise my plans accordingly' and 'I prioritise my tasks so that I do the most important and urgent ones first', responses from two other questions in this category were identified to determine if the students had shown any gains and progress in managing their time and prioritising their tasks more efficiently. The two questions were:

- I have a daily to-do list that I update regularly.
- I am able to prioritise important tasks and complete them.

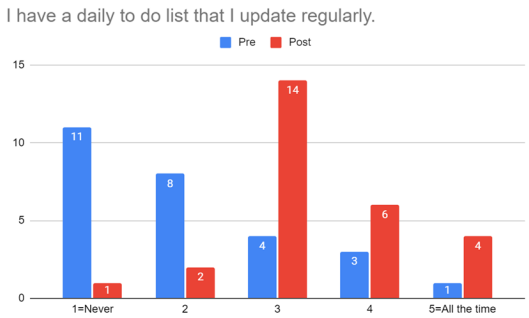

Figure 1. The use of a 'to-do list'

Based on the results obtained as seen in Figure 1 above, most of the students did not update their daily to-do list before the intervention. They were also not aware of how to prepare a to-do list or schedule and update it regularly, to help them better manage their time and prioritise their tasks more productively. However, there have been some gains observed post-intervention with 14 students rating their response as '3' and 10 students rated '4' or '5' for this question. Additionally, it is noteworthy to highlight the marked improvement demonstrated by the students after they have received support as compared to pre-intervention when the majority of the students then rated '1' or '2'.

A further analysis of the results was conducted to see if there were any difference in gains between the upper secondary and tertiary groups students.

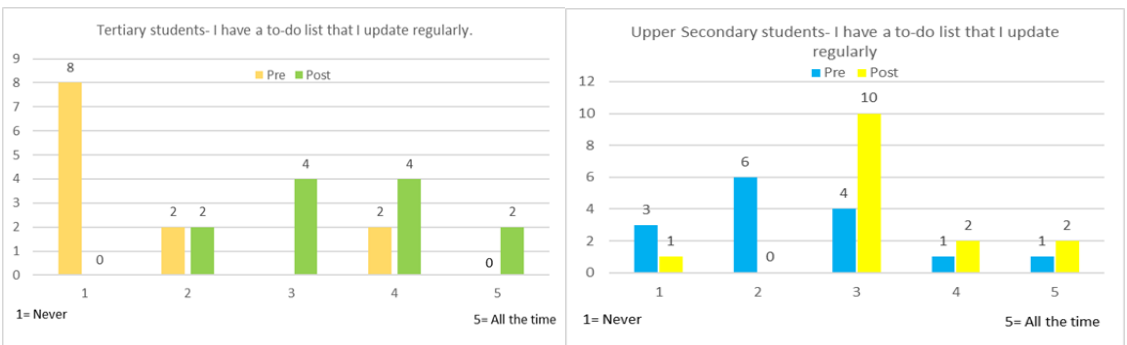

Figure 2. Comparison of Tertiary and Secondary students for the use of 'to-do list'

Based on Figure 2, it can be inferred that most of the IHL students as compared to the Upper Secondary students did not have the habit of preparing a to-do list pre-intervention to help them take note of which tasks to prioritise and complete within a stipulated timeline. This is in spite of them being in higher education where workload tends to be more intense. On the whole, both groups have demonstrated awareness and knowledge post intervention in creating to-do lists to help them better plan and organise their tasks with IHL students making greater gains.

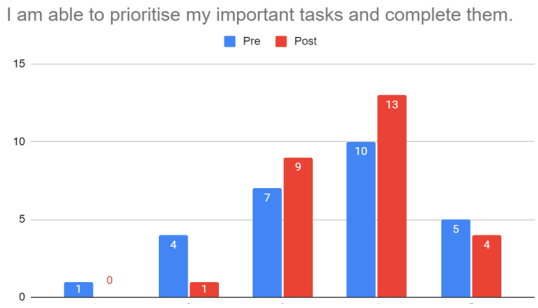

Figure 3. Ability to prioritise tasks

From Figure 3, most of the students have also shown improvement in their ability to prioritise and complete tasks that are more important and urgent in order to meet stipulated deadlines. More than half of the students have rated either 'Most of the time' or 'All the time' post intervention. While the effect size for the 'Time Management and Prioritisation Skills' module is small, there was still some progress and gains demonstrated by the majority of students.

Furthermore, the post 6 months interview responses have also shown that the students benefited from learning how to better prioritise their tasks, which in turn, allows them to manage their time more efficiently given the increased workload and assignments expected of them to undertake in tertiary education.

> *" iSS [iStudySmart™) really helped in time management and prioritising different tasks."*
>
> *"Time management is different [in higher education]... now I set a goal to finish [my work] at least 2 days before [the deadline] to overcome procrastination."*
>
> *"I learnt time management skills which [has] helped me as polytechnic [student] as [learning] is more self-directed."*

Planning and Organisation Skills

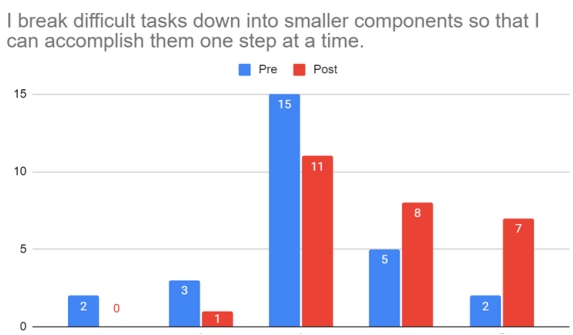

Figure 4. Ability to break tasks down

Referring to Figure 4, we can gather that prior to receiving intervention, most of the students do not know how to effectively manage their tasks, especially if they are challenging or demanding to complete. After the intervention, most of them now possess the awareness and ability to break down tasks into bite-sized ones in order to make the process of completion more manageable and less overwhelming for them.

As shown in Figure 5 above, both groups of students have demonstrated significant gains after receiving intervention and therefore, are more independent and confident in undertaking tasks especially those that are challenging or complex in nature. They also demonstrated similar progression patterns.

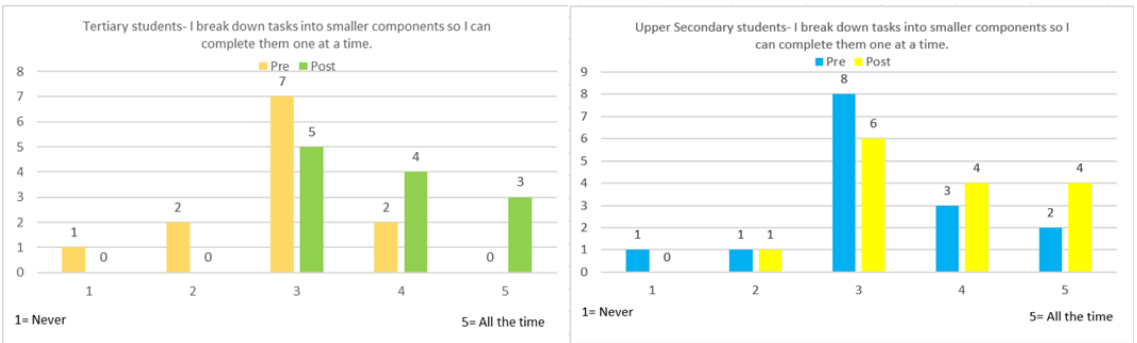

Figure 5. Comparison of Tertiary and Secondary students on their ability to break down tasks

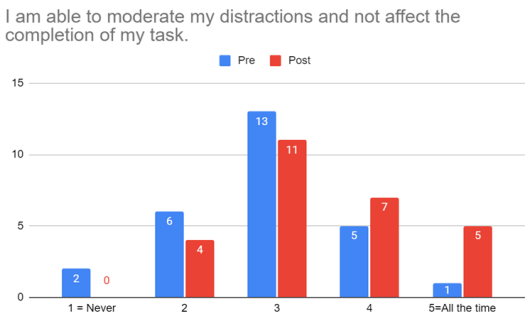

Figure 6. Ability to moderate distractions

While most of the students are still in the process of developing self-discipline and the ability to focus in order to see to the completion of their tasks without being distracted, it is still noteworthy to highlight that close to half of the students have reported improvements in their ability to moderate their distractions post intervention. Seven students chose 'Most of the time' and five students chose 'All the time' for this question.

RQ2: What is the effect of the iStudySmart™ online programme on tertiary skills (writing and presentation) of students with learning differences?

Tertiary Writing Skills

Students with dyslexia would generally experience difficulties when it comes to searching for relevant information to justify their points or arguments for their research. They may not know how to identify keywords that would help narrow the scope of research as well as discern information that is valid and reliable. From the Figure 7, there is certainly a positive increase in the students' confidence and ability to conduct research more effectively and independently.

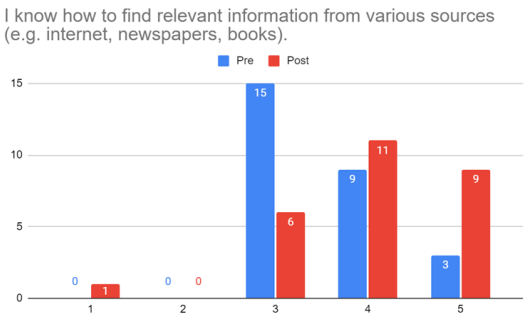

Figure 7. Knowledge of finding relevant information

The post interviews also revealed similar findings.

> *"The iSS [iStudySmart™ programme] taught me how to [cite] using APA [format] which is used by my school."*
>
> *"...how to source good materials online for any presentations."*
>
> *"The iSS [iStudySmart™ programme] [provides] a good foundation for research because when you are in polytechnic, there's a lot of [research assignments] especially for the mandatory modules."*

While the IHL and Upper Secondary groups of students have demonstrated progress in their ability to search for relevant information for research post intervention as shown in Figure 8, the IHL group has shown more gains. This could be due to the fact that IHL students have more opportunities to be involved in research or project work compared to Upper Secondary students. Thus, they are able to have more practice in applying the skills acquired in searching for information relevant to their area of research.

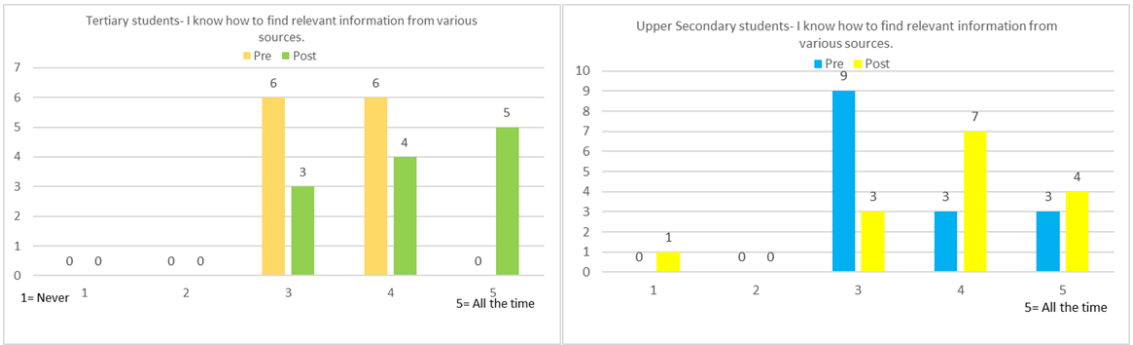

Figure 8. Comparison of Tertiary and Secondary students regarding finding relevant information

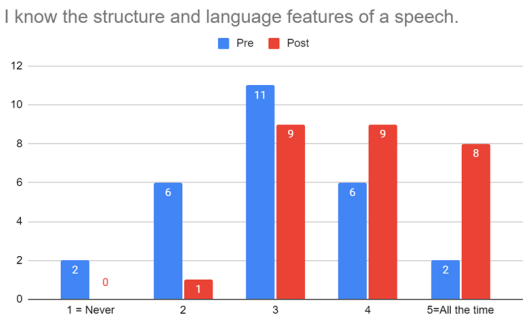

Figure 9. Knowledge of the structure of speech

It can be seen from the students' responses in Figure 9 that after receiving intervention, there was a significant positive increase in the students' perspectives and knowledge about the structure and language features of a speech for oral presentations.

- Presentation Skills

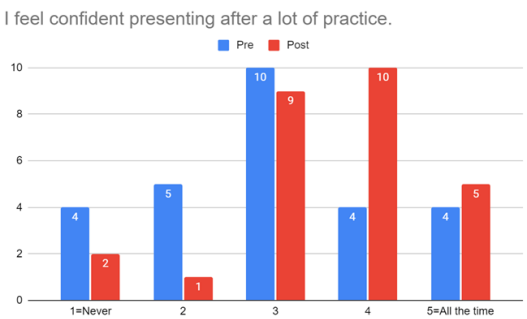

Figure 10. Confidence in giving oral presentations

In terms of the confidence gained with making presentations, more than half of the students have made either large or moderate gains. The results suggest that while making presentations may seem challenging and daunting to students with dyslexia especially if they do not have much exposure in public speaking, they gain more confidence when ample practice and guidance is provided to them.

As seen in Figure 11, prior to intervention, most of the students provided a neutral response '3' when it came to creating slides that are appealing, to support their oral presentation. In other words, they may not know how to incorporate visual aids in their Powerpoint or Google slides. Post intervention, it is evident that most of the students are now able to create engaging slides to help them during their presentation, with 20 students rating their response as either '4' or '5'.

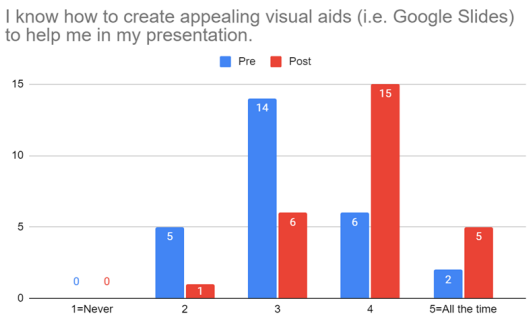

Figure 11. Creating visual aids

Besides the results obtained from the main modules related to study skills and executive functioning skills, it is also useful to understand the perception and preference of students when it comes to e-learning and online learning delivery and instructions.

RQ3: What is the effect of the iStudySmart™ online programme on the motivation and independence level of students with learning differences?

After the period of intervention, parents were invited to write testimonials. As displayed in Table 4 above, most of the parents indicated that there is an overall improvement seen in their children after the intervention. Similar to the findings from the pre- and post-questionnaires from the previous section, most of them have improved in their confidence, independence levels, stress management as well as time management and prioritisation, planning and organisation, research skills and presentation skills.
Likewise, similar to the findings, a parent had also indicated in her feedback after the intervention that while her son is able to cope with ITE, he is still finding it hard to plan in advance and rushes to complete his assignments at the last minute.

Table 4. Parent testimonials received after the intervention

Testimonials from Parents (Qualitative)
Thank you very much for your coaching and guidance provided to my son. Indeed, we are very comforted to have witnessed his progress and his confidence to present. This is in fact the first time we saw his sharing on this topic. We are very grateful for your care and guidance provided to him that has helped shape his frame of thoughts during the presentation stage and has helped him improve on his presentation skills. We believe that this platform has provided a great opportunity and exposure to learn and help boost the confidence level of an individual. We are glad that he has enrolled in this class and so fortunate to have you as his mentor. Thanks so much!
I do believe the programme has helped my daughter be more focused in searching for information [for her] research. A tool that is definitely useful in her studies now. I'm just so glad we've decided to let her join iStudySmart™. She has truly benefited a lot.
[We are] very grateful for your help in building confidence in [our daughter]. She has definitely improved in speaking more confidently.
The programme has really helped my son with his presentation skills and in planning his study schedule. The guidance from the DAS teacher also improved his communication skills with his HIL instructors. These are really useful skills in [IHL], enabling the student to be an independent learner.
I wish we had known about this programme much earlier. The title of the programme speaks for itself. iStudySmart™ has equipped my daughter with the skills and tools to manage her time better, prioritise and break down tasks into manageable ones as well as tools to plan and organise. This has helped with reducing and coping with stress. At the end of the course, the students were guided to apply their research, writing and presentation skills taught on the programme. *The programme has not only equipped my daughter with the skills but also built her confidence through the patience, understanding and encouragement received from her facilitator.*
From what I can see, [although he can keep up with the work in ITE], he usually waits till the last minute to do his assignments. There is no change.

Several other observations were provided by the teachers especially in the areas of motivation and independence after having supported and guided the students throughout the course of the programme.

Firstly, the level of progress is dependent on the student's self-motivation, independence and ownership given that iStudySmart™ is an online learning programme comprising e-learning and online consultation sessions. This means that e-learning may not be suitable for some of the students especially those with more complex learning profiles and challenged needs who require close supervision and reminders from the teachers to access their e-learning materials and complete their assignments.

Secondly, the students come from different schools and IHL institutions with varied learning needs and profiles. From interactions, experience and observations by the teachers, students with more severe learning challenges and co-morbidities tend to require more support, guidance and scaffolding. Working closely with parents and gaining their support also plays an integral part in the students' learning process and progress; from making sure their child accesses and completes their online modules and assignments promptly, to ensuring they turn up on time for their scheduled online consultation sessions.

RQ4: What is the effect of the iStudySmart™ online programme on the perceptions of online learning of students with learning differences?

Preferred mode of learning

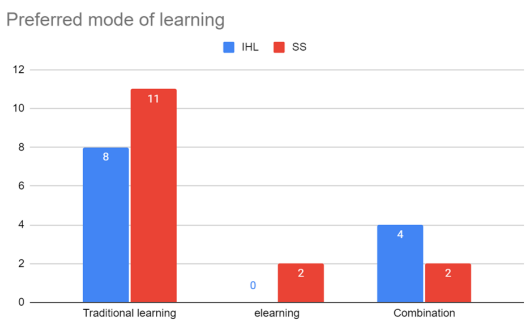

Figure 12. Experience with online (e-learning) delivery

From the figure above, the majority of students, 21 out of 27 students, have experienced e-learning as a result of the need to pivot online at the height of the COVID-19 pandemic in 2021. The IHL and Upper Secondary students were already quite familiar with the Student Learning Space (SLS) and Blackboard respectively as these e-learning platforms were used in schools to access materials, content and assignments virtually.

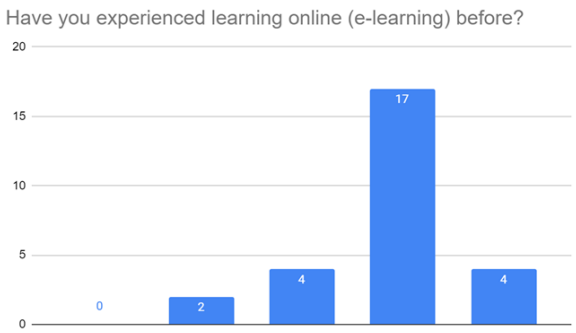

Figure 13. Preferred mode of learning

However, when it came to indicating their preference, most of the IHL and Upper Secondary students chose traditional learning over e-learning or combined learning as their preferred mode of learning. Some of the reasons cited include:

- the familiarity and assurance having the teachers in class to guide and encourage them
- the increased interaction and engagement with teachers and classmates in a face-to-face learning environment
- the instability of internet connectivity which may disrupt the e-learning experience

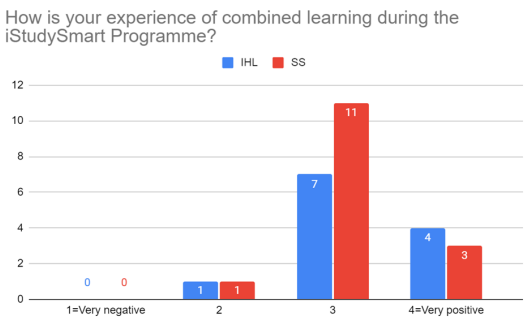

Figure 14. Experience with combined learning in iStudySmart™

While most students preferred traditional teaching over e-learning or online learning as shown in Figure 13, it is interesting to note that most of the students rated their e-learning and online learning experience on iStudySmart™ as very positive after the completion of the programme as seen in Figure 14. Some of the reasons that have contributed to a positive learning experience for the students in spite of the lessons being delivered virtually are shown in table 5.

Table 5. Reasons for liking combined learning

What do you like about combined learning (e-learning and online learning)?	**IHL**	**SS**	**Overall**
I get to learn on my own most times and interact with my friends and teachers on other times	6	7	13
I get to rotate between self-paced online learning and online instruction and guidance provided by my teacher.	5	6	11
I can learn at my own pace most times, reducing my stress and anxiety.	8	10	**18**
I get to learn through a variety of activities using many different learning styles.	**9**	10	**19**
I prefer that most instruction is delivered online, with the teacher providing support in small-group settings.	4	**11**	15
I like that it offers flexible time frames that can be personalised to my own schedule.	7	10	**17**

Most of the students felt that the combination enabled them to learn through a variety of learning methods to meet their preferred learning styles. Most of them also appreciated that the mode of learning was flexible and they were able to learn at a pace which accommodated their needs and schedule thereby, reducing their stress levels. Furthermore, some students mentioned that the user interface such as the online instructions and the e-learning materials were presented in a way that has helped them better understand the lessons.

It is interesting to note though that from the students' responses, most of the IHL students felt that learning through a variety of activities to cater to their learning needs was a factor that was important in their learning. On the other hand, most of the Upper Secondary students had indicated that learning through a teacher in a small-group setting was preferred. This may be because the latter group is not as exposed or used to a flipped approach or e-learning and, hence, preferred to have a teacher guide them instead.

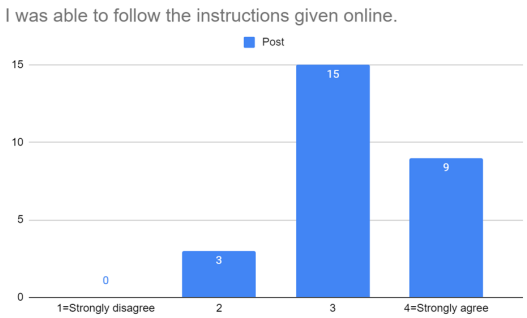

Figure 15. Students' ability to follow instructions online

Most of the students have also indicated that they were able to follow the lessons as they felt the instructions provided online were clear, straightforward and easy to follow. The positive responses might also be due to the teacher support received which was critical in enabling a positive and enriching learning experience. Students were also able to reach out to their teachers to seek support, guidance and clarification whenever they encountered any challenges in their learning

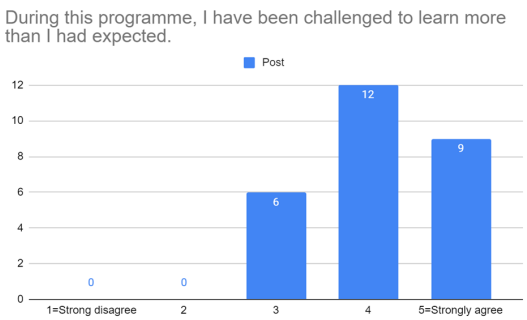

Figure 16. Students' responses on whether they have been challenged to learn more

Lastly, most of the students also shared that they were challenged to learn beyond what they had expected, prior to receiving support. Out of the 27 students, 21 of them have either rated 'strongly agree' or 'agree'. This suggests that the majority of students have learnt and acquired more knowledge and skills than they had expected prior to joining the programme.

DISCUSSION

Most of the students showed improvements after receiving support on the iStudySmart™ programme over a duration of six months especially in the acquisition of skills in

planning and organisation, tertiary writing and presentation domains where a statistical difference was found. The effect sizes also ranged from moderate to large.
While the effect size calculated for selected questions under time management and prioritisation is small, the 6 months post interview responses demonstrated positive impact as the skills acquired helped the students cope better with the increase in rigour and workload in higher learning.

Upper secondary school students and tertiary students have also positively reviewed the programme, acknowledging that they are better equipped with skills and techniques to confidently overcome challenges they may experience in their higher education studies. The post interview responses, testimonials and feedback received from students, parents and facilitators have also been very encouraging as observations have indicated that they have seen positive development in their children and cited the increase in confidence, research and presentation skills, organisation and time management as some of the benefits gained from the intervention.

Some parents have indicated that although there has been progress observed in the acquisition and applications of skills from the executive functioning and study skills categories, it is noteworthy that most of these skills need to be practised and applied across the different domains consistently and over time. Hence, it may take a while for significant progress to be demonstrated by the students. Besides, iStudySmart™ is a six-months, two term programme, and therefore, more notable gains could potentially be observed over a longer duration of intervention.

Finally, preliminary discussions also suggest that a lack of opportunities to demonstrate and practice the taught skills in school, and a limited meta-awareness of their own skills may influence the rate of progress. However, no firm conclusion can be drawn due to the relatively small student numbers. Therefore, it is important to continue reviewing and monitoring the trends and observations with incoming batches of students.

LIMITATIONS AND FUTURE RESEARCH

Despite the best intentions, this research, however, is subject to several limitations. First of all, the sample size of the participants used to evaluate this study is small. Consequently, statistical tests may not be able to identify important relationships within a particular data set. The findings and analysis, therefore, cannot be generalised to a large population, although it is a step towards understanding the challenges and barriers faced by students with dyslexia and other SpLDs in higher education in Singapore.

Secondly, there was no control group involved in the study; only an experimental group that consists of Upper Secondary and Tertiary students enrolled in the iStudySmart™ programme. Hence, a comparison between the two groups was not established in order

to examine if the effect and gains observed is due to the intervention provided and not other extraneous variables.

Next, two out of the three researchers are also the teachers and the creators of the iStudySmart™ programme which may inevitably account for some biases. Further, while there is a set of curriculum, teaching principles and pedagogical approaches to guide the teachers, the differing levels of expertise, teaching styles and experience may also result in some degree of difference between researchers.

Lastly, the student participants have varied learning profiles and needs. Those who require more support and guidance from the teachers were given more than the stipulated number of online consultation sessions. Such accommodations may affect not only the research design but also the responses provided by the students in the post-survey. Further, the students were asked to complete both the pre- and post-surveys independently. While this practice is recommended in order to eliminate any biases, the students who have learning challenges may encounter difficulties reading or understanding some of the survey items. In view of them not being able to seek clarification from the teachers, their responses, therefore, may not be a true representation of their actual learning experience.

In order to counter some of the limitations presented above, the following may be explored in future studies. Firstly, the iStudySmart™ programme could be conducted on a larger sample size to better evaluate the benefits of the intervention and draw more meaningful conclusions. In addition, as most of the skills covered would need to be practised, applied and developed over time, perhaps a longer intervention duration in future runs of the programme can be considered. Moreover, a controlled study, where controls were only involved in pre- and post-questionnaires and not intervention, should also be considered.

Finally, enhancements made to the programme and curriculum can also be looked into, to possibly include other relevant and important skills such as note-taking and critical thinking that are also crucial in helping students especially those with learning differences cope and navigate challenges encountered in higher education.

CONCLUSION

A short-term intervention demonstrated that both Upper Secondary and Tertiary students could improve their study and executive function skills effectively, with an online and e-learning delivery model designed to address these learning needs. Significant improvements were made in a range of skills, in a study which demonstrates the relevance of these skills for future success. If these results can be replicated in future studies, they can play an important role in preparing students with learning differences for higher education and the workplace.

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