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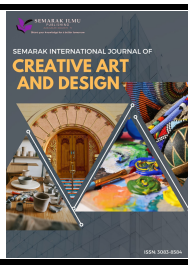

Ortxelics; An Interactive Device for Student with Disabilities

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ABSTRACT

This study presents *Ortxelics*, an interactive device aimed at people; mainly students with disabilities (dyslexia and autism) in a specific environment. Targeted towards families, guardians and students, the interactive device is designed to offer personalized, adaptable tools following their different age groups, that can cater to the unique learning needs of dyslexics and autistics students. Using a design thinking approach, the project involved phases of research, ideation, prototyping, testing, and refinement. The final product incorporates three key features: an application to personalize the tools, a device used to customize the application, a customized panels for hands-on activity. These components are intentionally combined to create an empowering learning environment for students with disabilities, helping them to overcome challenges and build confidence in their abilities. Aligned with the Sustainable Development Goals (SDGs), *Ortxelics* supports in increasing learning experience, empathy and minimizing wastage. The results from user testing are then used to improvise *Ortxelics* according to the target audience's needs and wants, to meet their expectations while taking into consideration the manufacturing process of the product and its costing.

1. Introduction

Dyslexia is one most common cause of academic failure and underachievement. The National Assessment of Educational Progress in 2010 consistently finds that about 36% of all fourth graders read at a level described as "below basic" [1].

Looking at children with autism spectrum disorder (ASD), they struggle with understanding emotions, including recognizing feelings through nonverbal signals, understanding people's emotional and cognitive processes as stated by Ifat Bar, Sigal Eden and Ofer Golan in 2025 [2].

In response to that, interactive devices also could help these students gain confidence not just in school, but also at work for adults who are diagnosed with dyslexia and are willing to utilize the interactive device.

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1.2 Relations between Internet of Things (IoT) and Interactive Device

The Internet of Things (IoT) refers to different devices connected with the existence of technology that allows them to communicate with each other. These devices are typically merged with sensors, software in which mechanical as well as digital machines are also included. IoT devices cover a wide spectrum, from common household gadgets to sophisticated industrial tools. Increasingly, businesses across various industries are adopting IoT to boost efficiency, enhance customer service, improve decision-making, and increase overall business value.

An interactive device is a technology designed to engage users in a dynamic, hands-on experience, often responding to their actions in real-time. These devices can range from touchscreens that react to the user's finger movements, to more advanced systems like virtual reality headsets that immerse users in a fully interactive 3D environment. By combining hardware and software, interactive devices create a seamless interface where users can manipulate digital content, control smart home systems, or even engage in educational activities. The core of these devices lies in their ability to adapt and respond to user input, making technology more intuitive, personalized, and engaging.

1.3 Relations between an Interactive Device and Dyslexics

To relate this to dyslexics, interactive devices can be incredibly beneficial for individuals with dyslexia, as they offer personalized, adaptable tools that can cater to the unique learning needs of dyslexics. These devices often include features like text-to-speech, customizable fonts, and interactive visual aids that help break down complex information into more digestible parts.

For example, an interactive reading app might highlight words as they are read aloud, helping dyslexics follow along more easily and improving their reading fluency. Additionally, the immediate feedback and engaging nature of interactive devices can make learning more enjoyable, reducing the frustration often associated with traditional methods. By leveraging the strengths of interactive technology, these devices can create an empowering learning environment for dyslexics, helping them to overcome challenges and build confidence in their abilities.

1.3 Analytical Data

Press Release on 17th August 2023, from the data taken in the year 2021, Ministry of Finance and Economy, people who are slow learners are at 350 out of 7,024 (5%) people with 232 (5.4%) people being male and the rest 118 (4.3%) people are recognized as female. stated that dyslexia is perhaps the most common neurobehavioral disorder affecting children, with prevalence rates ranging from 5-10% to 17.5%.

1.4 Hadiths

Hadith of Anas Radhi Allahu ‘Anhu says that “I once heard the Prophet PBUH say: “"Indeed, Allah the Almighty said: "If I test one of My servants blindly in both eyes and he is patient, I will replace his eyes with Paradise," (Narrated by al-Bukhari) [3].

Apart from that, there is an ayat from the Quran Surah Al-Ma’idah, verse 2 [4], about how Islam encourages its believer to help the special needs community.

وَتَعَاوَنُواْ عَلَى ٱلۡبِرِّ وَٱلتَّقۡوَىٰۖ وَلَا تَعَاوَنُواْ عَلَى ٱلۡإِثۡمِ وَٱلۡعُدۡوَٰنِۚ وَٱتَّقُواْ ٱللَّهَۖ إِنَّ ٱللَّهَ شَدِيدُ ٱلۡعِقَابِ (2)

Which means, “And help you to do virtue and piety, and do not help in committing sin (immorality) and trespassing. And be devoted to Allah for indeed, Allah is the Most Merciful of His punishment (for anyone who disobeys His commandments).”

(*Al-Ma’idah*: 5:2).

From the mentioned Hadith above, it can be concluded that Allah SWT encourages us as the believer to always be kind and helpful especially to these special needs community.

There is an area where no studies have been conducted, in which lies the lack of inclusivity, user-centered design solutions that relate to the interactive design for individuals with dyslexia and autism that could effectively be solved. The aim of this research is to support and enhance the learning and communication experiences of individuals with dyslexia and autism by addressing their specific challenges in reading, writing, and processing information. The objective of this research is to

1. Create an interactive device to help them gain confidence in school, home or workplace.
2. Incorporate the students while letting them have fun.
3. Multisensory method to reinforce experience while providing clear and simple instructions.

1.5 Literature Review

1.5.1 What Makes a Good Design [10 Principles of Good Design]

Martin Bouza in 2023 wrote an article referring to Dieter Rams as one of the most influential industrial designers of our time [5]. Rams created innovative products that embodied his philosophy of "less but better" design, which has significantly shaped modern design culture. For over 40 years, he led design teams at the German household appliance company Braun, leaving a lasting impact on the field with his famous 10 Principles of Good Design. Isabel Prochner in 2025 also discusses Ram’s ten principles in Call to Move Beyond Dieter Ram’s Principles of Good Design [6].

1. Innovative – The potential for progress in design is far from exhausted. Technological advancements continually present new opportunities for original creations. However, imaginative design evolves alongside improving technology and cannot exist as an end.

2. Useful Product – A product is intended for use, and it must meet not only functional but also psychological and aesthetic needs. Good design prioritises the usefulness of a product while eliminating anything that might detract from it.

3. Aesthetic – A product's aesthetic quality is essential to its usefulness, as it influences daily interactions and impacts people's well-being. Only well-crafted objects can achieve true beauty.

4. Understandable Product – It clarifies the structure of the product. Ideally, it enables the product to convey its function clearly, utilising the user's intuition. At its best, it is self-explanatory.

5. Unobtrusive – Purpose-driven products function like tools. They are neither decorative items nor works of art. Therefore, their design should be neutral and restrained, allowing space for the user's self-expression.

6. Honest – It does not exaggerate a product's innovation, power, or value. It refrains from misleading consumers with promises that cannot be fulfilled.

7. Long-lasting – It avoids trends, ensuring it never appears outdated. Unlike trendy designs, it is built to last for many years, even in today's disposable culture.

8. Thorough down to the last detail – Every aspect must be intentional and carefully considered. Attention to detail in the design process demonstrates respect for the consumer.

9. Environmentally friendly – Design plays a crucial role in environmental preservation by conserving resources and minimizing both physical and visual pollution throughout the product's lifecycle.

10. Little design as possible – Emphasising, "Less, but better," good design aims for simplicity without oversimplifying. It enhances the core functions of a product.

1.5.2 What makes a good design [8 golden rules]

Ben Shneiderman is a professor at the University of Maryland, where his work is often compared to other prominent design experts like Don Norman and Jakob Nielsen. Looking at his influential book, Designing the User Interface: Strategies for Effective Human-Computer Interaction, Shneiderman in 2016 outlines his eight golden rules for effective interface design [7]:

1. Strive for consistency by using familiar icons, colors, menu structures, call-to-actions, and user flows when designing similar scenarios and action sequences. Standardizing how information is presented allows users to apply their previous knowledge from one interaction to the next without needing to relearn actions. Consistency is crucial in helping users become familiar with your product's digital environment, enabling them to achieve their goals more easily.
2. Provide shortcuts for frequent users. As users become more experienced, they often seek quicker ways to complete tasks. For instance, both Windows and Mac systems offer keyboard shortcuts for functions like copying and pasting, allowing advanced users to navigate the interface more efficiently and with less effort.
3. Ensure informative feedback. Users should always know their status and what is happening. For every action, there should be appropriate, human-readable feedback within a reasonable time frame. A good example of this is showing users their progress through a multi-step form or questionnaire. In contrast, a poor example would be displaying an error message that includes an error code, rather than a clear and meaningful explanation.
4. Design dialogues to provide closure. Avoid leaving users uncertain about the outcome of their actions. For instance, after completing an online purchase, users appreciate receiving a "Thank You" message along with confirmation and receipt, clearly indicating that their transaction was successful.
5. Implement straightforward error handling. Users dislike being told they have made a mistake, so systems should be designed to minimise errors. When errors do occur, provide users with clear, simple instructions on how to resolve them quickly and painlessly. For example, highlight fields that were left blank in an online form to guide users in correcting the issue.
6. Allow easy reversal of actions. Designers should ensure that users have clear options for undoing actions at various stages, whether it is a single action, a data entry error, or an entire sequence of steps. As Shneiderman [7] emphasises, offering users the ability to reverse their actions increases confidence and reduces frustration. Support an internal locus of control. Empower users by allowing them to initiate actions and feel in command of their interactions within the digital environment. By designing systems that behave as users expect, you build trust and give them a sense of control over the events in the interface.
7. Human attention is limited therefore, interfaces should be kept as simple as possible, with a clear information hierarchy and a focus on recognition over recall as it is easier because it involves identifying familiar cues that trigger relevant information from memory.
8. From these 8 golden rules, it can be concluded that design is beyond just an art. It consists of understanding human anthropometry and ergonomics as well as attempting to understand

the behavior of target audiences by trying to minimise the amount of effort and reversing the actions from target audiences.

1.5.3 Anthropometrics and Ergonomics

Anthropometry is the science of measuring and understanding the physical traits of the human body, like size, shape, strength, and how we move or work as stated Pheasant and Steenbekkers in 2005 [8]. It's key to creating products, spaces, and systems that fit people's needs by considering factors like gender, age, ethnicity, and occupation. Anthropometry helps improve comfort, performance, and safety and relates it to the ergonomics of a product.

Apart from that, to ensure that workplaces and products fit workers' body size and movement, it's important to consider the physical characteristics of the target users as stated by Garneau and Parkinson in 2016 [9]. By doing this, work environments can be better tailored to meet the needs of the people using them as stated by Kroemer and Grandjean in 1997 [10]. Whether it's designing a chair that supports good posture or tools that reduce strain at work, it plays a crucial role in making everyday environments healthier and more efficient, while also helping to prevent injuries and establish industry standards.

Anthropometry is highly sensitive to measurement errors as stated by Villamor and Bosch in 2014 [11]. To minimise variability and improve accuracy, the World Health Organization WHO in 2006 [12] has recommended several quality assurance practices: (i) using standardised methods for data collection, (ii) providing thorough training and monitoring for data collectors, (iii) regularly calibrating and maintaining equipment, and (iv) conducting periodic checks on the reliability of measurements. Additionally, the International Organisation for Standardisation (ISO) has developed guidelines (ISO, 2008; ISO, 2013) that outline anthropometric practices, helping ergonomists make meaningful comparisons between different population groups worldwide. This also includes the measure of precision and reliability. Precision is a characteristic of a specific measurement technique on a specific body dimension as stated in a study by Norton and Olds in 1996 [13].

The analytical data for precision and reliability by the study of Chavalitsakulchai and Shahnavaz in 1993 [14] can be concluded that the accuracy of the measurements was checked and confirmed by rechecking measurements three times for each subject.

1.6 User-Centered Design

The knowledge from, respectively, ergonomics and usability to supply user needs in a structured manner is provided by the User-Centered Design method Chammas *et al.,* 2015 [15]. It is a systematic process for the design of interactive systems. Coming to who lays down the technical specifications for the UCD method, it is the *American National Standards Institute*, more popularly known as ISO. The ISO 9241-210 standards have objectives that focus on the enhancement of the user's experience, reduction of errors, time used in support and training, and acceptability and efficiency within the interactive systems. This includes the realisation of ergonomic standards and usability methodologies to develop interactive systems that revolve in the interest and needs of the users.

This approach enhances efficiency and contributes to human well-being, accessibility, and sustainability. Additionally, it takes into consideration the potential impact that this interactive system may have on user performance, health, and safety. ISO defines the user experience as "perceptions and responses resulting from the use or anticipated use of a product, system, or service". The user experience includes a wide variety of elements that range from feelings, emotions, beliefs, and expectations to physical and physiological reactions that manifest themselves through

changes in behavior or state before, during, and after the use of the product. It is inseparable from engaging direct-user experience. It follows then that all stratagems to enhance users' experience should carry equal weight with efforts toward functional requirements improvements and technological feature improvements.

The current issue is the lack of a dedicated, specialised product for the target audience which is students with disabilities. This project aims to develop an interactive device designed specifically to support these students by enhancing their learning and communication experiences.

2. Methodology

2.1 Survey Questions

In this section, Ortxelics has handed out the online survey questions made using Google Forms with target feedback of 50 respondents and collected for 15 days which was sent on 15th October 2024 and closed on 30th October 2024. The survey sent respondents are from family and guardians who have Dyslexics members in the family. Apart from that, respondents who have not experienced Dyslexics also taken into consideration to gather their opinions.

From the analysis gathered, most the age group of target audiences for Ortxelics is from 18 to 24 years old at 46.4%, which includes parents, guardians, friends, teachers and the students themselves while the minority of them is 17 and below. In addition to that, suitable devices that got most voted from the target audience are controllers with 39.3% while the minority of them voted for mouse with 10.7%. Meanwhile, the different learning medium for target audiences with most of them voted for is tablet with 57.1% while the minority of them voted for PC/laptop with 14.3%. To further dive into the target users' opinions, they were asked to state the challenges alongside with recommendations that could be beneficial for this research. The target users stated that it must be ergonomically friendly for them, that it is challenging for target users to keep up with the pace due to longer understanding the content, specialized products are too expensive, complex setup, limited flexibility in class, lack of natural interaction with the other students and they need to have regular updates. Some of the respondents do not know anyone with dyslexia and autism. Finally, the suitable theme that could fit the interactive device with most of them voted for cartoon with 53.6% and minority of them voted for MIB at 14.3%.

2.2 On Field Observation, Evidence and Elaboration

We managed to arrange visits to Al-Ameerah Al-Hajjah Maryam School, Spg 66-38-60, Kampong Bengkurong BF1920 with the approval from Miss Nurussa'adatul Firdaus Saifulbahri, the principal on 12th February and 13th February in the morning from 9 am to 11.30 am and observe the kindergarten students aged 4 to 6 years old. The aim of this field observation is to ensure that the behavioural observation of the students is beneficial and would give some input to this project.

In this observation, we will be looking at the:

1. Different behaviours of each student with autism and dyslexia.
2. How the students will act with the presence of an observant (newcomer).
3. Will there be any Hawthorne effect (students act differently due to the awareness of being observed) throughout the observing process?
4. How the students learn in school; what method (traditional or modern).
5. How the students and teachers utilise the utilities provided by the school.
6. Main theme of the school.

7. Observants will try to communicate and socialize with the students to understand how they behave even more.

In this section, we will be providing proof and the current activities as well as the environment for the students and teachers that were observed. As a disclaimer, all pictures at the different environments in the school are taken with consent from the principal itself, Miss Nurussa'adatul Firdaus Saifulbahri however, there will be no full pictures of students as it is to pay respect to their privacy, there are only pictures of students from behind and half face of the student.

Table 1
Photos taken at Al-Ameerah Al-Hajjah Maryam School

Environment/Surrounding	Elaboration
	Shown here is the outdoor area of the administration area of the school. The main theme of the school is playful, colourful and bold colours to attract students. No students could be seen around this area as it is strictly for administrative officers, school helpers and teachers only.
	Shown here is another outdoor space of the administration area of the school. No students could be seen around this area as it is strictly for administrative officers, school helpers and teachers only.
	Shown here is the classroom that took place for the observation session. In this picture there is a student from behind heading towards the trampoline. The main idea of the school is to ensure that students feel safe and enjoy school while learning, hence, the plenty of choices of toys for the students to play with and to keep them busy from disturbing or annoying their classmates.

	This picture shows the situation where the student is seen playing with the observant in the classroom. Hawthorne effect could be seen which may affect the reliability of the session.
	Shown here is the library area of the school where students can get a reading session with their respective teachers. A few of the students get to behave while a few others cannot and run around in the library.
	Shown here is the television and whiteboard used to learn and conduct classes in the classroom.

	Shown in this picture is the number of the Teacher Izzati. A few students were being obedient and listened to the teachers, whereas a few students still did not listen to the teachers.

	Shown here is when the student is learning the alphabet with Teacher Izzati in the classroom. A few students were being obedient and listened to the teachers, whereas a few students still did not listen to the teachers.

From this observation too, it can be concluded that the students are learning using both traditional and modern methods; in which for traditional they are using medium such as pens, pencils, crayons and marker pens to conduct the classworks or homeworks and modern in terms of the usage of devices such as televisions to watch the educational videos on social media. By the existence of these medium provided by the school, it can be seen that the medium and stationary such as pens etc are well utilised by then putting up the end product of a project around the classroom, which made the students feel more appreciated and enhance the classroom more in a good way; avoid classroom from being dull which could either lift up the mood of the students or could turn them into more hyperactive. From here it can be seen that the main theme of the school is playful, colourful which mainly enhances the fun environment of the school. Observants also successfully communicate and socialize with the students.

3. Results

3.1 Product Design Specification (PDS)

The PDS stands for a set of requirements necessary in product design in the context of characteristics that a product needs to possess for satisfying the needs of customers along with goals of projects; they constitute a bridge between ideas initiated and the final design output which outlines the function etc.

Table 2
PDS gathered from the surveys and research conducted to meet the needs of target audience

Functions	• It should be able to display welcoming openings such as cartoons. • It should have audio, in speech. • It should have simple buttons, i.e. emoticons.
Safety	• It should not have any sharp edges to protect users from any harm. • It should have a stable base with rubber to ensure they stay in place.
Size	• It should be a size that is portable and is handheld.
Weight	• It should not weigh more than 5kg.
Appearance	• It should be aesthetically pleasing, minimalism. • Form from ideation and based on cartoons.

	• Interesting and attractive colours.
Cost	• Not more than BND 100.00.
Environment	• Suitable for at home, school and workplace.
Users	• People with Dyslexia of all ages. • Mainly for students who are 5 years old and above.
Materials	• Polylactic Acid. • Fabric.

3.2 Finalized Design – Ortxelics
3.2.1 3D Rendering

In this section, the 3D rendering of the final design based off the PDS specified earlier will be shown, showing the isometric views, opened and closed views at different potential set up for Ortxelics. Different colour options are also shown in the figures below.

Fig. 1. Front view in white

Fig. 1. It shows Ortxelics from the front view when it is opened in the colour white, in which the platform is customized for target audience to design it however they desire.

Fig. 2. Close-up front view in white

Fig. 2. Shows the close-up view of the product when it is opened, to clearly show the platform where target audience could customize their own design.

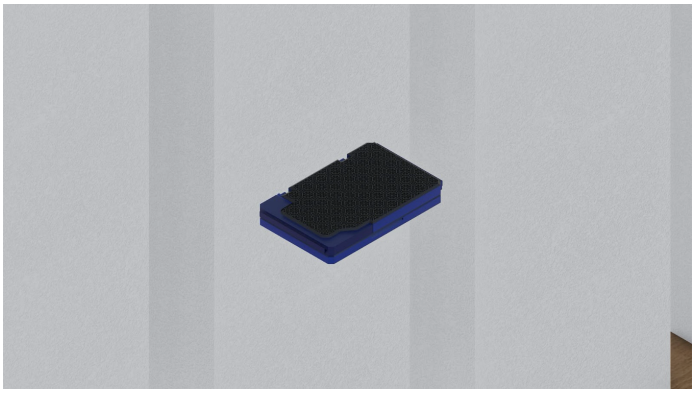

Fig. 3. Front view in blue

Fig. 3. Shows the front view of the product when it is closed to ensure that it is easy to store when not in use and is portable as well as lightweight.

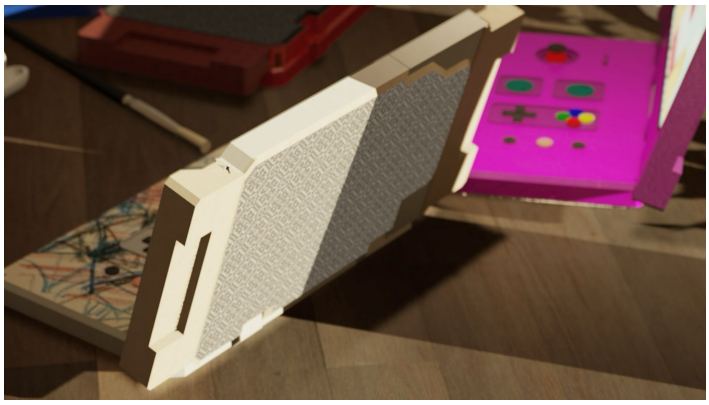

Fig. 4. Back view in white

Fig. 4. Shows the back view when opened in white, which shows the batik design in which the inspiration is taken from the Melayu in MIB.

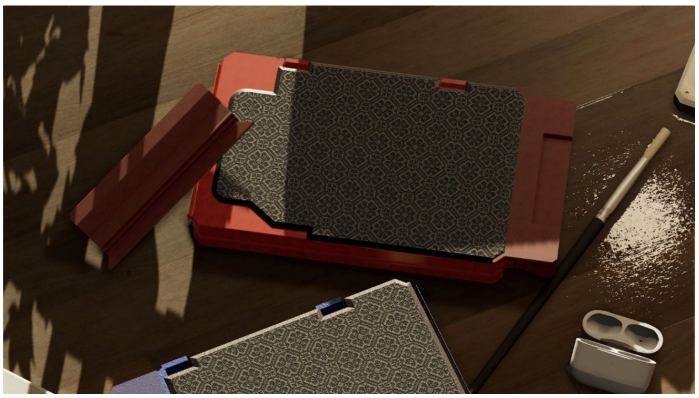

Fig. 5. Closed back view in red

Fig. 5. Shows the back view when closed in red, which shows the batik design in which the inspiration is taken from the Melayu in MIB.

Fig. 6. Colour options

Fig. 6. Shows the different colour options provided on a study table.

3.2.2 2D Drawing

A two-dimensional (2D) technical drawing using the software, AutoCad, is a precise and scaled technical drawing that effectively communicates all the information related to a product's design, dimensions, and construction. Such drawings form the cornerstone of the engineering and manufacturing sectors because they offer a clear blueprint for product manufacture or assembly. In contrast to concept sketches, 2D technical drawings are extremely accurate and adhere to standard drawing conventions to ensure consistency and readability between teams and industries.

The 2d drawing will consist of 4 different components which are:

1. Handles.
2. Cover for buttons.
3. Button Slots/Compartment.
4. Phone Slot/Compartment.

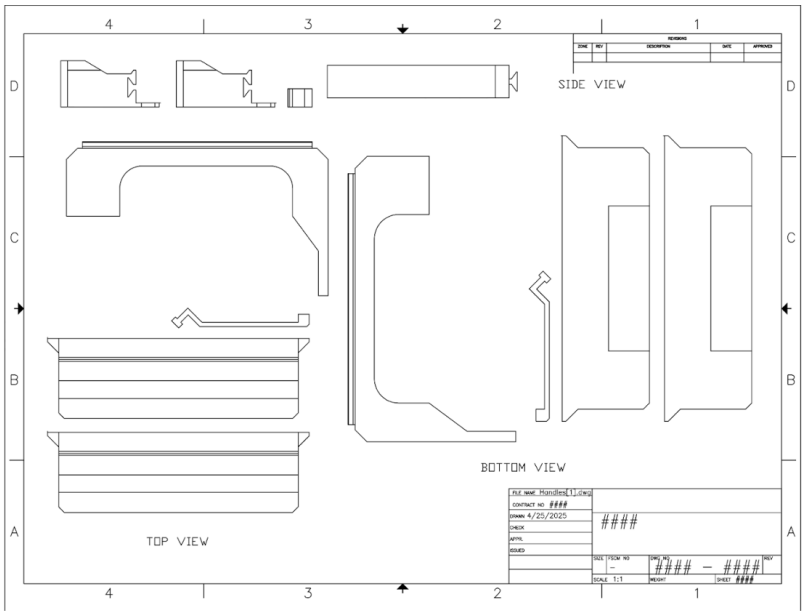

Fig. 7. Handles

Fig. 7. Shown above shows the AutoCad 2D drawing for the first component, which consists of the top view, side view and bottom view with the scale of 1:3.

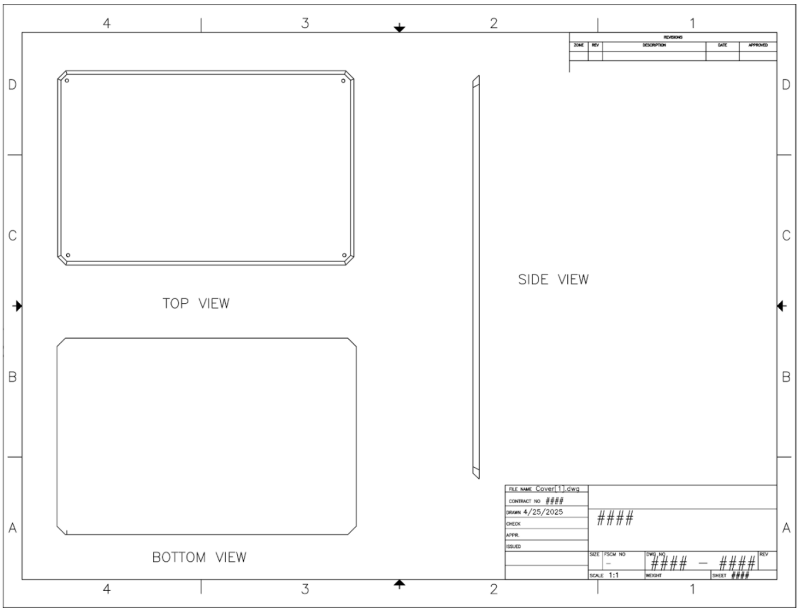

Fig. 8. Cover for buttons

Fig. 8. Shown above shows the AutoCad 2D drawing for the second component, cover for the buttons, which consists of the top view, side view and bottom view with the scale of 1:3.

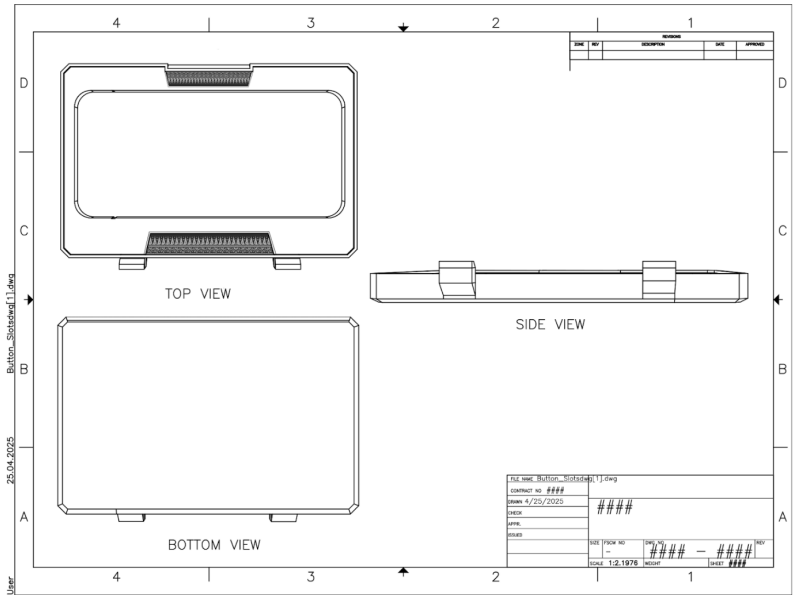

Fig. 9. Button slots/Compartment

Fig. 9. Shown above shows the AutoCad 2D drawing for the third component, button for the slots/compartment, which consists of the top view, side view and bottom view with the scale of 1:3.

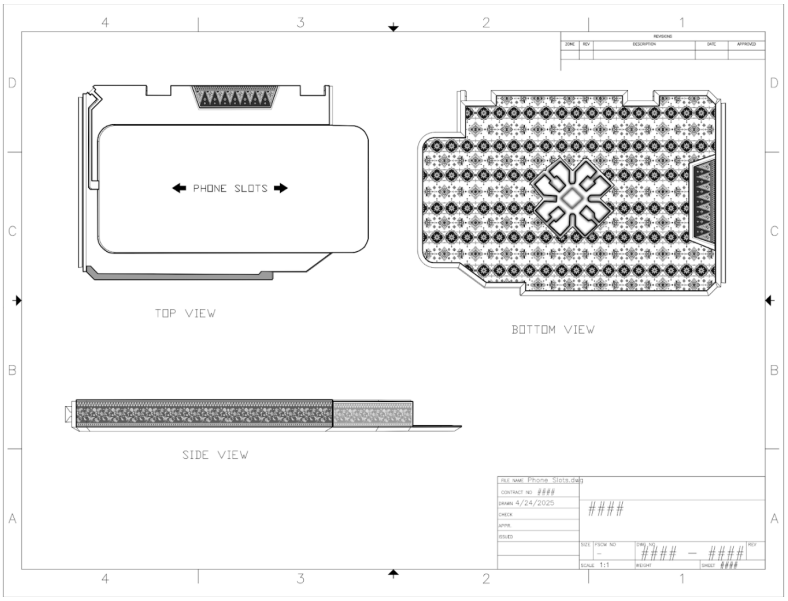

Fig. 10. Phone slot/compartment

Fig. 10. Shown above shows the AutoCad 2D drawing for the fourth component, phone slots/compartment, which consists of the top view, side view and bottom view with the scale of 1:3.

3.2.4 Application development

In this section, the application of this project will be shown using the application, TinyTap, where we are able to design and publish our own game and installed on both iOS and Android. This is beneficial as the observing session earlier could be implemented into this game such as learning the alphabet for dyslexics and telling the students to express their feelings; 'How are you?' questions for both autistic and dyslexic students. This application can be installed and is designed to be interactive, colourful and has audio. This application is installed on an Android device.

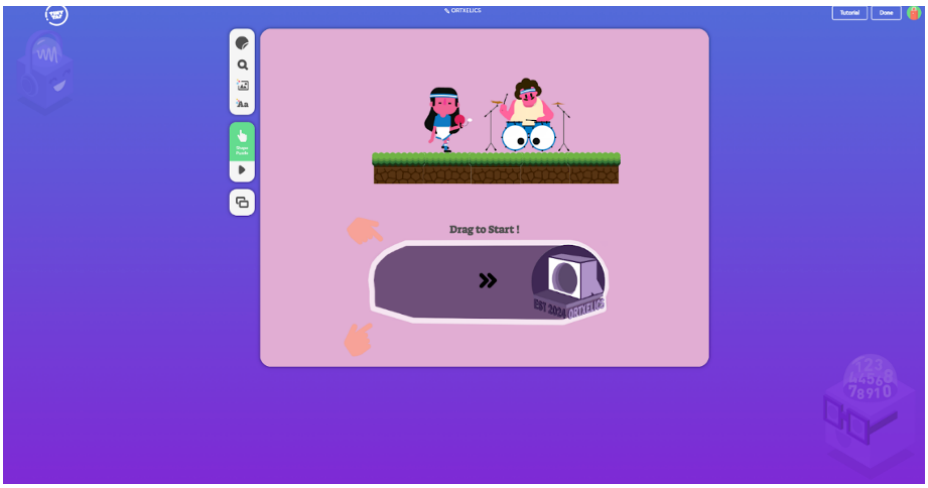

Fig. 11. Assembled front isometric view

Fig. 11. Shows the first page of the application with audio for the target audience to listen to the instructions given.

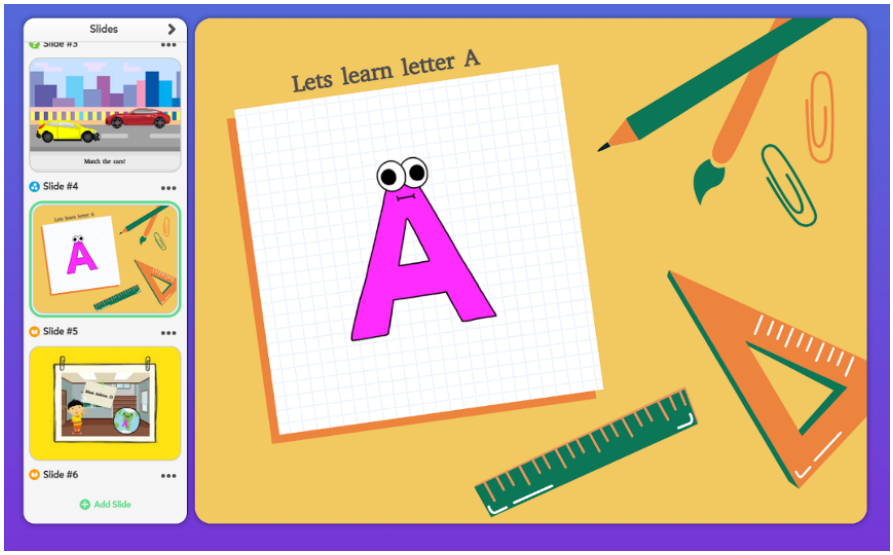

Fig. 12. Different pages layout (learn alphabet)

Fig. 12. Shows learning the alphabet are not just for dyslexics, but it is also suitable for preschool students with colourful cartoon characters to attract the target audience.

Fig. 13. Different pages layout (how are you?)

Fig. 13. Shows the options of emotions to ensure target audience could express their feelings better, since they had difficulties in showing expressions such as things that disappoint them, situation that makes them feel anger etc.

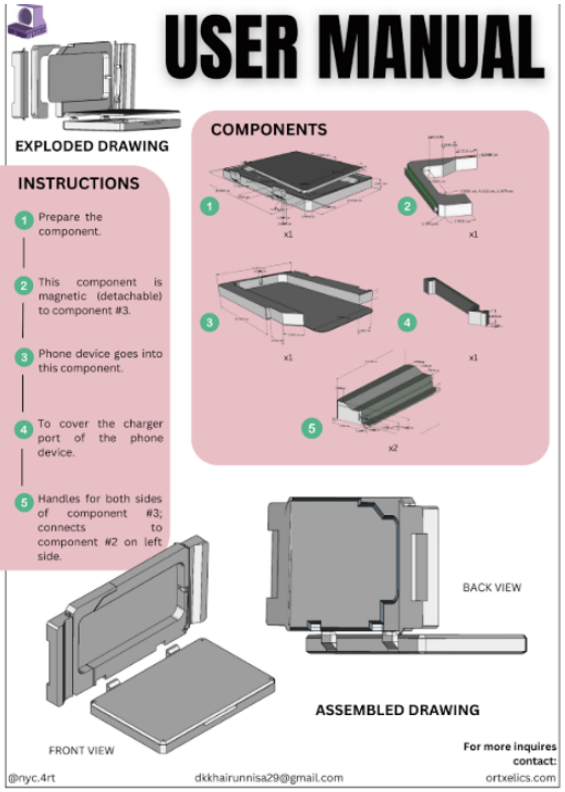

Fig. 14. Different pages layout (How are you?)

Fig. 14. Shows the user manual used for target audience with the guides from step 1 to step 5.

3.3 User Testing and Feedback

There are approximately 30 respondents from the distributed final survey questionnaires to target audiences. From the users' feedback, it can be concluded that:

1. Usage Frequency - 60% of the target users used the Ortxelics 2 to 3 times per week and the minimum of 10% of the target audience used the product rarely.
2. Ease of Use - 75% of the target users responded with Very Easy to use, whereas the minority of the 5% of Hard to use.
3. Design and Appearance - Majority responded with 80% with Excellence and minority responded with Poor with 5%.
4. Learning Improvement - Majority responded with 85% with A Lot and minority responded with Not at All with 5%.
5. Technical Issues - Majority responded with Rarely with 80% and minority of 4% responded with Often.
6. Class Engagement - Majority responded with More Motivated with 90% and minority of 3% responded Less Motivated.

4. Conclusions

To summarize, the creation of the interactive device specially intended for dyslexic and autistic students illustrates a finely tuned balance between innovation, cultural awareness, and user-centered design. Thorough research, field observation, idea generation, prototyping, and testing were carried out in this process to make sure that the product addressed the special sensory and

learning requirements of its users. The incorporation of traditional Bruneian woven material does not only add to the sensory and tactile experience of the device but also invokes a sense of cultural identity and pride. By embracing the marriage of modern 3D printing technology with a rich local heritage, the product is a distinctive and meaningful educational tool that promotes engagement, comfort, and inclusivity.

The project showcases how sensitive design can empower children with varied learning requirements while embracing cultural craftsmanship. This could also be beneficial for guardians; they can help the children or provide improvements by implementing the products into their daily lives. SDG 11 is implemented by using wooden boxes, avoiding plastic usage into the overall packaging of Ortxelics and the ethical production of the product. In the future, Ortxelics could be improvised further in terms of aesthetics and marketing, to ensure the target audience and needed users reach our marketing area, to improve the standard of living of these special communities, to ensure they feel involved.

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