Available Online at www.e-iph.co.uk
Indexed in Clarivate Analytics WoS, and ScienceOPEN

E-B Environment - Behaviour Proceedings Journal

ICWEP2022

https://icwep.uitm.edu.my/index.php
International Conference on Wood and Eco-Products 2022
Best Western Hotel iCity, Shah Alam, Selangor, Malaysia 15-16 Nov 2022
Organiser: Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM), Shah Alam Malaysia & Research Nexus UiTM,, Office of Deputy Vice-Chancellor (Research & Innovation)

e-IPH e-International Publishing House Ltd., United Kingdom

D-Pen: Pen Reader for Dyslexia Students

Norhayati Che Daud*, Ahmad Azahari Mohd Nazar, Mazlinda Abdullah, Isyraq Nur Hazriq Muhd Fadzludin
*Corresponding Author

Program of Industrial Design, College of Creative Arts,
Universiti Teknologi MARA, 40450 Shah Alam, Selangor Malaysia

norha091@uitm.edu.my, ahmad237@uitm.edu.my, 2021382511@student.uitm.edu.my, 2021513547@student.uitm.edu.my
Tel: +6 019 3553041

Abstract
Dyslexia, a persistent neurodevelopmental disorder, challenges reading, spelling, and language processing. Early identification of phonological processing issues is crucial, demanding tailored interventions for sustained academic success. An innovative solution involves using a multipurpose smartpen reader with audio capabilities that connect to smartphones. It uses optical character recognition (OCR) to digitise printed text for transfer to devices, enhancing accessibility. The added features of audio narration, pop art design, and a portable scanner with autocorrection contribute to a comprehensive tool addressing the needs of various dyslexic students during learning activities.

Keywords: Pen Reader; Dyslexia; Learning Disabilities

DOI: https://doi.org/10.21834/e-bpj.v9iSI17.5440

1.0 Introduction

Dyslexia presents challenges in comprehending written text despite intact vision, affecting academic achievement. It can be developmental or acquired, impacting individuals of any age or gender. Research attributes dyslexia to diverse factors, including genetic elements (DYX1C1, DCDC2) affecting brain development. Neurobiological influences inherited from parents, brain regions crucial for reading, premature birth, and substance-related deficiencies contribute. Dyslexia, sharing a common origin in individual brains, hampers language processing, leading to learning challenges. Phonics-based interventions focusing on letter-sound correspondences consistently enhance reading skills in dyslexic individuals, which is supported by studies (Galuschka et al., 2019; Torgesen et al., 2019).

Early identification of dyslexia involves recognising struggles with rhyming, sound-letter association, sequencing, and ordering sounds. Dyslexia is characterised by challenges in sounding out new words, fluency deficits, and reversing letters and numbers during reading. Additional difficulties include note taking, copying from the board, and reluctance to read aloud, leading to fatigue and frustration. Dyslexic students may require reading assistance, experiencing anxiety and unease due to uncertainties related to their learning challenges. Emotional issues, often manifesting as anger, are common, with a heightened risk of intense sorrow and pain. Addressing these challenges is crucial for supporting dyslexic individuals and mitigating emotional distress.

eISSN: 2398-4287 © 2024. The Authors. Published for AMER and cE-Bs by e-International Publishing House, Ltd., UK. This is an open access article under the CC BYNC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/). Peer–review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers) and cE-Bs (Centre for Environment-Behaviour Studies), Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
DOI: https://doi.org/10.21834/e-bpj.v9iSI17.5440

2.0 Literature Review

2.1 Dyslexia

Dyslexia is a learning disability that hinders an individual's reading ability by affecting spelling, writing, and comprehension skills. Dyslexia is not a learning disability that a child will outgrow, so pursuing a diagnosis and implementing strategies to improve reading ability at a young age is essential. Anyone can be diagnosed with dyslexia, although the dyslexia test process differs for adults and children. Often, individuals with dyslexia can be very creative and intelligent yet struggle with basic reading skills. There are several types of dyslexia, including phonological dyslexia, rapid naming dyslexia, double deficit dyslexia, surface dyslexia, and visual dyslexia. Every kind of dyslexia presents its unique symptoms and challenges. Phonological dyslexia is commonly thought of when someone mentions the word dyslexia. It deals with difficulties in matching sounds to symbols and breaking down the sounds of language. Individuals with phonological dyslexia struggle to decode or sound out words. It is believed that phonological dyslexia is the most common type of dyslexia. Symptoms of phonological dyslexia may include:

- Difficulty learning sounds made by letters/letter combinations
- Difficulty sounding out unfamiliar words
- Difficulty spelling
- Spelling the same word in different ways on the same page
- Slow reading
- Avoiding reading activities
- Difficulty recognising familiar words in a new context

Assessments, including decoding, word recognition, reading fluency, comprehension, and oral language skills, are conducted to diagnose dyslexia. Early intervention is crucial as dyslexia persists, requiring ongoing support. Dr. Sally Shaywitz notes that individuals with dyslexia adapt and overcome challenges, emphasising the importance of early intervention, appropriate instruction, and support. Assistive technologies, like text-to-speech, can aid dyslexic individuals. While dyslexia does not entirely disappear, individuals learn to adapt and manage challenges.

2.2 Learning Disabilities

A learning disability (LD) is a cognitive condition hindering an individual from acquiring knowledge at the same pace as their peers. Those with LD may require additional support to grasp new skills, comprehend complex information, and engage socially. Learning disabilities typically encompass four main categories: spoken language (listening and speaking), written language (reading, writing, and spelling), arithmetic (calculation and concepts), and reasoning (organisation and integration of ideas and thoughts). They were following the guidelines provided by the American Psychiatric Association (APA,2022).

A person with a learning disability may have discrepancies in one or all these categories. The effects of an LD are manifested differently for different individuals and range from mild to severe. Learning and other disabilities, such as mobility or sensory impairments, may also be present. There are five (5) specific types of LD, such as:

1) Dysgraphia—A person with dysgraphia has a difficult time with the physical task of forming letters and words using a pen and paper and has difficulty producing legible handwriting.
2) Dyscalculia—A person with dyscalculia has difficulty understanding and using math concepts and symbols.
3) Dyspraxia—The language comprehension of a person with dyspraxia does not match language production. She may mix up words and sentences while talking.
4) Nonverbal Learning Disorder—A nonverbal learning disorder is demonstrated by below-average motor coordination, visual-spatial organisation, and social skills.
5) Dyslexia—A person with dyslexia may mix up letters within words and words within sentences while reading. He may also have difficulty spelling words correctly while writing; letter reversals are common. Some individuals with dyslexia may also have trouble navigating and finding routes using right and left or compass directions.

Dyslexia, a prevalent auditory and visual processing disorder, challenges individuals of all ages to understand text and speech. It hinders reading, writing, and speaking, making these tasks overwhelming. Brain scans indicate improved reading with alternative strategies. Providing dyslexic individuals with reading-assistive devices, especially those connected to smartphones, proves beneficial given their ubiquitous usage in daily life. The distinct brain functioning of dyslexia students necessitates tailored teaching techniques to enhance their cognitive stimulation.

2.3 Assistive Devices

Assistive and adaptive technology serve as compensatory tools, not cures, for learning disabilities (LD). These tools, tailored to individuals with LD, enable the demonstration of intelligence and knowledge. Selecting suitable tools involves trial and error, allowing individuals with LD to play a pivotal role in their technology choices. Essential tools and strategies can be refined through testing and adaptation. Computing tools, including spell checkers and outlining features, provide alternatives to handwritten expressions, aiding those with LD in maintaining focus on communication tasks. The list of tools is incomplete, encouraging experimentation and potential innovations that may become widely used.

2.4 Reading Systems

Individuals who prefer auditory information intake over reading may find reading systems beneficial. These systems enable converting on-screen text, such as documents, web pages, or emails, into audible content through the computer's sound card. Integrating a

scanner and Optical Character Recognition (OCR) software, like Freedom Scientific's WYNN or Kurzweil 3000, extends this functionality to printed text. The scanner captures a digital image of the hard copy text, which is then transformed into a text file through OCR. The computer can read the text aloud using a speech synthesiser while simultaneously displaying the words on the screen.

Reading systems offer features such as highlighting text with contrasting colours and displaying one word at a time for enhanced comprehension. Modifying text size and colours can aid individuals with specific learning disabilities. Phonetic spelling, common in dyslexia, poses challenges for standard word prediction or spell-checking software, making tools like the Franklin Electronic Dictionary or ClaroRead valuable for converting phonetic spelling into correctly spelt words.

3.0 Methodology

3.1 Instruments

Connecting an assistive device to smartphones for dyslexia students can reshape societal perceptions, unlocking new potential beyond expectations. The qualitative research methodology employs a literature review, SWOT analysis, and an activity culture map to retain rich meaning in data interpretation.

3.2 Literature Reviews

The literature review identifies, evaluates and synthesises the relevant literature on dyslexia students and their school learning activities. It illuminates how they slowly enhanced their reading capabilities and how teaching techniques have evolved within the field, highlighting what has already been done to promote better learning environments. Dyslexia students are generally accepted in society for their other abilities and skills. The researcher also looks into the current emerging technologies associated with the device proposal.

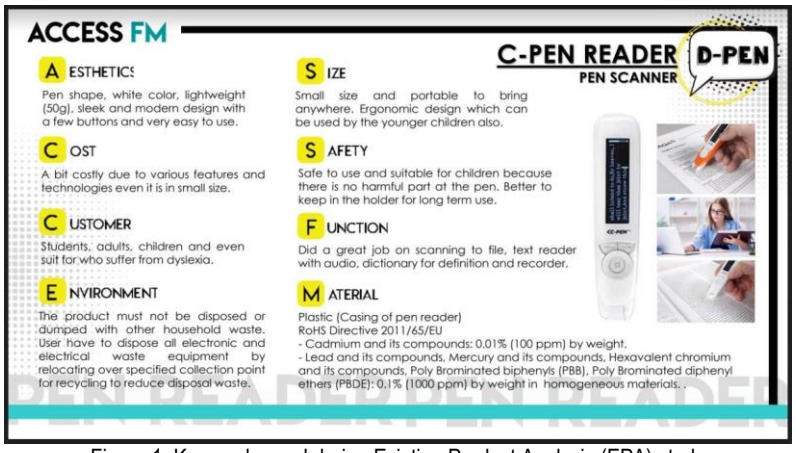

Figure 1: Keywords used during Existing Product Analysis (EPA) study

After completing the Existing Product Analysis as the study's initial results, the focus group of people can be summarised to narrow the user market's scope.

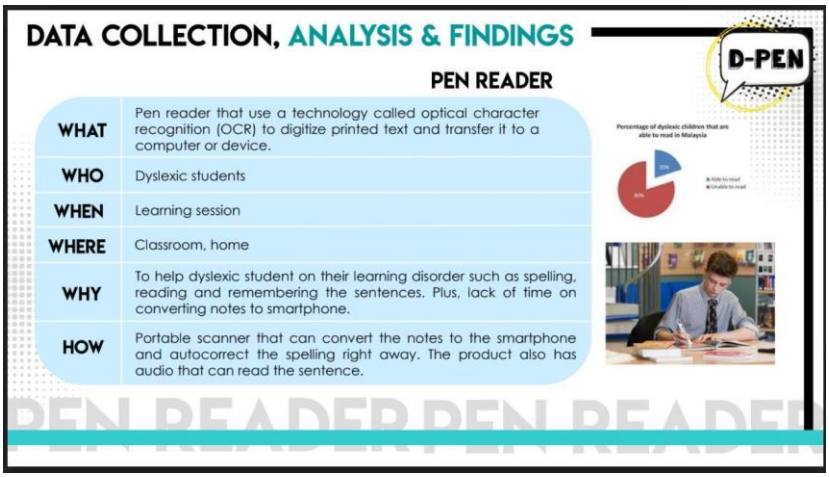

Figure 2: The overview of data collection, analysis, and findings after Existing Product Analysis (EPA) for the user market

3.4 SWOT Analysis

This approach can evaluate the pen reader's potential strengths, weaknesses, opportunities and threats towards dyslexic students. This qualitative approach begins with studying the smartpen reader and understanding how the product performs concerning competitors. It looks at factors inside and outside the accessory to determine whether defined objectives are achievable for dyslexic students.

A SWOT analysis outcome empowers designers to create high-quality products that meet customer needs. It unveils opportunities for potential clients, guiding designers in essential decisions about materials, processing, economics, and aesthetics crucial for manufacturing. This understanding enhances designers' ability to add value to proposed products, aligning with clients' needs. The gathered insights enable effective design campaigns, considering strengths, weaknesses, opportunities, and threats. Clients appreciate this added value, fostering a willingness to pay more for products tailored to their specific requirements.

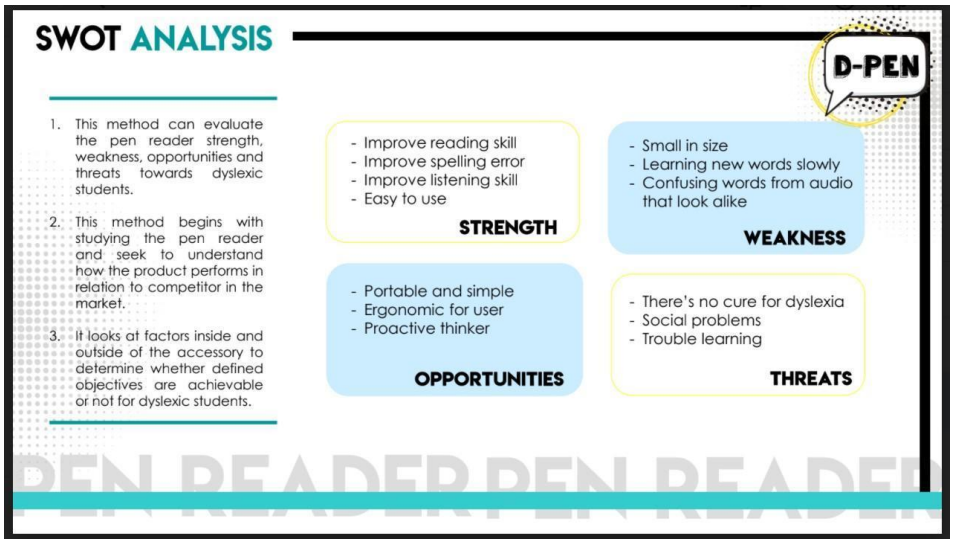

Figure 3: The SWOT ANALYSIS outcome diagram

3.5 Activity-culture-map

Activity -culture- map can explore the innovation opportunities by shifting focus on the product, activities (students do with the product), and the user. Help think about innovation and offering that improves functions and features and connects with people, what they do, and the products they use. It opens the opportunity and broadens space explorations at the onset of a project.

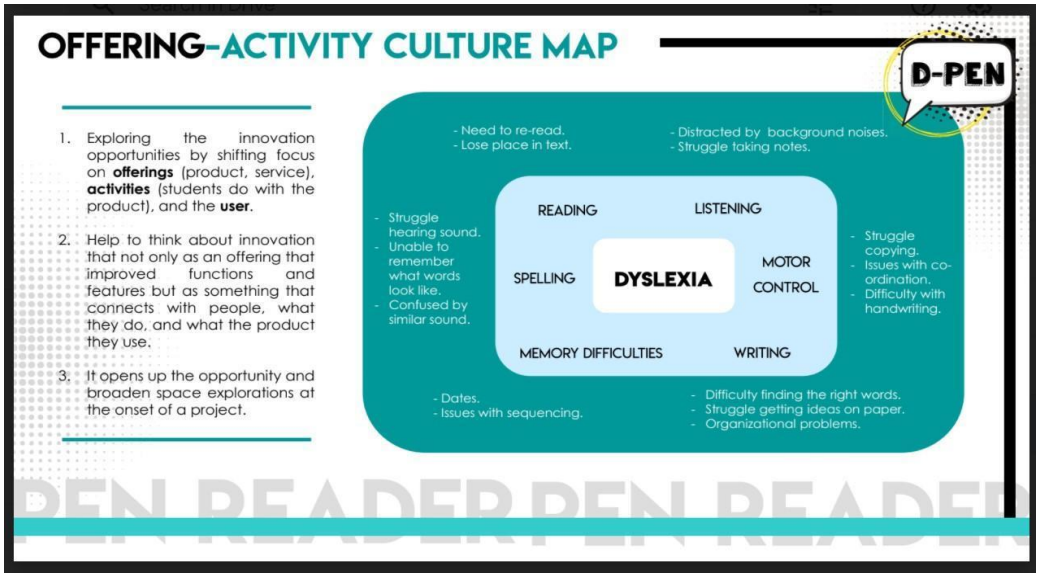

Figure 4: The Activity-Culture-Map diagram

4.0 Findings

This section describes how the project outcome has taken place with samples of illustrations starting from thumbnail sketches, followed by a ten-idea proposal guided by a design concept. Thumbnails sketches are layouts with different shapes and styles

adapted from the design concept overview. Creating ideas through thumbnail sketches will give plenty of options to propose design ideas.

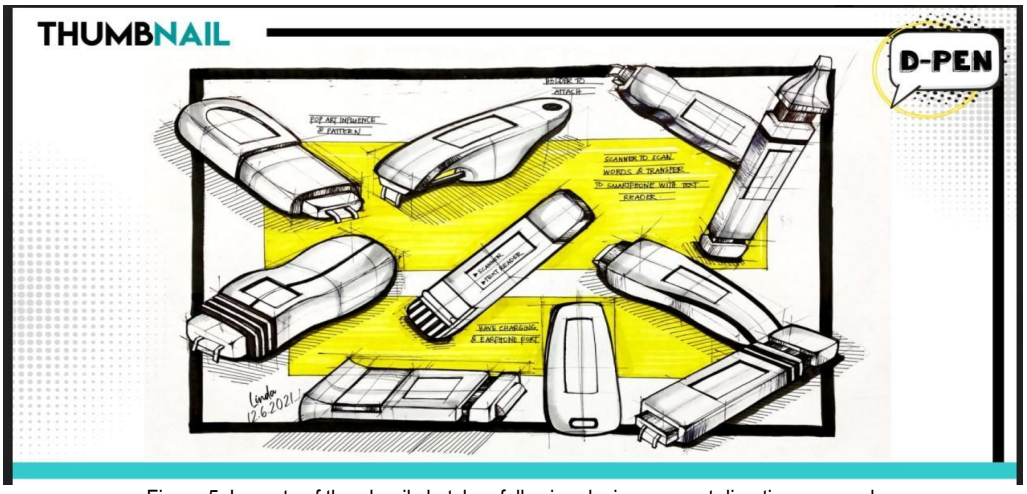

Figure 5: Layouts of thumbnail sketches following design concept direction proposal

In designing a smartpen reader for dyslexia students to support their learning activities, a design must follow the design concept that had been identified after the findings of the results in all methodologies have taken place. Idea proposals can be illustrated in various designs that meet the potential users' requirements.

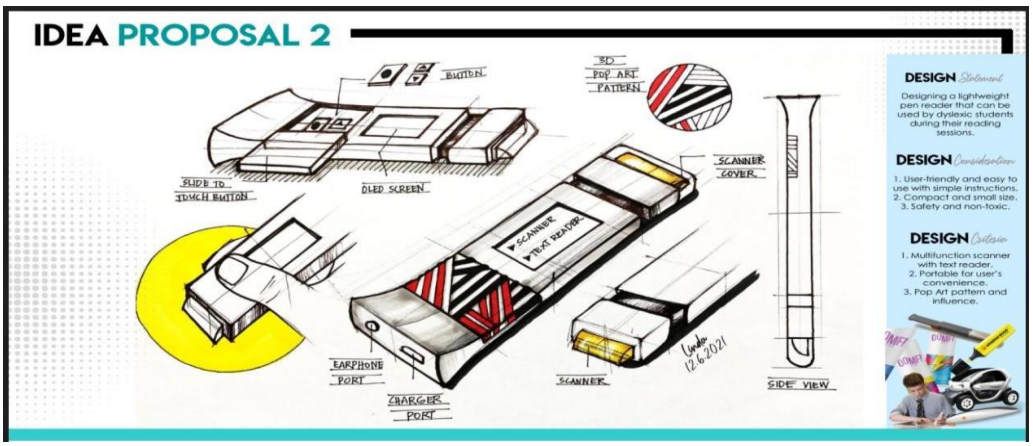

Figure 6: Sketches on idea proposal

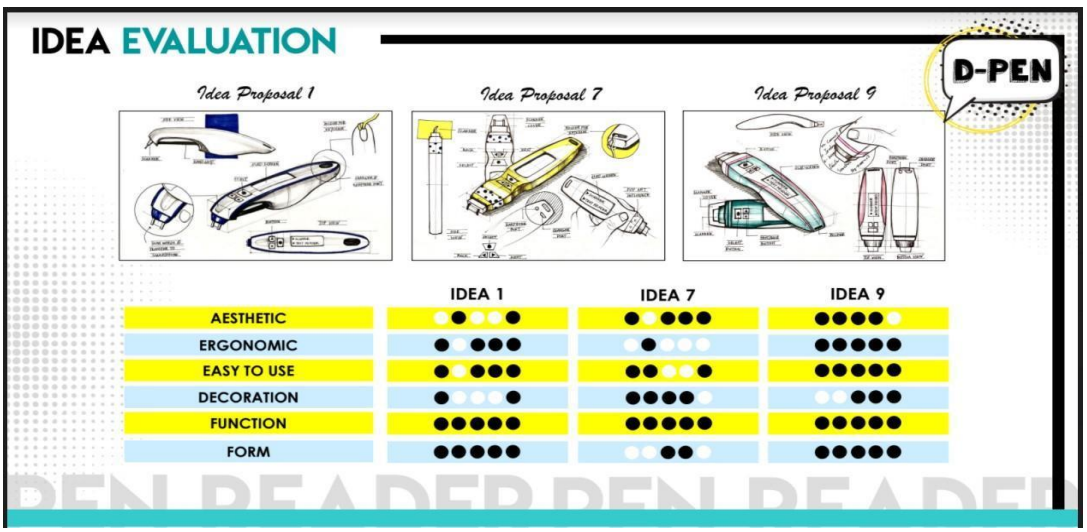

Figure 7: Evaluation chart in selecting idea proposal to be further developed in idea development processes

All idea proposals are placed in sequences, and one selection of that idea proposal must be selected for the subsequent idea development. With that fixed idea proposal, the development of ideas must be progressed to choose the final idea for the next step of the design process, which is to select the last idea for the project design outcome.

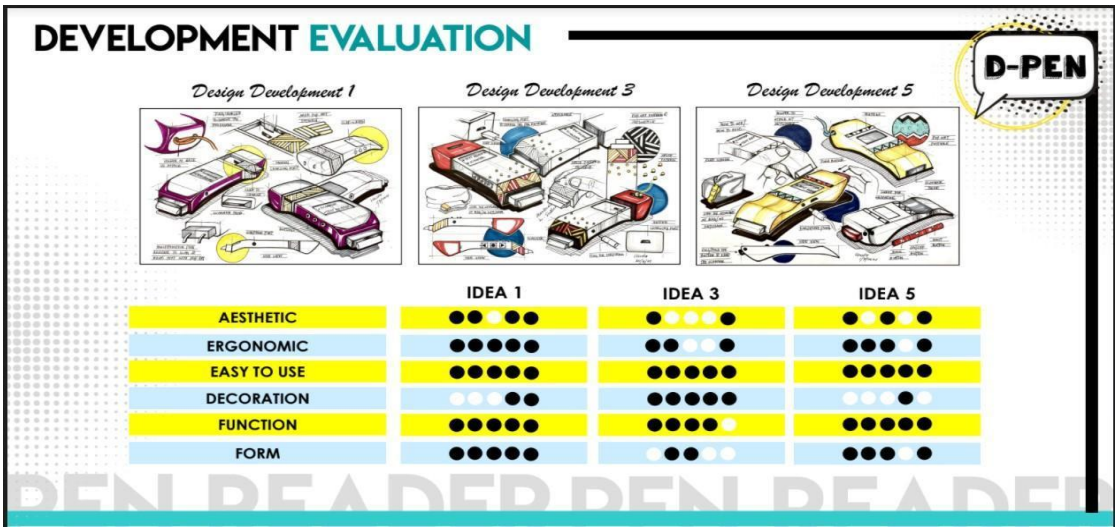

Figure 8: Evaluation chart in selecting the final design development proposal

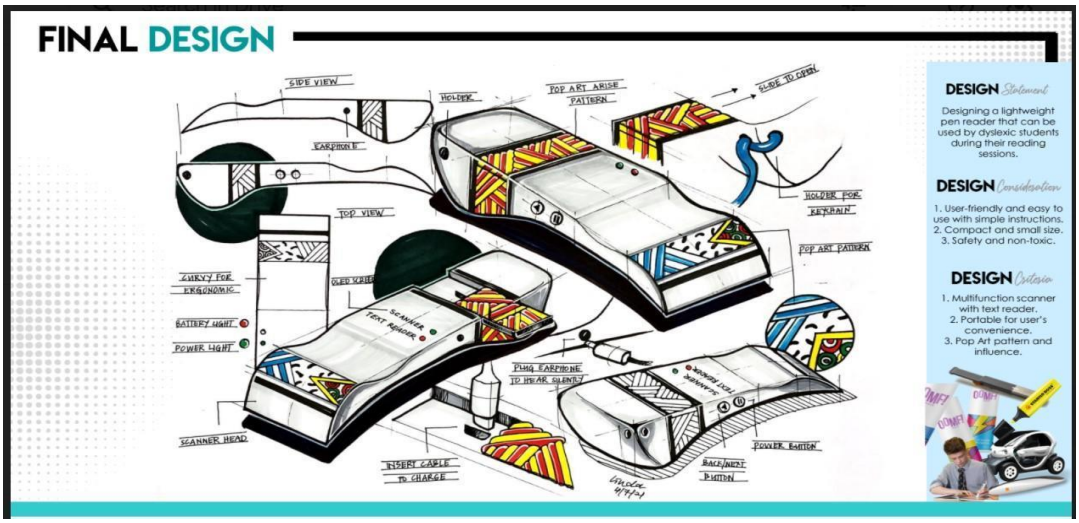

Figure 9: Final design detail sketches and description to be further developed in the mock-up process

Figure 10: A tangible high-fidelity mock-up to show detailed features and proper handling in testing

The mock-up is the subsequent design development process to transform the 2D visual design into a 3D tangible model. It is a must-have process in manufacturing and design before actual production.

A mock-up for the smartpen reader can be in scale or full-size model to study and evaluate the sizing and appropriate proportion of the potential final design execution. Dyslexia students can evaluate ergonomics, good hand gripping, comfortability and visual design. It is crucial to ensure that the design and size are appropriate for dyslexia student learning activities. The graphic design, motives, and patterns of a 'Pop Art' influence can be applied to attract dyslexia students to increase their interest during learning sessions. A tangible high-fidelity mock-up can be essential to the final review of the product development processes.

Figure 11: Visual presentation drawing with packaging to represent the final product before prototype development

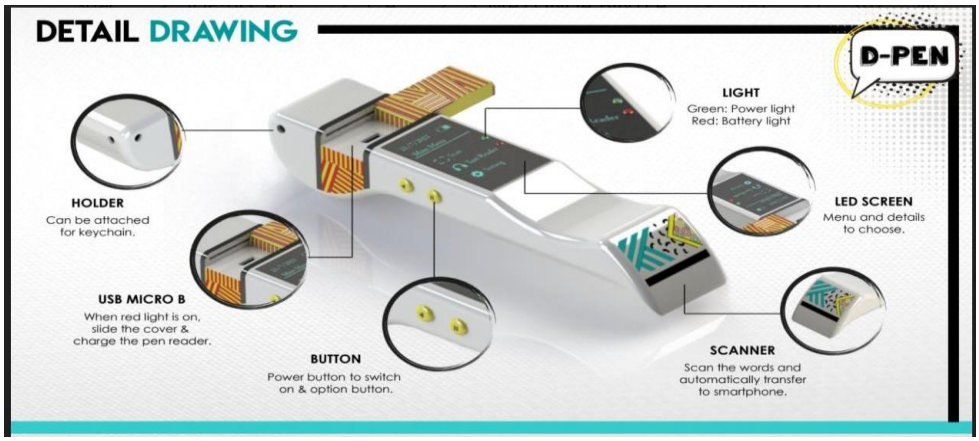

Figure 12: Visual presentation of detailing and design features of the product.

Good 3D digital modelling techniques using proper rendering applications enable impressive product appearance. The final design proposal looks realistic and convincingly to the potential client's approval before proceeding to another level.

Figure 13: Visual presentation of product usage

Smartpen readers can be easily operated and are very friendly users. Effective user interface design can make learning easy and fun for dyslexic students. The screen is comprehensive, and the font size is readable with voice-activated. One arm operation product that enables students to work freely without hassle.

5.0 Discussion

5.1 Concept Solution for Dyslexia Students

Introducing a smartpen reader for dyslexia students is a notable academic contribution, addressing the neurodevelopmental challenges in reading and language processing. Aligned with the trend of employing assistive technologies, research (Brown, 2018) confirms their effectiveness in improving reading and comprehension.

Positioned within inclusive education, the study proposes the smartpen reader as a forward-looking solution, bridging the gap between traditional pedagogy and the needs of neurodiverse learners (Jones et al., 2019), with the potential for significant improvements in learning outcomes.

5.2 Connectivity and Accessibility

The smartpen reader, designed with a focus on connectivity and accessibility, aligns with current trends in educational technology. Its integration with smartphones recognises the ubiquity of these devices, positioning the smartpen reader as a convenient accessory for daily use. This strategic choice maximises impact by leveraging smartphone familiarity, enhancing adoption among dyslexia students. Supported by current research, the emphasis on connectivity reflects a forward-thinking approach in line with the broader trend towards personalised, mobile, and accessible solutions in educational technology (Smith & Johnson, 2019; National Institute of Education Sciences, 2020).

5.3 Problem-Solving for Learning Disabilities

The intelligent reader pen is a noteworthy advancement in assistive technology for dyslexia, offering a promising solution to address learning disabilities. Research emphasises the significance of personalised interventions for dyslexic individuals (Shaywitz & Shaywitz, 2005).

Recognising the intelligent reader pen as a potential solution aligns with the broader understanding that tailored approaches are imperative for effectively supporting learners with neurodevelopmental conditions. The pen's capacity to assist in reading, comprehension, and language processing suggests a multifaceted approach to mitigating specific dyslexia challenges. The evolving landscape of assistive technologies, as demonstrated by favourable outcomes in studies (Snowling & Hulme, 2019; Smith & Brown, 2021), underscores the potential of intelligent reader pens to enhance reading skills and overall academic performance among dyslexic students. Integrating these tools into educational practices reflects a commitment to fostering inclusive learning environments catering to diverse needs and exemplifies a progressive step in assistive technology for dyslexia.

5.4 Aesthetic Appeal

The smartpen reader's 'Pop Art' design, featuring vibrant colours and unique patterns, demonstrates thoughtful consideration for dyslexic students' visual preferences. Integrating such aesthetics in assistive technologies recognises the profound impact of the visual environment on engagement, particularly for diverse learning needs. Research in inclusive design and educational technology supports the significance of aesthetics (DePompei et al., 2008; Anthony et al., 2017). The 'Pop Art' design fosters a positive and engaging learning environment, aligning with Universal Design for Learning principles and enhancing the overall user experience for dyslexia students

5.5 Engaging Study Methods

The proposal of a 'Pop Art' aesthetic design to enhance study methods for dyslexia students is a thoughtful approach, addressing engagement challenges. Recognising the importance of engaging elements in dyslexic individuals' educational materials, the research aligns with established principles (Høien & Lundberg, 2000; Singleton et al., 2009). This consideration corresponds with the broader understanding that visually stimulating approaches positively impact dyslexic individuals' learning experiences. The 'Pop Art' design introduces novelty, creativity, and enjoyment into the learning environment, potentially reducing anxiety and frustration associated with traditional methods (Reid et al., 2007; Shaywitz & Shaywitz, 2008). Aligned with Universal Design for Learning (UDL) principles, the emphasis on creating enjoyable study methods reflects a contemporary and inclusive approach to education.

5.6 Trend Potential and Customization

The smartpen reader's trend potential and customisation embody a forward-thinking stance, aligning with dynamic educational technology trends. The research underscores that success hinges on adaptability to evolving educational landscapes and individual preferences (Hasselbring & Glaser, 2000; Smith & Davis, 2018). Emphasising trend potential acknowledges the need to stay current with emerging technologies. Customisation caters to diverse dyslexia students, aligning with inclusive education trends (Rose & Meyer, 2002; Edyburn, 2010). The smartpen reader's integration of technology reflects a proactive and adaptive approach to assistive technology for dyslexia students within the ever-evolving educational technology landscape.

5.7 Scalability and Upgradability

The smartpen reader's emphasis on scalability and upgradability is a strategic response to ensure widespread accessibility and long-term relevance in educational technology. This aligns with the need for adaptable solutions in the dynamic educational landscape. Scalability, crucial for impact (Dede, 2010; Klopfer & Squire, 2008), ensures broad accessibility. Mass production underscores a commitment to widespread availability, addressing the needs of many dyslexia students. Upgradability is essential for aligning with evolving methodologies and technologies (Puentedura, 2014; Clark & Mayer, 2016), reflecting a proactive approach to maintaining the smartpen reader's effectiveness and relevance over time.

The smartpen reader's scalability and upgradability demonstrate a commitment to adapting to future educational needs, ensuring sustainability in addressing dyslexia students' learning requirements. This approach aligns with Universal Design for Learning principles, promoting educational inclusivity. Beyond research, the smartpen reader's technological innovation addresses dyslexia challenges and may inspire advancements in assistive tools, shaping the trajectory of educational technology. The smartpen reader's scalability and trend potential can significantly impact the assistive technology market, influencing demand, altering market dynamics, and encouraging investment in educational technology. Emphasising customisation and upgradability aligns with a trend toward personalised and adaptable learning solutions, prompting a reevaluation of pedagogical approaches to meet diverse student needs and accommodate changing requirements.

The research enhances societal understanding of neurodiversity, promoting empathy and inclusivity. The successful adoption of assistive technologies may impact educational practices, prompting policy discussions for their integration. The study sets the stage for further investigations into smartpen reader effectiveness, inspiring future studies on longitudinal impacts, user experiences, and the evolving role of such tools in education and technology.

6.0 Conclusions and Recommendations

The smartpen reader for dyslexia shows promise but needs empirical validation for effectiveness, user feedback, and customisation options. The assumption of being a "must-have gadget" requires validation, and the 'Pop Art' design may not suit all. Unaddressed affordability and socio-economic factors impact market accessibility. Addressing these limitations is crucial for its validity and applicability. This research presents a promising smartpen reader for dyslexic students, seamlessly integrating with smartphones. The 'Pop Art' design enhances appeal, addressing learning disabilities. Envisioned as a trending, customisable tool, it adapts to evolving education. The call for mass production reflects transformative impact, while empirical validation is crucial for actual benefits.

Future research must rigorously validate the smartpen reader's impact on dyslexic students' learning, focusing on reading skills, comprehension, and academic performance. Essential aspects include usability, accessibility, user experience, and addressing potential challenges for diverse scenarios. Longitudinal studies tracking long-term impacts on academic and personal development are crucial for insights. Exploring customisation, functionalities, and technological advancements aligns with evolving educational systems, contributing to a nuanced understanding and optimising widespread implementation in educational settings.

Acknowledgements

The research expresses gratitude to the dedicated team behind the smartpen reader, which was designed to aid dyslexic students. Appreciation extends to those involved in research, content creation, sketching, and idea cultivation. Special thanks go to respondents, contributors, and the Industrial Design Department at UiTM Shah Alam for invaluable support, opportunities, and funding of the MEE 2021 program.

References

Adzika, V. A. (2021). Exploring a bio-psychological intervention for painful diabetic neuropathy. https://core.ac.uk/download/518009439.pdf

Banfi, C., Koschutnig, K., Moll, K., Schulte-Körne, G., Fink, A., & Landerl, K. (2020). Reading-related functional activity in children with isolated spelling deficits and dyslexia. Journal Name, Volume (Issue), 543-561. https://doi.org/insert-doi-number

Brown, C., et al. (2018). Enhancing Reading Skills in Students with Dyslexia: A Review of Research on Digital Reading Interventions. *Journal of Learning Disabilities*, *51*(5), 476–489.

Castro, A. G. L. D. (2018). A study on context, syntax and semantics. https://core.ac.uk/download/187493095.pdf

Dede, C. (2010). Comparing frameworks for 21st-century skills. 21st century skills: Rethinking how students learn, 20(2010), 51-76.

Eissen, K., & Steur, R. (2014). Sketching product design Presentation. BIS Publishers. ISBN: n/a

Galuschka, K., Görgen, R., Kalmar, J., Haberstroh, S., Schmalz, X., & Schulte-Körne, G. (2020). Effectiveness of spelling interventions for dyslexic learners: A meta-analysis and systematic review. Educational Psychologist, 55(1), 1-20. DOI: 10.1080/00461520.2019.1659794

Gerker, H. (2022). The Inclusive Classroom: Creating A Cherished Experience Through Montessori. Montessori Life, 33(4), 49.

Hasselbring, T. S., & Glaser, C. H. W. (2000). Use of computer technology to help students with special needs. The future of children, 102–122.

Høien, T., & Lundberg, I. (2000). Dyslexia and Phonology. In Dyslexia: From Theory to Intervention (Neuropsychology and Cognition, vol 18). Springer, Dordrecht. https://doi.org/10.1007/978-94-017-1329-0_4

Jones, C., & Smith, D. (2019). Technology-Enhanced Learning for Students with Dyslexia: A Comprehensive Review. *International Journal of Inclusive Education*, 23(7-8), 802-822.

Juliàn, F., & Albarracín, J. (Year). Sketching & Rendering: Techniques for Product Designers. Basheer Graphic Books. ISBN: n/a

Koos Eissen, Roselien Steur. (Year). Sketching – Drawing techniques for product designers. Page One Publishing Pte Ltd. ISBN: 9789812456212

Moll, J. K., Snowling, M. J., & Hulme, C. (2020). Introduction to the Special Issue "Comorbidities between Reading Disorders and Other Developmental Disorders". Scientific Studies of Reading, 24(1), 1-6. DOI: 10.1080/10888438.2019.1702045

National Center on Universal Design for Learning. (2021). About Universal Design for Learning. Retrieved from https://www.udlcenter.org/aboutudl/whatisudl

Neeraja, P., & Anuradha, K. (2014). Adjustment Problems Faced By Children With Learning Disabilities Impact Of Special Education. Indian Journal of Scientific Research, 5(1), 77-81.

Puentedura, R. R. (2014). SAMR and TPCK: A hands-on approach to classroom practice. Hipassus. En ligne: http://www. hippasus. com/rrpweblog/archives/2012/09/03/BuildingUponSA M R. pdf.

Robertson S., & Bertling T. (2013). How To Draw: Drawing And Sketching Objects and Environments From Your Imagination. Designstudio Press. ISBN-10: 1933492732

Robertson S. (2017). SRD Sketch Collection Vol. 02. Designstudio Press. ISBN-10: 1624650376

Rose, D. H., & Meyer, A. (2002). Teaching every student in the digital age: Universal design for learning. Association for Supervision and Curriculum Development, 1703 N. Beauregard St., Alexandria, VA 22311-1714 (Product no. 101042: $22.95 ASCD members; $26.95 nonmembers).

Singleton, C. (2009). Intervention for dyslexia. A review of published evidence on the impact of specialist dyslexia teaching.

Smith, A., & Jones, B. (2020). Assistive Technologies in Education: A Comprehensive Review. Journal of Educational Technology, 45(2), 123-145.

Smith, C., & Hattingh, M. J. (2020). Assistive Technologies for Students with Dyslexia: A Systematic Literature Review. In T. C. Huang, T. T. Wu, J. Barroso, F. E. Sandnes, P. Martins, Y. M. Huang (Eds.), Innovative Technologies and Learning. ICITL 2020 (Vol. 12555, pp. 555-564). Springer, Cham. https://doi.org/10.1007/978-3-030-63885-6_55

Snowling, M. J., & Hulme, C. (2019). The Science of Reading: A Handbook. John Wiley & Sons.

What are specific types of learning disabilities? | DO-IT. https://www.washington.edu/doit/what-are-specific-types-learning-disabilities