Vision screening in primary school children

DNB311 ID Studio 7: Capstone Research Report

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Authenticity Statement

This is to certify that to the best of my knowledge, the content of this report is my own work. This report has not been submitted for any subject or for other purposes. I certify that the intellectual content of this report is the product of my own work and that all the assistance received in preparing this report and sources have been acknowledged.

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Executive Summary

Refractive errors are common among children and can result in reduced visual acuity when left uncorrected. Because children may not recognise that their vision differs from others, early identification through accessible screening is important. School vision screening provides an opportunity to identify children who may require further assessment, particularly where access to eye care services may be limited. However, existing screening technologies and processes also present opportunities for improvement in accessibility, child engagement and integration.

This project investigated how a design approach could contribute to the early screening of refractive errors in primary school children through different research methods such as secondary research into refractive errors, childhood vision screening, existing screening technologies, benchmarking of existing screening products, primary research of mixed methods approach consisting of two surveys and a semi structured expert interview.

The findings indicated that children may not recognise visual difficulties, with many adult participants reporting limited awareness of differences in their vision during childhood. Participants also described visual difficulties affecting school and everyday activities. Experiences of school screening were inconsistent, while parents emphasised the importance of earlier and more frequent screening, clear communication and making children feel comfortable and safe. The expert interview reinforced the importance of simple screening and the limitations associated with existing objective screening technologies. The potential benefit of combining complementary screening methods was also identified.

These findings informed several design opportunities, including integrating screening approaches, improving physical interaction and child engagement. The project identifies an opportunity to develop a more accessible and child centred physical screening experience while maintaining the distinction between screening and professional diagnosis.

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Section 1

1.1. Introduction
1.2. Background
1.3. Benchmarking

1.1. Introduction

Refractive errors are one of the most common causes of vision impairment in children which include conditions such as myopia, hyperopia, and astigmatism (WHO, 2023). Although these conditions can be treated with glasses and contact lenses, they may remain undetected in children who do not recognise that their vision is affected or are unable to communicate what they are experiencing. As a result, a child may have blurry or distorted vision without the underlying cause being identified (Hopkins et al., 2019).

This is particularly relevant during primary school years, as children are taught to read, write, view information from distances and engage with their peers and surrounding environment. Loh et al. (2024) mentions that undetected refractive errors can create difficulties that may affect a child's ability to take part in everyday school activities. Early identification provides an opportunity for children with potential vision problems to receive further assessment and proper intervention.

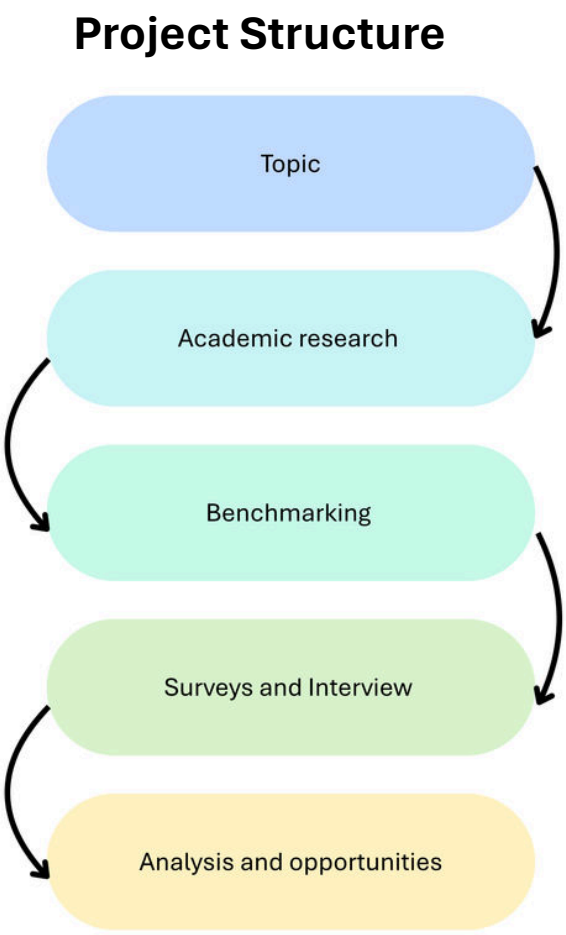


Figure 1
Project Structure.

While established methods of vision screening and eye examination are available, the process of identifying refractive errors involves more than the clinical detection of a visual condition (Evans et al., 2018). Parents, teachers and health professionals can all play a role in recognising potential vision problems and providing the appropriate support for children. This creates an opportunity to examine how current vision screening and early intervention could improve school experience and their daily lives.

The aim of this project is to explore the challenges associated with identifying refractive errors in primary school children and investigate opportunities for early screening and intervention through a child friendly design approach. The research examines existing literature, screening approaches and products, alongside the perspectives of parents, adults and professionals in the paediatric optometry field.

1.2. Background

Figure 2

Professional optometrist holding glasses and eye chart in the background, eyesight and vision problems concept, copy space

Note. From "Shutterstock" by Stokette, 2022 (https://www.shutterstock.com/image-photo/professional-optometrist-holding-glasses-eye-chart)



World Health Organisation estimated that at least 2.2 billion people are affected by various forms of vision conditions in 2023. Common eye conditions include refractive errors, cataracts, diabetic retinopathy, glaucoma and age related macular degeneration (Centers for Disease Control and Prevention, 2024). Refractive errors occur when the eye does not focus incoming light correctly onto the retina, resulting in blurred vision. The main types include myopia, which affects distance vision, hyperopia, which can affect near vision and astigmatism, which can cause blurred or distorted vision (National Eye Institute, 2025). This project focuses specifically on refractive errors in primary school children and the potential benefits of early identification and intervention.

Refractive errors are common among children, with prevalence in myopia becoming an increasing concern among school aged children globally, with evidence suggesting that it is affecting one third of children and adolescent (Liang et al., 2024). Refractive error can also change as children grow, meaning that their visual needs may change throughout their school years (Hopkins et al., 2019). These changes highlight the importance of identifying potential problems and monitoring children's vision during development.

The consequences of uncorrected refractive error can go beyond the experience of blurred vision. Poor visual acuity can make tasks such as reading from a board, viewing printed material and completing detailed work more difficult (Wood et al., 2018). Research has associated uncorrected vision in children with educational and functional difficulties, problems that need attention before they begin to interfere with school participation. The effects can also extend into social and physical activities, particularly where clear vision is needed to interact confidently with other people or navigate unfamiliar environments (Loh et al., 2024).

1.2. Background

Several approaches are currently used to identify potential vision problems in children, including visual acuity testing, instrument based screening and comprehensive eye examinations (Pang et al., 2025). Instrument based methods can provide objective measurements and allow screening to be conducted in settings such as schools and community health programs. Results from research done by Li et al. in 2023, large Queensland school screening program suggested that combining visual acuity testing with photoscreening can improve the identification of children requiring further assessment, with a higher positive predictive value when both screening methods indicated referral compared with either method alone. However, vision screening is intended to identify children who may require further assessment rather than provide a definitive diagnosis (Wang et al., 2022). Comprehensive eye examinations are still required to determine the underlying condition and appropriate treatment.

The effectiveness of early identification therefore depends on more than the screening method itself. Research has shown that children referred to professionals following a school based screening may not complete eye examinations, with barriers including cost, scheduling, distance and limited access to eyecare services (Silverstein et al., 2021, Ravindran et al., 2020). Other research has also identified positive outcomes from teacher administrated screening and the importance of teachers, school and community support in encouraging families to follow through with referrals (Cunha et al., 2026). These findings suggest that childhood vision screening is part of a broader system involving children, parents, schools, health professionals and access to services. Consequently, opportunities for design solution extend beyond developing a screening technology alone and may include improving the usability, accessibility and child centred experience of screening.



Figure 3

Ophthalmologist examining the eyesight of a young boy with a trial frame during a routine checkup in a modern clinic setting

Note. From “Shutterstock” by H. Serhii, 2025 (https://www.shutterstock.com/image-photo/ophthalmologist-examining-eyesight-young-boy-trial)

1.3. Benchmarking

Benchmarking was conducted to examine existing technologies used for vision screening and refractive assessment in children. Products were selected based on their relevance to primary school children, portability, screening capability, child engagement and suitability for use outside conventional optometry settings and to compare their technical capabilities. The benchmark included the Welch Allyn Spot Vision Screener, Plusoptix Vision Screener, Adaptica 2WIN, GoCheck Kids and M&S Smart System FirstTest. The key characteristics of each product are compared in **Figure 5** table while their relative design characteristics are further evaluated using the **Figure 6** radar diagram .

Figure 4
Products selected for benchmarking

Product	Spot vision screener	Plusoptix	Adaptica 2WIN	GoCheck Kids	M&S Smart System FirstTest
					
Product type	Handheld photoscreener	Autorefractor/Binocular photoscreener	Refractive screener/Binocular photoscreener	Smartphone photoscreening app	Electronic visual acuity screener

Figure 5
Benchmarking existing products (10= Excellent, 1= Poor)

Product	Portability	Automated screening	Refractive assessment	Visual acuity	Engagement	Physical interaction	School settings
Spot vision screener	8	10	8	1	8	5	10
Plusoptix	9	10	8	1	9	5	10
Adaptica 2WIN	10	10	10	1	8	5	10
GoCheck kids	10	8	6	1	7	1	9
M&S FirstTest	5	9	3	10	10	7	8

1.3. Benchmarking

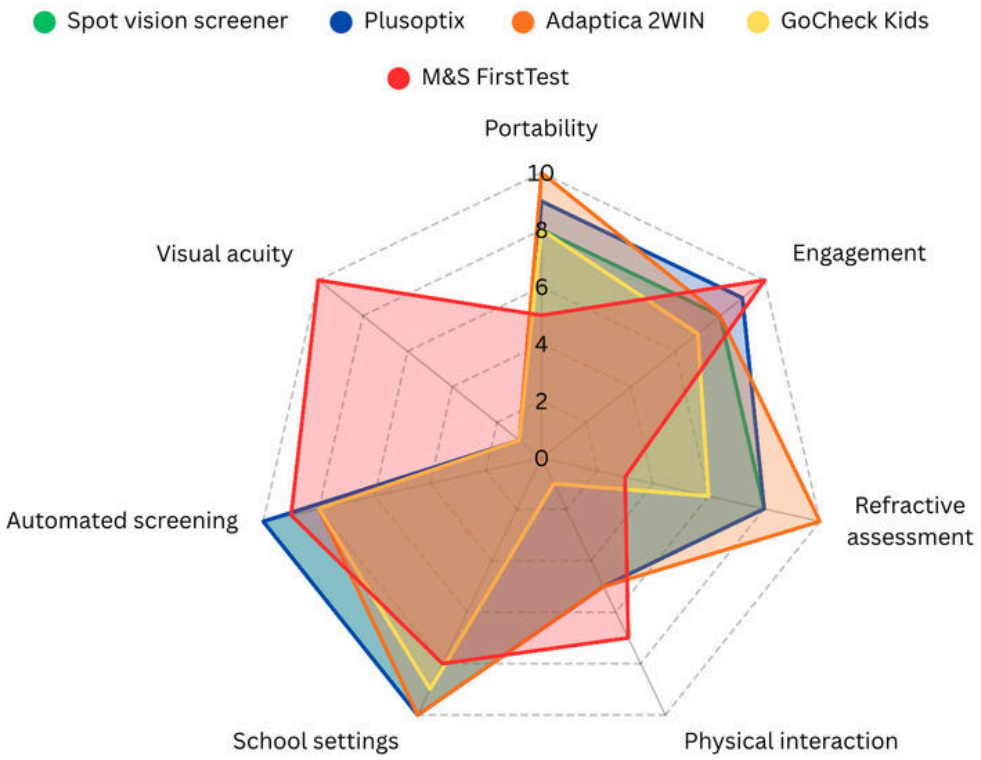


Figure 6
Design characteristics of existing products on a radar diagram

The Spot Vision Screener, Plusoptix and Adaptica 2WIN demonstrate that portable, automated instrument based screening is already well established. These devices can rapidly assess children without requiring conventional subjective visual acuity responses, while providing measurements associated with refractive error and other visual risk factors (Peterseim et al., 2020). Research has also directly compared the Spot vision screener and Plusoptix as paediatric photoscreeners, demonstrating their established use for detecting amblyopia risk factors and estimating refractive errors successfully (Zhang et al., 2019).

The benchmark also identified different approaches to accessibility and interaction. GoCheck Kids demonstrates how smartphone technology can be used as an alternative to dedicated screening hardware, while FirstTest provides an electronic approach to visual acuity testing (Silverstein et al., 2020, Lui wt al., 2017). These products demonstrate that screening can be adapted for different environments and levels of technical infrastructure. However, existing devices remain primarily focused on measurement efficiency and clinical referral rather than integrating multiple screening approaches into a single physical experience.

1.3. Benchmarking

A significant finding was the potential value of combining screening methods. A research done in a Queensland school screening program used both the Spot photoscreener and a visual acuity test. The study found a positive predictive value of 0.91 when both methods indicated referral, compared with 0.73 for photoscreening alone and 0.76 for visual acuity alone (Li et al., 2023). This finding directly supports an opportunity to investigate how complementary screening methods could be integrated into a single child centred product.

The benchmarking also highlighted opportunities for improving the physical experience of screening. Existing products incorporate fixation targets, sounds, displays and automated measurements to maintain the child's attention, but there is comparatively less emphasis on physical interaction and engagement. Similarly, portable refractive screening devices demonstrate that objective measurement is achievable, creating an opportunity to explore how refractive assessment could be translated into a more child centred physical form without replacing comprehensive optometric assessment.

Overall, the benchmarking demonstrated that the market already provides effective individual screening technologies. The opportunity identified is therefore not to create another conventional vision screener, but to explore integration, child centred physical interaction, portability and accessibility.

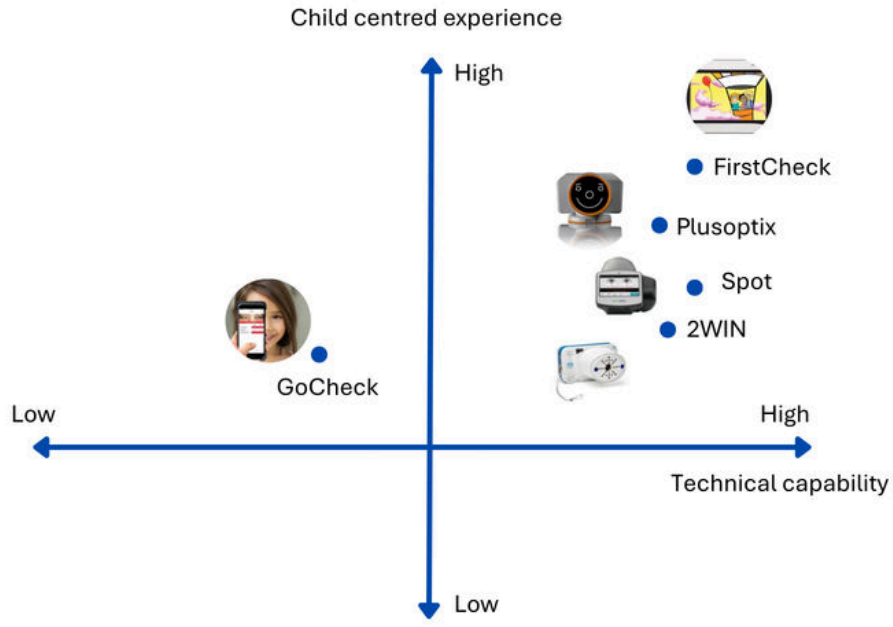


Figure 7
Existing products matrix based on child centred experience and technical capabilities

Section 2

2.1. Research

2.2. Analysis and Findings

2.1. Research

Primary research was conducted to develop a deeper understanding of experiences surrounding childhood refractive errors, vision screening and access to eye care. The research aimed to complement the secondary research by investigating personal experiences, caregiver perspectives and professional knowledge. A mixed method approach was used, combining quantitative and qualitative research methods. Two surveys were conducted with different participant groups, followed by a semi structured interview with an expert in children's vision and optometry.

Methods

A mixed method approach was selected because the project required both measurable responses and more detailed accounts of individual experiences. Quantitative data from closed ended survey questions was used to identify patterns and trends across participants, while qualitative responses provided greater insight into personal experiences, concerns and expectations. The expert interview provided a professional perspective on current vision screening practices, technologies and challenges.

Survey 1.

The first survey investigated the experiences of adults who had worn glasses since childhood. The purpose was to understand how vision difficulties were identified, whether participants experienced vision problems at school, their experiences with vision screening and eye testing, and their experiences of wearing glasses. This survey consisted of 21 responses and included a combination of multiple choice, scaled and open ended questions. The survey was distributed by Google Forms to collect retrospective accounts of childhood experiences with refractive errors and vision correction.

Survey 2.

The second survey focused on parents and caregivers to provide a different perspective on children's experiences with vision difficulties and screening. The survey investigated how vision problems were identified, access to eye examinations, experiences with school based screening, and what parents considered important with eye care for their children. It also included questions about children's comfort, communication and engagement during the screening process. The survey received seven responses. The smaller sample was considered exploratory and was used to identify experiences and perspectives rather than produce statistically representative conclusions.

2.1. Research

Interview

A semi structured expert interview was conducted with Dr Shelley Hopkins, a paediatric optometrist and QUT lecturer specialising in children's vision. The interview was selected to gain professional insight into how vision screening is currently conducted with primary school children and the capabilities and limitations of existing screening technologies. Questions explored current screening methods, assessment procedures, children's responses to screening, the roles of parents and teachers and potential opportunities for improving screening. The semi structured format allowed key topics to be addressed consistently while providing flexibility to explore relevant points raised during the discussion. The interview also included a demonstration of the Welch Allyn Spot Vision Screener, providing first hand explanation of how the device is used in a school screening context.

Analysis methods

The survey data was analysed using descriptive statistics, including response frequencies and percentages, to identify notable patterns within the close ended questions. Open ended survey responses were reviewed and grouped into recurring themes. The expert interview was analysed thematically by identifying repeated topics and significant insights relating to screening technology, engagement, accessibility and limitations. The findings from both surveys and the interview were then compared with the secondary research to identify areas of agreement, recurring issues and potential design opportunities.



Figure 2
Data collection

Summary

The research combined the perspectives of adults with childhood experience of wearing glasses, parents and caregivers, and a children's vision professional. This provided a broader understanding of the social, practical and clinical aspects of childhood vision screening. The combination of quantitative survey data and qualitative responses enabled both patterns and individual experiences to be considered. These findings were used in the following analysis to identify key themes, user needs and opportunities for further design development.

2.2. Analysis and Findings

The collected data was analysed to identify recurring patterns across the two surveys and the expert interview. Quantitative responses from closed ended survey questions were analysed using frequencies and percentages, while open ended responses were reviewed thematically to identify common experiences and concerns. The adult and parent/caregiver surveys were analysed separately because they represented different perspectives, before being compared with the expert interview to identify areas of agreement and difference. The main findings were organised into five themes: awareness of visual difficulties, impact on school and everyday activities, accessibility of screening, children's experience of screening, and limitations and opportunities within current screening practices.

1. **Children may not recognise that their vision is different**

A key finding was that children may not recognise that their vision is different from their peers. Answers to the question number 6, in the adult survey, 8 of 21 participants (38%) reported being somewhat aware that their vision was different, while 7 participants (33%) reported being not at all aware. Only one participant described being very aware. This suggests that visual difficulties may not always be recognised by children themselves (**Figure 9**).

This was also reflected in how participants first became aware of their need for glasses. Ten of the 21 adults (48%) reported noticing symptoms themselves, compared with five (24%) whose parents or guardians noticed symptoms and four (19%) whose teacher or school noticed symptoms (**Figure 10**). However, the open ended responses showed that some participants had considered blurry vision to be normal. This finding was strongly supported by the expert interview, where Dr Shelley Hopkins explained that children may not realise the change in their vision because gradual changes become their normal experience.

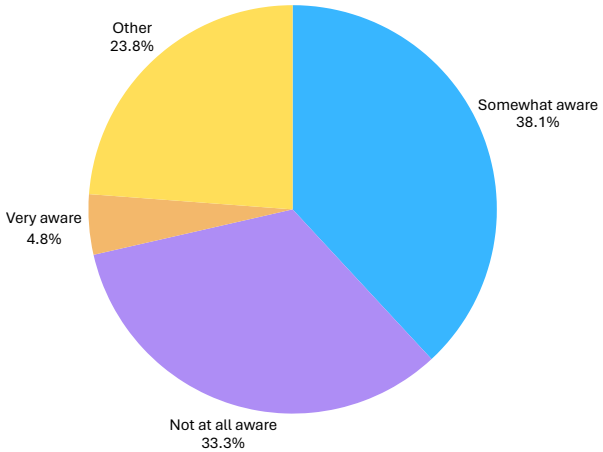


Figure 9
The child being aware of their vision (n=21)

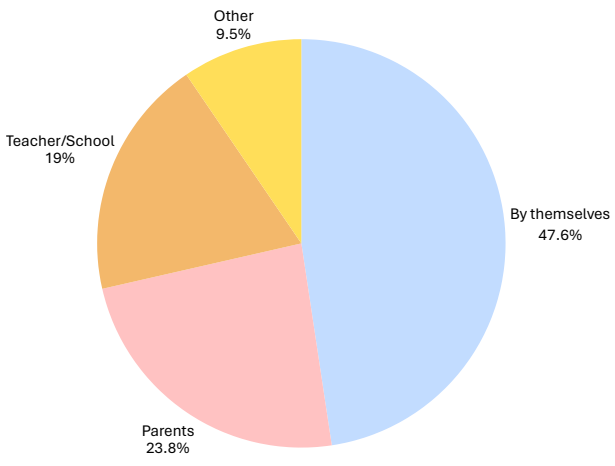


Figure 10
How they realised that they needed glasses (n =21)

2.2. Analysis and Findings

2. **Visual difficulties can affect school and everyday activities**

Ten of 21 participants (48%) reported that their vision often affected their school experience, while a further two (10%) reported that it affected them frequently. Responses described difficulties seeing the board, reading, recognising people at a distance and participating in sport. Parent/caregiver responses similarly identified difficulties seeing the board, reading, watching television from a distance and squinting as a symptom.

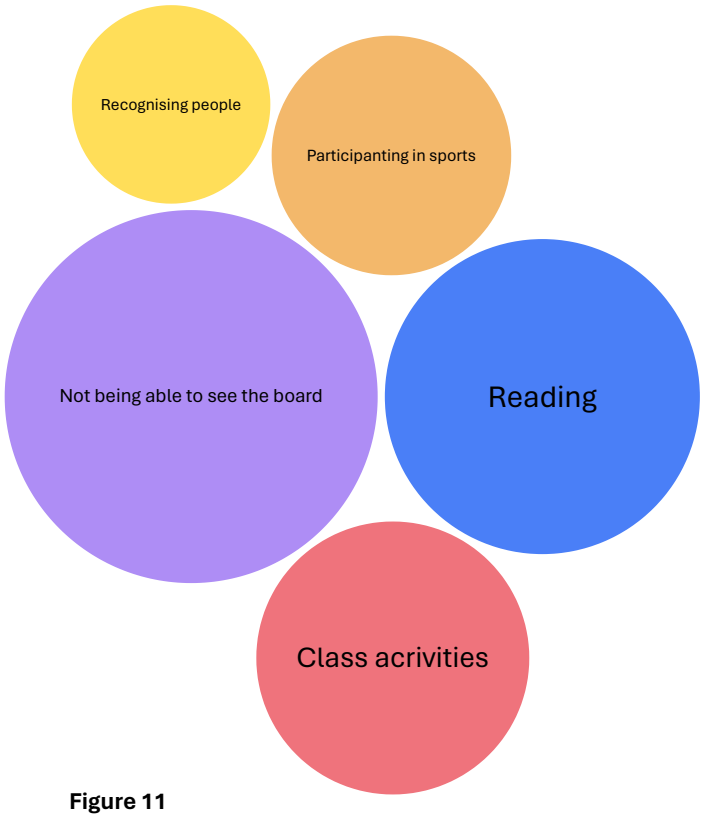


Figure 11
Difficulties in their daily lives (n =21)

These findings suggest that visual difficulties may be experienced through ordinary school activities rather than being recognised as an eye related problem. One parent reported that their child was struggling at school but that they did not initially think this was related to eyesight. Although the small sample does not establish a causal relationship between vision and academic performance, the responses demonstrate the practical ways in which unrecognised visual difficulties can affect children.

3. **School vision screening was inconsistent**

The survey results indicated that school screening was not consistently experienced or remembered. In the adult survey, 12 of 21 participants (57%) reported that their school did not conduct vision screening, while five (24%) remembered receiving school screening and four (19%) were unsure. Similarly, only one of seven parent/caregiver respondents identified school screening as the source of their child's vision check, while four reported that their child was assessed by a specialist and two were unsure.

Several parent responses suggested a need for more frequent school screening, clearer communication with parents and schools. This finding is relevant to the design opportunity as it indicates that screening needs to be accessible within environments where children already spend significant amounts of time.

2.2. Analysis and Findings

4. **Children's comfort and engagement influence the screening experience**

The results suggest making screening understandable and comfortable for children. Although five of seven parent/caregiver respondents described their overall testing experience as positive and one as somewhat positive, their suggestions for improvement included explaining the process to children, using simple communication and involving parents when concerns are introduced.

The adult survey provided further insight into what participants remembered about testing. Positive responses included testing being fast, friendly attitude from the specialist, interesting equipment and visual testing methods such as pictures. Some participants specifically mentioned equipment that looked like toys or enjoyed the visual elements of the test. This indicates that the physical and sensory experience of screening can influence how children perceive the process.

The expert interview reinforced this finding. Hopkins explained that visual acuity testing can be difficult even with trained staff and that picture matching is used to make the process more game like for children. She also noted that some children are shy or reluctant to participate, making it important for screening to remain simple, less threatening and less complex.

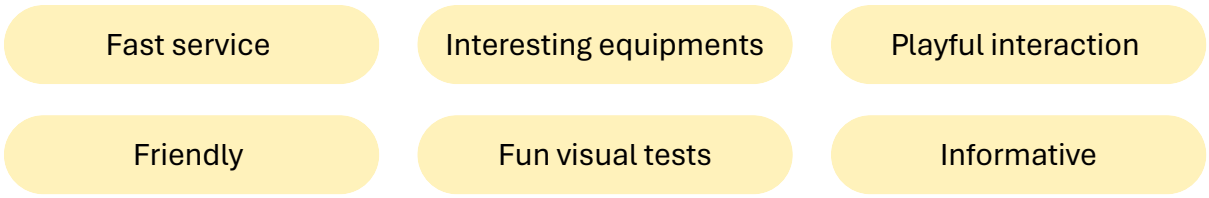


Figure 12

Memorable and positive aspects from their screening experience (n =21)

5. E**xisting screening technology has strengths and limitations**

The expert interview demonstrated that objective screening technologies can make school screening faster and provide useful information, but they still require visual acuity testing. The Spot Vision Screener provides an estimate of refractive error and screens for other indicators, but the results require further interpretation and refinement by an eye care professional. Dr Hopkins also identified limitations including false positives and misidentification of longsightedness in young children.

A significant finding was the potential value of combining objective screening with visual acuity testing. Dr Hopkins suggested that an instrument combining a Spot screening method with electronic visual acuity could be effective as the electronic acuity systems can reach the testing endpoint more efficiently. This provides a clear direction for further investigation during the design development stage.

2.2. Analysis and Findings

Summary

Overall, the findings indicate that children may not recognise visual difficulties themselves, while parents and teachers may also have difficulty identifying problems before they become noticeable. The research shows inconsistent experience of school screening, impact of visual difficulties during everyday school activities, and the importance of making screening comfortable and engaging for children. Existing screening technologies provide valuable objective information, but their limitations and separation from visual acuity testing which is an opportunity to investigate more integrated, accessible and child focused approaches to early screening.

Section 3

3.1. Discussion
3.2. Design implications
3.3. Conclusions

3.1. Discussion

The research findings reinforce the findings from literature review, the importance of early identification of refractive errors in children, while also highlighting that effective screening depends on more than the accuracy of the screening technology. The literature identified uncorrected refractive error as an important cause of reduced visual acuity and established the role of school and community screening in identifying children who may require further assessment (Cunha et al., 2026. The primary research supports this need by showing that children may not recognise that their vision differs from others. In the adult survey, 71% of participants were either not at all or only somewhat aware that their vision was different during childhood. This aligns with the expert interview, where Dr Hopkins explained that children may consider gradual changes in vision to be normal because they have no comparison for what clear vision should look like.

The findings also support research linking visual function with children's participation in school activities. Participants described difficulties with seeing classroom boards, reading, recognising objects at a distance and participating in everyday activities. While the survey findings cannot establish a causal relationship between refractive error and academic performance, they demonstrate how reduced visual function can become part of a child's everyday school experience.

A further connection between the literature and primary research concerns the limitations of screening and follow up. The literature established that screening identifies children who may require further assessment rather than providing a definitive diagnosis, while research has shown that referral does not always lead to follow up care (Silverstein et al., 2021, Ravindran et al., 2020). The expert interview similarly emphasised the distinction between screening and comprehensive eye examination. This suggests that the design opportunity is not to replace clinical assessment, but to improve the initial screening experience and its accessibility.

The research adds to the identified gap by shifting attention from screening accuracy alone towards the physical and experiential aspects of screening. Existing technologies demonstrate that rapid objective screening is achievable, but the research indicates opportunities to make screening more child centred, understandable, portable and physically engaging. Combining complementary screening approaches may also provide an opportunity for further investigation, supported by both the expert interview and research showing improved positive predictive value when photoscreening and visual acuity testing were used together. Overall, the findings suggest that a design approach can contribute by improving how existing screening capabilities are integrated into a practical and child friendly experience.

3.2. Design implications

The research identified several opportunities for a design approach within childhood refractive error screening. Rather than developing a device based solely on increasing measurement capability, the findings suggest that design should address the interaction between the child, screening technology, operator and screening environment. The following implications were identified as priorities for subsequent concept development.

Research findings	Problem	Design opportunity
Children may not recognise poor vision	Problems can go unidentified	Proactive screening
School screening is inconsistent	Children may not be screened	Portable school screening
Children can find testing difficult	Cooperation/fixation can be challenging	More engaging interaction
Existing devices are clinical looking	Experience is relatively clinical	Child centred physical design
Different screening methods have limitations	Follow up may be difficult	Explore combined screening

Figure 13
Design opportunities

Support proactive identification

A key finding was that children may not recognise that their vision is different from others. This creates an opportunity for screening to be designed around proactive identification rather than requiring children to recognise and report a problem. A screening product should allow screening to be conducted efficiently with minimal dependence on a child's ability to describe their own visual experience. Objective screening technologies demonstrate the potential for this approach, but the physical product should make the process straightforward for operators and comfortable for children.

Combine complementary screening approaches

The research identified potential value in combining objective refractive screening with visual acuity testing. Existing devices generally focus on particular forms of assessment rather than providing a single integrated physical experience. This creates an opportunity to investigate a product that can incorporate complementary screening methods while clearly distinguishing screening from diagnosis. Any integrated system would need to communicate that results are an indication for further assessment rather than a spectacle prescription.

3.2. Design implications

Prioritise child centred interaction

Both the surveys and expert interview identified children's comfort, understanding and willingness to participate as important factors. Children may be shy, uncertain or reluctant to engage with unfamiliar testing equipment. The design should reduce the clinical and intimidating qualities of conventional screening. Physical interactions such as pressing, turning, sliding, matching or following visual targets could provide children with an active role in the screening process. These interactions should remain purposeful and must not compromise the reliability of the assessment.

Design for portability and different environments

The literature and research show that screening beyond conventional optometry clinics, including schools and communities with more limited access to services is important. Portability should be considered as a system requirement rather than simply reducing product size. The design should support transportation, setup, storage, cleaning, charging and protection of components. A compact product that transforms into a stable screening workstation could help address the practical requirements of mobile or school screening.

Support operators and screening consistency

The product should also consider the needs of teachers, screening staff and health professionals. Screening may involve users with different levels of clinical experience, making clear instructions, intuitive controls and effective feedback important. The design should make correct positioning, fixation and operation easy to understand. However, the product must not imply that non clinical users can diagnose refractive errors or prescribe corrective lenses.

Consider the wider screening pathway

The research identified communication and follow up as important parts of the broader screening process. Results should be presented clearly and in a way that supports appropriate referral and communication with parents or caregivers. The design should contribute to a screening pathway that is accessible and child centred rather than treating the screening device as an isolated object.

Together, these implications establish a direction for concept development integration, child centred physical interaction, portability, usability and accessibility. The next stage of the project can explore these opportunities through physical form, mechanisms, interaction and concepts.

3.3. Conclusions

This research investigated opportunities to improve the early screening of refractive errors in primary school children through industrial design. The literature review established the importance of identifying refractive errors early, particularly because children may experience reduced visual acuity without recognising that their vision differs from others. It also demonstrated that school and community screening can improve access to early identification, while screening technologies have limitations and do not replace comprehensive eye examinations.

Primary research expanded these findings through the perspectives of adults with childhood experiences of wearing glasses, parents and caregivers, and an expert in children's vision and optometry. The findings indicated that children may not recognise visual difficulties, while parents and schools may also have difficulty identifying problems early. Participants described visual difficulties affecting school and everyday activities, inconsistent experiences of school-based screening, and the importance of children's comfort and engagement during testing. The expert interview showed the limitations of existing screening technologies and the potential value of combining complementary screening methods.

Together, the research identified an opportunity for a design opportunity to contribute to childhood vision screening through improved physical interaction, portability, integration and child centred experiences. Rather than attempting to replace professional eye examinations, future design development should focus on making early screening easier to access, easier to use and more comfortable for children. These findings provide the foundation for the subsequent concept development and evaluation stages of the project.

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