

Exploring Design Opportunities in an Autism Spectrum Disorder Unit of a Post-Primary School

Empowering Students with ASD

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Exploring Design Opportunities in an Autism Spectrum Disorder Unit of a Post-Primary School To Improve the Quality of Life of Students with ASD.

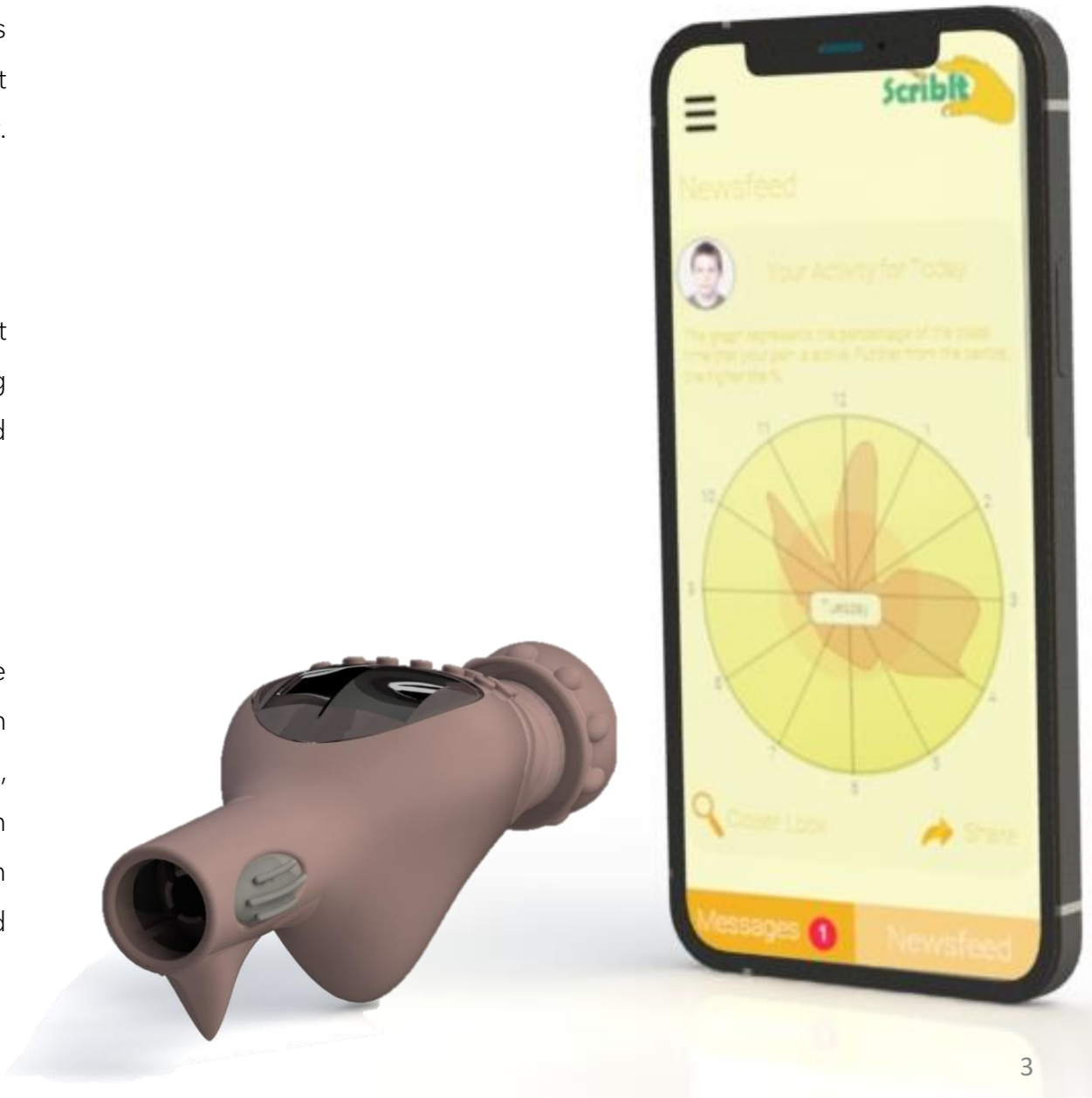


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A motivational pen/pencil grip that is complimented by an app which support students with ASD academically and socially.

The Scribit grip encourages students to get writing through motivational messaging while also encouraging the dynamic tripod grip with its sleek and universal design.

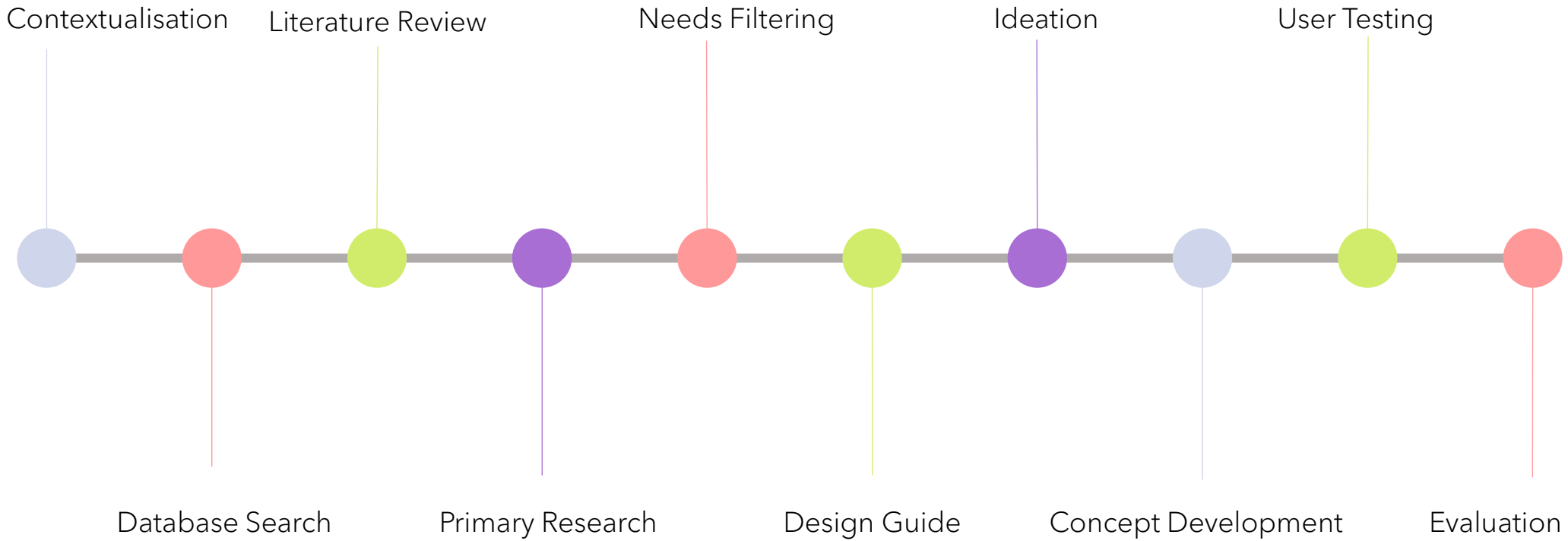
The complimentary Scribit app tracks the grip activity while allowing the student form connections with others through challenges, messaging and sharing data. It is a platform where teachers can share feedback with students based on school work submitted via the app.



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The Design Process



An explanation of ASD focusing specifically on post primary students and a rationale why this area was chosen to be addressed.

Introduction and Contextualisation

Autism Spectrum Disorder (ASD)

Autism Spectrum Disorder (ASD) is a term used to describe deficits in social communication, social interaction and repetitive and restricted behaviours (Deacy *et al.* 2015; Young *et al.* 2017). Autism, Asperger syndrome, child disintegrative disorder, and pervasive developmental disorder are all characterised under the spectrum of ASD (Hart and Whalon 2011).



Challenges Encountered by Students with ASD

- 1 Efforts to include students with ASD in mainstream are made difficult as funding, resources, curriculum and teacher knowledge and training is scarce (Tiwari *et al.* 2015).
- 2 Students with ASD prefer routine in their day to day lives (Symes and Humphrey 2011) but post-primary schools can present challenges in the form of timetable changes, different teaching styles, different classroom settings etc. (McGillicuddy and O'Donnell 2014).
- 3 Social communication and interaction are some of the challenges faced by people with ASD and with the unpredictable nature of communication and interaction, these actions can be overwhelming and cause anxiety levels to rise (Spiker *et al.* 2012).
- 4 Children with ASD are more susceptible to bullying from their peers than typically developed children due to their socio-communicative and behavioural difficulties (Cappadocia *et al.* 2012)

The Irish Context

Many children and adolescents with ASD in Ireland have many unmet service needs as demand significantly outweighs supply. There are also geographical issues as there are no services within proximal distance to ensure easy access for the individuals (Roddy and O'Neill 2020). With this in mind, it would be an essential area of Ireland's population to target and support to provide them with a solution that could support them while waiting for services or even eliminate the need for the service.

Over 70% of children with an ASD diagnosis in Ireland participated in less than 5 days of moderate to vigorous physical activity over a two week period. This is in stark contrast to only 23% of typically developing children (Healy et al. 2017). A solution to help reduce this gap in activity between neuro typical individuals and individuals with ASD is needed. This would help reduce obesity, cardiovascular disease, diabetes but also create an opportunity for social interaction that is a limitation commonly associated with ASD.

There is a significant gap in the literature focusing on the needs of post-primary students with autism. Only 10% of the literature gathered focused on students aged 12-16 years and this mainly focused on the higher functioning autistic students. Consequently, very little is known about effective interventions and provisions for individuals with more severe autism and learning disabilities (Parsons et al. 2011).

Why I Chose this Area of Research

It is clear that students with ASD and their parents need the support that is clearly not forthcoming currently. There appears to be a wealth of knowledge, understanding and support surrounding children with ASD but this does not seem to carry through to adolescence.

As previously mentioned, students with ASD have limitations in communication and interaction, don't cope well with change, are susceptible to bullying and experience high levels of anxiety. If these issues are merged with the lack of funding and resources, it is evident that there is a significant opportunity to address some issues within mainstream secondary schools and essentially provide a solution that will support the students with ASD and their supporting network.

For these reasons, I have chosen to *Explore Design Opportunities in an Autism Spectrum Disorder Unit of a Post-Primary School.*

Aims, objectives and anonymity of participants.

Background

The Aims of the Research



1 To identify opportunities and challenges faced by students with ASD in a school environment with teaching staff, peers and the physical environment itself with the view to understanding their everyday experiences.

2 To explore ways of improving ASD students' difficulties in a post primary school setting paying particular reference to how products, services and systems might assist them.

3 To research, develop and design a product, service or system which assists, improves and/or enriches the experiences of students with ASD.

4 The aims of the research will primarily focus on both interpersonal and metacognitive skills but the focus will narrow as the research develops.

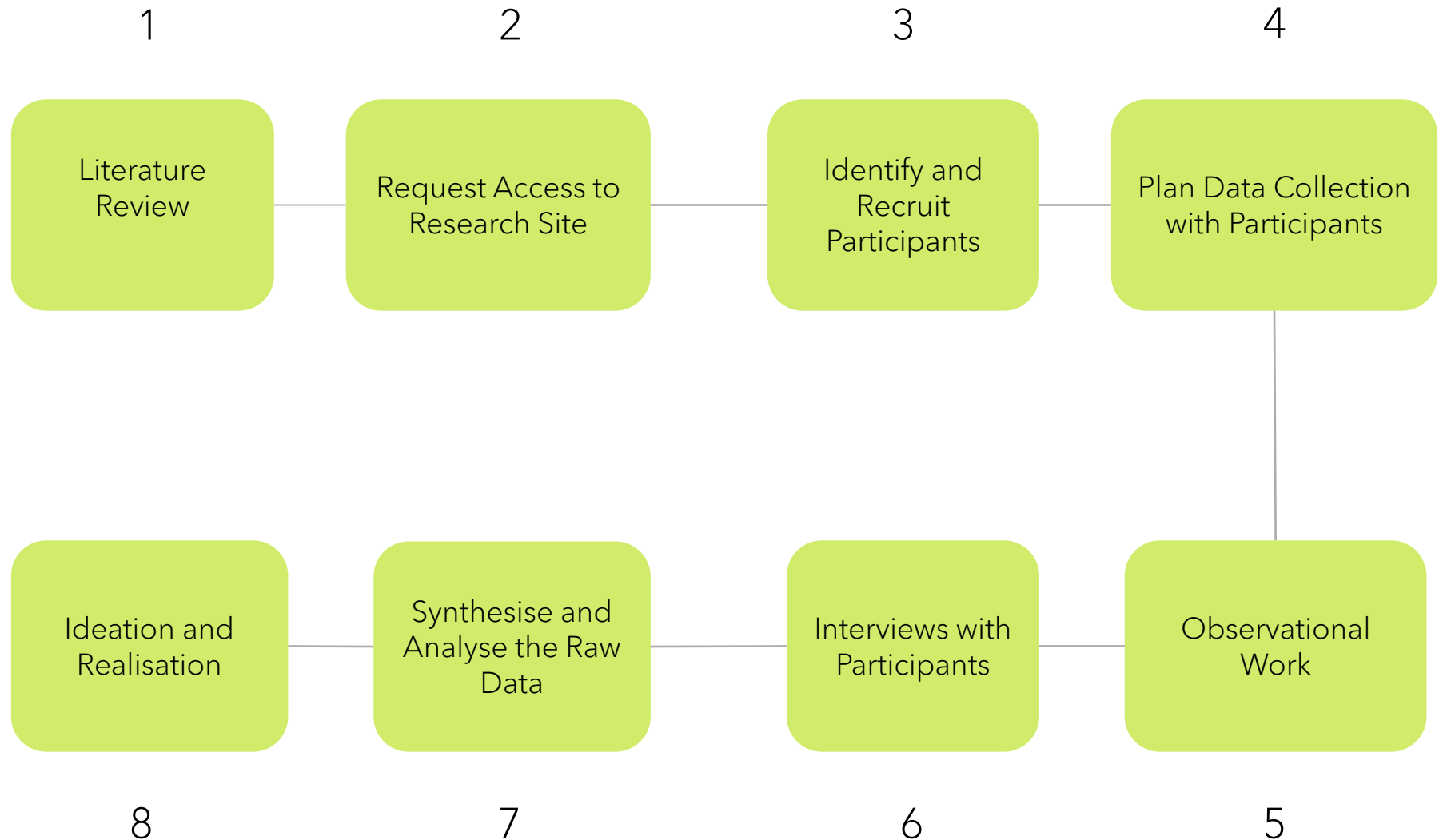
Objectives

- Carry out a review of the literature to gain some understanding of the behaviours and experiences of people with autism.
- To avoid affecting the participants behaviours and responses by remaining impartial and create a level of trust with them.
- To remain conscious of the environment as well as the participants themselves.
- To ensure that I gain as much detail as possible in the interviews to confirm data obtained through observations
- To collaborate with peers and other professionals in the filtering process to identify the most important need to be met.
- To explore and utilise different prototyping and design techniques during ideation.

Research Questions

- What areas of school life do students with ASD thrive in?
- What do ASD students struggle with?
- How do ASD students cope with difficult scenarios?
- What aids are available to students with ASD in a school environment?
- What strengths do students with ASD possess that typically developing students may not have?
- How do teachers meet the needs of students with ASD?
- Do ASD students find the ASD unit beneficial?
- What services/products do ASD students find most beneficial to them?
- Do parents and family identify the same needs as ASD students?
- What type of environment do students learn best in?

Plan of Investigation



Stakeholders



Special Educational Needs Coordinator



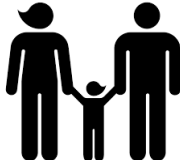
Doctor



Speech and Language Therapists



Secretary



Parents



Retailer



Student with ASD



Caretaker



Student Population



Delivery Companies



Design and Manufacturing company



Teachers



Special Needs Assistant

Data Protection and Anonymity



- Information will be stored in a locked cabinet while the research is ongoing.
- Data will be stored on the UL network protected under a password.
- Location of the ASD Unit will remain anonymous.
- Participants' names will be replaced with pseudonyms or numbers.

Knowns vs Unknowns

Knowns

- Students with ASD face challenges with communication and interaction.
 - Autistic students tend to require routine in their day-to-day lives.
 - Students with ASD can often be excluded from classes and other school events.
 - Students with ASD may require some extra help while in class.
 - Some students with ASD are higher functioning and are quite academic.
 - Some students with ASD can have an SNA to support them.
-

Unknowns

- Are students content when on their own?
 - What does a meltdown feel like?
 - Can students with autism control their meltdowns?
 - What strategies can be put in place to support students with ASD?
 - Is the ASD unit actually beneficial?
 - If so, what is it about the ASD unit that actually helps and supports them?
 - Why do students with ASD have issues with communicating and expressing their feelings?
-

- An exploration of the literature based on students with ASD in post-primary schools.
- Database search of Scopus and ScienceDirect.

Literature Review

Literature Review Format

- A database search was carried out to explore the literature in relation to the experiences of students with autism spectrum disorder (ASD) in a secondary school setting.
- A thematic analysis was carried out in the majority of the articles found.
- These themes include:
 - Inclusivity of Students with ASD
 - Classroom Engagement
 - Information Acquisition
 - The Social Experience
 - Bullying
 - Mental Health
 - Supports for Students with ASD.
- It was recognised that there was a lack of participant voice and little empathy experienced by the researcher so qualitative papers were utilised

The first database search was carried out on **Scopus** with the following limiters:

Database 1

- o design AND (asd OR autism OR autism spectrum disorder) AND students AND school (*236 articles*)
- o AND mainstream (*33 articles*)
- o AND secondary (*15 articles*)
- o AND (adolescent OR teenager) (*14 articles*)
- o Title and Abstract Screened: (*4 articles*)
 - University (-3)
 - Written Language (-1)
 - Elementary School (-6)



The database search produced **4 relevant articles**.

Database 2

The second database search was carried out on *ScienceDirect* with the following limiters:

- asd OR autism OR autism spectrum disorder) AND mainstream secondary school (*942 articles*)
- 2008 -2020 (*728 articles*)
- AND (teenager OR adolescent) (*385 articles*)
- Research and Review Articles (*233 articles*)
- AND communication (*166 articles*)
- AND design (*127 articles*)
- AND self-management (*66 articles*)
- Title and Abstract Screening

Title and Abstract Screening Criteria:

- Nursing (-2)
- Outside of School (-10)
- ASD Diagnosis (-2)
- Participants too Young (-8)
- Not Relevant to ASD (-28) (Next Page)
- Intellectual Disability (not specific) (-10)

Minus a Total of **(60)**

The database search produced **6 relevant articles**

Examples of Topics not Relevant to ASD:



- Treating deaf children
- Diabetes in children
- Genetic Testing in Children
- Schizophrenia
- Future of Psychiatry

Scopus Results

- Falkmer, M., Oehlers, K., Granlund, M. and Falkmer, T. (2015) 'Can you see it too? Observed and self-rated participation in mainstream schools in students with and without autism spectrum disorders', *Developmental neurorehabilitation*, 18(6), 365-374.
- Hebron, J.S. (2018) 'School connectedness and the primary to secondary school transition for young people with autism spectrum conditions', *British Journal of Educational Psychology*, 88(3), 396-409.
- McKeithan, G.K. and Sabornie, E.J. (2020) 'Social-behavioral interventions for secondary-level students with high-functioning autism in public school settings: A meta-analysis', *Focus on Autism and Other Developmental Disabilities*, 35(3), 165-175.
- Songlee, D., Miller, S.P., Tincani, M., Sileo, N.M. and Perkins, P.G. (2008) 'Effects of test-taking strategy instruction on high-functioning adolescents with autism spectrum disorders', *Focus on Autism and Other Developmental Disabilities*, 23(4), 217-228.
- Sreckovic, M.A., Hume, K. and Able, H. (2017) 'Examining the efficacy of peer network interventions on the social interactions of high school students with autism spectrum disorder', *Journal of autism and developmental disorders*, 47(8), 2556-2574.

ScienceDirect Results

- Cresswell, L., Hinch, R. and Cage, E. (2019) 'The experiences of peer relationships amongst autistic adolescents: A systematic review of the qualitative evidence', *Research in Autism Spectrum Disorders*, 61, 45-60.
- Edgington, L., Hill, V. and Pellicano, E. (2016) 'The design and implementation of a CBT-based intervention for sensory processing difficulties in adolescents on the autism spectrum', *Research in developmental disabilities*, 59, 221-233.
- Hochhauser, M., Weiss, P. and Gal, E. (2015) 'Negotiation strategies of adolescents with high-functioning autism spectrum disorder during social conflicts', *Research in Autism Spectrum Disorders*, 10, 7-14.
- Reutebuch, C.K., El Zein, F., Kim, M.K., Weinberg, A.N. and Vaughn, S. (2015) 'Investigating a reading comprehension intervention for high school students with autism spectrum disorder: A pilot study', *Research in Autism Spectrum Disorders*, 9, 96-111.
- Sreckovic, M.A., Brunsting, N.C. and Able, H. (2014) 'Victimization of students with autism spectrum disorder: A review of prevalence and risk factors', *Research in Autism Spectrum Disorders*, 8(9), 1155-1172.
- Whitehouse, A.J., Durkin, K., Jaquet, E. and Ziatas, K. (2009) 'Friendship, loneliness and depression in adolescents with Asperger's Syndrome', *Journal of adolescence*, 32(2), 309-322.

Qualitative Papers

Qualitative papers were provided by my supervisor to support the quantitative papers found on Scopus and ScienceDirect

Gulec-Aslan, Y., Ozbey, F. and Yassibas, U. (2013) "' I Have Lived an Autism Experience. Autism Is an Interesting Disease": The Life Story of a Young Man with Autism', *International Education Studies*, 6(1), 74-84.

Humphrey, N. and Symes, W. (2010) 'Responses to bullying and use of social support among pupils with autism spectrum disorders (ASDs) in mainstream schools: A qualitative study', *Journal of Research in Special Educational Needs*, 10(2), 82-90.

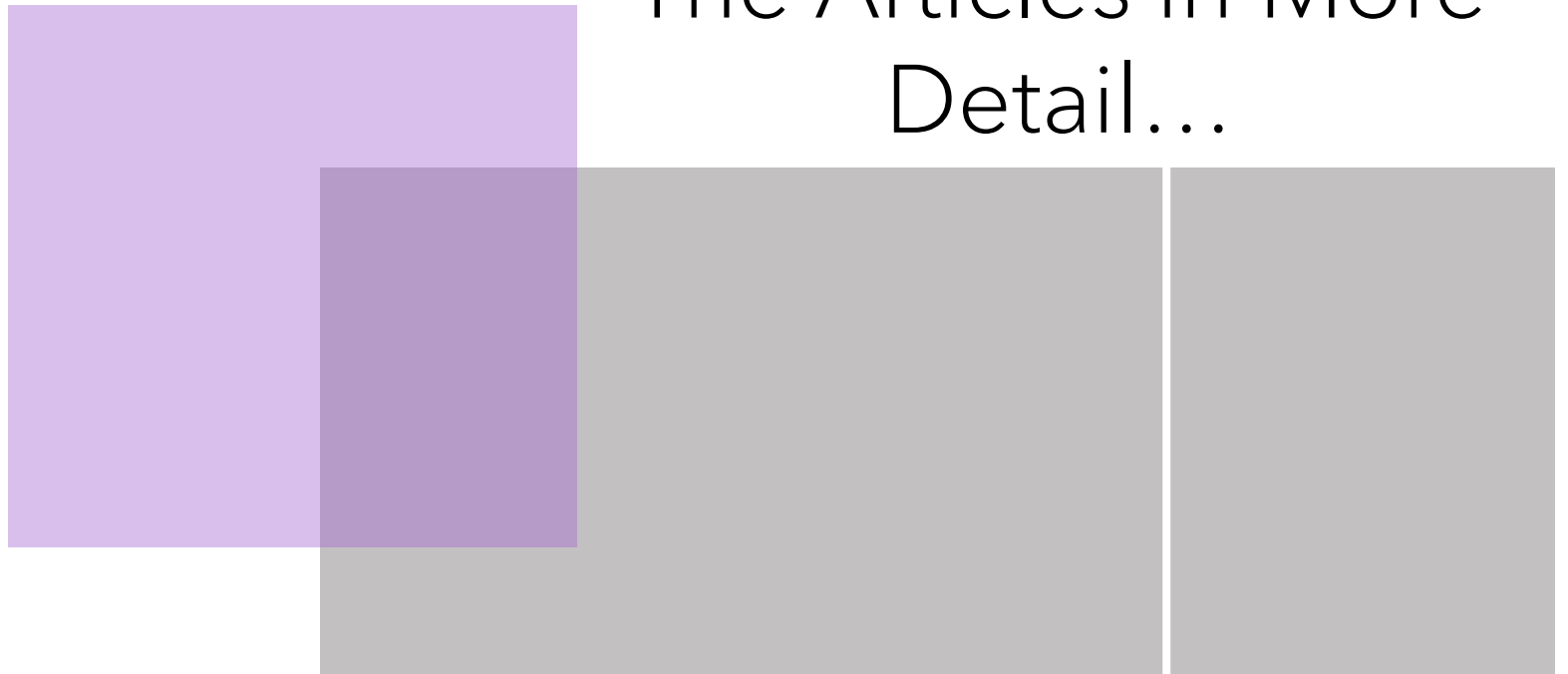
Penney, S.C. (2013) 'Qualitative investigation of school-related issues affecting individuals diagnosed with autism spectrum disorder and co-occurring anxiety and/or depression', *Autism Insights*, 2013(5), 75-91.

Saggers, B., Hwang, Y.-S. and Mercer, K. (2011) 'Your voice counts: Listening to the voice of high school students with autism spectrum disorder', *Australasian Journal of Special Education*, The, 35(2), 173-190.

Howe, F.E. and Stagg, S.D. (2016) 'How sensory experiences affect adolescents with an autistic spectrum condition within the classroom', *Journal of autism and developmental disorders*, 46(5), 1656-1668.

An overview of the articles produced by the database search.

The Articles in More Detail...



School Connectedness and the Primary to Secondary School Transition for Young People with Autism Spectrum Conditions

Hebron (2018)

To **investigate** and compare the *connectedness* of adolescents with ASD and their typically developing (TD) peers during the *transition from primary to secondary* education.

School connectedness can be defined as 'the extent to which students feel personally *accepted, respected, included, and supported by others* in the school social environment' (Goodenow 1993 p. 80).

The **Psychological Sense of School Membership** (Goodenow 1993) questionnaire is used to measure the levels of connectedness among students.

28 primary feeder schools

29 secondary schools

The author **visited schools 4 different occasions** to complete the questionnaire:

- Last term of primary school (**T1**)
- End of first term 1st year secondary school (**T2**)
- Last term of 1st year secondary school (**T3**)
- Start of first term 2nd year secondary school (**T4**)

Examining the Efficacy of Peer Network Interventions on the Social Interactions of High School Students with Autism Spectrum Disorder

(Sreckovic *et al.* 2017)

To explore the effects of a *peer network intervention* on the *frequency of bullying victimization* of students with ASD.

3 participants *with ASD diagnosis*

14 TD peer participants

Rural high school located in a South-eastern state in the United States

Peer network implementation strategies developed by Carter *et al.* (2013).

Peer network meetings and *observations* took place during lunch twice a week for approx. 4 weeks (30 mins approx.)

Snacks and games were provided during the meetings.

Initiations and Responses were recorded during meetings.

A researcher-developed survey was used to assess the *satisfaction of the intervention* from the *perspectives of the participants with ASD, one of their parents, the peer partners and the school guidance counsellor*

Social-Behavioural Interventions for Secondary-Level Students With High-Functioning Autism in Public School Settings: A Meta-Analysis

(McKeithan and Sabornie 2020)

The **purpose** was to synthesize available **social and behavioural intervention evidence** found in published studies, related to secondary students with higher functioning autism in public school settings.

Study inclusion:

- Diagnosis of ASD
- Aged 11-22 years
- Participating in at least 1 general education class
- Interventions delivered in mainstream school
- Single-case design research study
- Participants with a minimum IQ of 75
- Written in English
- Published in a peer-reviewed journal
- A line graph to display data across all phases of a study

The search produced **2,990** studies, **13** of which met the inclusion criteria.

4 studies with **10 participants** utilized **peer-mediated interventions** to increase social interaction initiation, decrease inappropriate behaviour, and generalize social interaction skills.

3 studies implemented **self-management strategies** to improve behavioural outcomes and increase social interactions.

Social narratives were used in **3 studies** with **4 participants** to initiate and maintain acceptable conversation skills.

Naturalistic intervention was used in **1 study** by with **3 participants**.

Prompting was used in **1 study** by and **1 participant** to motivate a student to engage in transition-related behaviours.

Effects of Test-Taking Strategy Instruction on High-Functioning Adolescents With Autism Spectrum Disorders

(Songlee et al. 2008)

The **purpose** of this study was to investigate the effects of **teaching the Test-Taking Strategy** to high-functioning adolescents with ASD through an intensive after-school program.

Four secondary students participated in the study.

Participation Criteria:

- Education eligibility of autism in Nevada.
- Aged 12-17 years.
- IQ above 100
- Reading achievement of at least 4th grade
- Attendance of a mainstream education classroom for at least 1 period daily.
- Agree to participate in 3 sessions a week for a 6 week project.

The **Test-Taking Strategy Instructor's Manual** (Hughes et al. 1988) was used to provide the test-taking instruction.

Sessions lasted **50 mins** in duration (5 mins on **directions**, 25 mins on **baseline tests**, 20 mins in **relaxation room** with research assistant).

Probe Tests (5 sections - fill the blank, true/false, multiple choice, matching and essay type questions).

Probe Test Score Sheet - To evaluate student performance in probe test.

Advanced Practice Test - Recently taken tests taken in general education classrooms.

Advanced Practice Test Score Sheet - To evaluate student performance in advanced practice test.

Generalisation Tests - Designed by the first author to assess the students implementation of the test-taking strategy.

The Experiences of Peer Relationships Amongst Autistic Adolescents: A Systematic Review of the Qualitative Evidence (Cresswell et al. 2019)

The **purpose** of the systematic review is to synthesise reported qualitative findings on how *autistic adolescents experience peer relationships*, including *the rewards and challenges*, from *their perspective*.

PRISMA guidelines and **the Joanna Briggs Institute** (Pearson 2004) meta-aggregative approach to qualitative synthesis informed this review process.

Inclusion Criteria:

- Qualitative research or mixture
- Autistic adolescents' experience of friendship and victimisation only
- Written in English
- Published 1997 - 2017
- Participants aged 10 -19
- In the adolescents' perspective

Info Extracted:

- General details
- Population
- Phenomena of interest and context
- Methodology
- Settings and cultural information
- Retrieved form papers
- Findings

Credibility according to reviewers perceptions were added to each finding:

- ***Unequivocal*** - backed up beyond reasonable doubt and not open to challenge.
- ***Credible*** - lacking clear evidence and open to being challenged
- ***Unsupported*** - not backed up by any evidence

The Design and Implementation of a CBT-based Intervention for Sensory Processing Difficulties in Adolescents on the Autism Spectrum

(Edgington *et al.* 2016)

This study aimed to assess the feasibility of a new 8-week *cognitive behavioural therapy (CBT)-based* group intervention for *self-regulation of sensory processing difficulties*.

Participant Inclusion Criteria:

- Written consent from both parent and adolescent.
- Diagnosis of autism or Asperger's Syndrome.
- Sensory issues identified by the school.
- Parent-reported functional hearing and vision.
- Aged 11-16 years in July 2013.
- Ability to answer written and oral questions.
- An IQ of 70 or above.

7 male adolescent participants from mainstream secondary school.

Adolescent/Adult Sensory Profile (Brown and Dunn 2002) questionnaire was used to assess *sensory preferences* and *response experience*.

Short Sensory Profile (Dunn 1999) was completed by parents on the *observable sensory behaviours* of their children.

The Repetitive Behaviour Questionnaire (Turner 1999) questionnaire measures the frequency of repetitive behaviours.

Questionnaires were completed by the respective participants (*pre-intervention*).

Group Based Sessions once a week for 8 weeks (*intervention*).

Data was collected during week 9 (*post-intervention*). Data was collected 8 weeks later to see if the intervention was maintained (*maintenance*)

Victimization of Students with Autism Spectrum Disorder: A review of Prevalence and Risk Factors

(Sreckovic et al. 2014)

The **purpose** of this review is to synthesise literature on *the prevalence of victimization of students with ASD* and highlight *factors related to victimization*.

Inclusion Criteria for literature to be reviewed:

- Must include participants with *ASD diagnosis*.
- Quantitative *data on prevalence of victimisation* needed to be reported.
- Participants had to be of *school age* (4-21 years)
- Published 2002 - 2014

21 articles met the inclusion criteria:

- **15 studies** reported prevalence of victimisation of school-going students with ASD.
- **14 studies** related to factors related to the victimisation (**8 of which** also reported prevalence rates).

The review is divided into **2 sections**:

- Prevalence of victimization of youth with ASD
- Factors related to the victimization of students with ASD

Prevalence of victimization of youth with ASD was synthesised according to:

- Weekly prevalence rates
- Monthly prevalence rates
- Yearly prevalence rates
- General prevalence rates
- Victimization by diagnosis

Factors related to the victimization of students with ASD were synthesised according to:

- Individual factors
- Contextual factors

Friendship, Loneliness and Depression in Adolescents with Asperger's Syndrome (Whitehouse et al. 2009)

The purpose of this study was to highlight the *experiences of loneliness* and *depressive symptoms* and the *association of these feelings with friendship quality* in adolescents with Asperger's Syndrome (AS).

Participants in this study included:

- 35 adolescents with AS.
- 35 typically developing (TD) adolescents.
- All were attending *mainstream secondary school*.
- All participants (both AS and TD) were matched on *age, school year and gender*.

Childhood Asperger Syndrome Test (Scott et al. 2002) was completed by parents to further *confirm the symptoms of their child's AS*.

Friendship Quality Questionnaire (Parker and Asher 1993) examines children's *perceptions of various qualitative aspects* of their best-friendship.

Friendship Motivation Questionnaire (Richard and Schneider 2005) examines *why individuals develop friendships* and whether they are intrinsically motivated.

De Jong-Gierveld Loneliness Scale (De Jong-Gierveld and Kamphuls 1985) *examines the levels of loneliness* of its participants.

Centre for Epidemiological Studies Depression Scale - Children's Version (Weissman et al. 1980) is a questionnaire *used to measure the depressive symptomatology* in children.

Investigating a Reading Comprehension Intervention for High School Students with Autism Spectrum Disorder: A Pilot Study

(Reutebuch et al. 2015)

The purpose of the investigation was to pilot the use of Collaborative Strategic Reading-High School (CSR-HS) and to document subsequent changes in reading comprehension and to collect data on social interactions and challenging behaviour.

Collaborative Strategic Reading (CSR) teaches students to apply metacognitive and cognitive strategies *for improving comprehension*.

CSR-HS is an adapted version of CSR that can be used across a broad range of students to *support reading for meaning* or to *develop students' reading comprehension* in settings such as resource rooms.

1 to 1 tutoring (implementer and student with ASD) *for 20-30 mins once a week*.

Typically Developing Peers *worked with students with ASD* during the intervention phases.

Inclusion Criteria for participants was:

- Enrolment in high school
- Aged 13-22 years
- Receiving special education under diagnosis of ASD
- Reading on at least 2nd grade or above
- Receiving instruction primarily in academic content throughout the school day in inclusive settings.

Before reading, the teacher helped students make *connections to prior knowledge*.

During reading, 1st peers *discussed any sections* where one or both didn't understand and rewrote the section in their own words and 2nd, *answered true/false questions* in predetermined places in the text and justified their answers..

After reading, the paired *peers reviewed the main ideas of the text* and logged it in their journals.

Negotiation Strategies of Adolescents with High-Functioning Autism Spectrum Disorder during Social Conflicts

(Hochhauser et al. 2015)

The aim of this study was to identify the strategies and *styles used for negotiation* in conflict situations by adolescents with Higher Functioning ASD (HFASD) and *compare them* to those used by typically developing (TD) adolescents.

21 participants met the following inclusion criteria:

- Aged 12-18 years
- Attending mainstream secondary school.
- Have a diagnosis of HFASD.

27 age and gender matched TD peers participated in the study.

Five factor negotiation scale was used to study *youth negotiation* and *leadership development*, examines *adolescent negotiation attitudes* and *behaviours* (Nakkula and Nikitopoulos 1999).

Five factor negotiation examines the following 5 factors:

- *Self confidence* - being an assertive negotiator.
- *Cooperation* - willingness to work together..
- *Communication* - to communicate ones position effectively.
- *Compromise* - willingness to give up something to address another's needs.
- *Conflict resolution* - willingness to come to a solution to the argument.

ConflicTalk questionnaire (Kimsey and Fuller 2003) measures the following conflict management styles among youth and adolescents:

- *Self-focus* (confrontation)
- *Other-focus* (avoidance)
- *Problem-focus* (negotiation)

Comparative Design - HFASD vs TD peers

Responses to Bullying and Use of Social Support Among Pupils with Autism Spectrum Disorders in Mainstream Schools: A Qualitative Study (Humphrey and Symes 2010)

To examine the relationship between *social support and bullying* from the perspectives of pupils with ASD.

36 pupils aged 11-16 years

All pupils had a diagnosis of ASD and were on their *school's SEN register*

12 secondary schools in the north-west of England.

A phenomenological approach was used in this paper

Semi-structured interviews were utilised for *data generation* which provided a *voice for participants and a window into their thoughts, feelings and experiences*

The six basic phases of thematic analysis outlined by Braun and Clarke (2006) were implemented, namely,

- Data familiarisation
- Generation of initial codes
- Searching for themes
- Reviewing themes
- Defining and naming themes
- Report production

"I Have Lived an Autism Experience. Autism is an Interesting Disease": The Life Story of a Young Man with Autism (Gulec-Aslan et al. 2013)

The purpose of this study is to define and *understand the life experiences* of a young man with ASD referring to *his life story*.

This is a *qualitative study* carried out by a "*narrative research*" in order to *understand the life experiences* of a person ASD in a *chronological order*.

Kenan was born in 1988. During the research process in 2011, he was enrolled in the fourth year of his engineering program.

Kenan was diagnosed with "ASD/Autism", marked by *high functionality*

The findings are *interpreted and presented* into *five themes*:

- Who am I?
- Autism story
- Social experiences
- School experiences
- Future plans.

Qualitative Investigation of School-Related Issues Affecting Individuals Diagnosed with Autism Spectrum Disorder and Co-occurring Anxiety and/or Depression (Penney 2013)

The purpose of this project was intended to *explore the experiences* of individuals with ASD who developed a *co-occurring depressive and/or anxiety disorder*.

A group comprising *parents of individuals* diagnosed with *ASD and co-occurring mental health disorder*

A second group comprising *individuals diagnosed* with *ASD and co-occurring mental health disorder*.

Face-to-face procedures

Online interview procedures

This research study was designed using a *qualitative framework* in which the researcher sought to *hear the voice of the participants and understand their individual stories* as they attempt to make sense of them.

It has been documented that the behaviours associated with co-occurring *mental health issues often go unrecognized* both by educators and by physicians, or that the *behaviours are assumed to be part of the disorder*

The researcher used an *unstructured interview* format to *allow participants to have control over the information they shared* during the interview process.

YOUR VOICE COUNTS: LISTENING TO THE VOICE OF HIGH SCHOOL STUDENTS WITH AUTISM SPECTRUM DISORDER

(Saggers et al. 2011)

The research examined current *inclusive education* practice and their *experiences* in a mainstream school from the perspectives of the student on the spectrum.

A *Qualitative research* was carried out where data were gathered through two sets of interviews. The first interview was conducted in the middle of the second school term, and was followed by a second interview two weeks later.

Nine high school students with ASD (seven boys and two girls),

Aged 13 and 16

All participants were *receiving an inclusive education*

The participants had *been diagnosed with ASD* by medical practitioners and all *met the requirements for additional government-funded education support*.

The students were enrolled in a large mainstream high school in Brisbane, Australia.

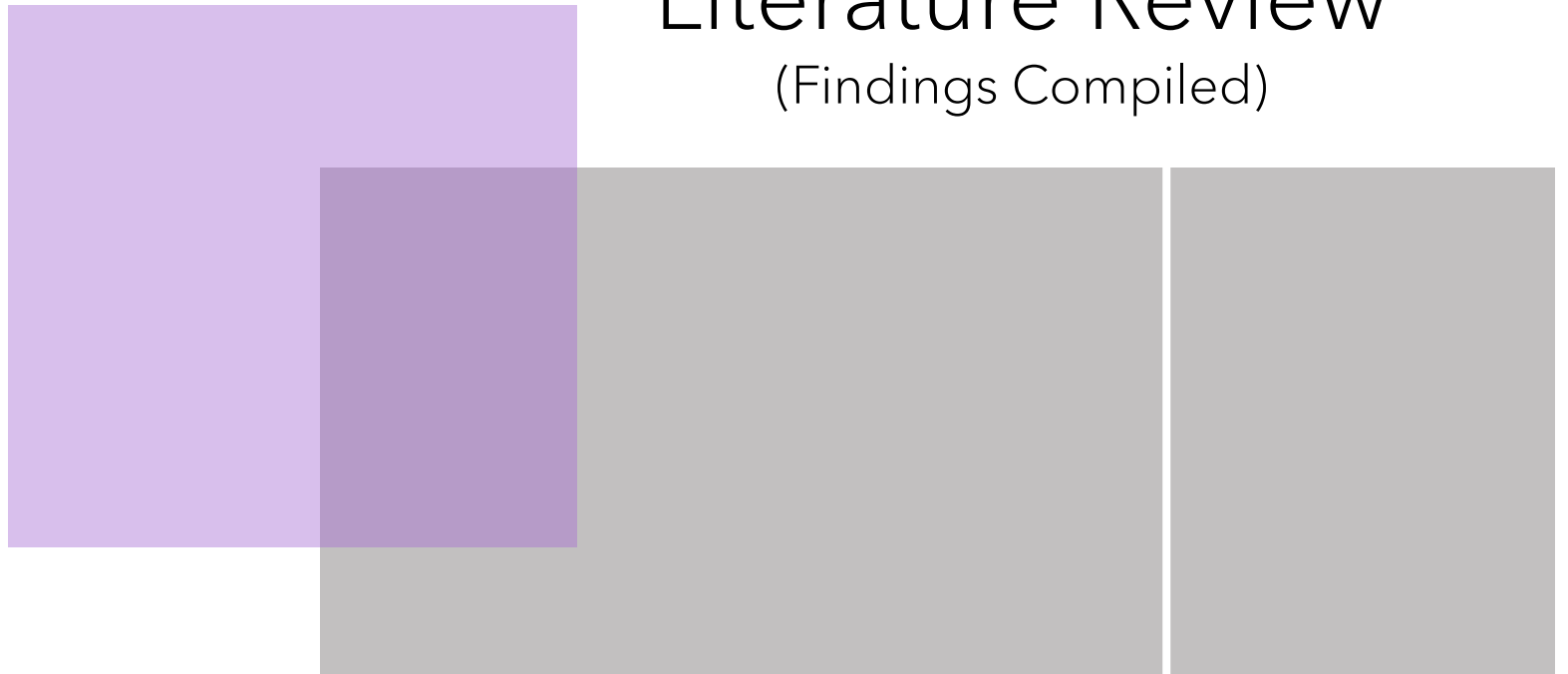
The students attend the *mainstream classes* but **obtain any necessary support** from the special educators and ancillary staff based on their individual needs.

Data were analysed *using constant comparative methods*

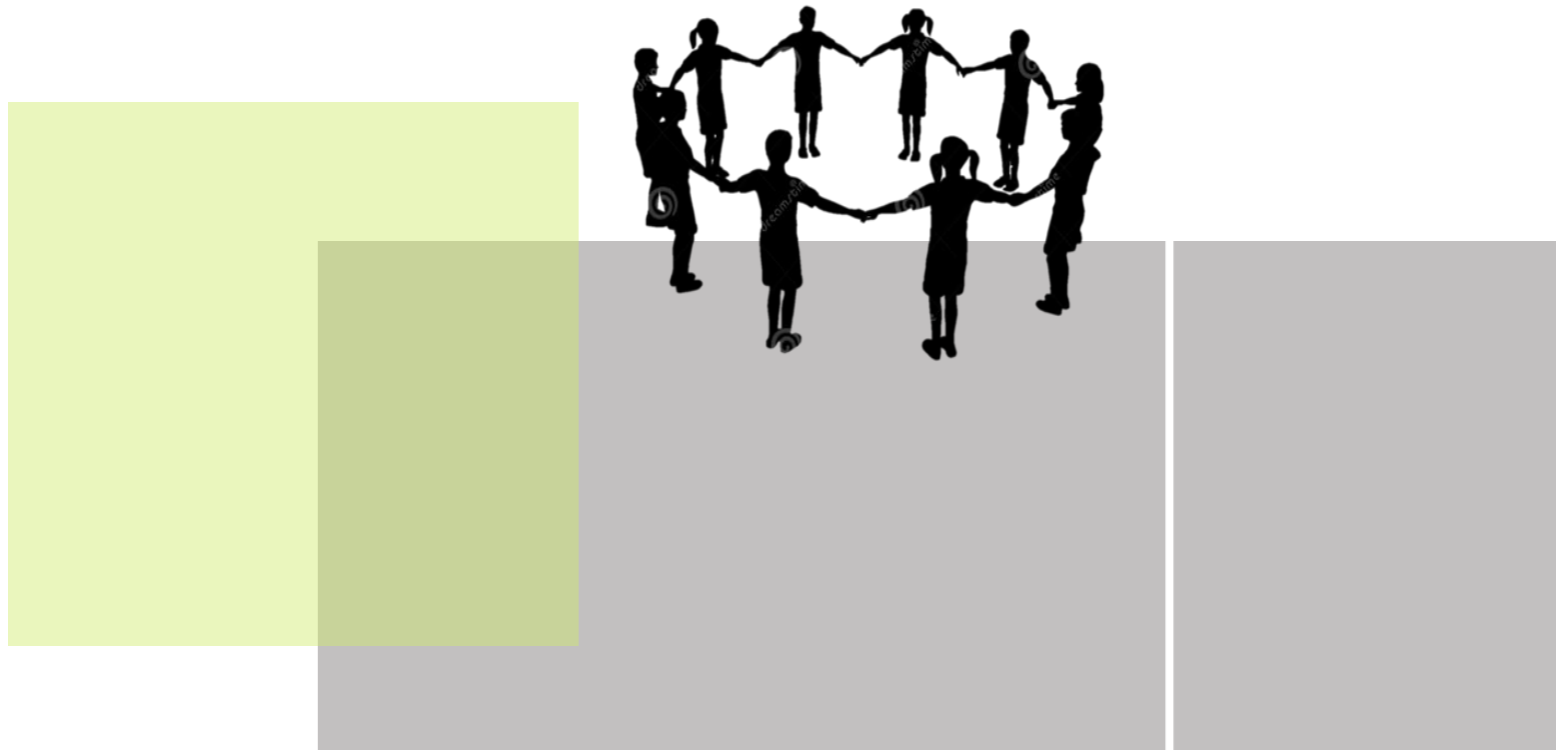
- Themes were identified:
 - Inclusivity
 - The Social Experience
 - Bullying
 - Wellbeing of Adolescents with ASD
 - Classroom Engagement
 - Supports for Adolescents with ASD
- Data was correlated and compiled into a literature review.

Literature Review

(Findings Compiled)

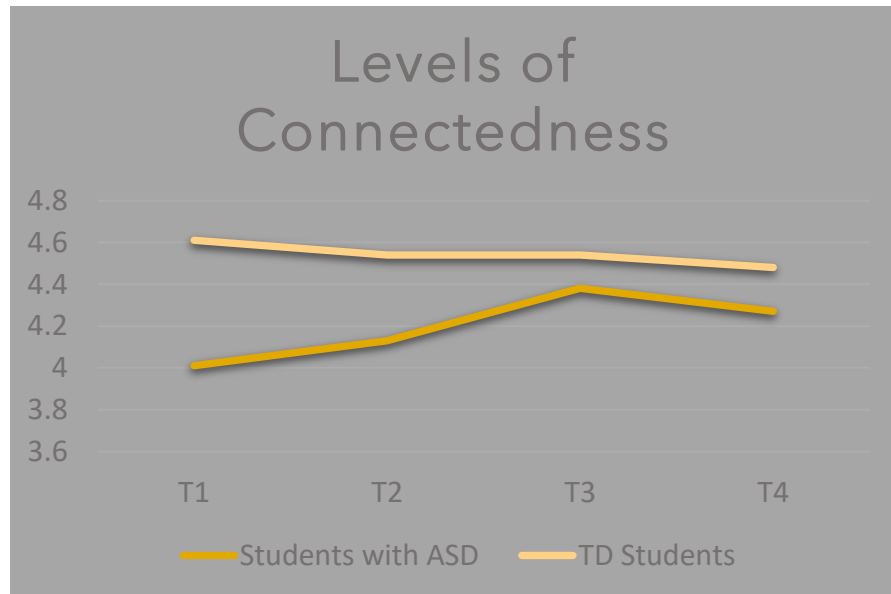


Inclusivity



Primary to Post-Primary Transition and Inclusivity

Connectedness is defined as 'the extent to which students feel personally accepted, respected, included, and supported by others in the school social environment' (Goodenow p. 80, 1993). It is clear from the graph that students with ASD experience lower levels of connectedness than typically developing (TD) students throughout the study and this is particularly evident at the end of primary school.



The graph shows the results from a study carried out by Hebron (2018) investigating the connectedness experienced by students with ASD and TD students.

- Last term of primary school (T1)
- End of first term 1st year secondary school (T2)
- Last term of 1st year secondary school (T3)
- Start of first term 2nd year secondary school (T4)

Levels of connectedness are substantially lower for students with ASD at T1. This could be due to difficulties experienced in primary education with social interaction and behaviour pre diagnosis.

The levels for the two groups begin to converge from T1 to T3. This may be due to the onset of adolescence for TD students and their disengagement from education (Daly et al. 2009). The increase in levels for students with ASD may be due to the effectiveness of the transition programmes implemented by the participating schools although a limitation of this study by Hebron (2018) is that these schools

self-volunteered and may be aware of the effectiveness of their programmes. There is an element of concern as the two groups begin to diverge from T3 to T4 indicating that the levels of connectedness for students with ASD are declining again.

Transition from primary to secondary school can be a challenging time for both TD adolescents and adolescents with ASD but it is evident from Hebron (2018) that it is an opportunity to implement the correct transition strategies to ensure all students (specifically students with ASD) make the transition seamlessly. Hebron (2018) found that effective transition programmes will allow students to immerse themselves and become included in the school community. School connectedness can ensure an inclusive and supportive school environment before, during and after the transition period from primary to secondary education and protect students with ASD from mental health issues associated with ASD (Hebron 2018).

Teachers and the school environment play an important role in ensuring a child feels included (Gulec-Aslan et al. 2013)

The Role of Teachers in Inclusivity

Through qualitative research, Saggars et al. (2011) and Gulec-Aslan et al. (2013) identified the important role qualified inclusive education teachers play in developing these individuals. When interviewed by Gulec-Aslan *et al.* (2013) the participant recalled that the time he spent in school as very much related to academic goals and objectives rather than feelings of inclusion, collaboration and interaction. He recognises



that these were areas that he struggled with and lacked support in. Students with ASD describe inclusive teachers as significant in their success. These students feel relatedness and active listening are key characteristics in making them feel understood and treated fairly (Saggers *et al.* (2011). While schools are encouraged to be inclusive, not all schools are making the efforts: "... one of the school authorities told me that he had graduated from psychology department and a child with autism could never go to school so I was supposed not to have a dream about this ... I didn't give up



Nextel2011 (Flickr)

and at last he started to go to the school and had a good teacher. When they found a school that catered for Kenan's needs, we were lucky that he had a very good teacher. The teacher always supported us and Kenan. By making Kenan's good qualities conspicuous, she gained him a place in the classroom. It gave him the opportunity to succeed and flourish with one teacher quoted: 'I will keep my eyes on him, I'm sure he will be very successful'" (Gulec-Aslan *et al.* 2013).

Parents feel that an effective school management is key in setting the standards within a school to promote inclusive learning and an overall acceptance of diversity: "When you got a principal that says, okay, I'll do this, the teacher seems to be more on board. I'd have to say that any time the principal has been good, the school has been good. It is very, very correlated, yes. I think it is because good principals hire good staff" (Penney 2013).

It is clear that teachers have a key role to play in the support of students with ASD but this support is not always integrated within schools.

One participant described themselves as a 'perfectionist' but would not participate or engage with anything unless they were certain how to do it which "wasn't often and no one helped" them (Penney 2013). Students felt that the responsibility of adapting to the school environment was left to them. They believe that teachers should be educated so they can create a school atmosphere where the onus is on the environment to adjust to the needs of the individuals with ASD. Teachers who structured their classroom to be more inclusive and allowed students personal time to regain control and reduce anxiety levels when experiencing some sensory difficulties, have much more respect from parents and students than those who don't (Penney 2013). With teachers structuring their classroom to allow for inclusivity, it is clear that the school environment has an important role in the inclusivity of students with ASD.

The School Environment and Inclusivity

School environments can be very unpredictable for students with ASD. They could involve large crowds where students are making noise and

potentially jostling and bumping off each other (Penney 2013). This was supported by Howe and Stagg (2016) where all participants felt that their sensory difficulties affected their learning by inhibiting their concentration levels. One particular participant states "when I am in mainstream classrooms I can hear lots of conversation/noise and it makes me feel tired". Penney (2013) highlighted the anxiety felt by her participants when they were touched in these crowded situations. One participant described it as a sensation of "loosing a part of my body" and that he would need to get it back. "I had to touch parts that touched me to get my body back; I can't explain it that's just the way it was." Students would then report him to school management and he would be sent home. This finding is conflicted by Howe and Stagg (2016) where participants feel that touch did not affect them as much unless they were in an unstable state already such as "only when I'm stressed, or things go wrong".

This student felt that the unpredictability of the school environment did not cater for his needs and only increased his anxiety: "It's hell. It would

help if teachers realize a lot of sensory and social aspects of high school can directly impact the work in school. Very negatively in some cases, at least mine.” This particular participant had attempted suicide three times as a consequence of feeling different and feeling of never being able to fit in with others in life: . “I see all the kids getting girl friends and boy friends and nothing for me, well not that I want a girlfriend yet.”

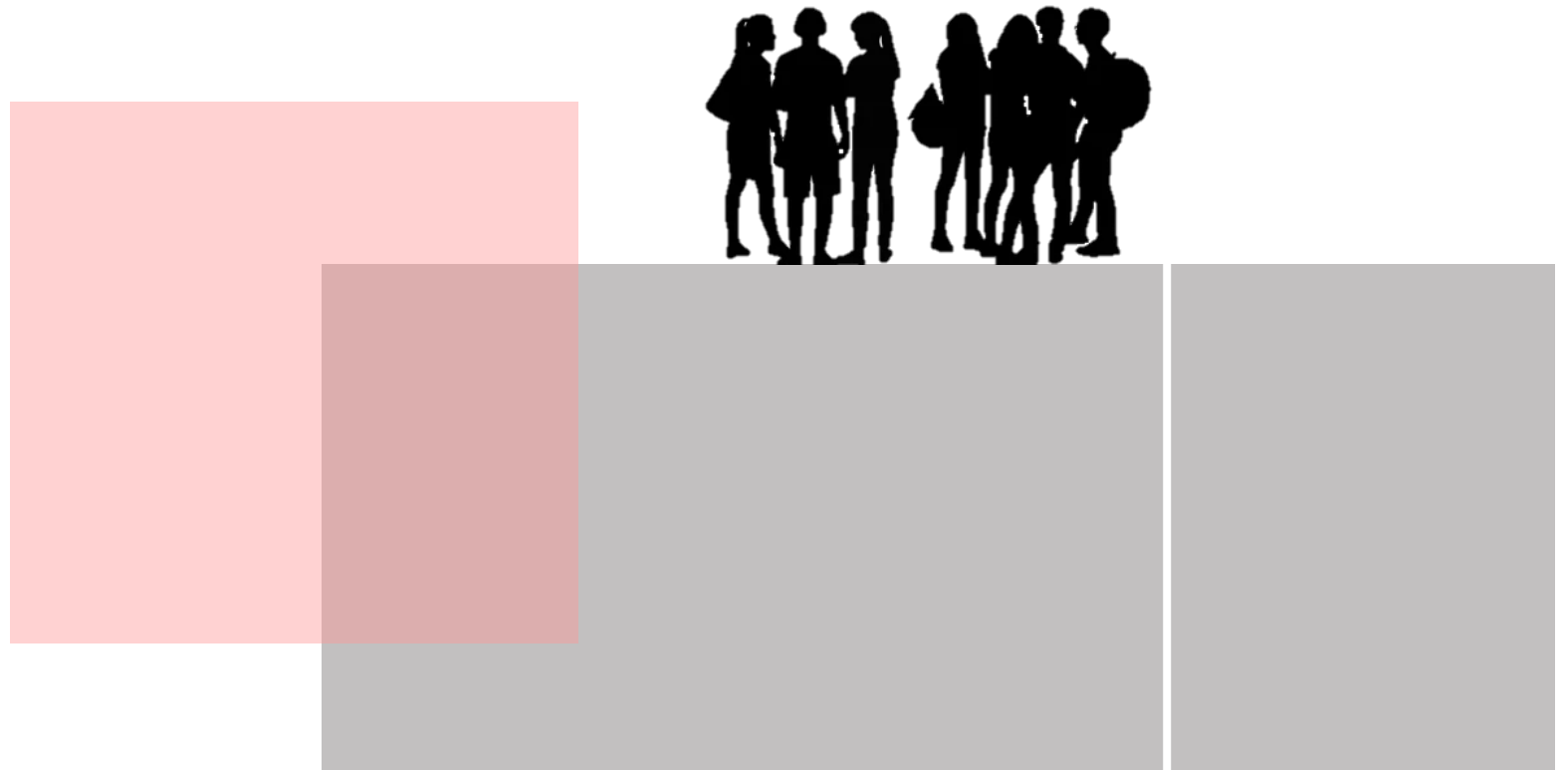
Penney (2013) reported that students were dropping out of school due to learning difficulties and challenges with their sensory sensitivity. These difficulties or challenges may result in tiredness among students with ASD (Howe and Stagg 2016). Noise was the most common sensory issue among participants (Penney 2013; Howe and Stagg 2016). They would use iPods or chew gum to drown out loud noises of the environment around them but this leads to them being reprimanded due to iPods and chewing gum being forbidden on school grounds. “The sensory piece of Asperger’s is a big part of it too ... there needs to be more awareness about it. I’d just tell teachers that we aren’t trying to be rude by

listening to music or chewing gum. I’d tell people to stop being so narrow minded.” These sensory issues within the school environment leads to even further challenges for students with ASD within their social circle (Penney 2013). The most common emotions experienced by participants were described as “anxious” and “uncomfortable” with “frustrated”, “annoyed” and “physical discomfort” (“shouting makes my ears hurt”) also mentioned (Howe and Stagg 2016).

Key Points

- The transition from primary to post-primary school is a key opportunity to give students with ASD a sense of connectedness.
- Teachers play an important role in inclusivity and this is highly recognised by students with ASD and their parents.
- Listening and speaking to students and acceptance of diversity were key strategies used by teachers to making them feel included.
- Teachers are not always willing to make the effort to include students.
- Sensory difficulties in the environment made it difficult for students with ASD to concentrate
- Students were dropping out of schools due to their sensory deficits.

The Social Experience



A participant with ASD described autism as a 'harsh and interesting disease' which had negative impacts on his life where he felt he was different from other children in his childhood (Gulec-Aslan et al. 2013). It is widely understood that people with ASD lack interest in forming relationships/friendships, often prefer social isolation and have limited positive social interactions with peers (Wagner et al. 2004). However, other literature suggests that people with ASD have interest in building friendships but often struggle to interact due to the social challenges associated with ASD (Bauminger et al. 2003; White et al. 2007). With these conflicting views in mind, this section will explore the social experience of students with ASD in school settings focusing on 'motivation and loneliness', 'the social challenges for students with ASD', 'resilience and coping strategies', and 'social conflict'.

Motivation and Loneliness

Findings from Whitehouse *et al.* (2009) partially corresponded with the assumption that students with Asperger's Syndrome (AS) had a preference for social isolation as they



had significantly lower levels of motivation to make new friends compared to their TD peers. Some students lacked motivation as they felt their academics was more important (Humphrey and Symes 2010; Gulec-Aslan et al. 2013): "just can't be bothered" (Humphrey and Symes 2010) and: "actually there was always only one thing in my mind: to be successful. My obsession with success is so strong that when I fail, I feel that I don't exist" (Gulec-Aslan et al. 2013). It is important to note that as the levels of motivation were reported lower in those with ASD, they were not completely absent (Whitehouse et al. 2009)

2009; McKeithan and Sabornie 2020). Cresswell *et al.* (2019) partially supports this finding as they identify that adolescents have a desire to be included and be part of society.

The 'betrayal/conflict' subscale of the *Friendship Quality Questionnaire (FQQ)* utilised by Whitehouse *et al.* (2009) indicated that loneliness is an indicator of poor relationships and this correlated with the views of their parents. Whitehouse *et al.* (2009) found that students with AS reported higher levels of loneliness than the comparison group. Unfortunately failure in forming friendships and poor quality relationships often led to feelings of loneliness and as a result they tend to tread carefully when seeking friendship in the future: "It is a big trouble that you cannot socialize. I got a number of disadvantages because of what I lived through in the past" (Gulec-Aslan *et al.* 2013). While levels of loneliness were higher than their TD peers, the levels of loneliness felt by the adolescents with AS were not significantly high overall (Whitehouse *et al.* (2009).

There is concern surrounding these findings as relationships during adolescence are essential to the individual's development (Whitehouse *et al.* 2009).

The Social Challenges for Students with ASD

Many adolescents experience challenges during their teenage years but this is very much intensified for students with ASD as they may need to show higher levels of resilience than their TD peers who may not have the understanding or tolerance of their characteristics (Gulec-Aslan *et al.* (2013). Gulec-Aslan *et al.* (2013) describes their participant with ASD: " ... he was so introvert in this meeting, he seemed to ignore how he was seen from outside during his communication with people and his talk to himself ...", "He was sitting on the edge of the chair and playing with his hood strings with a sour face. When a mutual friend introduced us, we shook hands without an eye contact ..."

Humphries and Symes (2010) identified students who found integrating with their

classmates difficult: "I'm just naturally shy"; "I'm a bit of a quiet character, I sort of struggle to... join in with groups of people" and "I just stay upstairs because I don't really go out for break because in school I don't really like crowds." Penny (2013) had similar findings: "I always felt awkward and didn't know why."

Gulec-Aslan *et al.* (2013) established that shyness may be communicated through the reluctance to make eye contact with other individuals even though there is no malintent meant by it: "if you have just noticed, I mostly avoid looking at your face when I talk. But my avoidance is not intentional. I don't know its cause. When I try to make eye contact, it happens that, how can I put it, as if an arc was occurring in-between, as if an electrical jump was happening ... It is not intentional." In this semi-structured interview, the participant says he uses the avoidance of eye contact to maintain focus in the conversation "I forced myself a lot, I tried, and you know, I try to keep looking at someone for five or ten minutes, but meanwhile, if I attempt to talk, I utter foolishness. I utter nonsense." As students use

eye contact to try maintain focus while conversing, it is also important to them that they are interested in the topic of conversation (Saggers *et al.* 2011; Gulec-Aslan *et al.* 2013): "I realized many different things in people whom I call friends ... When the topic does not suit them, they stop talking about it. When they talk about what I like, what is interesting for me, it makes me very happy" Gulec-Aslan *et al.* (2013); "it's good to socialise...when it's about something I like" (Saggers *et al.* 2011).



Subsequently, many individuals with ASD sought friendships based on activities and interests rather than emotional or affectionate traits (Cresswell *et al.* 2019). This understanding of friendship is different to how TD individuals interpret their friendships and it seems that although the individuals with ASD believed they had strong friendships, their parents had a more negative perception of the friendship (Whitehouse *et al.* 2009; Cresswell *et al.* 2019). Although there seems to be a difference in perception of friendship, individuals with ASD acknowledge that they have difficulties in socialising but they try to make an effort in improving these deficits "Socializing and coming together with friends were more difficult once, but these are not so difficult now. But, of course, you can't talk with every guy. I try to improve myself over the time. I even exert effort to do this" (Gulec-Aslan *et al.* 2013). Individuals with ASD may acknowledge that they struggle to understand the 'social norms' but when they did understand the 'social norms', they struggled to perform them effectively. Subsequently, many TD individuals had little

interest in forming a friendship with them due to their refusal/inability to act as what was socially acceptable yet they still desired friendship (Whitehouse *et al.* (2009). This was particularly evident in group situations where anxiety levels increased as they felt they were being watched by a number of people at once (Whitehouse *et al.* 2009). This lack of interest from TD individuals in forming friendships with others with ASD may be due to a lack of understanding on the TD individuals' behalf (Saggers *et al.* 2011; Sreckovic *et al.* 2017; Cresswell *et al.* 2019). Sreckovic *et al.* (2017) found that individuals with ASD with co-morbid intellectual disability (ID), found it much easier to interact with others due to more of an understanding surrounding their behaviours. While the individuals with ASD without co-morbid ID, find social interactions more challenging, their levels of interaction from baseline to intervention reflected those of randomly selected students. This highlights the resilience that may be shown by those with ASD.

Resilience and Coping Strategies

Many of the participants with ASD blamed their diagnosis for their difficulties in making friends suggesting that they're "restricted who I can't talk to and who I can get on with and that" and that they "find it hard to make friends and keep 'em" (Humphrey and Symes 2010) and felt that "people do not understand" them (Gulec-Aslan et al. 2013). While many of the individuals with ASD blamed themselves or their diagnosis for these failures, others were more determined and accepted that autism was a part of who they were (Gulec-Aslan et al. 2013). A



participant of Gulec-Aslan *et al.* (2013) shared a short anecdote of a time when he was receiving exam results: "We had a midterm exam and grades were announced. All grades were terrible... Ultimately, it was my turn. Friends asked whether I would check the grades I looked and saw the grade but my friends didn't want to see. It was 85. There was a disadvantage of it. They ran after me as I raise average grade. My fault was raising the average, get it ..." He allowed himself to see the humorous side of a moment shared with classmates.

Many of the adolescents with ASD spoke about choosing friends who supported them in expanding on their social skills while others set out to imitate others or rely on past experiences to mask their social incompetencies while trying to fit in (Cresswell *et al.* (2019). Other students use hobbies (eg. soccer, tennis and handball) to create a more structured and predictable opportunities to have conversations and interactions (Saggers *et al.* 2011).

Social Conflict

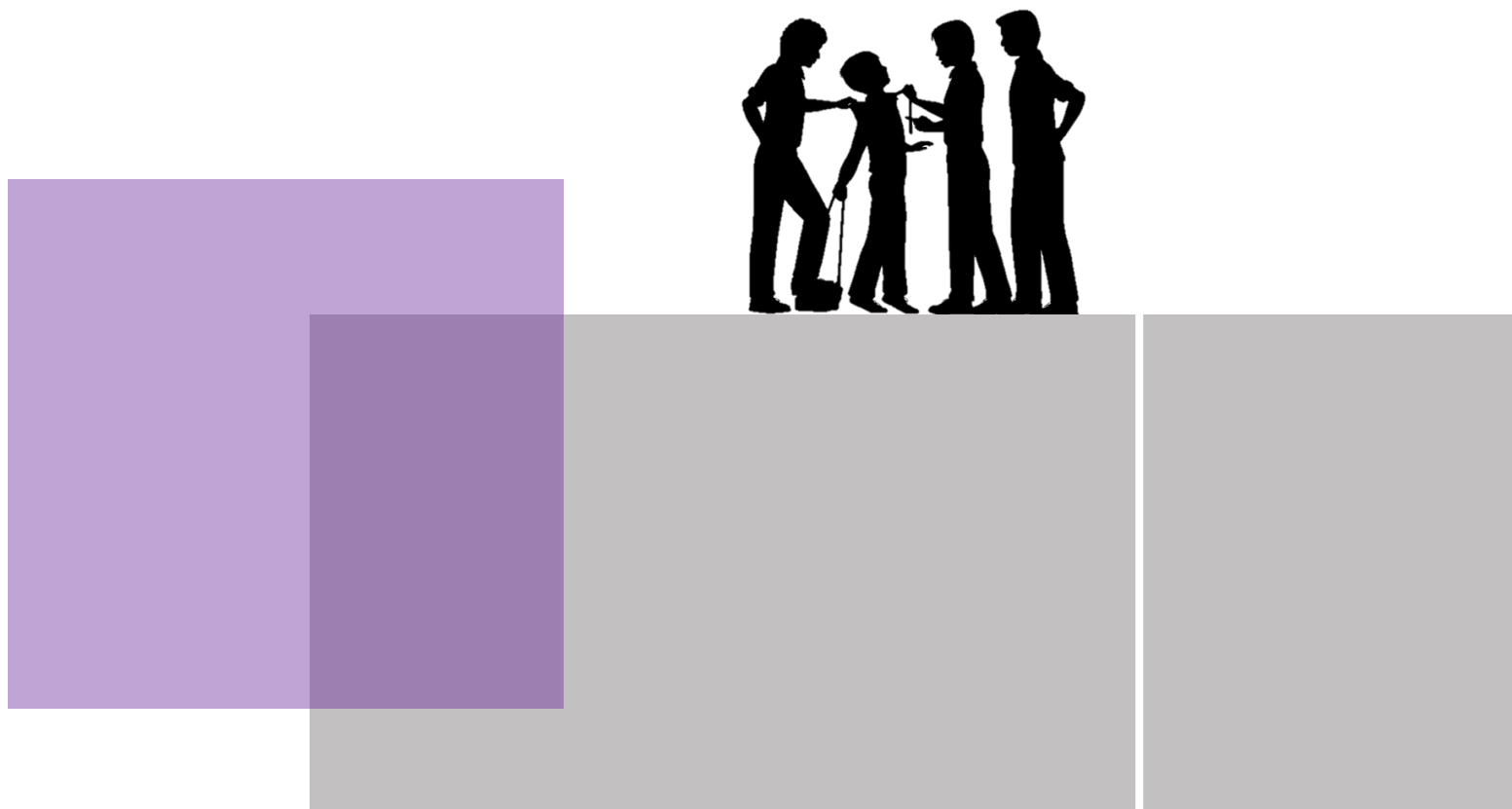
Following an investigation into the ability of students with HFASD to resolve conflict with the use of negotiation strategies, Hochhauser et al. (2015) found that they had significantly poorer abilities to utilise the negotiation strategies compared to TD adolescents. The ability to negotiate and resolve conflict is an integral part of forming and maintaining friendships (Laursen et al. 1996) which is another barrier to quality friendships (Hochhauser et al. 2015). Gulec-Aslan et al. (2013) highlighted this barrier when their participant found it difficult to reconcile with individuals who may have mistreated him "I'm absolutely upset when I am treated unfairly. This unfair treat can be legal or illegal ... I never forgive it in any way. It is valid for everyone, such as my parents, teachers, and friends ..." Due to poor self-confidence and cooperation, adolescents with ASD lack the tools required to resolve conflict. Instead of confronting conflict, adolescents with ASD were found to avoid conflict using coping strategies (Hochhauser et al. 2015; Edgington et al. 2016). Cooperation is particularly

important in negotiation when both parties seek to come to compromise that benefits both (Hochhauser et al. 2015). Individuals with HFASD can find compromise challenging as it requires a mental flexibility where both parties empathise with the other which is not a characteristic of HFASD (Hochhauser et al. 2015).

Key Points

- Some students with AS lack motivation to form friendships.
- The changes that teenagers experience during adolescence is challenging but this is very much intensified for those with ASD.
- Making eye-contact can be a struggle for adolescents with ASD.
- Teenagers with ASD may prefer forming friendships with those who have similar interests to them rather than making an emotional connection.
- Individuals with ASD often believe that their friendship is stronger with TD individuals than it actually is.
- Individuals with ASD may have unusual actions/habits that may make others reluctant to be friends with them.
- Some individuals with ASD tend to blame their diagnosis for their lack of friendships.

Bullying



Bullying is a serious issue among school-going adolescents with ASD and has been identified as a key concern for parents of students with ASD (Sreckovic *et al.* 2014). Individuals with autism are often victims of bullying due to the aforementioned difficulties with social interactions (Sreckovic *et al.* 2017) and the repetitive behaviours and anxieties they express (Edgington *et al.* 2016). There is a higher incidence of victimisation among adolescents with disabilities than TD adolescents and as a result may not perform to their academic potential in school (Sreckovic *et al.* 2014). This section explores the victimisation of students with ASD focusing on 'forms of bullying', responding to bullying', and 'the implications of bullying' beginning with the 'reasons for bullying students with ASD.'

Reasons for Bullying Students with ASD

Navigating the social and academic realms of school can be challenging enough for students with ASD without the distraction and impacts of bullying (Sreckovic *et al.* 2017).

Cresswell *et al.* (2019) found that students with ASD viewed themselves as easy targets and felt that others did not want to be in their company.

Repetitive behaviours (such as humming, constantly calling out in class) can frustrate their TD peers leading to bullying (Sreckovic *et al.* 2014). The mother of an individual with ASD tells of her experience of her son who has these repetitive and irritating behaviours: "he started to colour the walls with crayons of his brother. He used to colour the wall one night all with blue, and another night all with orange. Next day, I cleaned all the walls. I can't remember how long it lasted. Once, I was very ill and I couldn't clean the walls. That night, he didn't sleep and didn't draw on the walls. Thus, I decided not to clean the walls. When the walls weren't cleaned during a week, he quitted his painting passion" (Gulec-Aslan *et al.* 2013). Another article reported irritating behaviour where the individual is lecturing their TD peers about the dangers of their actions (such as smoking) and breaking school rules (Penney 2013). When being⁵⁷

lectured like this, TD individuals often take advantage of these differences in attitude by carrying out these actions and break rules to escalate the individuals behaviour: "They would you know just nudge into him knowing it would bother him. He had no kind of filter so he would just blurt and the kids would constantly say stuff just to provoke him." Unusual interests or obsessions like "vacuum clearers," "Yu-Gi-Oh cards," or "anime" or their fears such as "the end of the world, "global warming" or "spiders" are used by bullies to target students with ASD (Penney 2013). This view of power that TD individuals feel over those with ASD is often the reason for victimisation and this only exacerbates their social challenges (Cresswell *et al.* 2019) and increases their prevalence of victimisation due to their inability to read social cues and act 'normal' (Whitehouse *et al.* 2009). Having outlined the motives for bullies, it is necessary to address the forms which bullying takes.

Forms of Bullying

Much of the qualitative literature analysed indicates that verbal bullying or teasing is the

most prominent form of bullying for students with ASD in secondary schools (Saggers *et al.* 2011; Gulec-Aslan *et al.* 2013;). "Of course, I have some problems with my friends. In primary school there was nothing like teasing. I was subjected to it, teasing, mostly in secondary school" (Gulec-Aslan *et al.* 2013).



Katey Kettell (Flickr)

"Some of the students just don't understand certain situations. And some of them call me mentally retarded" Sagger *et al.* (2011). Quite often, bullying of this nature initiates at post-primary level as outlined by a mother of an adolescent with ASD "He started secondary school with an enthusiasm, like every child... The first year of the secondary school was very troubled; his friends were teasing him...He didn't have many friends ..." A similar experience was described by a participant

where he was not bullied in elementary school but bullying began for him in junior high school (Penney 2013). When victimisation of this form has occurred, individuals have different ways of responding and the essay will now highlight these responses.

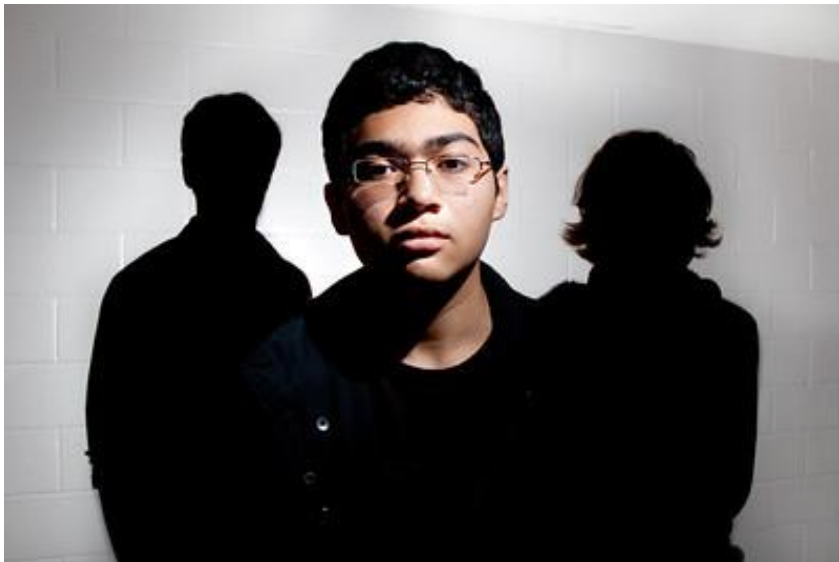
Responding to Bullying

The victims have different ways of responding to the bullying. Some report it to parents or teachers, others minimise the seriousness of the situation while others try to change their behaviour so they may be socially accepted.

Humphrey and Symes (2010) found that while many of their participants resorted to violence in adversity, reporting incidences of bullying was the most common response to the issue. Some pupils tended to report the issues to teachers, while other pupils stated that they "wanted the teachers to come to me, instead of me going to them" (Humphrey and Symes 2010). Some students chose not to report incidents of bullying to school staff once it was not physical "Some of it you just basically

don't really need to, because as long as they don't do anything physically harmful to me, there's no point" (Saggers *et al.* (2011). Teachers need to be extra vigilant to the potential of bullying among their students rather than waiting for pupils to approach them. Gulec-Aslan *et al.* (2013) interviewed the mother of the participant with ASD, and she recalled of a time when the intervention of teachers helped her son enormously: "When Kenan entered the class, girls were coming near him, kissing and caressing him as if he was younger. If the teacher had scorned Kenan and let other children tease him, our life would have been more problematic, I guess." Pupils turn to teachers when being victimised as they have the power to act and discipline pupils but pupils will only report to a teacher if they are taken seriously and know that action is going to be taken against the bully: 'the school is quite serious about bullying' (Humphrey and Symes 2010). In addition to this, pupils felt there was no purpose in reporting an incident to a teacher if they felt nothing was going to be done about it: 'I've not had the best teachers in the

world and erm...I just er... rather not talk to them, 'cause I don't know whether they're going to come up with a nice comment or a horrible comment'. Clearly it is vital that teachers respond to incidents of bullying in the correct manner and try to build a strong teacher-student relationship (Humphrey and Symes 2010; Sreckovic et al. 2017). It is worth mentioning that participants in Humphrey and Symes (2010), a very small number of the participants portrayed their teachers in a negative light and an even smaller number said they didn't have a teacher they could confide in. In other articles some students with



ASD feel that teachers are not trained adequately to intervene and deal with bullying and if it is not dealt with, "school is a dangerous place to be" (Penney 2013). Interestingly, while students depend heavily on teachers for protection, participants feel that teachers aren't trained enough to intervene during incidents of bullying (Penney 2013), yet there is minimal literature available on interventions to tackle the issue of victimisation directly (Sreckovic et al. 2017). Victims of bullying also reported incidents to their friends but similar to victim's attitude with teachers, they will only seek help from their friends if they feel they will do something to help them: 'Like if I have a friend who knows who they are, they might be able to do something about it' (Humphrey and Symes 2010).

Pupils were reluctant to seek help from parents as they felt that they wouldn't be able to resolve the issue and they wanted their school life to remain private to them: "I don't really like it 'cause then she [mum] finds out a few secrets, what I'm up to in school." While students may not turn to parents to seek help,

some did turn to siblings for support (as one participant mentioned how his sister 'stuck up' for him) again, because they felt that they would be competent in solving the issue (Humphrey and Symes 2010). Interestingly, parents of students with ASD understood that their children were never victimised and were generally accepted throughout the school community (Penney 2013).

Some students decided to deal with issues themselves and only sought help if the problem escalated. The most common strategy used by these students was to ignore the bully with one stating, "I just try and ignore them and that's the best way to do it and then they'll just stop picking on you" (Humphrey and Symes 2010) and they decide to stay "off their [other students'] radar" (Penney 2013). While the majority of the participants chose to ignore the bully, some decided to resort to violence: 'Cause that was just the easiest way for me, either pay him all the money or get it [bag stolen by another pupil] back by force, which is what I did' (Humphrey and Symes 2010).

Previously mentioned, Humphries and Symes (2010) highlighted that teachers were the first port of call when students were being bullied but in fact, it appeared that the victims friends who made them feel safest when at school. One student mentioned "[I've] got friends that stick up for me" so while teachers are their main protectors, there needs to be interventions to promote support from friends considering friendship provides security to the students at school. Individuals with ASD should be encouraged to build relationships with the students with ASD so they feel comfortable in confiding in them (Humphries and Symes, 2010).

Implications of Bullying

Teasing and bullying are seen as the biggest impacts on academic performance and attainment for students with ASD, especially when they don't feel safe at school (Saggers et al. 2011; Sreckovic et al. 2014). As previously outlined, many of the victims change their behaviour to be socially accepted but changing their behaviour may lead to some barriers for the individual to avail

of academic supports offered to them and concurrently preventing them from being themselves which may have a major impact on their overall performance at school (Cresswell *et al.* 2019).

Even though much of the bullying was instigated by a small number of pupils, this led to some trust issues for the victims towards their other classmates leading to stress and anxiety: 'It's annoying people that come near me, I just get anxious and stressed' and '[other pupils] make me feel stressed all the time' (Humphrey and Symes, 2010). Bullying and the lack of trust may lead to isolation from others with one stating "I hate them anyway and just avoid them at all costs, so it really doesn't bother me" (Humphrey and Symes, 2010).

Finally, individuals with ASD often have perception deficits and may not realise that they are the victim of bullying (Sreckovic *et al.* 2014). Instances similar to this have been portrayed by Penney (2013) where a participant describes incidents of bullying as

"joking" where individuals hid his gym clothes, moved his things and turned off the light when he was using the bathroom. There were similar situations described by participants of Saggars *et al.* (2011) "Well nobody teases me that much. It's just I sort of interpret it the wrong way as teasing, when they're just jibing me. Just for fun I guess. Yeah. But friendly" and many of these participants were unsure whether the bullying was actually harmful or if the perpetrator was trying to be friendly. To tackle these issues, Sreckovic *et al.* (2014) recommends that students with ASD should be taught when and when not to trust people and in an attempt to reduce their naivety.

Key Points

- Repetitive and irritative behaviours and unusual interests are among some of the key reasons for individuals being targeted for bullying.
- Verbal bullying is most prevalent.
- Individuals only reported bullying if they thought something would be done about it. Others just chose to ignore it.
- Poor academic performance and anxiety are some of the implications of bullying.
- Some students find it difficult to recognise when they are being bullied

Wellbeing of Adolescents with ASD



Incidences of mental health issues such as depression and anxiety are widely associated with individuals with ASD (Whitehouse et al. 2009). Yet many individuals with ASD are unaware of the connection of mental health with their diagnosis and many were left frustrated having not been made aware of the associations. They were left with the burden of having to cope and research these mental health issues on their own (Penney 2013). This section will now delve into the mental health of students with ASD by addressing 'causes of poor mental health', mental health and the school environment', 'recognising poor mental health' and 'coping with poor mental health'.

Causes of Poor Mental Health

As previously mentioned, poor quality friendships often lead to victimisation of students with ASD (Sreckovic et al. 2017). Adolescents with AS were found to experience higher levels of loneliness than the comparison group and this is primarily due to poor quality friendships and isolation (Whitehouse et al. 2009).

Studies have revealed adolescents with ASD who were having suicidal thoughts and one who attempted suicide due to the victimisation, exclusion and isolation they endured (Carter 2009; Sreckovic et al. 2014). These students who were victimised were not only bullied occasionally but consistently over long periods of time (Cappadocia et al. 2012) which can lead to lasting impacts on self-esteem (Salmivalli et al. 2005). Although anti-bullying policies are in place in many schools, unfortunately they are not as effective as intended by many of the schools. Therefore it is essential that schools research and implement prevention and intervention strategies to counteract bullying (Sreckovic et al. 2014) and promote each individual's academic ability.

Mental Health and The School Environment

Incidents of bullying were some of the reasons for anxiety but the unpredictable nature of the school environment was another key factor (Penney 2013). Some students with

ASD enjoy school and the potential success that may arise from that (Gulec-Aslan et al. 2013) but others find school a much more overwhelming experience with one



Evolution Labs (Flickr)

participant explaining "I came home [from school] and got down on the floor and I just cried and I swore and I said 'I can't go there [school] anymore.' Oh well, that was a horrible school, that was a terrible school and I don't I am no longer going there now and

everything and yet I have nightmares sometimes" (Penney 2013). One participant describes how receiving her timetable with unexpected free periods caused her to have a panic attack. The same individual describes how breaks during class are incorporated into her individual plan but she has experienced times where she became overwhelmed and tried to leave the room only to have her path blocked by the teacher only to increase her anxiety even further. She had her own interventions to help her calm her anxiety such as scented hand cream, hand sanitiser or listening to music (Penney 2013). Students with ASD often struggle to adapt to rules and routines when transitioning from primary to secondary school and may need to use medication to help them cope: "he has anxious personality since he has difficulty in figuring out the situations and rules around him. He is extremely anxious and his drugs are for anxiety" (Gulec-Aslan et al. 2013)

Recognising Poor Mental Health

A participant in Penney (2013) reports that no one recognised his depressive symptoms until he attempted to cut his wrists. When parents

noticed changes in the mindset of their children (low activity, lack of interest, sleeping a lot), teachers were unable to identify these issues but instead described it as , “he’s coming out of his autism, improving” and other teachers described it as “common behaviour for adolescents” and “Oh, that is puberty, this is normal welcome to adolescences” (Penney 2013). Some parents feel that the way their child is being treated and bullied in school is the reason why they are having nightmares and panic attacks and this is having a major impact on their schooling and mental health: “Your child is in so much pain and anguish he is saying ‘please shoot me, please kill me.’ I attribute part to what was happening in school because of the way he was treated, he was treated so ugly” (Penney 2013). Given the vulnerabilities that students with ASD have to depressive symptoms, it is paramount that schools create a positive and inclusive school community where all students are accepted and supported right throughout their schooling years (Hebron 2018). Stakeholders and

teachers in school program design need to be aware of the associations between social-behavioural deficits, mental health, overall academic progress, and post-secondary school outcomes (McKeithan and Sabornie 2020).

Coping with Poor Mental Health

Adolescents with ASD reported sub levels of self-confidence (Hochhauser *et al.* 2015) and are seeking out coping interventions from teachers, doctors and other professionals and urging them to collaborate with their parents while keeping their wellbeing at the forefront: “We are looking for strategies but one thing I would say, teachers, medical doctors, whatever, is to make parents aware of the strategies that could be out there.” (Penney 2013). Students with ASD can acknowledge that they have tendencies (eg. inability to make/maintain eye contact) that they may have no control over and realise that they are unable to ‘fix’ them. This urge to ‘fix’ these tendencies may have an effect on their mental health. It is important that they and their peers

are encouraged to accept these tendencies rather than try to 'fix' them (Gulec-Aslan et al. 2013).

They desire strategies with situations that can be affected such as anxiety management skills and social skills so they can maintain their self-esteem and mental health throughout their adolescent years (Penney 2013). Teaching strategies such as adolescents with and without ASD engaging in academic tasks in pairs which would benefit the mental health of students with ASD (Reutebuch et al. 2015).

Key Points

- Poor mental health is often due to poor quality friendships, victimisation, unpredictable school environment, suicide and isolation.
- Anti-bullying policies have not performed as well as anticipated.
- Medication can be used sometimes to help individuals with ASD cope with their mental health.
- Teachers often aren't able to identify poor mental health.
- Poor mental health is sometimes related to their inability to 'fix' their unusual behaviours

- Anxiety coping strategies and teaching strategies that promote interaction are often used as interventions to improve individuals mental health.



Ellie Louise (Flickr)

Classroom Engagement



McKeithan and Sabornie (2020) highlighted that existing methods of delivering information are not meeting the needs of students with HFA consistently and many of these students are leaving school and into Throughout the literature reviewed in this study, there is a general consensus that school can be challenging for any adolescent but especially those with ASD. Education has made a shift in it's attitude in recent years (Songlee et al. 2008). It has moved from teaching those who are 'capable' to a belief that education is for every student and every student should be encouraged to reach their academic ability (Songlee et al. 2008). To analyse the classroom engagement of students with ASD, the essay will now discuss the 'importance of success for students with ASD', 'how students with ASD learn', 'barriers to classroom engagement', 'encouraging classroom engagement' and 'the impact of poor classroom engagement on parents'.

Importance of Academic Success for Students with ASD

Some students with ASD are totally focused on being academically successful as stated by a participant in Gulec-Aslan *et al.* (2013): "What I liked much during my school life - primary school, secondary school, high school and including university - is to be 'successful'. Of course, being successful is still an obsession for me." It is important that these students are supported yet due to the poor communication skills associated with ASD, some students can be deemed as "low functioning" and consequently "unable to learn." Parents felt their children were not achieving their academic potential as they were not being challenged enough (Penney 2013).

How Students with ASD Learn

Many students with ASD are visual learners (Marks et al. 2003; Penney 2013) and may have language deficits which makes it difficult for them to organise ideas and comprehend and articulate information (LePage and Courey 2013). Gulec-Aslan *et al.* (2013) ⁶⁹

supported this finding when their participant was trying to explain his issue with eye contact: "I can explain by drawing, maybe it helps you to understand, okay?" Evidence-based practices are key to the students interpreting and understanding information (Songlee et al. 2008) yet many general education teachers often feel unprepared for adulthood and are unequipped with the necessary skills to live effectively (Bennett and Dukes 2013).

Songlee *et al.* (2008) identified strategies for teachers to help students with ASD and learning deficiencies to perform better in assessments. Participants in their study saw their results increase from baseline to intervention to maintenance. The consistency of having a plan to follow and the positive results of that was seen not only improve result but reduce anxiety, increase engagement and reduce challenging behaviour.

Reutebuch et al. (2015) had similar findings when they provided students with ASD

strategies to improve their reading comprehension. This strategy involved peer work with a TD peer where they analysed comprehensions together and took notes. Students showed improvements in their reading comprehension and expressed improved confidence. Reports from the participant's teachers noted that the students were reading more in class, more interactive with peers during group assignments and volunteering to read more in class.



Ernie (Flickr)

Similar to Reutebuch et al. (2015) teachers often place these students into groups with other students to try and address issues of

note taking and reading but this can often have the opposite effect. "There was nothing but long, group activity, which is like "feeding me to the sharks" that kind of stuff was like that for me. I hated working in groups, just hated it but almost everyday there was group stuff. There was so much noise everyone talking at the same time and nothing but chaos." (Penney 2013).

Barriers to Classroom Engagement

Penney (2013) supports this where parents of students with ASD claim that their child's challenging behaviour and inability to adapt to the constant changes in the school environment is partially due to the teachers' lack of understanding of the complexity of ASD: "Everyday I would get calls from school saying he was screaming and wasn't behaving properly." Parents continued, "We had predictably bad results. When you treat an autistic spectrum child with an anxiety disorder like they are normal then you are going to get bad results. You are going to get a situation where the child does not cope well and acts out and does not learn, you know,

that's what happened." Saggars *et al.* (2011) supports this finding where participants claim their ability to learn and participate is compromised by loud noises and large crowds within the classroom I think it would have to be - you know some children in class like to make a lot of noise and racket and they're just a bit too noisy and stuff like that. I reckon those type of students that try and stand out; those are the hardest thing here I don't like it when there's, you know, the rooms are - when they're cramped, well just small."

According to Gulec-Aslan *et al.* (2013), teachers have a major role to play in the development of the student not only in school but for when they have graduated also: ""I was lucky about the teachers; what I mean by saying I was lucky is that if your teachers in the primary school are good, your life goes very well ... If your teachers in the primary school are good, you know, you don't have much trouble about the life, in my opinion. Because, whatever you do, the things and values they have taught to you remain until the end of your life."

In contrast to this, participants in Saggars *et al.* (2011) found teachers who were angry and yelled at students were less approachable and found that they learned less in their classes: "Well, no not really. Most of its loud and it disrupts me a bit. Well I do mind sometimes if it is, well I do, wait what was it? Oh yeah, well I do sort of care if people are yelling at other students. Cause it does disrupt me from my work a bit. Yeah."

The primary means of assessment for adolescents in schools is examinations (Songlee *et al.* 2008). This is an area of academic life where students with ASD struggle (Hendricks and Wehman 2009). Students explain that they are able to answer the questions and understand the information but they struggle with time-management due to the pace at which they are able to write and that this was not a fair reflection of their knowledge: "I can tell what the answers to exams a lot easier if I have to write then they're slower. Writing exams didn't ever tell what I knew" (Penney 2013) Many parents felt that fine motor skills were holding their child

back and it was difficult for them to maintain pace with their peers in general classroom settings and in assessment (Penney 2013). These thoughts were shared by students with ASD where they felt that their hand-writing was negatively affecting their school performance as they found it demanding and exhausting: "Well my arm, my finger here gets a bit sore because I, you know, I've got a callous here.....And well it just sort of hurts my arm when I write a lot. Well I, I see my handwriting as neat. Well sometimes it is. Sometimes it isn't."

Encouraging Classroom Engagement

Teachers are encouraged to collaborate with parents "parents know their kids. They know what works and what doesn't work and they can help teachers. I don't know why but so many want to reinvent the wheel or they just think they know it all because they've had other children with autism. Well that doesn't make them an expert in all children with autism, does it?" Parents felt that teachers were reluctant to communicate with parents about the needs of the student as they felt

they were 'experts' and it was not necessary to do so.

Students with ASD and their parents are crying out for school staff to have a better understanding of the behaviours, appropriate classroom management, and structuring the school environment to accommodate behavioural and learning differences yet teachers are crying out for the help and support required to put these structures in place (Penney 2013).

Saggers *et al.* (2011) identified that students with ASD were able to relate to their teachers much more when they were strict but understanding and when their classroom was much more structured but allowed for flexible and fun learning: "Because, well he's just, he tells us stories and that. I think he's the most lenient of all my teachers I have and he's nice" and another student stating "I don't know, she's not strict but she does her job properly and she's just nice and she's understanding. Yeah, like she's not strict but she's not soft."

Impact of Poor Classroom Engagement on Parents

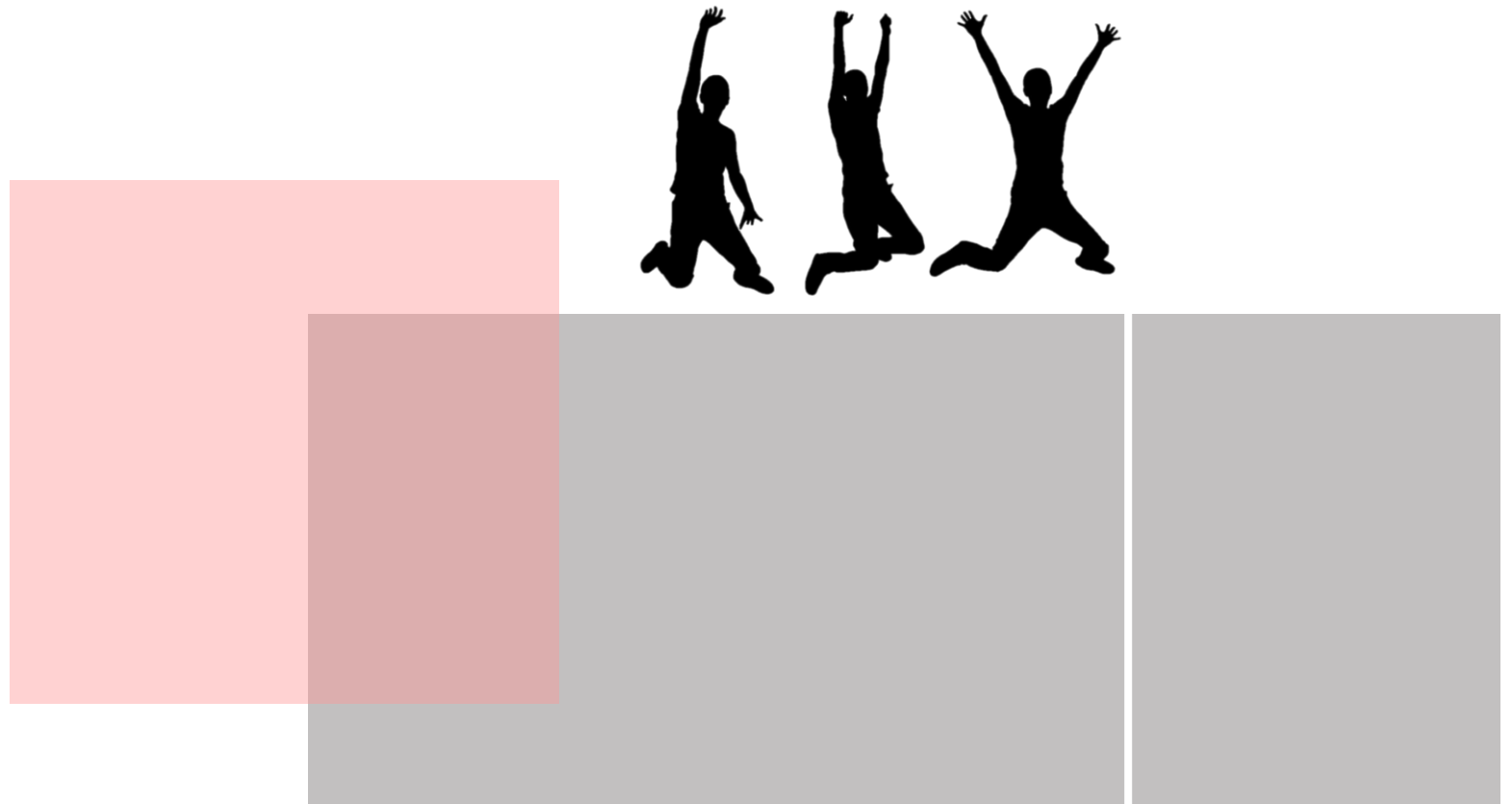
Parents are heavily impacted by their child's behaviour in school and feel that they have to be extra vigilant that their needs are being met. Many parents find it difficult to concentrate on their work for fear of a phone call from the school asking her to collect them and take them home "but at the same time his behaviour in school became even worse. It was terrible. I used to be at work and I would be a wreck until 2:30 when I knew he would be out of school. At 2:30 I would relax if he had made it through the day without a phone call. I mean, up to 2:30 or so I would be waiting for a phone call saying he was freaking out or acting out with the other kids or whatever." Parents didn't believe that sending the student home from school was the correct approach to tackling the child's behaviour: "They didn't know what to do but sending him home wasn't the right answer" (Penney 2013). According to Penney (2013) many of the parents blamed themselves for their child's behaviour: "It was like this was my fault somehow I was raising a rotten kid and the

implication was like 'you're spoiling him' and that I was somehow a rotten parent (Penney 2013).

Key Points

- Many individual learners are determined to achieve academic success.
- Many students with ASD are visual learners and may have language deficits.
- Many teachers feel unequipped to meet the needs of students with ASD.
- An increase in engagement has seen a decrease in anxiety.
- Noise and other distractions can often make it difficult for students with ASD to concentrate.
- Students with ASD engaging in challenging behaviours is also creating difficult situations for parents.
- Written assessments are extra challenging for students with ASD due to their inability to write fast.
- Teachers are encouraged to collaborate with parents on the best strategies to manage their children but some may seem reluctant to do so.

Supports for Adolescents with ASD



Whitehouse *et al.* (2009) recommends that early intervention is considered when a child has been diagnosed with AS. It is recognised that the lack of social context of where the individual lives, the characteristics of the friends that they hang around with and the individuals personal traits makes the implementation of interventions all the more taxing.

Within schools, students with ASD feel that supports in managing personal issues, social challenges and academic difficulties tend to their needs within the school culture: "Like with some things it's sometimes not curriculum or stuff like that I need help with. It's maybe just personal stuff, which is good. It also helps." "Yeah, yeah. ... and also unit tutorials we get down here in school, in the unit.... And we also do this social skills which helps us socialise" (Saggers *et al.* (2011).

This section will focus on 'social supports' and 'academic supports'.

Social Supports

While facing these emotional challenges, participants in the various studies felt that school provided them with the optimum opportunities to make friends and many of the friendships were facilitated by in-school autism support centres Cresswell *et al.* (2019). Sreckovic *et al.* (2017) contributed to this finding by identifying the effectiveness of peer networks in a school environment. When paired with their TD peers, students with ASD were observed increasing their interactions. capable of social interaction when sufficiently supported. Although initiations from students with ASD decreased from intervention to generalisation, interactions in terms of responses remained albeit reduced.

McKeithan and Sabornie (2020) found that interventions using social narratives had a consistently high impact on participants. Self-management strategies and peer mediation strategies (others with diagnosis) were also strong in some cases but not all. Studies where TD students were involved in the intervention implementation and studies₇₆

where the researcher actively collaborated with teachers to carry out the intervention also had a moderately strong effect on students with HFA.

Strategies that encourage individuals with HFA to acknowledge other peoples' perspectives, role play and interact with non-diagnosed individuals in familiar school environments have proven to be the most successful intervention strategies identified by McKeithan and Sabornie (2020). Students with HFA are also encouraged to distinguish between acceptable and nonacceptable behaviours by monitoring and recording their own responses.

Suitable social interventions may aid students with ASD in changing their behaviours when interacting with classmates which may result in the participants being more acceptable and less irritating to their peers (Sreckovic *et al.* 2014). Having supportive peers and friendships have proven to reduce the incidence of bullying for adolescents with ASD (Sreckovic *et al.* 2014). With this in mind,

peer network interventions may be effective in promoting social interactions and relationships resulting in a reduction to victimisation (Sreckovic *et al.* 2014; Sreckovic *et al.* 2017).

While social interventions are important, it is important not to overlook the academic interventions.

Academic Supports

Students with ASD are keen to accept support from teachers but would prefer it to be done subtly and not be exposed to potential humiliation from their classmates (Saggers *et al.* 2011). One student from this study describes a teacher who always supported him and gave him hints rather than answers and instead of just spending time with him in the classroom, the teacher tended to other students in the class at the same time.

Reutebuch *et al.* (2015) investigated the effects of Collaborative Strategic Reading-High School (CSR-HS) on the reading comprehension of students with ASD but also

documented on their challenging behaviour and social interactions. Challenging behaviour displayed by participants in this investigation included off-task behaviour, task refusal, and skin picking all of which took the individuals attention away from academic tasks. The researchers provided structured strategies to the students with ASD to help them complete the task (reading comprehension) and in turn reduced the students' stress and anxiety levels and promoted academic engagement resulting in less challenging behaviour.

It is well documented that students with ASD struggle with reading comprehension post-intervention, students with ASD reported feeling more confident in their reading abilities while their subject specialist teachers verified this by stating that they were reading more and volunteering to read in class. Results in the participants comprehension probes increased from intervention phase to maintenance phase which indicates that the intervention was a success in improving their reading comprehension.

While deficits in social interaction and challenging behaviour are commonly reported difficulties for students with ASD in a school environment, Reutebuch et al. (2015) research proves that it is achievable to address these issues while targeting their academic skills.

Many students appreciate the sanctuary of the specialised unit where they could receive supplementary assistance from specialised staff away from the distractions of mainstream: "Just if I didn't have it, I'd probably be in much worse condition." "Because you get more help and there's not that many kids in one class" (Saggers *et al.* 2011).

Key Points

- Some students with ASD felt that school provided them with the best opportunity to form friendships.
- Social interventions have proven to be successful in promoting interaction.
- Students with ASD can sometimes feel embarrassed when seen to be receiving extra support from teachers.
- Strategies to carry out tests and assignments have proven to reduce challenging behaviour.

Conclusion

- Teachers are key to the inclusivity of students with ASD within the school community yet some are not keen to make the effort to include students.
- The transition from primary to post primary is a key opportunity to promote inclusivity.
- While some students with ASD blame their diagnosis for their lack of friendships, other students with ASD lack motivation.
- Some students with ASD felt that school provided them with the best opportunities to make friends.
- Similar interests are key for students with ASD to form friendships.
- Repetitive and irritative behaviours are some of the main reasons for bullying with verbal bullying being the most prevalent.
- Bullying significantly affects academic performance and anxiety levels.
- Students with ASD may be aware of their irritating behaviour as it is sometimes related to poor mental health.
- Poor mental health is often a result of poor quality friendships, victimisation and the unpredictable school environment.
- Students with ASD are generally visual learners who are determined to be academically successful.
- Many teachers feel unequipped to meet the needs of their students with ASD.
- Students are easily distracted.
- Increased engagement has led to reduced anxiety.
- Students written assessments most challenging due to their inability to write fast.

- An outline of the research process.
- A correlation of the data
- Primary research results
- Observations, Problems, Needs
- Needs Filtering
- Design Guide

Primary Research

Primary Research Process

- Interviewed participants
- Transcribed the interviews
- Identified themes
- Identified observations from the transcripts and themes
- Created problems and needs statements
- Filtered the needs statements using 3 rounds.
- Participants from the interviews were used for the last round of filtering to allow them to begin to have an input into the design process.



Participants Profiles



Name: Michelle Drake
Gender: Female
Position: Teacher
Subjects: Irish & English



Name: Caroline Reed
Gender: Female
Position: LCA/TY
Coordinator/Guidance
Counsellor



Name: Elanor O'Shea
Gender: Female
Position: Teacher
Subjects: Irish & English



Name: Frances Fox
Gender: Female
Position: Charity
Coordinator & Parent

Participants Profiles



Name: Sarah Rafferty

Gender: Female

Position: Teacher/Guidance
Counsellor

Subjects: Business Studies



Name: Siobhan Clarke

Gender: Female

Position: SNA



Name: David Meade

Gender: Male

Position: SNA

Primary Research Findings



Interview Process

1 Participants recruited from the school and informed of the study

2

Communication was made with participants to organise an appointment

3

Participants consented to the interview

4

Participants were reformed of the purpose of the study.

5

Interviews were held virtually on Zoom

6

Interviews lasted a duration of 40 minutes to one hour.

7

Interviews were transcribed.

8

Interviews were coded and a thematic analysis was performed.

Access to Files

Access to semi structured interview questions is in Design History File/ 0. Feasibility/ Interview Access_Preparation

Access to OPNs filtering is in Design History File/ 0. Feasibility/ Research Data

Access to transcripts is in Design History File/ 0. Feasibility/ Research Data/ Transcripts

Access to coded transcripts is in Design History File/ 0. Feasibility/ Research Data/ Transcripts/ Coded Transcripts

Access to themes is in Design History File/ 0. Feasibility/ Research Data/ Transcripts/ Coded Transcripts/ Thematic Grouping



Identified Themes

- Characteristics of ASD
- Inclusivity
- Independence
- Social Experience
- Student Academic Performance
- Student Wellbeing
- Teacher Training
- Teacher Attitude
- The Curriculum
- The Environment

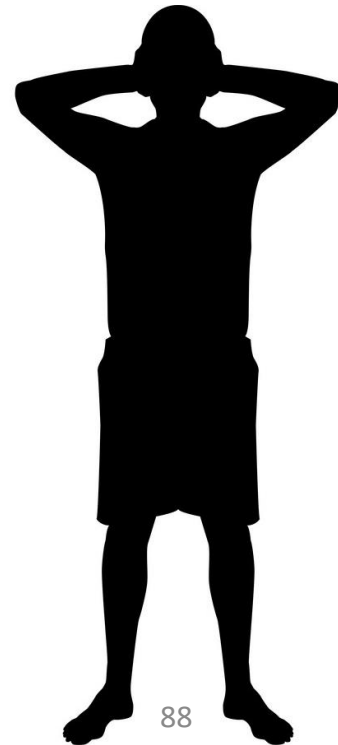
The next number of slides shares the key findings from each of these themes and presents some qualitative evidence to support these findings.



Characteristics of ASD

Key Findings:

- Students with ASD tend to get agitated by incidents that would be deemed minor. This agitation would be expressed in behaviours such as crying or stamping feet.
- Students with ASD who are rocking back and forth in their seat and flapping their hands are generally trying to regulate their senses.
- Students with ASD can often get distracted by the smallest of distractions and need refocusing.
- Students can be sensitive to bright lights and loud noises.
- One student in particular within the school can be quite impulsive when asking questions in class and can sometimes hinder the flow of the class and consequently delay the development of the other students in the class.



Characteristics of ASD

Qualitative Evidence

"And you know, the hand flapping, jumping up and down, rocking back and forth, which you know, are positive signs, their signs that a child is doing their best to regulate themselves"

"He could just start stamping on the floor and put his hands up to his face and start crying."

"So he might kind of keep asking questions, asking questions, and it can be very interrupting for the teacher."

"He could quite easily maybe distracted or get focused very much on one small detail. And then, you know, he kind of, you know, you've got to bring him back."

Inclusivity

Key Findings:

- Teachers have a big impact on the inclusivity of students with ASD in group work within a classroom setting. The peers in the group and the role of the ASD student is critical to ensure the individual with ASD is included within the activity.
- The school uses PE as a means to ensure students with ASD are included among their peers.
- The school has strategies in place for when they begin school in first year to try and promote inclusivity. They have an introduction day when they begin secondary school where they participate in activities that promote interaction and they are paired with a "buddy" in TY to help them settle in.
- Although the unit is used to benefit students both academically and socially, some teachers believe the unit has a negative impact on inclusivity of students with ASD due to the stigma that surrounds it.



Inclusivity Cont'd

- Some teachers believe there needs to be other strategies in place for older students with ASD to ensure they feel included.
- Teachers believe students with ASD have a label associated with them which makes it more difficult for them to feel included.
- Many teachers tend to discuss how well students are performing academically rather than how well included they are in the class and the school environment.
- Many teachers would like to bring the ASD unit to the mainstream classroom to reduce the need for students with ASD to leave the class and remain in mainstream which leads to improved inclusion.
- One individual believes that there are four barriers to inclusion and these include communication, sensory environment, predictability and the judgements and attitudes of others.
- Teachers believe that if the student is included in the classroom that it will spill over into the general school environment.

Inclusivity Qualitative Evidence

"Yeah, PE is hugely important. And they are and they are encouraged to take part."

"I think that the group work needs to be very structured, and that everyone has a role. So you have to carefully choose the role for the ASD pupil."

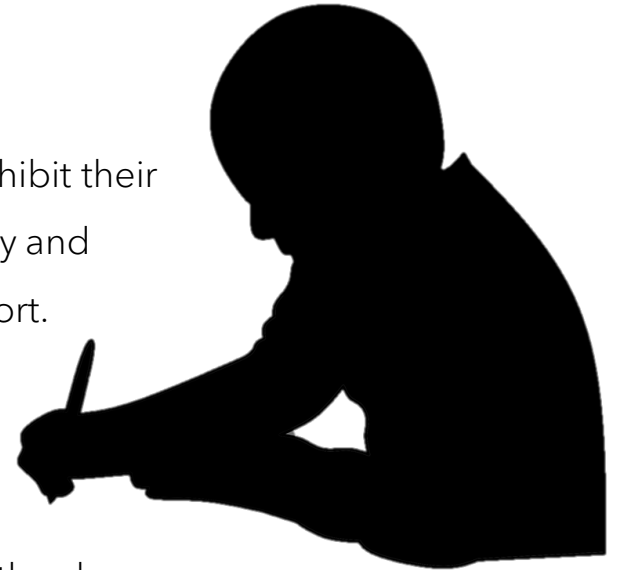
"Sometimes I think that there is this automatic association of, you know, 'Oh that's the, that's the thing that like unit the lads go in there."

"But we don't necessarily have conversations around, like, you know, around kind of methodologies and strategies. And, you know, what we could do to help this particular student feel more comfortable"

Independence

Key Findings:

- Teachers believe that it is important that students can be responsible for themselves and their work where possible.
- Some teachers think that SNA's can do too much for students which can inhibit their independence while others believe that SNA's employ a helicopter strategy and hover over students and intervene when they feel the student needs support.
- Higher functioning students with ASD generally do not require an SNA.
- Some students are asked to carry out chores such as making purchases at the shop to try and develop some of the basic skills required for adulthood.
- Teachers encourage some students with ASD to sign up to transition year and leaving cert applied where they have more time to develop skills required for their day to day living.



Independence Cont'd

- Many teachers believe that students should be shown how to do things rather than having others carry out activities and other duties for them.
- Some believe that parents can do too much for them also which makes it difficult for school staff to encourage independence.
- There is a lack of support for some students with ASD when they leave school. School staff hear little or no news as to how former students are progressing since they graduated from school.
- Some students allow SNAs to write all the notes for them in class but SNAs try to resist the temptation to do the work for them and they encourage them to take the notes down themselves.
- Teachers believe that it is a big change in the students' life when they progress from primary to secondary school as much of the work is done for them in primary school and the student is surprised when they don't have as much done for them in secondary school.



Independence Qualitative Evidence

"You'd write as much as you can there And then I'll take over from you or something like that. That's what you do. And you will know whether or not he's kind of just can't be bothered doing it and then handing it over."

"But it's also very important, I think, to know, when the student is at the stage that he can function without that SNA with him all of the time. Otherwise, it can be very smothering."

"They didn't even go to the shop...this is as important as learning maths and Irish English for them."

"They might go into more adult education a couple of days a week in COPE and things that as I find little jobs stacking shelves maybe two days a weekend centra or something and sometimes they might leave school and that's it like you don't hear about him anymore."

Social Experience

Key Findings:

- Many teachers have identified students who face challenges in interacting with others and seem isolated. This is most evident at lunch times.
- Teachers tend to lean towards group work and extra curricular activities when trying to support students with ASD socially yet according to an adult with ASD, group work can be very daunting for students with ASD.
- Some teachers believe that transition year and LCA are suitable for students with ASD who are struggling socially as the groups are smaller and there are many team building activities that help students interact.
- Some teachers believe that there are a number of extra-curricular clubs and activities available to students in the younger students in the school but there is a lack of social supports available to older students.



Social Experience Cont'd

- Teachers try to identify students who would be compatible with students who are struggling socially and would try to encourage them to interact with each other.
- Some teachers believe there is a stigma attached to those with ASD where neuro typical students may see them as “weird” and this makes it more difficult for them to socialise. Other teachers believe that neuro-typical students are empathetic towards students with ASD.
- None of the teachers interviewed saw a student with ASD being bullied but they are aware that this does not mean that it is not occurring.
- Some individuals believe that some students with ASD can feel embarrassed when they have a meltdown and this can significantly impact on their social status. The ASD unit can act as a safe haven for students when they are having a meltdown.
- Some teaching staff believe that some students with ASD don't understand how to behave in different settings e.g. they don't know when to be silent when others are silent in class.



Social Experience Qualitative Evidence

"If there's an outburst, it's, you know, there's a there's a class watching on and it can be difficult to kind of manage, I suppose you would have the support of an SNA, who might be able to take them to their down to the ASD unit, they might feel more comfortable."

"Because I would have been wary, again, of this pupil, you know, being prone to bullying. And I would have had to talk with the rest of them saying we're all a small team here, we're all looking out for each other and, you know, I expect everybody to look out for one another."

"Sometimes the student can be isolated socially, within a group, and you tend to, I suppose worry more about them...I think the biggest challenge is what happens at break time."

"And I do think our school like there is obviously a zero bullying, zero tolerance of bullying.... I know, that means that doesn't mean that it doesn't happen."

Student Academic Performance

Key Findings:

- Teachers tend to set smaller intermittent goals for students with ASD than other neuro-typical students in the class in order to keep them motivated and engaged.
- Many of the teachers recognise that each student with ASD have different academic needs and learn in different ways but they find it difficult to meet these needs. Some students learn best visually, aurally, or through writing.
- Teachers find some students with ASD lack motivation to learn in the classroom and find it very challenging to get them engaged.
- Students with ASD can find it easy to ask questions in class when they initially begin secondary school but this becomes more challenging each year they are in the school.
- Many of the students with ASD in the school are high functioning academically while there are also students who struggle significantly.



Student Academic Performance Cont'd

- Teachers believe the ASD unit is essential in supporting students individually in specific subjects that they are struggling with.
- Teachers feel that mainstream classrooms are not fully equipped to support students with ASD to remain in the class.
- Students with ASD can become very fatigued with the workload and often require SNAs to support them.
- Students with ASD often work better individually rather than within a group.
- Some students with ASD within this school are very eager to get work done to avoid having to do homework.



Student Academic Performance Qualitative Evidence

"They would often say that I can't do it. And I would say, "Come on, we'll try" And, you know, encourage them to do a small bit at a time."

"I do find that they need, ah..quite a bit of help in managing themselves but that's probably a skill they need to learn themselves you know, how to manage their time, how to organise themselves, how to organise their work."

"We find with one lad that id he's not taking the notes he's sort of bouncing up and down or he's looking through his pencil case and he's not focused and if he's taking down notes he's concentrating on the board or he's taking in something but if he don't take down all the notes."

"Yeah, I mean, some of them learn better visually, some of them are more auditory learners, some of them like stuff, you know, highlighted, or maybe printed a little bit bigger or better."

Student Wellbeing

Key Findings:

- Teachers use technology to anonymise students so they feel comfortable offering their opinions on various topics and eliminate the risk of social embarrassment.
- Teachers are concerned for some of the students with ASD as they have seen them become isolated within the classroom and general school environment.
- The unit is a safe environment for students to relax and remove themselves from the pressures of mainstream school life. It provides them with the opportunity to work within a smaller group and reduce any anxieties that may arise working within a mainstream classroom.
- Students with ASD can feel as though they are perceived as “thick” or “stupid” if they don’t understand a specific topic or ask questions.
- Students with ASD tend to need to go for a walk or take time out when they feel overwhelmed.



Student Wellbeing Cont'd

- Teachers are mindful of creating a safe environment for all students when planning their classes by creating some predictability on what topics they will be studying during the different days throughout the week and bringing some gamification to their class.
- Many teachers feel students with ASD need to improve on their organisational skills and can become panicked if they forget something they need for class.
- The ASD unit has the sensory products that required by students with ASD to regulate their senses that are absent in a mainstream classroom.
- The SNA is viewed as a person the student with ASD can turn to when they are overwhelmed or feeling anxious.
- Teachers set achievable goals for students with ASD so they feel that sense of achievement and improve on their self-esteem.
- Some students may not feel comfortable sharing with others that they are autistic.



Student Wellbeing Cont'd

Key Findings:

- Some people can confuse a meltdown with a tantrum and the individual with autism has no control over the meltdown.
- It is important that there is trust between the teacher and the student with ASD so the student feels safe when entering the classroom.
- Exams can have a negative impact on the mental health of the student with ASD.



Student Wellbeing Qualitative Evidence

"And actually, some of the most moving experiences I've had are when autistic students come up to me afterwards themselves and say that they've never disclosed to any of their peers that they're on the spectrum."

"So it takes the fear out of the situation, you know, that you're putting yourself out there. Am, and you might be judged. And I suppose the mentimeter allows a sense of anonymity."

"Alright, lads drop everything, get out the novels, we're going to read, like that would throw one or two of my students who are on the spectrum, because they were coming into English expecting to be looking at a poem answering questions."

"Sometimes those that are, you know, quieter or may have a learning difficulty am... or may have, you know am, a condition would possibly be a little bit more isolated in the classroom may not be as good at mixing with their peers."

Teacher Training

Key Findings:

- Teachers feel a lack of support due to poor information received at in-services.
- Training is not mandatory for teachers and is often left to their own initiative to source their own training.
- Some teachers believe that training for educating students with ASD should be mandatory where it should be renewed after a specific number of years while others feel that it would be too much to take on with other training.
- Some teachers feel that it should be training on the job so there is an in-depth understanding of how to meet the needs of the student rather than learning it in theory.
- Schools are open to training as they hire national autism charities to educate all their students on ASD but this doesn't appear to be utilised for teaching staff.
- Teaching staff ask questions of tutors at the student education courses.



Teacher Training Cont'd

Key Findings:

- Teachers tend to set smaller intermittent goals for students with ASD than other neuro-typical students in the class in order to keep them motivated and engaged.
- Many of the teachers recognise that each student with ASD have different academic needs and learn in different ways but they find it difficult to meet these needs. Some students learn best visually, aurally, or through writing.
- Teachers find some students with ASD lack motivation to learn in the classroom and find it very challenging to get them engaged.
- Many of the students with ASD in the school are high functioning academically while there are also students who struggle significantly.



Teacher Training Qualitative Evidence

"The kind of the unpredictability of it sometimes kind of throws certain teachers and not quite sure how to deal with it, and it will kind of fall back on the SNA to kind of sorted out, whereas there's some teachers that just will roll with it."

"To become a teacher when you're training or whatever, you study a module in college and if you're lucky, in all some of your schools might organize a workshop or whatever. But I mean, other than that, like um, you know, if you unless you take the initiative yourself, like, you don't really get that much training."

"It's not a requirement to be engaging in autism training. It's not even a requirement to have any special needs qualifications to teach a special class or an autism class, I mean, those things just absolutely baffled me."

"It's like a first aid course, you have to brush up on it, what every two years, like shouldn't it be the same, you know, when you're brushing up on your skills?"

Teacher Attitudes

Key Findings:

- Teachers believe that all students with ASD are different and no one strategy or approach will meet the needs of all students.
- SNAs find that reports that come with students with ASD from primary to secondary school are inaccurate and they don't make judgements until they meet the student face-to-face.
- Some teachers are better than others in managing students with ASD as they just "roll with it."
- Teachers tend to progress the levels of their tasks to try and push them outside their comfort zone so they can develop their social and communication skills.
- Although teachers don't see bullying occurring, they are not naïve to think that it does not happen.



Teacher Attitudes Cont'd

Key Findings:

- Teaching staff feel it is difficult for teachers to get to know the students with ASD as they only have them for 40 minutes at a time. This makes it difficult for them to meet their needs.
- Teachers recognise that some students find it difficult to adjust to timetables and changes in routine and so make allowances for them.
- Some teachers are aware of the inadequacy of some of the basic skills required for daily living and try to practice these skills with the students.
- Some teachers feel the pressure of having to teach to an exam and achieve good results and there is not enough emphasis on the need to educate students on the skills needed to live.



Teacher Attitudes Qualitative Evidence

"And I think that all teachers are in very different levels, you know, I, I've always had very positive experiences with the teachers I've engaged with, and either in my personal life for my daughter, or through as I am, and I've always been very open to learning and open to engaging in any new learning that is out there."

"It's important to strike that balance and know when the student can't manage in mainstream and when they need to be taken out. Am, you know, into the unit for that one to one help."

"I know, in college, it's drilled into us, you know, you're not teaching to the test, you're teaching, lifelong learning, and so on. And while that's all true, they still have to do a test at the end of the day."

"So maybe day one, when that ASD pupil comes in, you might be in a situation where well, he's going to take notes, and he's comfortable doing that, and he's happy, and he's getting his feet as part of a group. But you would hope that as the year progresses, that that role would evolve and that as time goes on."

The Curriculum

Key Findings:

- Participants felt that the Leaving Cert is too points driven and it can become too overwhelming for the students with ASD rather than the holistic development of the student. Leaving Cert Applied is a more practical Leaving Cert course to take for many students with ASD.
- Teachers feel that there should be more links between the curriculum and the community in order to educate students the necessary social and practical skills that they may lack.
- Participants feel that the higher functioning students with ASD are more than capable of completing the Leaving Cert but may become overwhelmed by the workload that is required in order to succeed.
- Transition year and Leaving Cert Applied are seen as beneficial for lower functioning students with ASD as they complete short courses to give them some certification and qualifications for when they leave school.



The Curriculum Cont'd

Key Findings:

- SPHE classes are part of the Junior Cycle curriculum where they educate students on life skills such as personal hygiene, relationships and basic living skills.

Junior Cycle has moved towards continual assessment but the Leaving Cert still remains as a one exam assessment.

- Participants feel that there should be a more practical approach to the leaving cert to meet the diverse needs of the students.

- Dyspraxia tends to be associated with ASD and this does not assist students with practical subjects. Students also have issues with hand writing within the theoretical subjects. This makes school very difficult for students with ASD.

- Some participants feel that the assessment strategy used during the COVID pandemic is suitable for students with ASD as they are assessed according to their performance over the past number of years.



The Curriculum Qualitative Evidence

"LCA would have they'd have more time and they practice practical skills, social skills more and so that's the mainstream setting."

"So there's, SPHE classes in education for living classes are very good, they're in that they do go through looking after yourself, you know, from sleep, nutrition and exercise point of view to managing your time to am, getting on with others in school to organizing yourself in school."

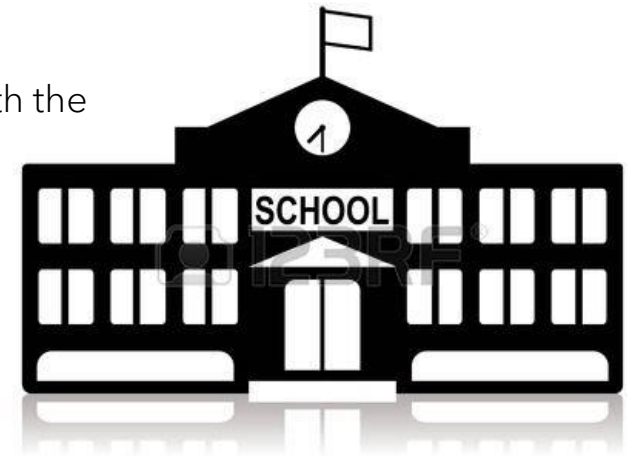
"There's certified courses within LCA, like first aid course, the safe pass course manual handling, hospitality skills, all of these are, you know, great additions to any education, because there's certificate courses that can be used outside of school and are very beneficial to them. So at least the leaving with some skills and some qualifications that they quite possibly would've not got in traditional am, leaving cert programme."

"So I think that's one of the deficits in mainstream at the moment where we're dealing with these needs for particular students. Am, and it's a one size fits all approach that certainly has the students on the margin."

The School Environment

Key Findings:

- Secondary school is more difficult for students with ASD than primary school as they have to keep track of their timetable and have different throughout the day.
- The ASD unit provides a safe area for students with ASD to go to when they are feeling overwhelmed. It is an area that is quiet and without large crowds.
- The current situation expects students to adapt to the environment but participants feel that the environment should be adapted to the students that occupy it. This includes students with ASD.
- Participants feel that students should be allowed familiarise themselves with the school environment prior to the beginning to the first term in first year.



The School Environment

Qualitative Evidence

"You can bring the child into the new environment so that they can become desensitized and familiarized with it, the better experience and the better transition, they're going to have."

"And, you know, it's, it's a minefield, and it's really scary for all children. But imagine how much more scary that is for the child who needs the structure and needs to predictability and needs to support."

"So you could have 30 lads in a mainstream class compared to 5/6 in the unit at a time. We have a sensory room that one lad would go in for 11 o'clock break that he would have his lunch in there for the 10 mins."

"It shouldn't just be the autistic person having to adapt themselves, in order to fit in or be accommodated. Everybody has a role to play. And in fact, we don't believe that it is the autistic person's job to adopt themselves, we believe. And it's really, society needs to meet us halfway."



Needs Filtering

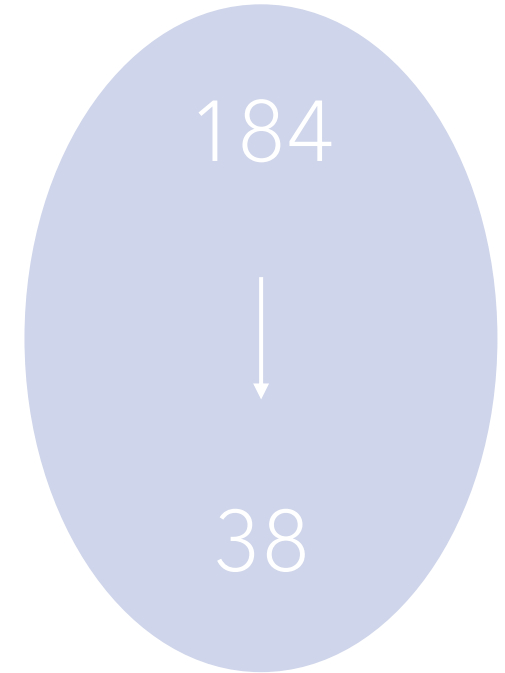
Access to OPNs filtering is in Design History File/ 0. Feasibility/ Research Data

Round 1

Score	Student Impact Criteria
4	This is really going to benefit the student
3	This is somewhat going to benefit the student
2	This may/may not benefit the student
1	This will not benefit the student

Score	Teacher Impact Criteria
4	This is really going to assist the teacher in meeting the student needs
3	This is somewhat going to assist the teacher in meeting the student needs
2	This may or may not assist the teacher in meeting the student needs
1	This will not assist the teacher in meeting the student needs

Score	Teacher Impact Criteria
4	This will really help parents care for their child
3	This will somewhat help parents care for their child
2	This may or may not help parents care for their child
1	This will not help parents care for their child

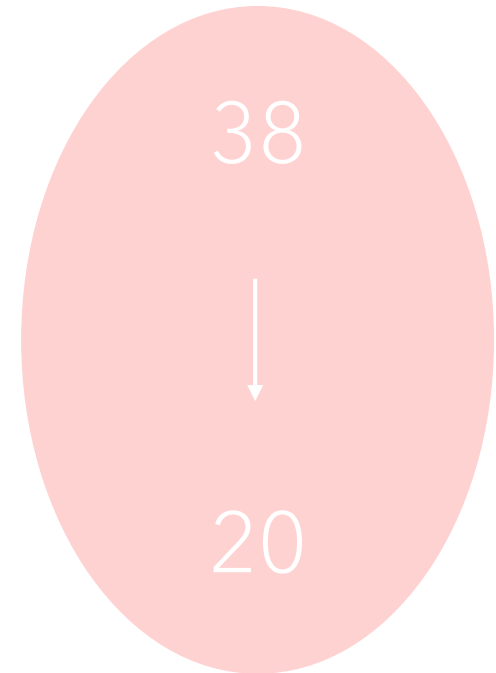


Anything that scored 11 or 12 got through to round 2

Round 2

Score	Feasibility Criteria
4	High Potential
3	Medium to High Potential
2	Medium to Low Potential
1	Low Potential

Score	Personal Preference Criteria
4	I'm really excited about this project
3	I like this project
2	I'm not sure about this project
1	I don't like this project



Anything that scored 19 or 20 got through to round 3



Filtering Outcomes from Round 1 and 2

Score	Need Statement
20	There needs to be a way for the student with ASD to block out external distractions
20	There is a need to help students with ASD memorise topic information better
20	There is a need to assist students in managing anxiety and frustration levels
20	There needs to be a way to mitigate/eliminate student meltdowns.
20	There needs to be a way to subtly block out the sound when moving in the corridor
20	There needs to be a method where students are able to explain how they are struggling
20	Solutions need to be affordable to schools so they can invest.
20	There is a need for people to recognise when a student with ASD wants to be left alone
19	There is a need to encourage communication and collaboration among teachers to understand and implement the best strategies to the best of their ability
19	There's a need to incorporate Neuro-typical students into the unit to remove stigma and normalise it.
19	Students need to understand their behaviours and their stimuli
19	There needs to be a way to regulate the student if they become overwhelmed in the corridor
19	There needs to be a way to encourage students to report incidents of bullying
19	There needs to be an easier way to help students complete the prescribed tasks.



Filtering Outcomes from Round 1 and 2

Score	Need Statement
19	There needs to be a way to assist students with integration at an earlier stage of secondary school
19	Students need to be protected from bullying
19	There needs to be a way to support students and their social skills
19	There is a need to incorporate sensory regulation objects in mainstream classrooms.
19	There needs to be a way for students with ASD to feel more comfortable sharing their experiences with their peers.
20	There needs to be a way for others to differentiate between a meltdown and a tantrum

Round 3

Some participants from interviews will participate in round 3 of the filtering process.

Participants will be given 5 points and they can be distributed among the remaining needs as they deem fit.

If participants feel strongly about one need they can choose to give all their points to that need or if they don't perceive one over the other, they can choose to give one point each.

This filtering method will remove any needs that participants don't feel are important but will also identify the needs that are most needed to be addressed.

Including the users in the filtering process is important as they will be best positioned to identify what needs are the most important to be met.

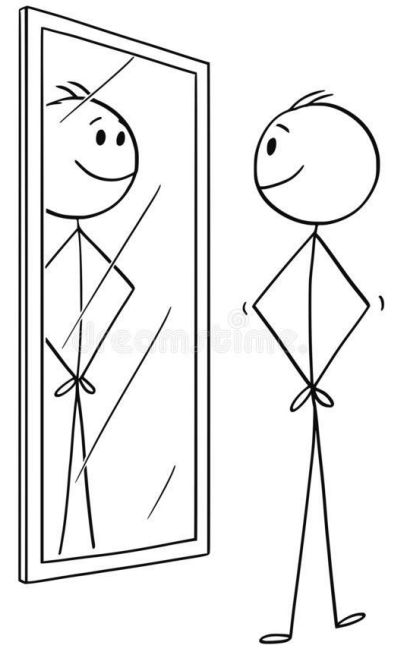


Final Design Needs Statements

Needs Statement	Score
There needs to be a method where students are able to explain how they are struggling	4
There needs to be a way to assist students with integration at an earlier stage of secondary school	3
There needs to be a way to support students and their social skills	3
There is a need for people to recognise when a student with ASD wants to be left alone	2
Students need to be protected from bullying	2
There is a need to help students with ASD memorise topic information better	1
There is a need to assist students in managing anxiety and frustration levels	1
Solutions need to be affordable to schools so they can invest.	1
There is a need to encourage communication and collaboration among teachers to understand and implement the best strategies to the best of their ability	1
There's a need to incorporate Neuro-typical students into the unit to remove stigma and normalise it.	1
There needs to be a way for students with ASD to feel more comfortable sharing their experiences with their peers.	1
There needs to be a way for others to differentiate between a meltdown and a tantrum	1

Reflection

- I am very satisfied with the insights I have received from the literature review. I felt I had a good foundation to take forward with me into the primary research.
- I felt it was really beneficial to put the overview slides of the different papers together as I had quick access to contextualise the information I was compiling in the literature review.
- I felt my line of questioning in the first two interviews was sub standard as I didn't delve deep enough to find the information I required. To address this, I felt it was important to reflect on my own performance in the interview and aim to correct this mistakes in the following interviews.
- I found the thematic analysis very beneficial in organising the data into individual documents for easy access later on.
- I was expecting to have a large number of OPNs after the first number of interviews but the data soon became saturated and information became repetitive.
- I feel the needs that I have extracted from the interviews offer a wide variety of potential solutions and will make for a very exciting ideation process.
- I would've liked to have included students with ASD in the interviewing process but the challenges that were as a consequence of COVID 19 made it difficult to do so.



- Gaining empathy through journey mapping
- Personas
- Brainstorming
- Research on potential concepts
- Storyboarding of concepts
- Prototyping
- Evaluation of concepts
- Concept selection

Ideation & Realisation

Design Guide



Must Have

- The solution must improve the overall school experience of the student with ASD.
- The solution must address as much of the student's school life as possible.
- The solution must make the student feel more included
- The solution must make the student feel safer within the school environment.
- The solution must not cause any harm to the user or those around them.
- The solution must be easily operated.
- The device must be reusable.

Nice to Have

- The design to be used by both students with ASD and neuro-typical students.
- It would be nice to have a solution that's subtle.
- It would be nice for the solution to raise awareness of autism.
- It would be nice if the solution could be used outside of school also.
- It would be nice to design a solution that is sustainable.
- To keep the student with ASD in the classroom as often as possible.

Knowns Vs. Unknowns

Knowns

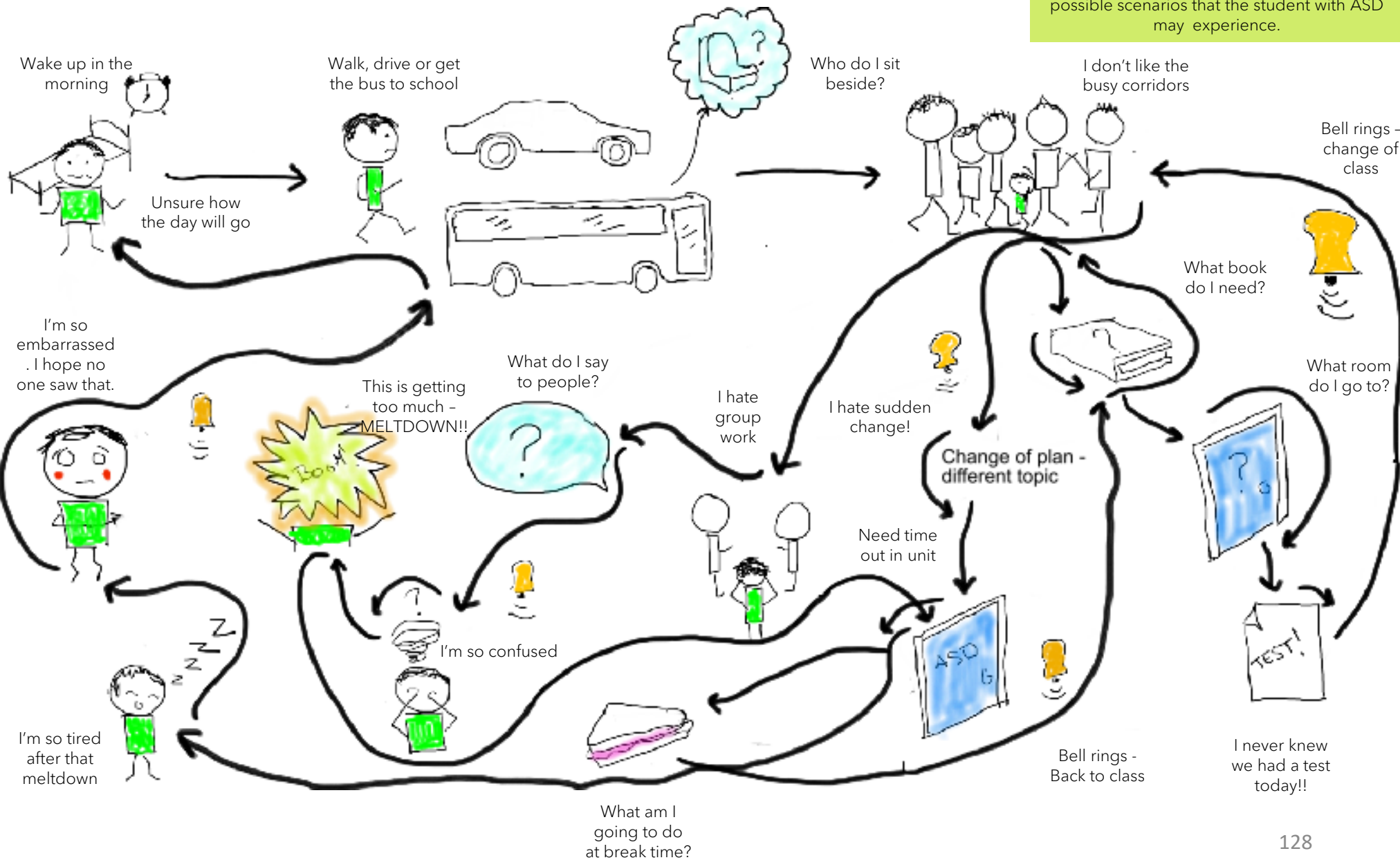
- Students with ASD may have anxiety issues.
- Students with ASD may have difficulty with interaction.
- Students with ASD may have difficulty maintaining focus.
- Neuro-typical students are generally considerate towards individuals with ASD in this school.
- Some teachers may find it challenging to manage students with ASD.
- There is a vast amount of products on the market for self regulation for people with autism.
- Some students can be shy about discussing their ASD diagnosis or their experiences.
- Some students with ASD may not understand how to interact with others.

Unknowns

- The optimum way to include all students with ASD as the spectrum is so broad.
- All the products that are available to students with ASD.
- The best materials to use in sensory regulation etc.
- How students with ASD would feel about wearing different devices.
- How open students with ASD and their parents would be to using new devices.
- The best way to integrate an individual who may be reluctant to speak.
- How to encourage individuals to interact with others who are happier being on their own. This is a life skill they will need to work within a team.

Empathetic Experience

The student leaves home every morning and is entering an environment that is unpredictable to them and can cause high anxiety. I wanted to break this down into possible scenarios that the student with ASD may experience.



Key Stakeholders



Parent

The solution needs to help the parent to ensure their son is safe and happy in school. If their son is happy in school, they will find it easier to convince him to go to school.



Teacher

The solution needs to help the teacher meet the needs of the student. Currently, many teachers are not confident in meeting the students needs and are unsure how to manage a student meltdown.



Special Needs Assistant

The Special Needs Assistant is the person who understands the student with ASD best in school. They are with the student most of the time. It is essential that the solution is easy to operate so they can assist the student with it.



Student with ASD

The student with ASD is the key stakeholder in this brief. The biggest impact from this solution needs to be on the student. The solution should reduce anxiety for the student while helping them integrate and learn with others. Many students can find school very overwhelming from trying to make friends, learning new concepts and trying to pass exams. Students with ASD tend to not want to be singled out so ideally, the solution will be subtle so they will not be perceived as different by their peers in the class.

Personas

Paul



Age: 14

Year: 2nd Year

Diagnosis: Autism

About Paul:

Paul is a quite boy. He keeps to himself but sometimes teachers notice that he would be looking around for some company. Unfortunately, Paul doesn't know how to approach people for conversation. Others find him a little bit "weird" so make very little effort with him. He has full access to the ASD unit so he receives help from support teachers in learning and acquiring these social skills.

He leaves the unit to join some mainstream classes but he is within the unit 40% of the time. Teaching staff fear that he may become overwhelmed by the volume of information to be learned so he engages in a shortened curriculum. He finds it difficult to communicate how he is feeling and when he doesn't understand something and becomes frustrated.

Simon



Age: 19

Year: 6th Year

Diagnosis: Asperger's Syndrome

About Simon:

Simon is a quite boy. He performs very well in school. He has a strong desire to be successful in education. He becomes very frustrated and overwhelmed when he can't understand something, if he has a lot of work to do or if he fails an exam. He requires a lot of structure to his day and does not take it well when surprises pop up. He doesn't communicate this with his teachers but they have observed these behaviours occasionally.

Simon doesn't like crowded corridors or loud noises and so spends much of his time in the ASD unit. As a result, he does not have many friends. Teachers are keen to get him integrating but he is reluctant to do so as he is fearful that he will say or do the wrong thing and his peers will see him as strange.

Personas

Mr. Hayes



Age: 37

Years Teaching: 16 years

Subjects: Geography and History

About Mr. Hayes:

Mr. Hayes is an experienced teacher in History and Geography. He predominantly teaches mainstream classes where some students from the ASD unit participate. He also teaches some of these students one to one in the unit. He enjoys teaching them but sometimes finds it difficult to meet their needs. He is finds it challenging trying to understand how they are feeling so he can approach them accordingly.

Mr. Hayes spends much of the class in mainstream with the student with ASD and the mainstream students are missing out as a result. He does not know how to deal with a student during a meltdown and seeks help from other teaching staff.

Mary Higgins



Age: 43

Relationship to the Student: Parent

Profession: Industrial Designer

About Mary:

Mary has a son in 2nd year of secondary school. She finds it difficult some mornings to convince her son to go to school as he is anxious about going into the unpredictable and crowded environment.

She often finds that her son is tired and exhausted when he returns from school and sometimes he can be very anxious. She has learned to leave him alone and give him time but it is upsetting for her as she feels she can't do anything for him.

She tries very hard to get her son involved in activities outside of school but he fails to make any close friends.

She gets upset as she sometimes doesn't understand how to help her son.

Personas

Katie



Age: 29

Profession: Special Needs Assistant

Years in her Position: 5 years

About Katie:

Katie is an SNA in her school where she is predominantly responsible for students with ASD. She knows a lot of these students very personally and they come to her when they need help. A lot of her students come to her when they feel overwhelmed from workload, sensory overload or just company. She encourages them to interact with their peers but they seem to feel more comfortable with her.

She sees many of her students when they have their meltdowns and how much of a toll it takes on them. They are physically tired after it and are embarrassed with the way they acted. She reassures them that they can't control their actions when they experience a meltdown but it doesn't seem to make a difference to them. She has concerns for their mental health.

John



Age: 16

Year: Transition Year

Persona Type: Neuro-Typical Student

About John:

John is a transition year student and is considered a popular student within the school. He is liked among his peers and is very outgoing.

John likes talking to people but doesn't know how to interact with the autistic students. He tries his best but finds them frustrating at times when they tell him how to act. Sometimes he finds that they make no sense in the conversation and he doesn't understand it.

When John is on his break from class, he wants to be able to relax with his friends and not feel uncomfortable at the risk of upsetting the students with ASD with something that he says.

Sensory Toys for Adolescents with ASD

These toys regulate the users senses with the different textures, lights, shapes and feel.



Jellyfish Aquarium tower that changes colours



Popping fidget with 11 different coloured balls.



Magnetic balls building blocks.



UFO Spinner that lights up different colours.



Fidget Cube for Stress Relief



Push Pop Anti Stress Fidget Toy



Sensory fidget toy - Puzzle snake cubes



Stress ball for stress relief



Tactile Atom Ball



Weighted shoulder wrap for calming pressure.



Palm Massage Roller that fits into the users hand.



Sensory Chair

Learning Aids for Adolescents with ASD

Can a Game help a child know where to look on a Face for Clues?

It looks like our FaceSay™ games do, with the help of our unique, patented method of "mapping", "quantifying" and "amplifying" the region around the eyes and eyebrows. In blinded grad student observations in the first randomized controlled study (N=49), students with an Autism Spectrum Disorder who played FaceSay (the intervention) or Tux Paint (the control) were observed on the school playground. The FaceSay students initiated more social interactions, made more eye contact and had fewer negative behaviors.

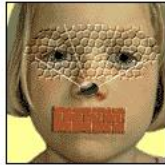


Image: HAOTIAN MAI.

Home > Education > Meet "Kiwi" A Robot that Helps Autistic Children Learn

Education Good News Technology

Meet "Kiwi" A Robot that Helps Autistic Children Learn



Proloquo2Go 4+

AAC for those who can't speak
AssistiveWare

#197 in Education

★★★★★ 4.8 • 5.7K Ratings

\$249.99 · Offers In-App Purchases

- Each concept is brainstormed individually.
- Research is carried out on its feasibility
- The idea is sketched and storyboarded.
- Prototypes are produced on the most suitable concepts.

Concepts





Audio

Alexa

Repetition



2. WatchMinder 3 \$69



Talking Photo Album, Voice Recordable with 6 Minutes Total Recording time, 20 Pages. Speaking and Listening Activities and Independent Living

Text-to-Speech



Trusting Relationship

Better Emotional State

Touch screen

Laptop

Better literacy

Headset

Keyboard

Class Group

Voice Activated

Solution could promote independent learning

Oral

Written

1 to 1 with teacher



Pen/Pencil

There is a need to help students with ASD memorise topic information better

Students were getting tired

Promoting Social Skills

Kinaesthetic

Attention

Aural

Environment

Visual

Brainstorming

Role Play

Modelling

Audio

Video

Information on the wall

Graphs

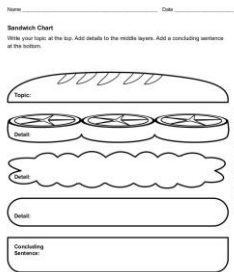
Picture Exchange Communication Systems (PECS) QuickTalk

Structure and Organise

Games



Spelling and grammar checker



Recording

Other students around

Posters

Distractions



Ideation 1

Improving Memorisation

Literature Research/Evidence	Idea
<ul style="list-style-type: none">• Learning might be thought of in an educational context as the formation of new concepts. These new concepts occur when existing concepts are joined or bound together.• Concept development occurs in the working memory.• The ideas presumably must co-exist in working memory for the concept to be formed.• Eg. To understand what a parallelogram is, the child has to understand what the word parallel means, and further to grasp that two sets of parallel lines intersect with one another. <p>(Cowan 2014)</p>	<ul style="list-style-type: none">• A book that has the teacher recorded teaching the topics on the page.• The teacher could be explaining how to do a question.• Device could be linked wirelessly to an interactive whiteboard.• If the user taps on a keyword on the page, it will show topics where the same keywords are used in the book and the user will be able to crosslink to form a new concept.
<ul style="list-style-type: none">• An example of the role that the physical environment can play is provided by a research in the field of forensic psychology, which shows that while working on a task, working memory resources are consumed by unintentional monitoring of the environment. <p>(Paas and Ayres 2014)</p>	<p>A device that will make will tell the student to focus again if he/she are going off topic.</p>

Literature Research/Evidence	Idea
<ul style="list-style-type: none"> • Pain can impact negatively on the working memory. (Paas and Ayres 2014) • Students tend to get tired from writing both physically and mentally (Primary Research) 	<p>There may be a device to support the users hand when taking down notes/writing.</p>
<ul style="list-style-type: none"> • Examples of how cognitive load can be influenced by individual differences, and not just the physical environment or expertise, include emotions and anxiety . (Paas and Ayres 2014) 	<ul style="list-style-type: none"> • Anxiety may arise from stress of not understanding a concept so the student may need a way to seek help from the teacher to explain it to him/her again. • May focus on solutions to control emotions further in the design process.

The solution will be a device where the teacher will have a microphone around their neck that will be connected to a tablet.

Potential Solution 1

(Creating Cross-Links to Form a Concept)

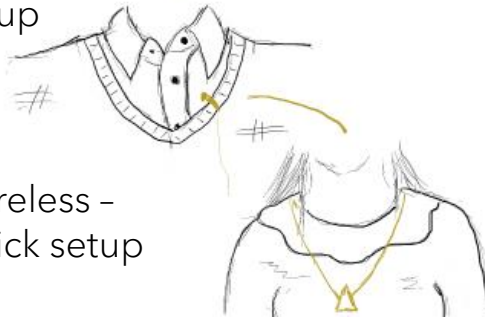


The device could be voice activated. Everything the teacher says does not need to be recorded

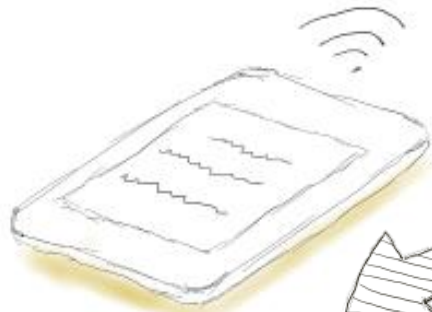


Headset - not very subtle

May take too long to set up with wires



Wireless - quick setup



Flat device - Schoolbag shape

Better aesthetics - top has mic mesh



Clip on to wireless device - Depends on device weight

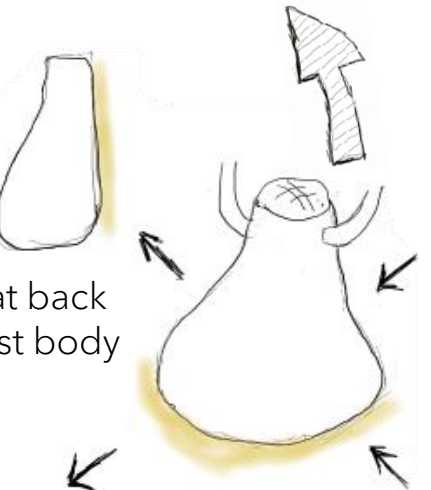


Necklace design

Side view - Flat back to lie flat against body



Front view showing curvature

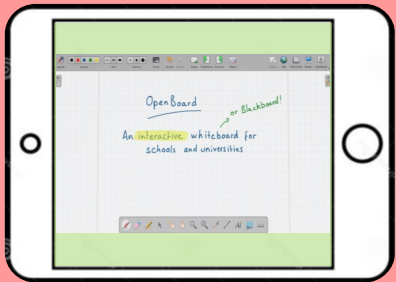
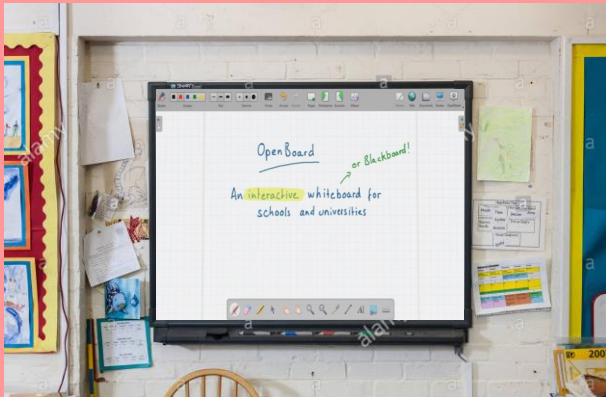


Recordings could be linked to QR code in students book ¹³⁸

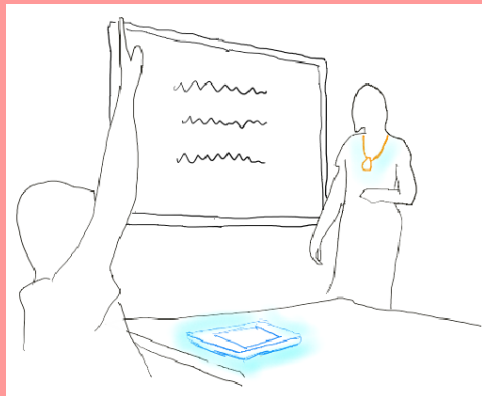


Potential Solution 1 Cont'd

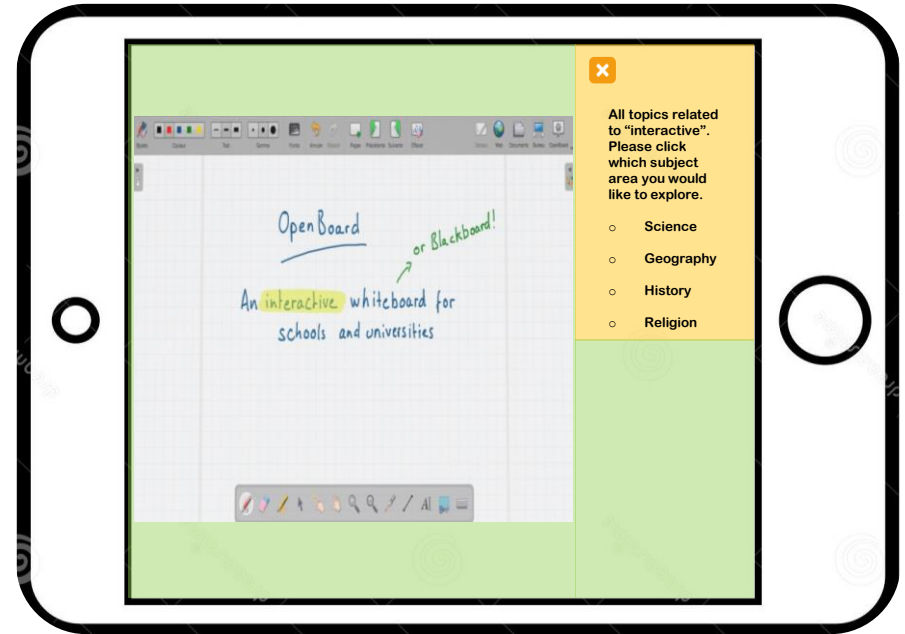
(Creating Cross-Links to Form a Concept)



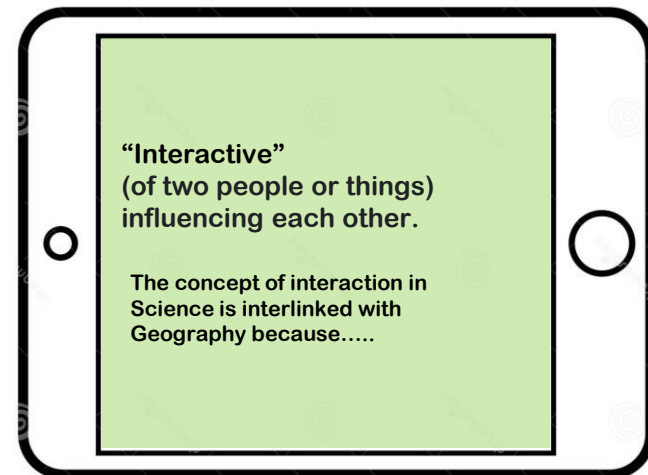
The tablet will be connected to the interactive whiteboard and that will be screen recorded on the tablet.



When the student highlights a word, it will provide them with the definition of the word and also identify cross curricular links to help the student understand the concept.



The student can highlight any term on screen and it will provide them with the subjects that the term is linked with on the curriculum.



Personas' Evaluation



Paul

This would benefit Paul in the classroom as it may make the workload easier for him. Having Paul within the classroom would increase his interaction which he craves.



Mr. Hayes

This would help Mr. Hayes as he would have to spend less time helping the student with ASD and be able to move around the room to help other students a bit more.



Simon

This solution would really benefit Simon as it would reduce the likelihood of him becoming overwhelmed when he doesn't understand something. It would also greatly benefit him in his ambition to be academically successful.



Katie

This solution would help Katie meet the needs of the student with ASD by assisting them in taking down the notes and the student would be easier to manage as they would not be as tired or confused.



Mary

Her son may not be as tired when he returns home from school as he would have some assistance in taking note etc. He would also have extra support when doing homework so this would relieve some pressure from Mary.

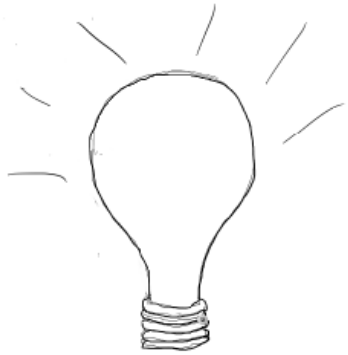


John

This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.

Potential Solution 2

(Keeping Focus/Attention)



A light could flash to focus the student again



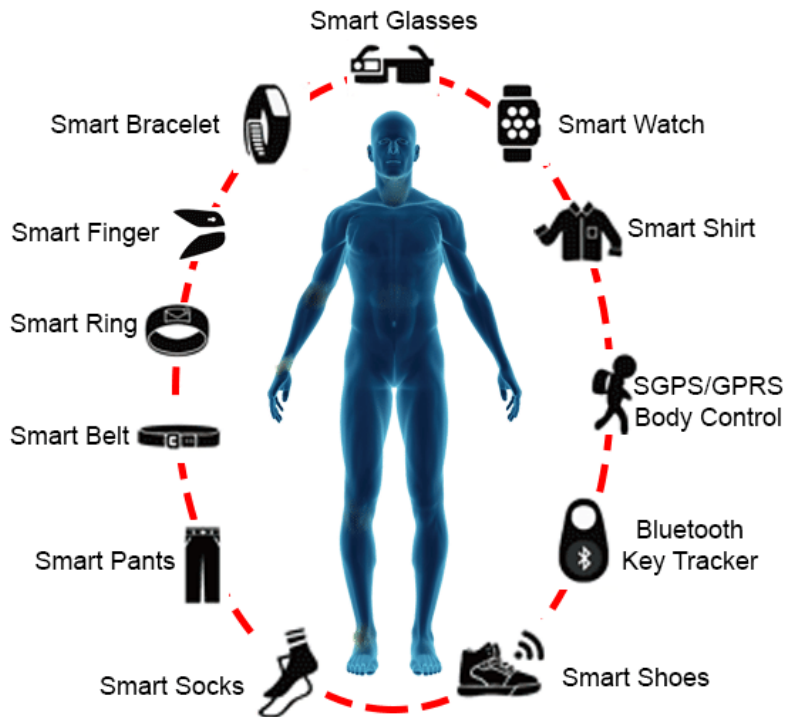
The device could tell the student to pay attention



The device can be integrated into/on to the students' ear



A smell could focus the student again within class.



The device could make physical contact with the student like a tap on the shoulder



There could be a vibration and the student could get a notification telling the student to pay attention.

Potential Solution 2 Cont'd

(Keeping Focus/Attention)

Identification of Real-Time Diagnostic Measures of Visual Distraction With an Automatic Eye-Tracking System

Harry Zhang, Matthew R. H. Smith, Gerald J. Witt

First Published December 1, 2006 | Research Article | [Find in PubMed](#)

Objective: This study was conducted to identify eye glance measures that are diagnostic of visual distraction. **Background:** Visual distraction degrades performance, but real-time diagnostic measures have not been identified.

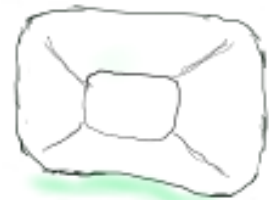
Conclusion: Correlation coefficients between several glance measures and reaction time or performance variables were reliably high, indicating that these glance measures are diagnostic of visual distraction. It is predicted that for every 25% increase in total glance

(Zhang et al. 2006)

Device attached
inside



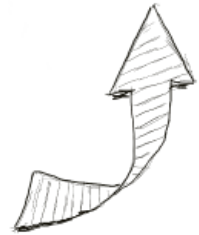
The device could be embedded in a rubber that could be attached to the inside of the users glasses. This would be more economic than buying new lenses or glasses.



A pair of glasses that can track eye activity and will vibrate when the student is not paying attention



The technology could be embedded into a lens that could be used in the users personal glasses frames



The technology could be embedded into a contact lens that would be connected to a watch. This would be much more subtle than a lens



A watch could be synced to the eye-contact/lens and flash to focus the student again.

Narbis Glasses Detect Brainwaves to Measure Attention, Turn Dark to Help Keep Focus

OCTOBER 29TH, 2019 MEDGADGET EDITORS OTC, PEDIATRICS, PSYCHIATRY



Similar Technology Available

A new device is coming out that aims to help people, particularly children, learn how to focus while doing homework, reading a book, and performing other attention demanding tasks.

The brainwave sensor can detect fluctuations in relevant brain activity and, once it notices that focus is being lost, the glasses slowly tint to become opaque. This forces the user to attempt to restore focus in order to continue performing the task. Doing so repeatedly is thought to improve the ability to stay attentive over extended time periods. This would be suitable for students with ASD as it is evident from the primary research that students with ASD tend to have poor attention spans.

Personas' Evaluation



Paul

The solution may make it easier for Paul to maintain focus and be part of the class and increase his interaction.



Mr. Hayes

This device would greatly help Mr. Hayes as he would not have to be constantly monitoring the student to see if they are focused and so he could continue to teach and help everyone in the class.



Simon

This would greatly help Simon in his ambition to be successful in school by maintaining his focus within class.



Katie

This will greatly assist Katie in keeping her student on task.



Mary

This device would help Mary's son maintain focus while doing his homework and leading to him being more productive. This would alleviate some stress for Mary.



John

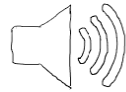
This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.

Potential Solution 3

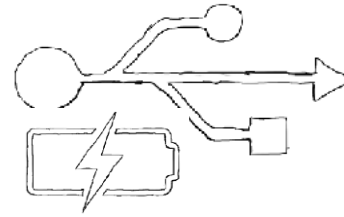
(Keeping Focus/Attention)



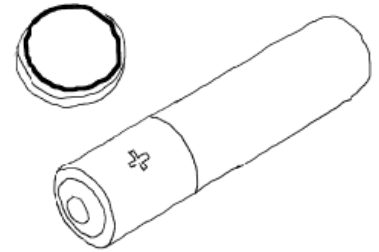
Inspiration taken from Fitbit exercise watches



Track pen movements so it can read back words when the user is tired.



USB charging from a mains plug



Batteries will be needed to power the device.



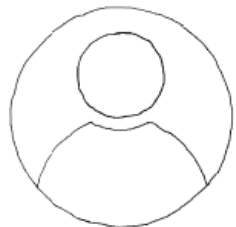
Praise



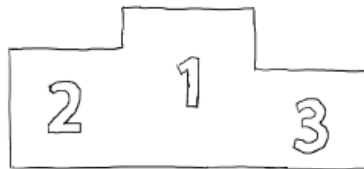
Motivation



Ergonomics



Personalisation



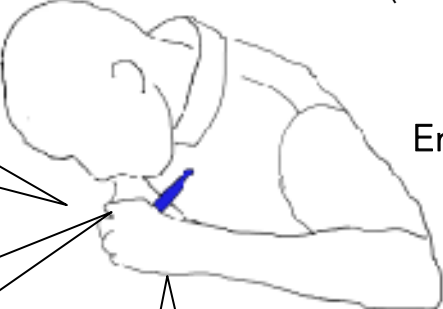
Competition



Potential Solution 3 Storyboard

(Keeping Focus/Attention)

Praise and Encouragement



"Congrats! You have written constantly for 25 mins!"

"Congrats! You have used 1% of ink! You have 38% remaining!"

"Well done! You're doing great! Keep it up!"

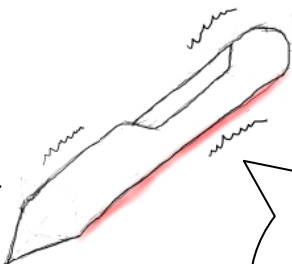
Motivation and Personalisation



"Mike, you are 25 words off your daily target! Get writing!"

"Mike, you haven't written in 10 minutes. Everything ok?"

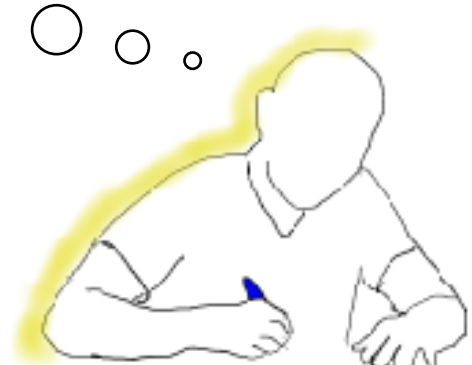
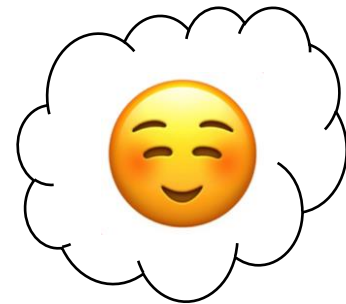
Competition



"You have 3 minutes to write as many words as you can! GO!"

You've been working really hard over the past 40 mins. How about a 5 min break?

Scheduled Breaks



Potential Solution 3 Prototyping

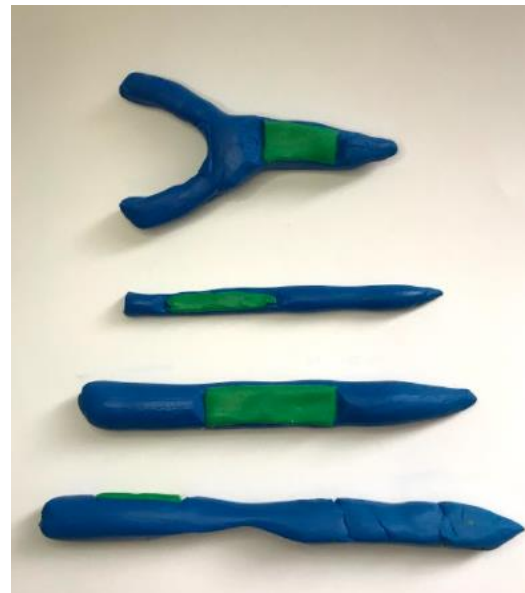
(Keeping Focus/Attention)



Iterations were created to investigate potential ways to rest the hand on/around the pen.

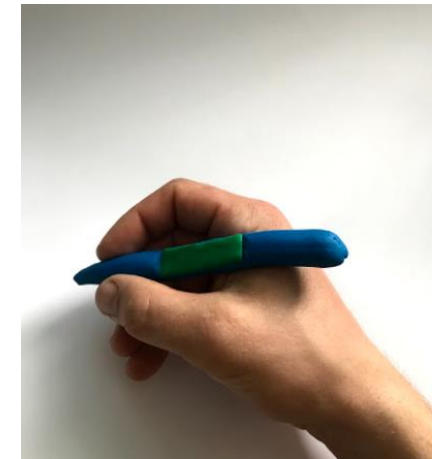


Pen too skinny for grip



Prototypes of the various pen designs were made with the positioning of the display screen on each in green.

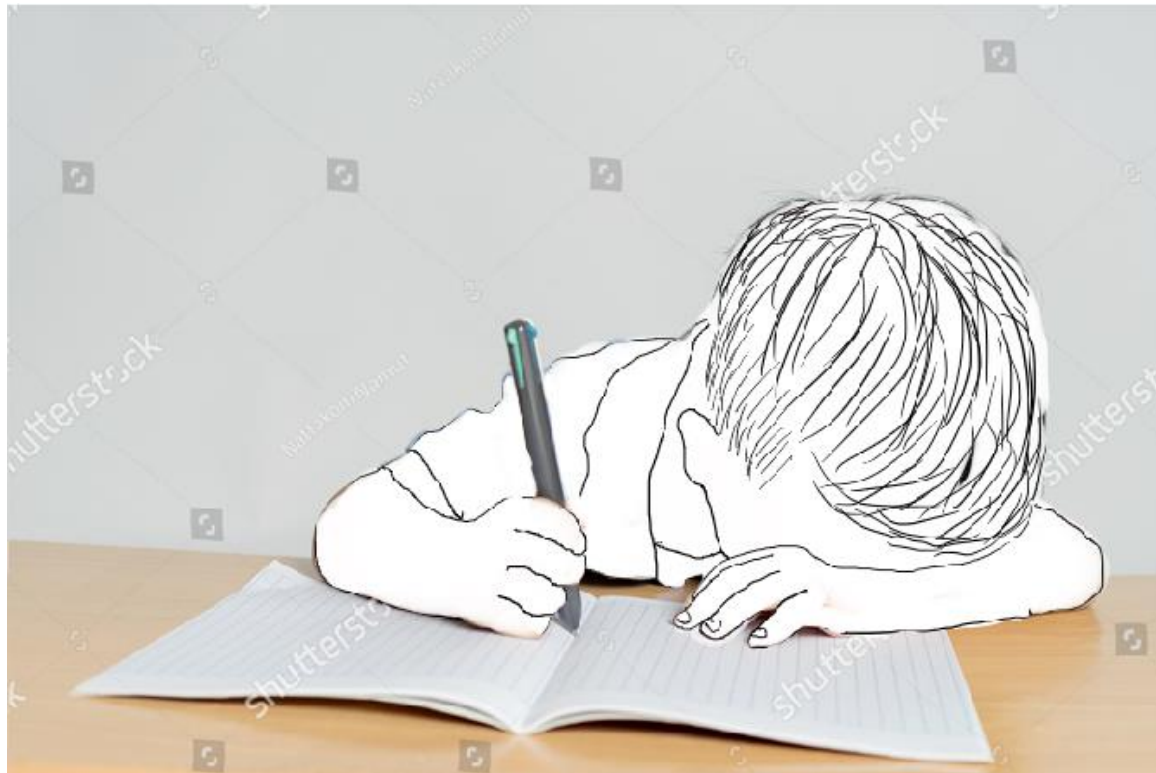
The curvature of the pen was considered. I don't feel it made a significant difference.



Thicker pen easier to grip and easier to fit electronics.

Potential Solution 3 Underlay

(Keeping Focus/Attention)



Personas' Evaluation



Paul

This solution may get Paul more engaged with his learning and improve his retention. This may help him spend more time in mainstream.



Mr. Hayes

This would help Mr. Hayes as he would be assisted by the device to help motivate the student to engage with the work assigned and would have extra time to help others.



Simon

This solution would be very beneficial to Simon as it would help him maintain focus and assist him when the workload becomes too overwhelming.



Katie

This will greatly assist Katie in keeping her student motivated and on task.



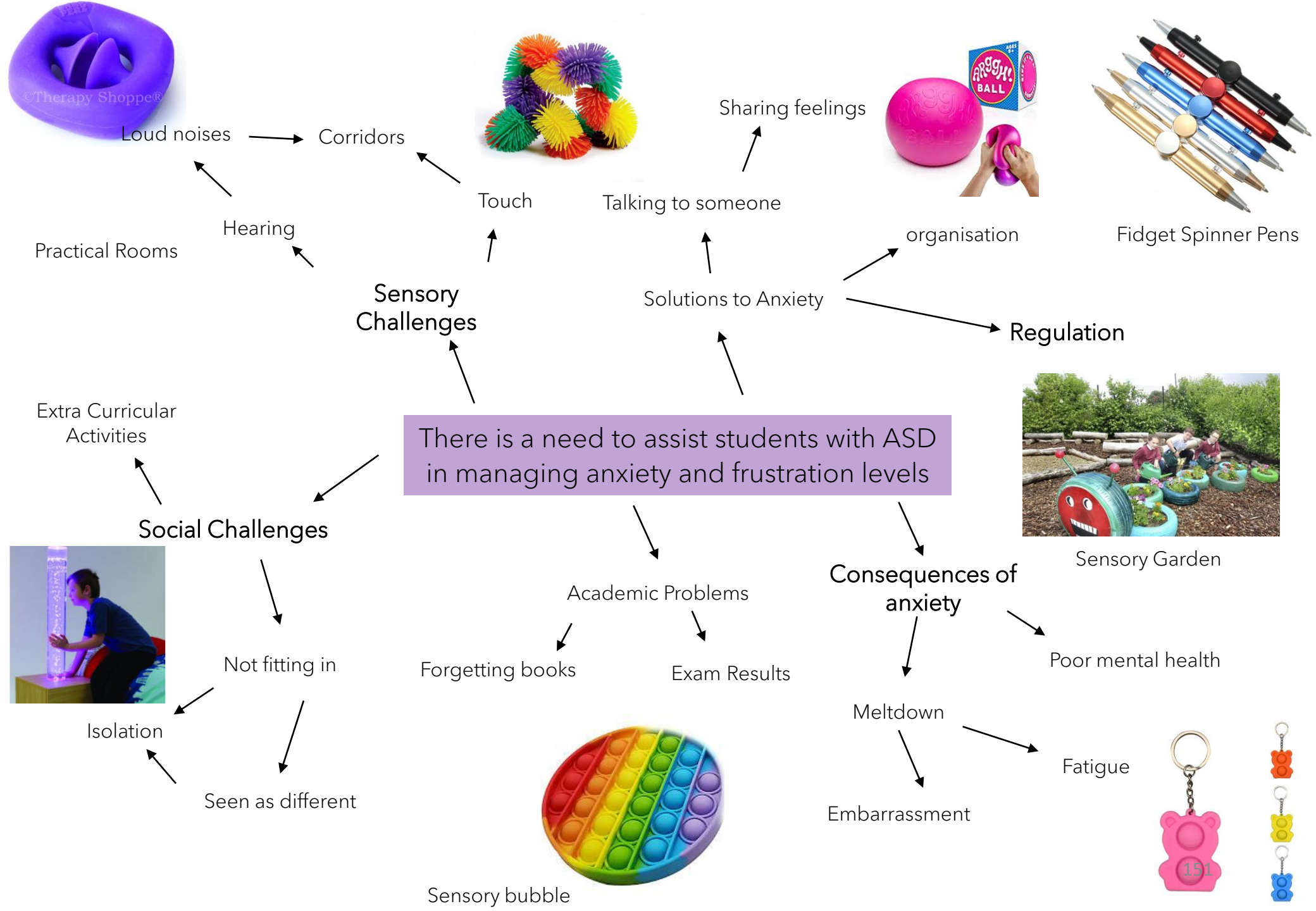
Mary

This device could be used by Mary to motivate her son to do homework. This would also make it easier for her to convince her son to attend school as he can set competitions for himself.



John

This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.



Ideation 2

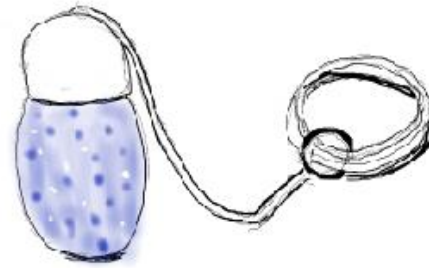
Reducing Anxiety

Literature Research/Evidence	Idea
<p>Alexithymia (challenges with emotional awareness) is often associated with anxiety for people with ASD. People with autism struggle with acceptance of their emotions and often push their feelings away. (South and Rodgers 2017)</p>	<p>A device that would help students with ASD share their feelings with others to help others gain empathy and understand them.</p>
<p>Social, communication and personal challenges were found to be key barriers to managing anxiety for people with ASD. (Nadeau et al. 2011)</p>	<p>A device that is subtle that would not impact on their social in school with their peers.</p>
<p>Anxiety may worsen during adolescence, as young people face an increasingly complex social milieu and often become more aware of their differences and interpersonal difficulties. (White et al. 2009)</p>	<p>It is key to design solutions to help students with ASD manage their anxiety where they are not seen as different by their peers.</p>

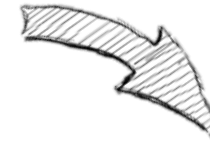
Potential Solution 4

Sensory Stimulation to Reduce Anxiety

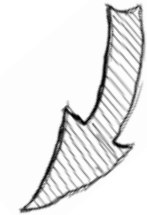
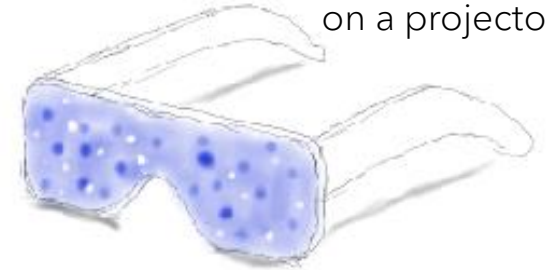
Spin the fidget spinner to generate bubbles in the sphere



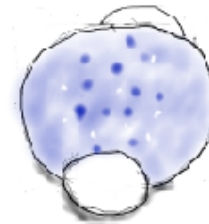
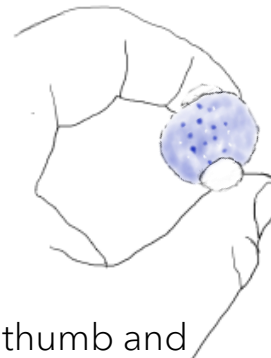
Lava lamp keyring



Glasses attachment that would portray bubbles like on a projector.



Fits between thumb and index



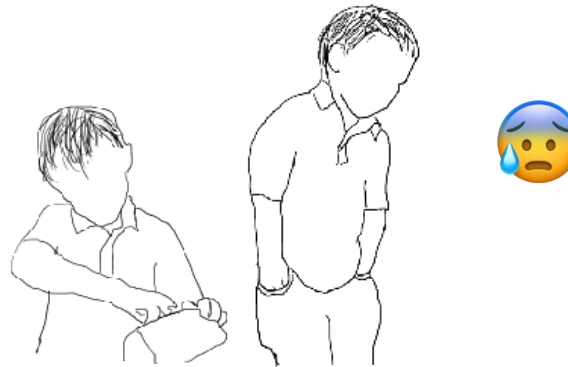
Squeeze the sides to make the bubbles.
Tactile and visual

Potential Solution 4 Storyboard

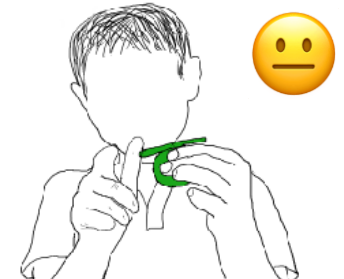
Sensory Stimulation to Reduce Anxiety



The student begins to feel stress/anxiety



He/she realises they need sensory stimulation and reaches for the device in their pencil case in the classroom or from their pocket in the general school environment.



He/she spins the device to generate the bubbles in the lava lamp until they feel their anxiety reduced.



The student is able to return to socialising or school work when he/she feels ready to do so.

Personas' Evaluation



Paul

This solution would help Paul when he becomes overwhelmed with work and needs to regulate.



Mr. Hayes

This solution would indirectly benefit Mr. Hayes as it would help regulate the student resulting in them being in a better headspace in the class and easier to teach.



Simon

This device would help Simon to reduce his anxiety levels when he becomes overwhelmed from workload. Reduced anxiety levels may put him in a better frame of mind to interact with others.



Katie

This will assist Katie when a student who is overwhelmed approaches her. She can give it to them so they can regulate their senses and may reduce the stress on Katie to help the student.



Mary

This device could be used at home and in school. It could be used at the activities that her son attends when he is feeling stressed. This may help him to interact better and form friendships as he would be more relaxed.

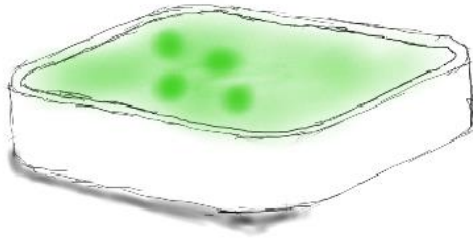


John

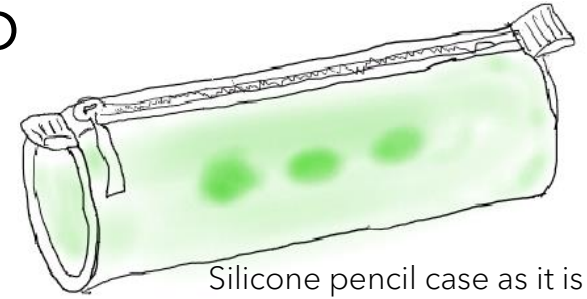
This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.

Potential Solution 5

Sensory Stimulation to Reduce Anxiety



Silicone sensory pad that can attach to the table



Silicone pencil case as it is subtle and accessible



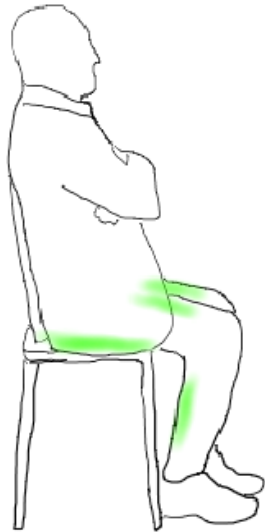
Silicone phone cover that they can use at home and in school.



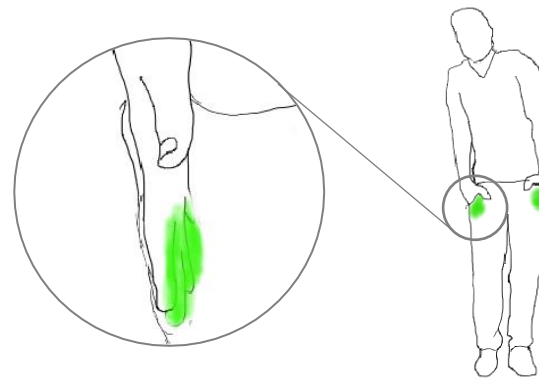
Vibrations could be added to enhance regulation



Waterfilled bubble instead of silicone



Sensory bumps/textures added to pressure points on trousers.



Silicone pockets so sensory regulation is easily accessible.



Potential Solution 5 Storyboard

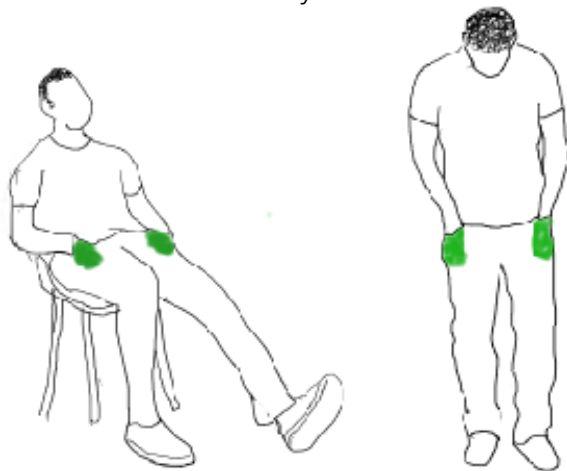
Sensory Stimulation to Reduce Anxiety



The student begins to feel stress/anxiety



The student can subtly self regulate individually or while chatting with friends.



The student will be able to self regulate either sitting down or standing up once they can access their pockets



The student can return to fully engaging in social interaction and learning once they feel comfortable doing so.

Personas' Evaluation



Paul

This solution would help Paul when he becomes anxious when interacting with his peers and may give him more confidence to do so.



Mr. Hayes

This solution would indirectly benefit Mr. Hayes as it would help regulate the student resulting in them being in a better headspace in the class and easier to teach.



Simon

This solution may help Simon to regulate himself when he is nervous about interacting with others resulting in him forming some connections with others around the school.



Katie

This will assist Katie when trying to calm the student down. It will also help the student interact with others and become less dependent on Katie.



Mary

This solution would not benefit Mary as much as other solutions but it could be worn by her son to activities outside of school if the activity allows. It may make it easier for her to manage her sons behaviours.

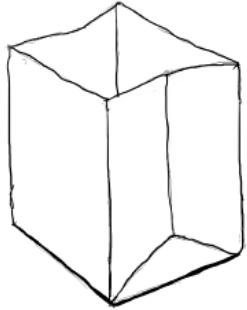


John

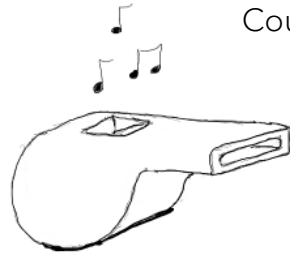
This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.

Potential Solution 6

Sensory Stimulation to Reduce Anxiety

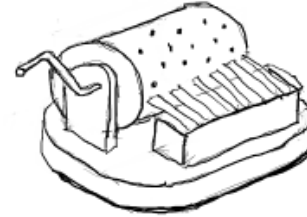


Paper bag used during anxiety attack.



Blowing a whistle for hyper ventilation

Could it play music?



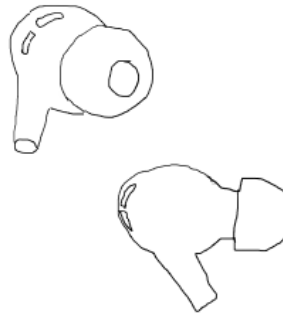
Similar design to a music box to make music



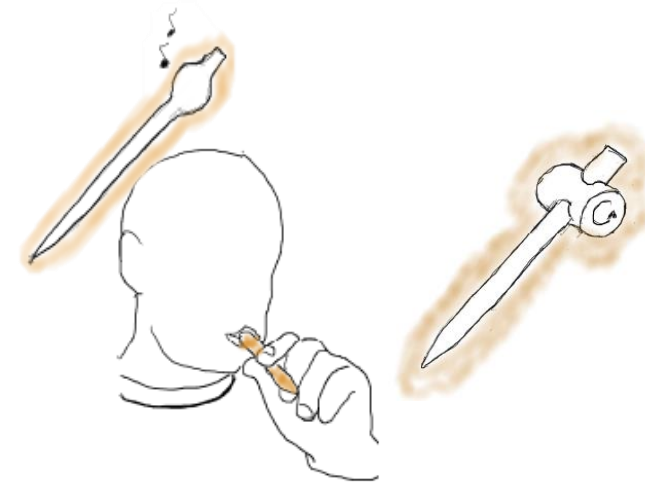
Could make soothing sounds like the birds or waves



Device can be subtle as the it can simulate someone who bites their pen while thinking



The sound could be transmitted through ear phones so no one else will know they are using the device.



Indication of how the device would work.

Back Pressure and Scents

Sensory Stimulation to Reduce Anxiety

Pursed Lips Breathing

- Pursed lips breathing is used as a strategy to treat hyperventilation.
- The exhale must be prolonged more than the inhale.
- The pursed lips creates a back pressure that opens up the airways and increases the secretion of CO₂.
- The technique gives the person control over their breathing while increasing their relaxation.

https://www.physio-pedia.com/Pursed_Lip_Breathing



Relaxing Scents

- The sense of smell can be used to reduce tension and stress within an individual.
- Lavender is commonly used in relaxation.
<https://www.mentalhelp.net/blogs/olfactory-sensations-smell-and-stress-reduction/>
- Other scents include:
 - Bergamot orange
 - Chamomile.
 - Clary sage.
 - Lemon.
 - Neroli.
 - Rose.
 - Ylang-ylang.

<https://www.medicalnewstoday.com/articles/324478>



Potential Solution 6 Storyboard

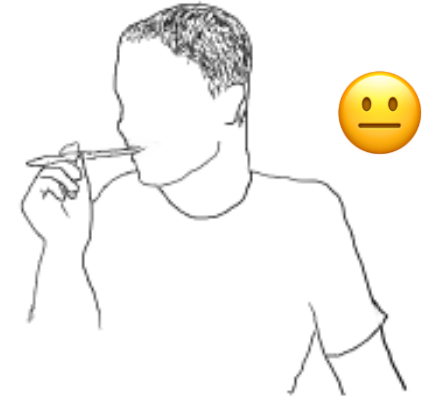
Sensory Stimulation to Reduce Anxiety



The user will experience anxiety or stress that may bring about a meltdown.



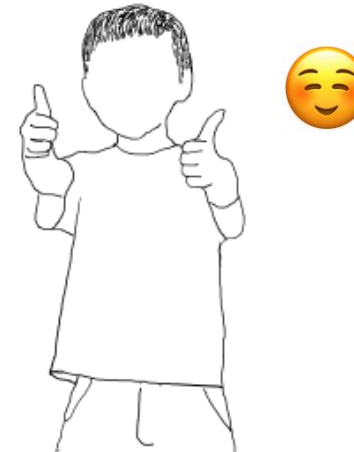
The user will reach for the device in his pencil case/bag



The user will blow on the device until they feel reduced stress.



The class can continue on oblivious to the fact that the student is treating his stress.



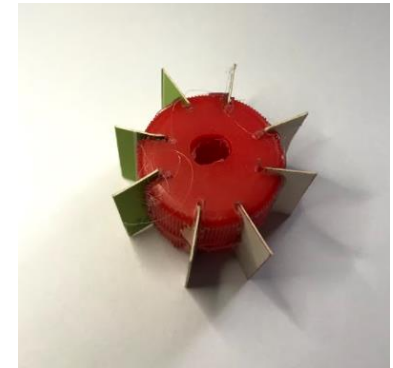
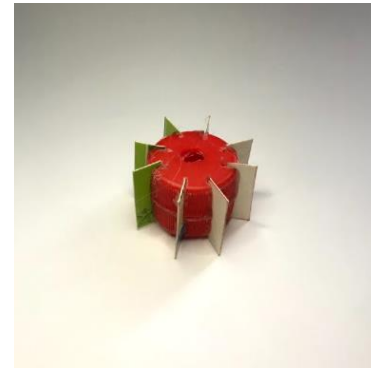
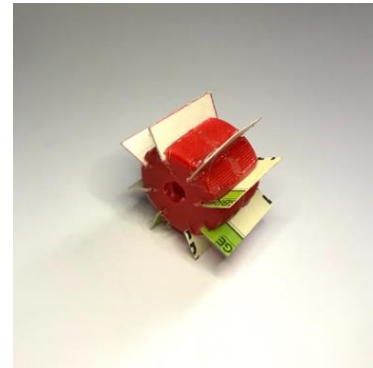
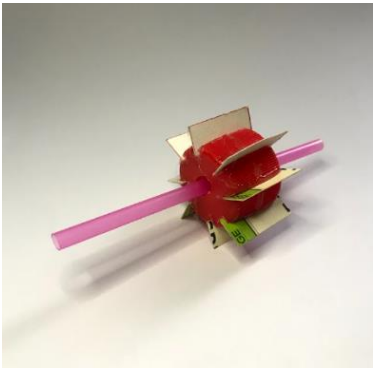
The user can treat his stress without any judgement from his peers.

Potential Solution 6 Prototyping

Sensory Stimulation to Reduce Anxiety



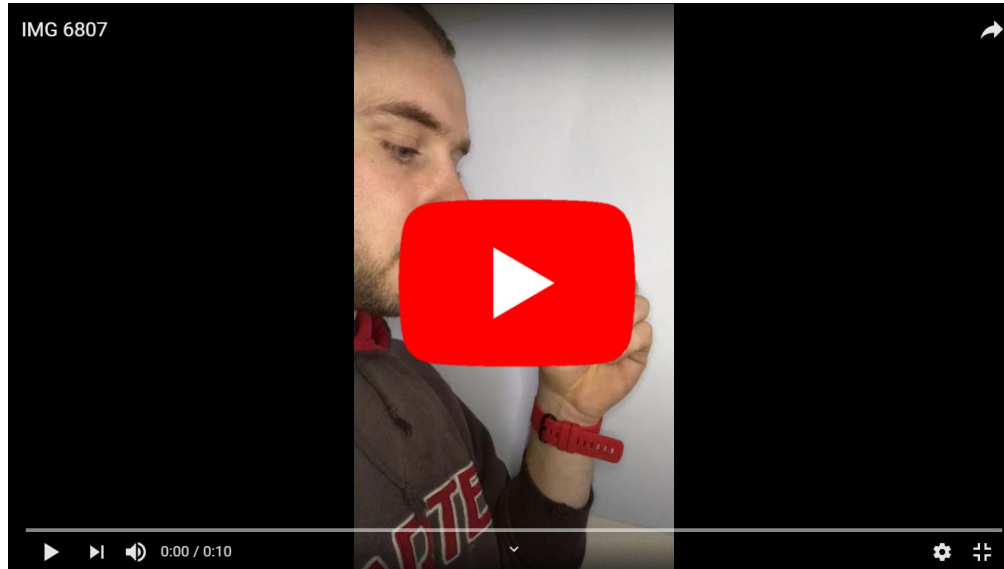
A prototype to test the subtlety of the solution. There was a whistle used for this prototype but the ergonomics of the mouthpiece would have to be explored further. The device would be very subtle to use and would not single out the student as different from the rest.



A prototype of the potential mechanism that could be used to create back pressure or the sound to create the soothing effect. It was effective and can be adjusted to increase/decrease the resistance.

Potential Solution 6 Video Prototyping

Sensory Stimulation to Reduce Anxiety



<https://youtu.be/X4h2wYjaMaA>

- o The video of the prototype shows how easy it is to move the mechanism.
- o There is a natural sound from blowing the device which could be utilised.
- o It is important to have the air entry off centre to ensure rotation of the mechanism.

Potential Solution 6 Underlay

Sensory Stimulation to Reduce Anxiety



Personas' Evaluation



Paul

This may assist Paul in reducing his anxiety levels while in class while not damaging his social status within his class. It is key for Paul that he is not seen as different in order to make friends.



Mr. Hayes

This solution would indirectly benefit Mr. Hayes as it would reduce the anxiety of the student resulting in them being in a better headspace in the class and easier to teach.



Simon

This solution will greatly benefit Simon when he becomes overwhelmed by the workload he has and it is a subtle way for him to relax without damaging his social reputation.



Katie

This will greatly assist Katie in helping the student when they become overwhelmed. If the student is happier, then it will be easier for Katie to meet the needs of the student.



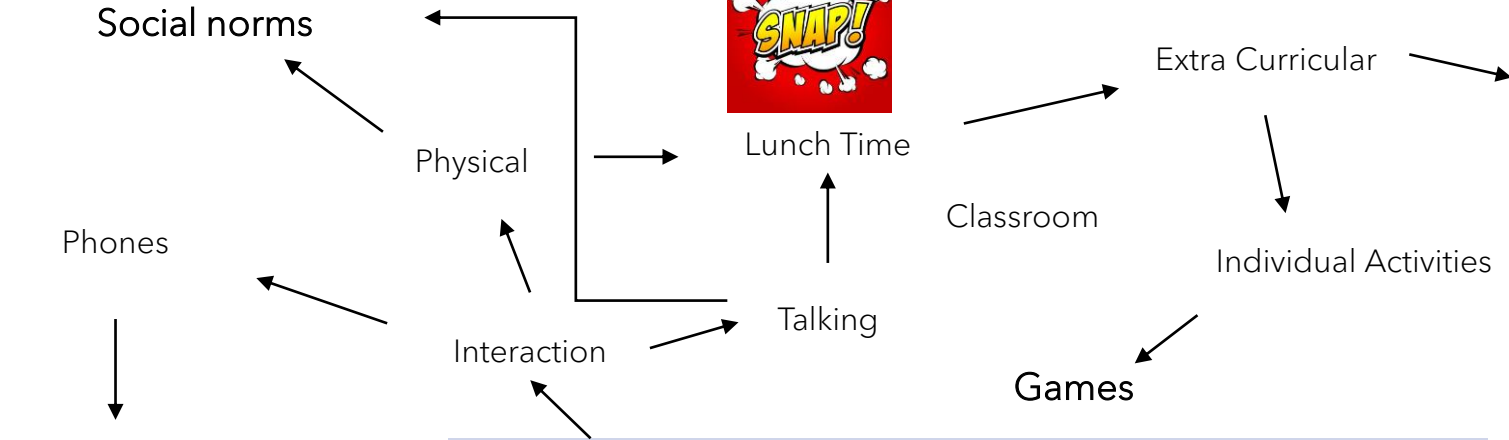
Mary

This solution may not help Mary as much. It could be used outside of school to alleviate stress but may not seem normal to have a pen in the boy's mouth outside of school the entire time.



John

This could be used by John if he is feeling overwhelmed. Students with ASD will also feel calmer and so John may feel more comfortable around them.

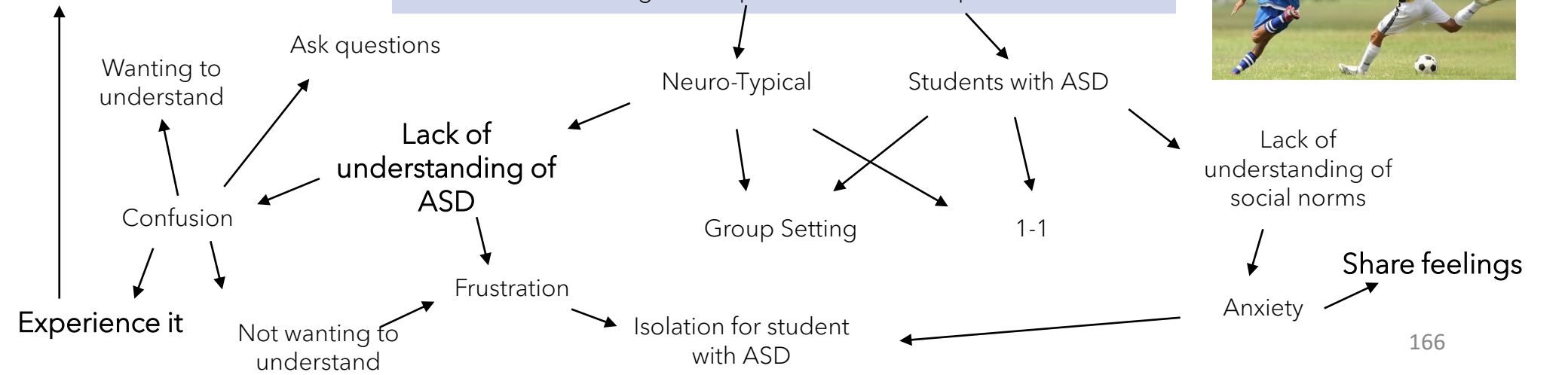


- o There needs to be a way to assist students with integration at an earlier stage of secondary school
- o There needs to be a way to support students and their social skills
- o Students need to be protected from bullying
- o There's a need to incorporate Neuro-typical students into the unit to remove stigma and normalise it.
- o There needs to be a way for students with ASD to feel more comfortable sharing their experiences with their peers.



Autism Day Activities

Experience the characteristics of ASD



Ideation 3

Literature Research/Evidence	Idea
<p>Empathy is a key factor in the success and intimacy of same sex friendships. It was also identified as a key driver of effective conflict management.</p> <p style="text-align: right;">(Chow et al. 2013)</p>	<p>A solution that allows students with ASD to share their experiences with the general school population with the aim of generating empathy among neuro-typical students. This may improve the social experience of the autistic student.</p>
<p>Cognitive Behavioural Therapy (CBT) is often used to alleviate stress and anxiety. It does this through 6 components 1. assessment of mood disorder,(2) affective education, (3) cognitive restructuring, (4) stress management, (5) self-reflection, and(6) practice.</p> <p style="text-align: right;">(Scattone and Mong 2013)</p>	<p>A solution that will allow the student to reflect on a social scenario that may not have worked out well for them. They can do this by recording the experience after it has happened and relive it through virtual reality.</p>
<p>Serious games are used as a learning tool o educate people on skills that they need to acquire. The serious game should have a storyline that is easy to follow that will keep them motivated to play the game. The game should also have the goals of the game targeted around the skills that need to be acquired by the player.</p> <p style="text-align: right;">Whyte, Elisabeth M</p>	<p>Design a game that would encourage the player to interact with others and teach them the strategies and skills to do so.</p>
<p>Students with ASD may not feel comfortable approaching teachers face to face when they are struggling. They would prefer if teachers approached them.</p> <p style="text-align: right;">(Humphrey and Symes 2010)</p>	<p>A solution that would allow students to communicate with teachers without having to confront them directly. This would reduce the likelihood of them having a meltdown and avoid/reduce the risk of social embarrassment. This may make it easier for them to interact with their peers.</p>

Potential Solution 7

Improving Social Interaction Through Education and Sharing Feelings



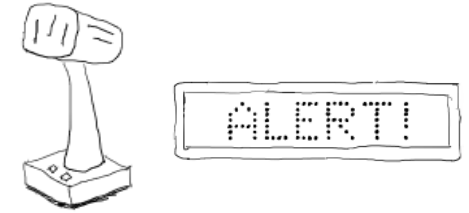
Target Neuro-Typical to help them understand.



Record feelings orally, typing or writing



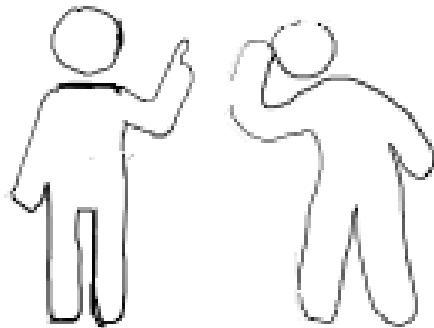
A comment/feeling is randomly chosen



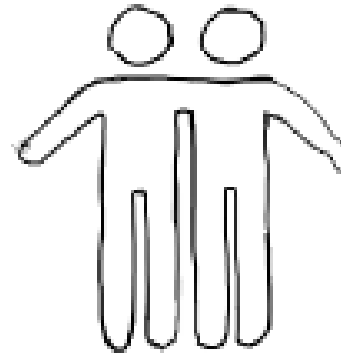
The comment/feeling could be read anonymously out over the school intercom or on a digital display board for the day.



Fortune Cookie? Neuro-Typical Students share experiences.



Other students will see/hear the experiences and feelings of the students with ASD and may be more understanding and empathetic.



With more understanding, neuro typical student may make more time for students with ASD.



Teachers will also be able to apply strategies to help the student if they understand how they're feeling.

Potential Solution 7 Storyboard

Improving Social Interaction Through Education and Sharing Feelings



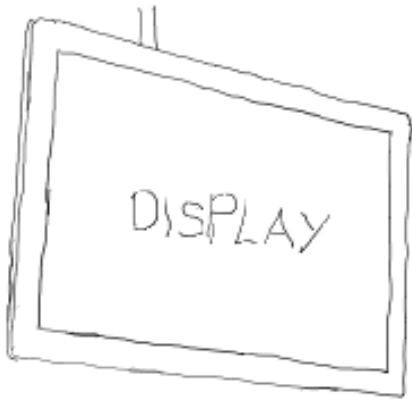
The student has an experience that he would like to share but finds it difficult.



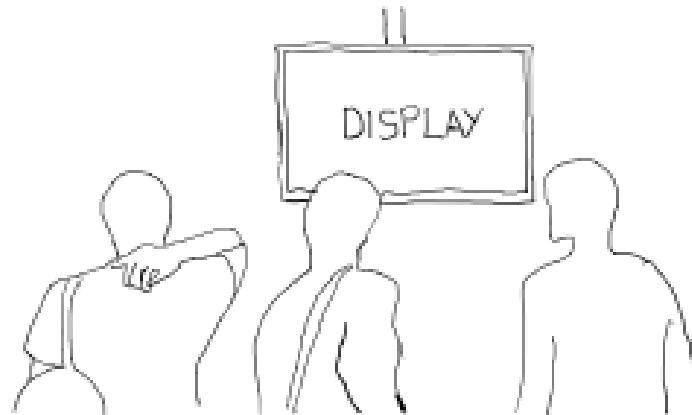
The student records the experience anonymously.



The experience will be chosen randomly by a teacher.



The experience will be shared on a display screen in the assembly area of the school.



The general school population will be able to read it and experience some empathy for the autistic student.



With some empathy acquired, the neuro-typical students may make an effort to interact with autistic students.

Personas' Evaluation



Paul

Helping Paul to share his feelings anonymously may help educate people about autism and they may understand him better and reach out to him.



Mr. Hayes

This solution would greatly benefit Mr. Hayes as he would be able to gain some empathy through reading/hearing some of the experiences of his students.



Simon

The ability to share feelings may help others to understand Simon's perception of experiences around the school and may provide a medium for him to offload the anxiety he may feel around the subject matter. This may also be a medium for him to speak as he doesn't feel comfortable speaking to others.



Katie

This solution would help students integrate with others in the class and so they would become less dependent on Katie for company.



Mary

This solution may not meet Mary's needs directly outside of school but it may help her son interact with others in school resulting in her son being in a better head space when he comes home.



John

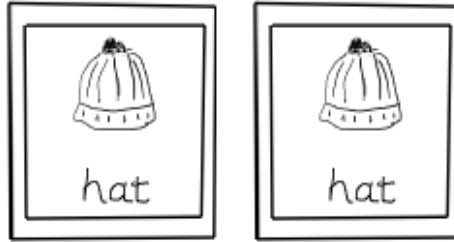
This would help John gain some empathy when trying to understand experiences from the perspective of the autistic student.

Potential Solution 8

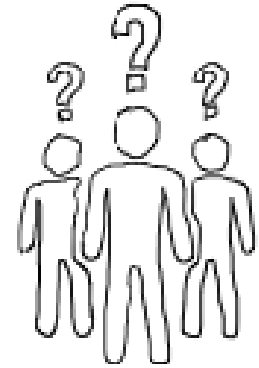
Improving Social Interaction



Jigsaw with a missing puzzle piece. They need to find the person who has it.



A game of snap to encourage people to go around and ask if they have the same card



Students will be encouraged to communicate with each other to find the match.



Play guess who with the profiles of the other students in the year. This will help the student to get to know their peers before interaction and will give them more confidence.



The activity would be carried out during the first days of school to encourage the transition from primary to post primary school



A dice with various different social challenges and they receive points for each challenge

Potential Solution 8 Storyboard

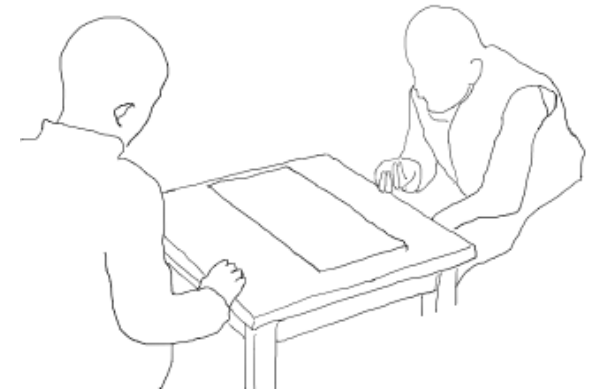
Improving Social Interaction



The student is starting secondary school on their first day.



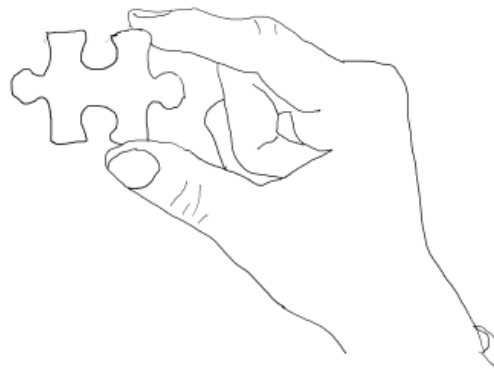
They may feel nervous and lonely and take refuge in their phone.



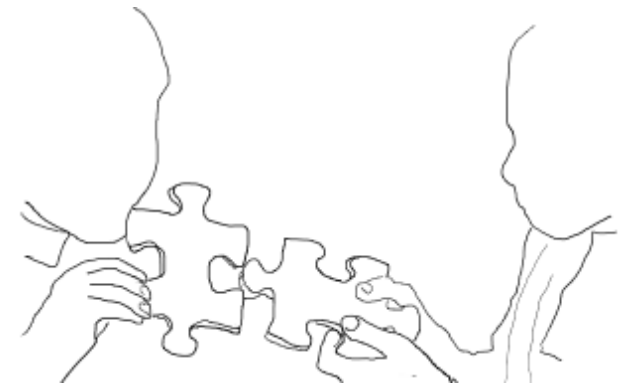
The student engages in the guess who game with a teacher to get to know the other students in his class



The student could then engage with some challenges decided by a dice.



The student could then look for the student with the final jigsaw piece or matching snap card.



The student may be able to identify a partner to complete a themed jigsaw with where the challenge is that they complete it with actions only and no oral speech.

This is a suite of games to gradually build the autistic child up to interacting with others in their class and potentially making a connection with someone.

Personas' Evaluation



Paul

This solution may help Paul to interact and get to know his peers. The teachers can decide what level he is at and recommend an appropriate game for him.



Mr. Hayes

This may not help Mr. Hayes but it may assist him in helping his students integrate with one another.



Simon

This solution would help Simon interact with others as the chosen game can be selected according to his level. While saying this, this solution would be more suited to someone starting out at second level education rather than someone leaving it.



Katie

This solution would help students integrate with others in the class and so they would become less dependent on Katie for company.



Mary

This would help Mary in her hope to help her son make friends. Maybe this could be used at home if a friend calls over or she could play with her son to help him get to know his classmates.

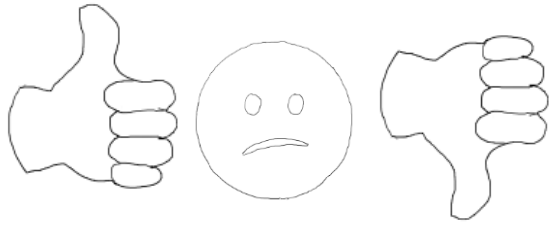


John

This could help John interact with the autistic students as it would create a topic for them to have a conversation and remove the challenge that may normally be there.

Potential Solution 9

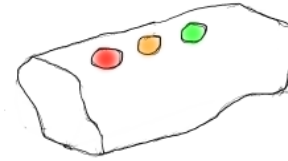
Improving Social Interaction by avoiding embarrassment from meltdown.
Promoting collaboration among teachers



Quick symbols to allow the students with ASD tell the teacher how they are feeling as they enter the class.



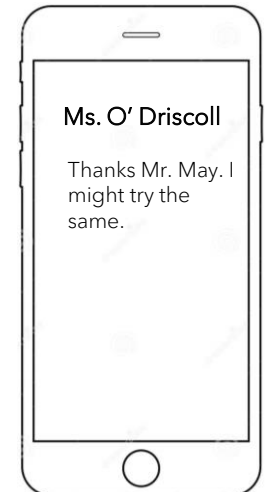
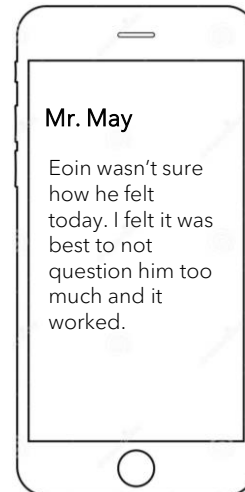
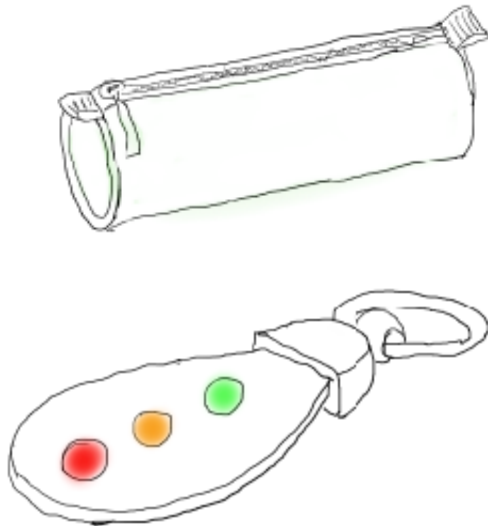
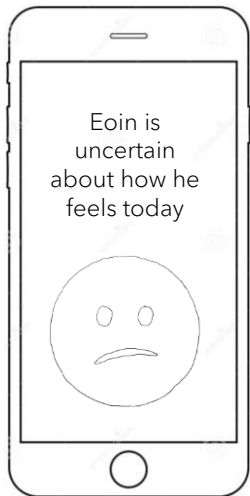
Data could be collated on the behaviours of the student in different circumstances to understand triggers.



A handsfree device that can fit in the users pocket with buttons integrated



There is a need to encourage communication and collaboration among teachers to understand and implement the best strategies to the best of their ability

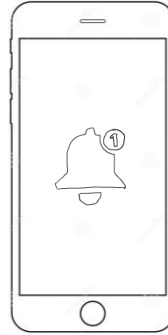


Potential Solution 9 Storyboard

Improving Social Interaction by avoiding embarrassment from meltdown.
Promoting collaboration among teachers



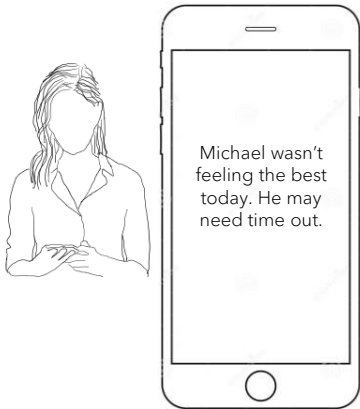
The student walks into the class and presses the button to show how he's feeling



The teacher will receive a notification on how the student is feeling.



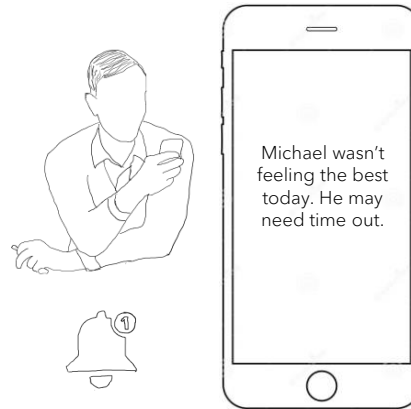
The teacher will check to see the status of the student.



At the end of class, the teacher can leave a comment on how the student is behaving/feeling.



The student presses the button when he enters the next class.



The teacher will receive a notification and the comments previous teachers made on him.



At the end of class, the teacher will leave a comment to add to the bank of comments.

Potential Solution 9 Prototyping

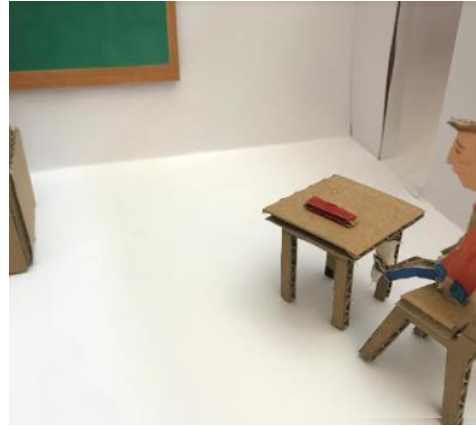
Improving Social Interaction by avoiding embarrassment from meltdown.
Promoting collaboration among teachers

1



Paul enters the room and he is not feeling the best.

2



Paul takes a seat at his desk and presses the button to communicate how he's feeling.

3



Ms. O'Driscoll receives a notification that Paul isn't feeling the best so she knows she needs to be more understanding.

4



At the end of class, Ms. O'Driscoll types a comment on how Paul behaved and performed in the class.

5



Paul enters the next class and presses the button to share how he is feeling with his new teacher.

6



Ms. Ryan receives the notification and comment posted by Ms. O'Driscoll and alters her strategies to try accommodate Paul.

Potential Solution 9 Underlay

Improving Social Interaction by avoiding embarrassment from meltdown.
Promoting collaboration among teachers



Personas' Evaluation



Paul

As this device helps users communicate their feelings with others in a non-verbal manner, it would be an ideal support for Paul.



Mr. Hayes

This solution best meets the needs of Mr. Hayes. It provides him with an insight into the thoughts and feelings of his students and he can adjust his lesson and strategies accordingly.



Simon

This solution would greatly benefit Simon as he would be able to share his feelings with teachers that he would have found particularly difficult to do previously. Teachers will then have a better understanding of him.



Katie

This solution will help Katie ensure that the student is in the correct frame of mind by allowing the communication between the student and the teacher.



Mary

This solution does not directly impact Mary only that her son may come home happier from school and she knows that efforts are being made to meet her son's needs.



John

This device would probably not be used by John but the impact it would have on others may reduce their anxiety and make John more comfortable around them.

The student is role playing real life experiences that they have already witnessed instead of situations constructed by a teacher which may/may not occur.

Potential Solution 10

Improving Social Interaction



Role Play



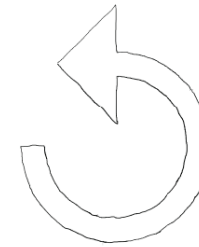
3D Imaging of the area the event took place.



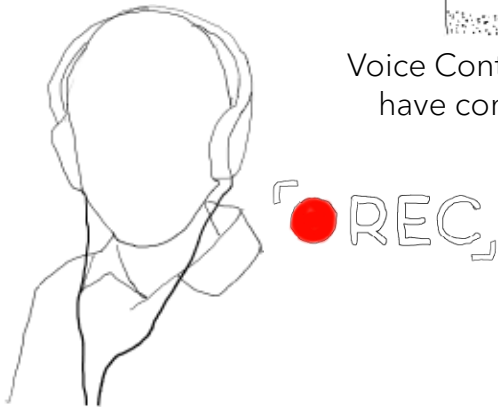
Use of virtual reality to relive the event.



Voice Control/Voice to have conversation



Ability to repeat and practice



The student would record the event with a script.



An ear piece could prompt the student in what to say after gathering data on previous experiences practiced



The student could wear a GoPro to record the event.

Potential Solution 10 Storyboard

Improving Social Interaction



A social moment occurs where the autistic student feels embarrassed or could've done better



The student returns to the unit to record the event as a dialogue script of the conversation



The script will be prepared and the virtual environment will be programmed using a computer.



The student will reexperience the conversation in the virtual reality and role play how he would respond to the situation.



The student can practice over and over again until he feels comfortable to respond to similar situations.



Potential Solution 10 Prototyping

Improving Social Interaction



Simon has an interaction with a peer resulting in embarrassment for him.



Simon returns to the ASD unit to record the interaction on the device.



The teacher uses the 3D imaging from the environment to recreate the interaction using VR.



Simon can relive the experience and practice his response if he was to experience this again.



Simon will encounter similar situations where he will be able to apply the skills he has practiced and learned.

Potential Solution 10 Underlay

Improving Social Interaction



Personas' Evaluation



Paul

As Paul has had many unsuccessful encounters with peers, this would be the ideal solution for him to practice his interactions and hopefully build relationships with others in his class.



Mr. Hayes

This may not help Mr. Hayes but it may assist him in helping his students integrate with one another.



Simon

This solution would greatly benefit Simon as he has a fear of social humiliation when speaking and interacting with others. It gives him the opportunities to practice real life situations where he can then apply what he has learned when they appear again.



Katie

This will assist Katie in helping the students integrate and she will become less dependent on her.



Mary

This device could not be used at home but would be helpful in helping her son to interact and these skills can be used outside of school.



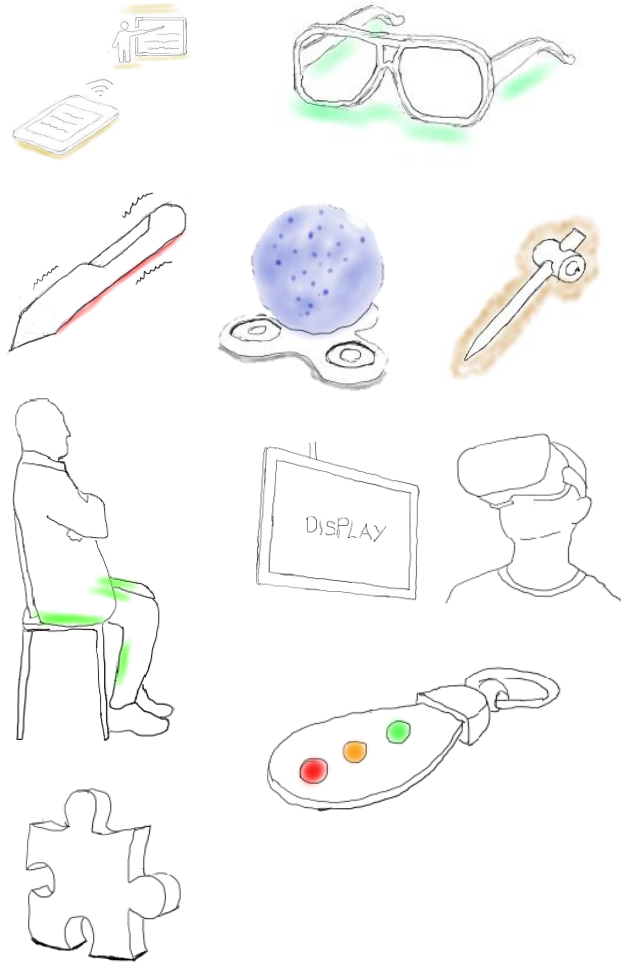
John

This will not be used by John but may help him interact with students with autism as they gain an understanding of the social norms.

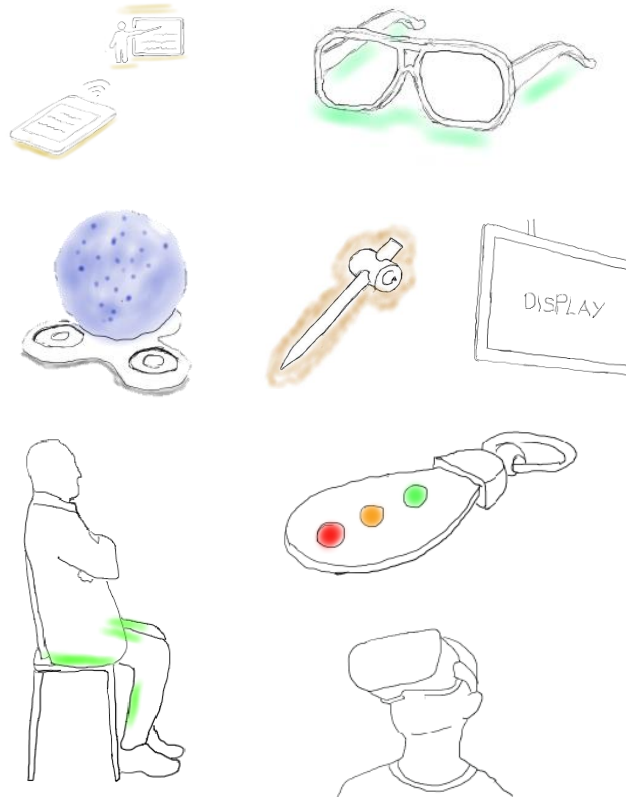


Ideation Conclusion

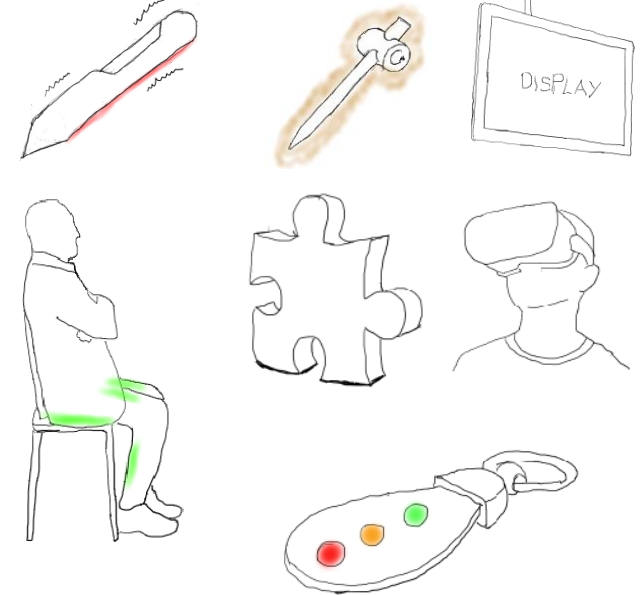
The solution must improve the overall school experience of the student with ASD.



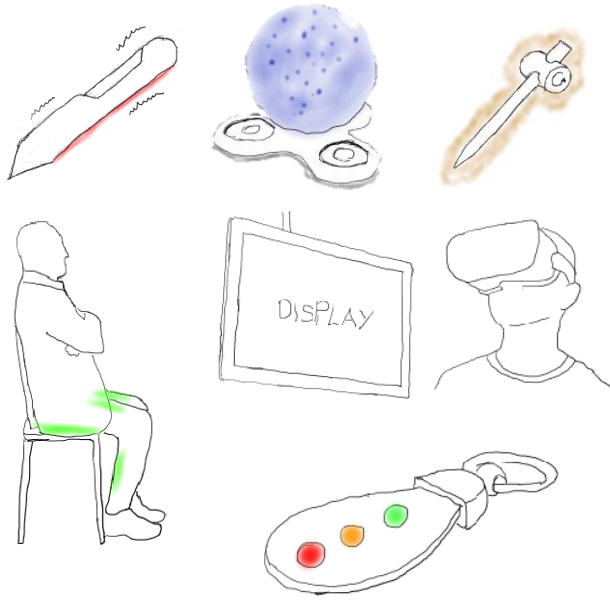
The solution must address as much of the student's school life as possible.



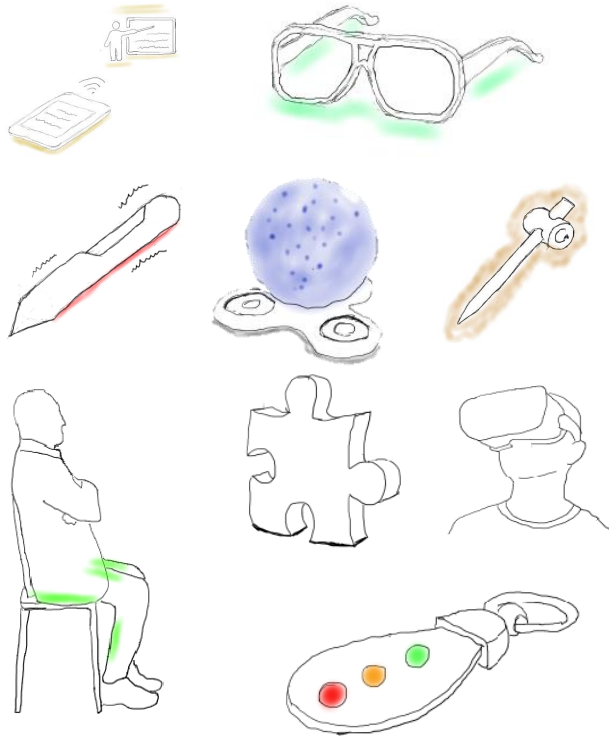
The solution must make the student feel more included



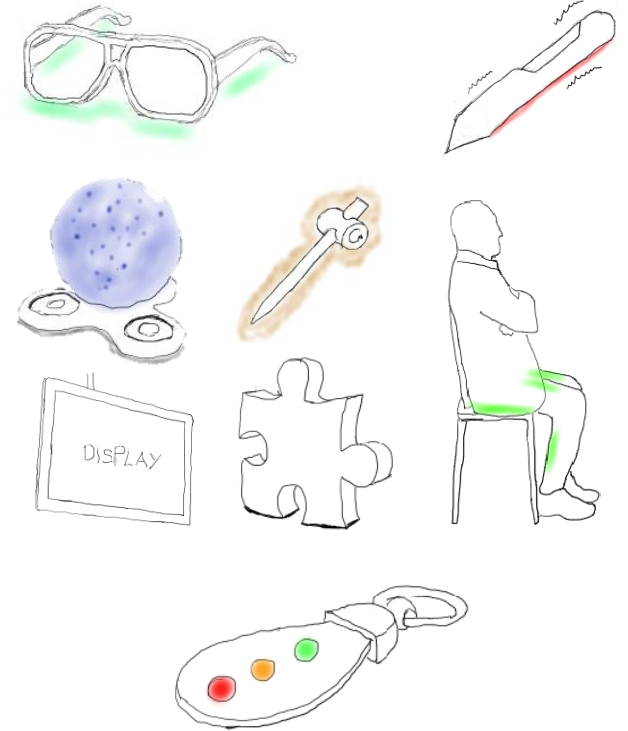
The solution must make the student feel safer within the school environment.



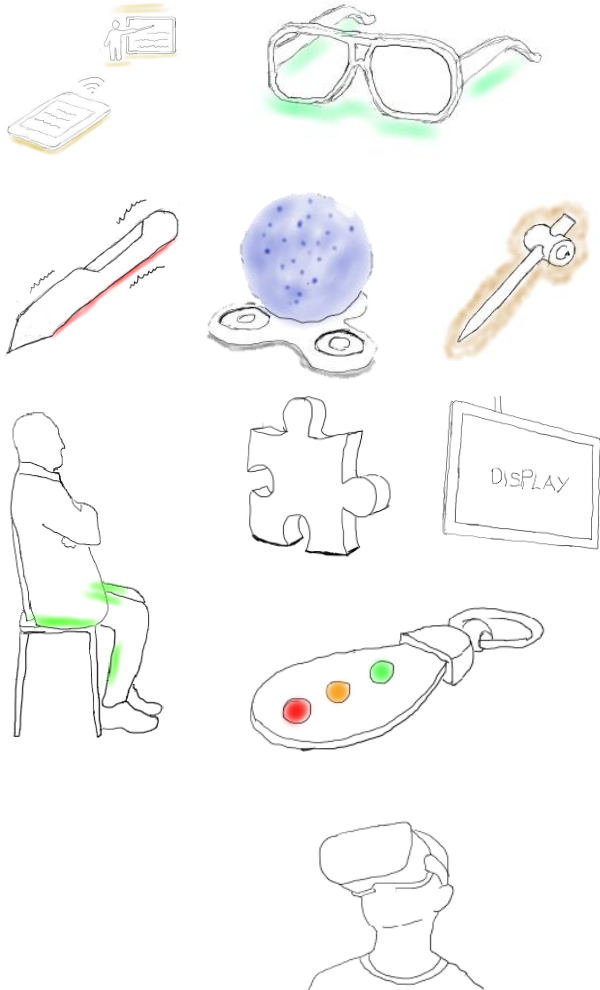
The solution must not cause any harm to the user or those around them.



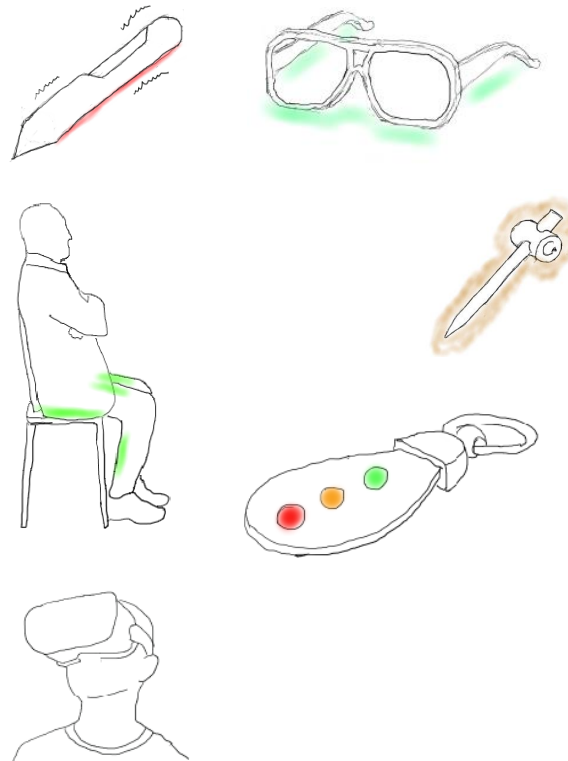
The solution must be easily operated.



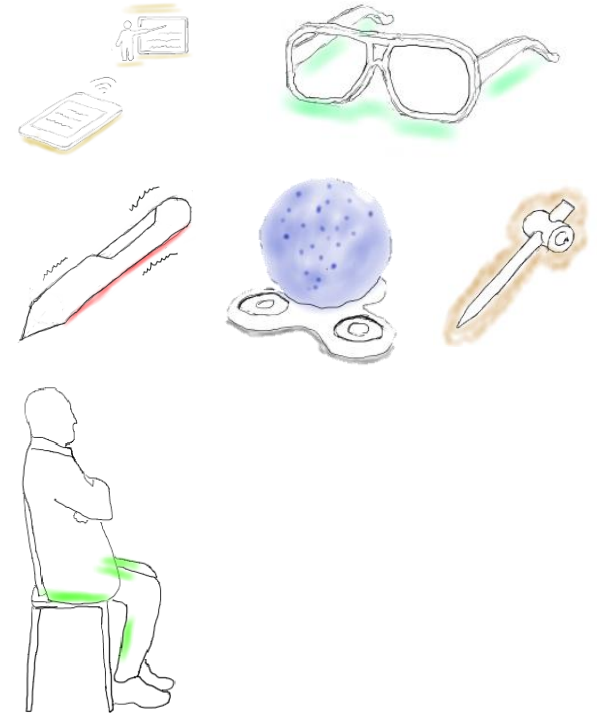
The device must be reusable.



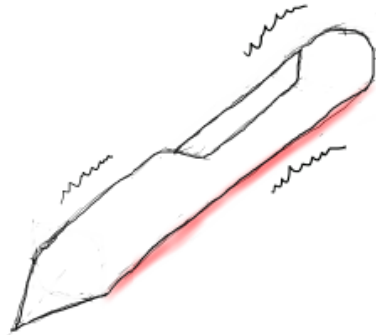
It would be nice to have a solution that's subtle.



It would be nice if the solution could be used outside of school also.



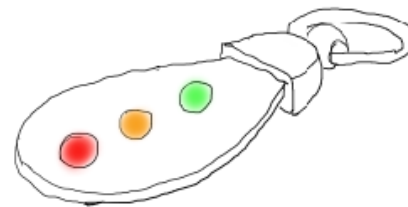
Chosen Ideas for Conceptualisation



- The pens were chosen as they met 7 out of 9 requirements of the design criteria.
- The subtlety is key if the student with ASD doesn't want to be seen any different.
- It can be used anywhere at any time throughout the day.
- It can also be used by neuro typical students who may experience anxiety or need motivation.



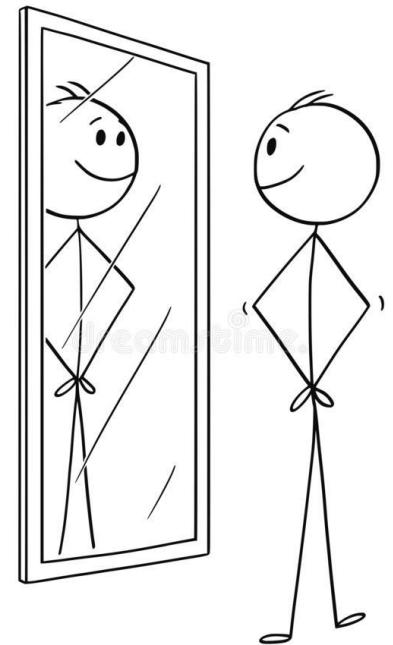
- The virtual reality role play met 7 of the 9 requirements of the design criteria.
- There could be major benefits to the student as they are reliving experiences that are real and practical.
- It can be used with their experiences with different people.
- It is more enjoyable than the worksheets they may have to fill out regarding role play.



- The communication keyring met 8 of the 9 requirements of the design criteria.
- It is a very subtle device that will not impact on their social status and other students may not even recognise they have it.
- It allows teachers to communicate effectively with one another which was a key deficiency identified in the primary research.
- It makes it easier for the student to communicate how they are feeling.

Reflection

- There are a wide array of ideas which all meet different needs of the potential users and improve their quality of life as a whole.
- I found it difficult to ideate individually on my own at times and found it really beneficial to brainstorm with peers in my class and other field experts.
- I recognise the need to speak to field experts and understand why some ideas would work and why other wouldn't.
- I feel my sketching has improved significantly in comparison to previous projects.
- I am happy that my sketching and presentation has improved but I still feel my presentation and graphical skills need improvement amid the very helpful advice I received from Niall.
- While there are some blue sky ideas, I found it very difficult to venture into deep blue sky territory.
- As most ideas help the end user significantly, I found it difficult to narrow the ideas down to three (the ones I will take forward to concept development).
- The main objective of this section was to ideate a vast array of ideas based on the needs extracted from the primary research. I feel I have done that as the ideas cover a vast array of needs and so I am happy with this section and they work I have put into it.



- Concept selection (field experts)
- Background Research
- Identifying Design Features
- Low fidelity prototyping and 3D printing
- Collaborating with field experts
- Grip concept
- Prototyping (3D printing)
- Pressure point design
- Gripping mechanism
- Evaluation
- Gripping mechanism (Iteration 2)
- Electrical components
- Charging device
- Manufacture and assembly
- Redesign for injection moulding
- Ultrasonic welding
- Materials
- Life cycle analysis
- Assembly process

- User storyboard
- Part Drawings

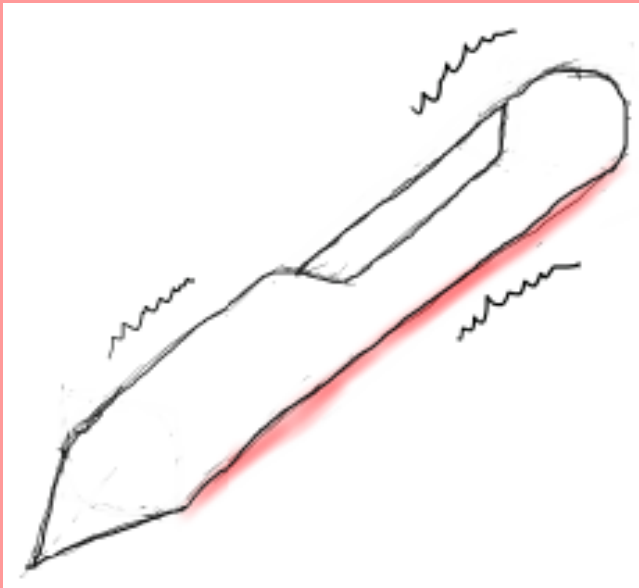
The App

- Rationale
- App features
- Task flows
- App graphics (fonts and colour schemes)
- Logo
- Various screen developments
- Parent monitoring
- Teacher version of the app
- Motivational messages
- Risk analysis
- User testing
- Persona evaluation
- Evaluation as per needs requirements
- Evaluation as per design guide

Concept Development

Solution 1

A Fitbit style pen that motivates and engages students with ASD.



Pros

- Meets my strengths in prototyping
- Subtle
- Can be used by neurotypical students also.
- Novel idea
- Can address dexterity through ergonomics.

Cons

- How far can the solution be taken
- How effective would it be in encouraging the students to engage.

Solution 2

A pen that can be blown into by the user to reduce anxiety.



Pros

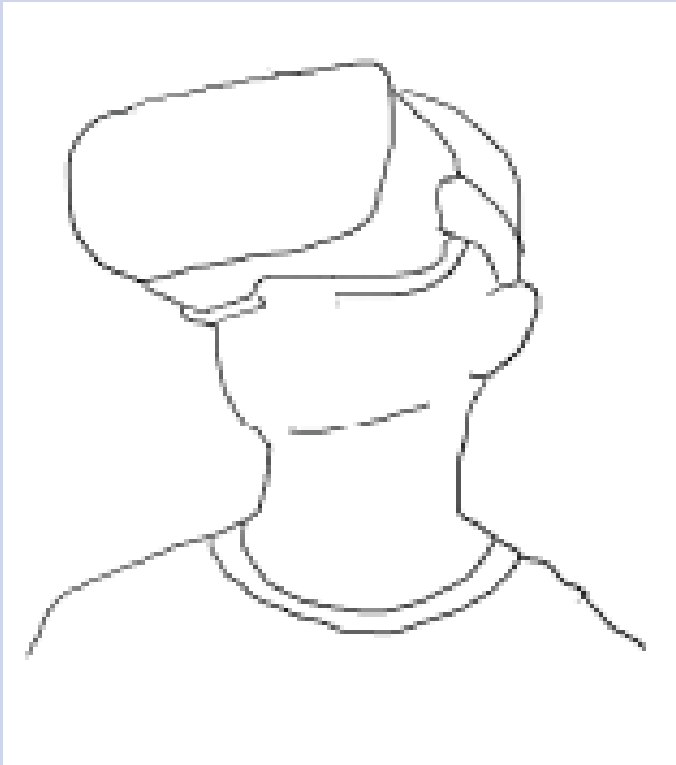
- Meets my strengths in prototyping
- Subtle
- Different from the traditional fidget toys.
- Can be ergonomically attractive.
- Can be taken different angles ie. Scents and sounds

Cons

- Challenges in not interrupting classes with sounds.
- Just addresses the needs of the student with ASD. May not support others in assisting them.

Solution 3

A virtual reality technology where students can practice social incidents with peers so they will perform better next time.



Pros

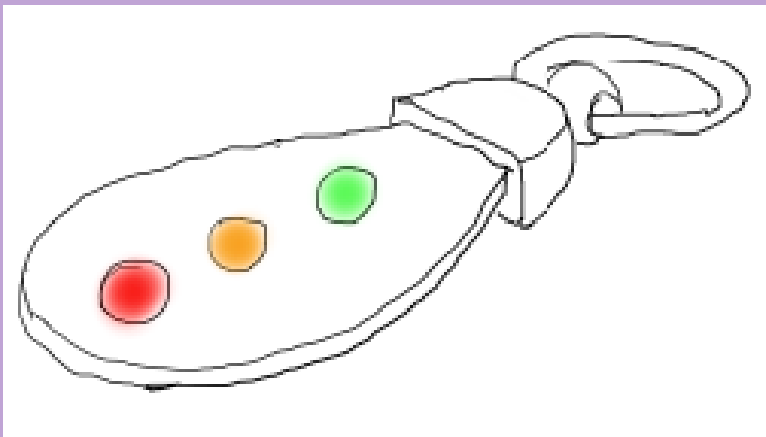
- Provides a more practical role play situation for the students.
- May be more attractive for students to engage in role play.
- Novel idea
- Situations can be practiced over and over again.

Cons

- Very much blue sky
- May be outside the skillset of teachers to programme.
- May not work to my strengths in terms of design.

Solution 4

A device that allows students with ASD share how they are feeling and facilitates collaboration among teachers to meet the needs of the student.



Pros

- Subtle
- Supports the student with ASD and teachers.
- Can allow for feelings personal to the student.
- Data can be collated to identify the triggers of anxiety and meltdowns.
- Data can be used to identify and implement strategies that best meet the needs of the student.

Cons

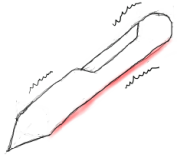
- Doesn't allow for my strengths in UI/UX prototyping.
- Depends on student honesty and engagement.
- Do teachers have time to engage with this in an already busy environment?

Collaboration with Field Experts

Contact was made with a field expert to help identify the best concept to take forward for the brief.

Solution 1

- Some students can hyper focus
- Will need to be connected to the cloud if it is to record writing and convert to oral (expense)
- May need software to operate on a computer.



Solution 2

- Some students may not like scents.
- Scents could affect surrounding students
- Sounds could be disruptive
- Need to personalise.



Profile 1



- Male
- Background in Human Computer Interaction
- Has a child with autism

Solution 3

- Meltdowns can build up over time
- Could it be a stressor tracker (wearable)?
- Could it encourage students to reflect on their stressors?
- Could it be automatically record?



Solution 4

- Pre-planned better. Current solution depends on accuracy and perspective.
- Would a student be likely to engage after having a negative experience?
- Too much expected of the user

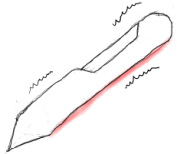


Collaboration with Field Experts

Contact was made with a field expert to help identify the best concept to take forward for the brief.

Solution 1

- Creates social reinforcement and reassurance.
- May need to have sound rather than vibrations for notifications.
- Vibrations may negatively impact their sensory regulation.



Solution 2

- Oils can affect other conditions such as seizures.
- Do students want sounds when agitated? Similar to “relaxing sounds” when on hold on a phone call.
- Could focus solely on breathing



Profile 2

- Female
- Background in intellectual disability nursing and lecturing



Solution 3

- Student needs to understand how they're feeling and the signs of a meltdown before using the device.
- Data protection
- Would a watch be more accessible.
- Should be linked to SNA also for when they may need to leave class with the student.



Solution 4

- Did not like it at all.
- Not fair for the student to relive such a negative experience.

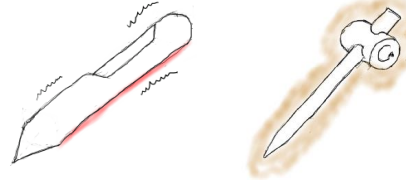


Collaboration with Field Experts

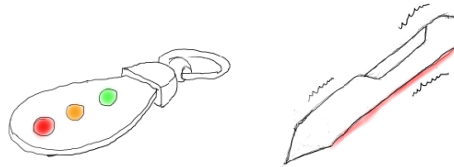
Overall Feedback from field experts.



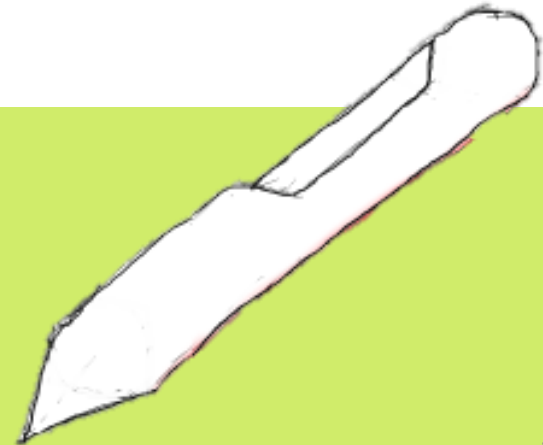
The pen would be the most appropriate from the solutions but should focus more on self-regulation and manipulation and should combine the senses.



The motivational pen would make the biggest impact closely followed by the communication device with the teachers.



The motivational pen will be taken forward to concept development as it was a common solution selected by both individuals. It is also a very novel idea that can be used universally and remove stigma and the label that may be placed on other students with ASD with other solutions. Dexterity issues can also be addressed with this solution.



Areas to Target in Concept Development



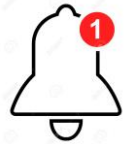
Types and methods of motivation



Ergonomics



Dexterity



Notifications and communication



Sensory Regulation

Concept Development Research



Types of Motivation



Intrinsic motivation is evident where individuals perform a task for their own sake or for personal enjoyment whereas extrinsic motivation is where individuals engage in tasks for external goals or rewards (Hennessey et al. 2015). This device will encourage extrinsic motivation as the user will have the aim to achieve regular goals set by the device.

Intrinsic motivation is more associated with academic attainment than extrinsic motivation but a coupling of both intrinsic and extrinsic motivation can be a powerful tool in academia (McGeown et al. 2014)

Researchers are placing a big emphasis on motivation as it plays a major role in academic attainment (Gilman and Anderman 2006) which is a key need identified from primary research.

A decline in academic motivation has been recognised in individuals enter into adolescence (Gottfried et al. 2001) so this device could be valuable to both students with ASD and neuro typical students.

Methods of Motivation



Motivation requires goals and activity as the goals provides the rationale and direction of the action.

Instructional Strategies

- Allow students to communicate and complete assignments through a medium that is convenient to them.
- Provide students with a challenging problem to be solved at the beginning of each class.
- Problem Based Learning (critical thinking, problem solving skills and organisation).
- Flipped Learning (Learner centred, peer interaction, Material given before hand to study).

(Afshar et al. 2019)

Motivational Interviewing is a client centred approach to enhancing intrinsic motivation by focusing on their own ambivalence and resolving it in a manner that aligns with their own values and beliefs rather than the values and beliefs of others.

Motivational Enhancement Therapy is a process that helps the patient progress through the stages of motivation by clarifying his/her own beliefs to achieve their ultimate goal.

(Pietrabissa et al. 2012)

Methods of Motivation



Expectancy-Value Theory implies that individuals are more inclined to be motivated if there is an expectancy of success. This is then coupled with the value that the individual places on *engaging with the task*. An effective way to increase expectancy is to organise the conditions so the individual is positive and hopeful.

Achievement Motivation Theory focuses on three factors:

- The motive for success
- *The probability of success*
- The value of success

Self-Efficacy Theory is defined as “individuals’ confidence in their ability to organize and execute a given course of action to solve a problem or accomplish a task.”

(Öztürk 2012)

Findings from Motivation Research



Provide support to the student.



Confidence in themselves.



Improve likelihood for success.



Improve Engagement²⁰³

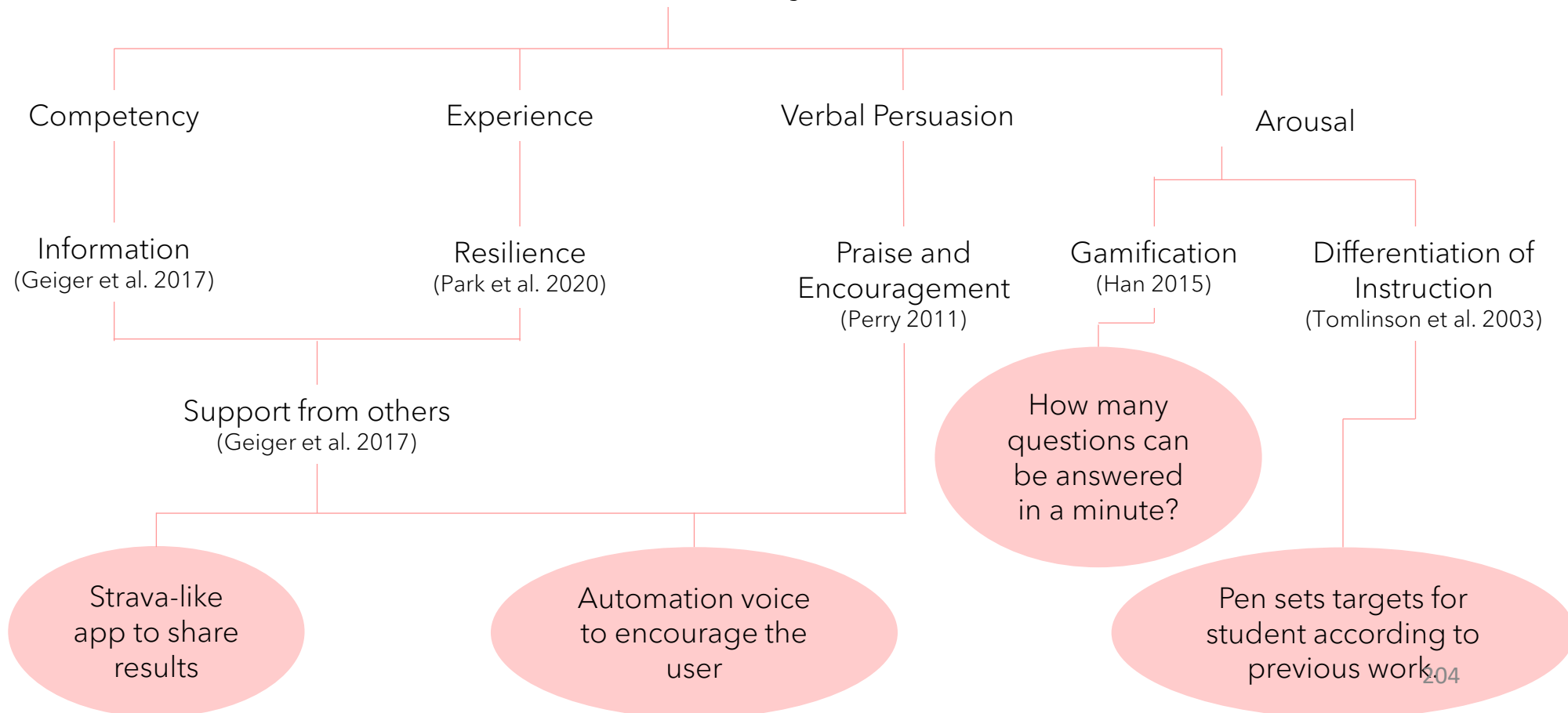
Self-Confidence



Adolescence is a time of drastic changes in life and individuals can become susceptible to reduced levels of self-confidence during this time (Alsaker and Kroger 2020).

Self-confidence can be related to self-efficacy (Perry 2011)

Self-Efficacy



Engagement



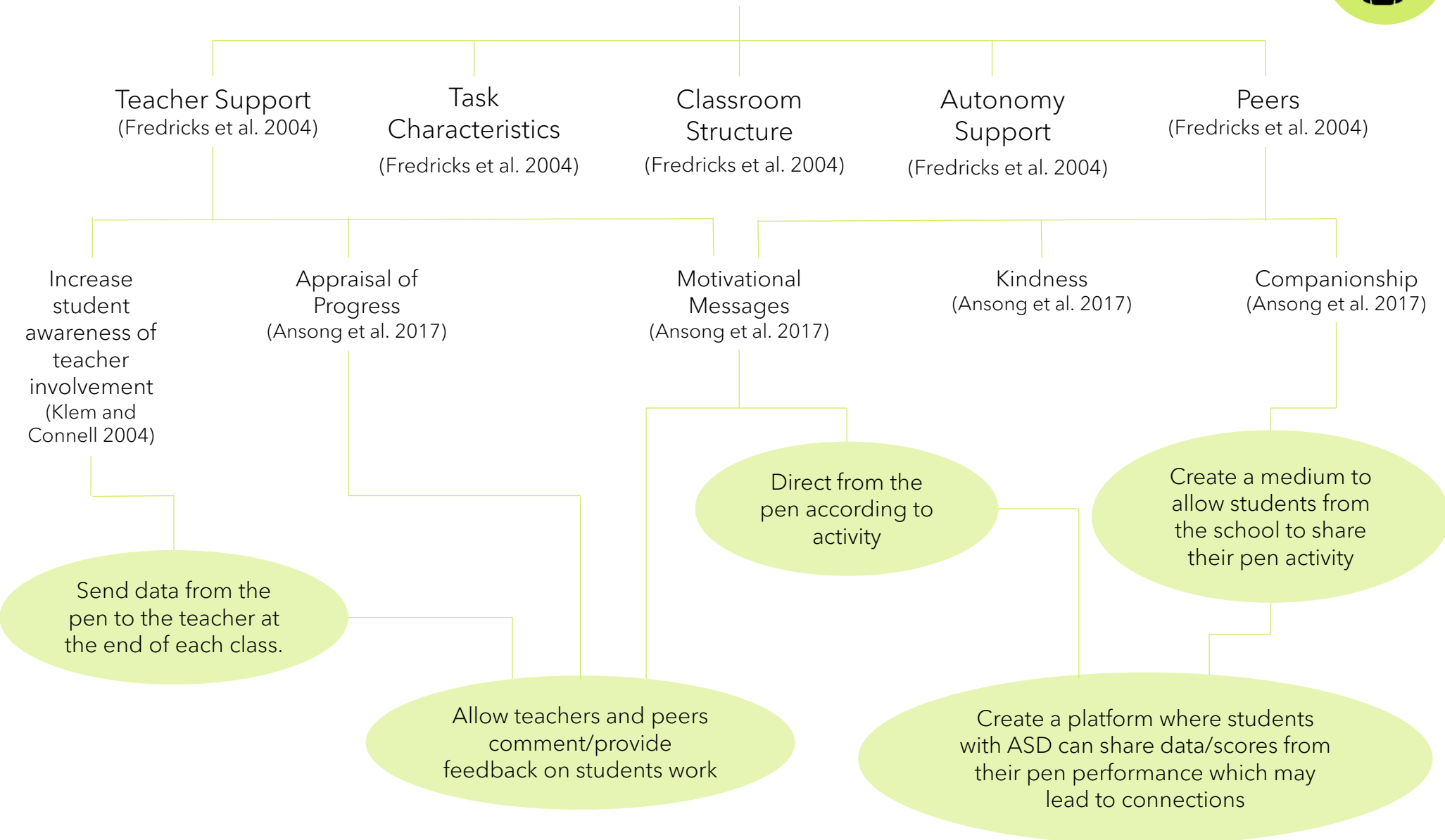
A positive, fulfilling, work-related state of mind that is characterised by vigour, dedication, and absorption (Schaufeli et al. 2002).

Students view schooling as boring or as a mere grade game, in which they try to get by with as little effort as possible (Burkett 2002).

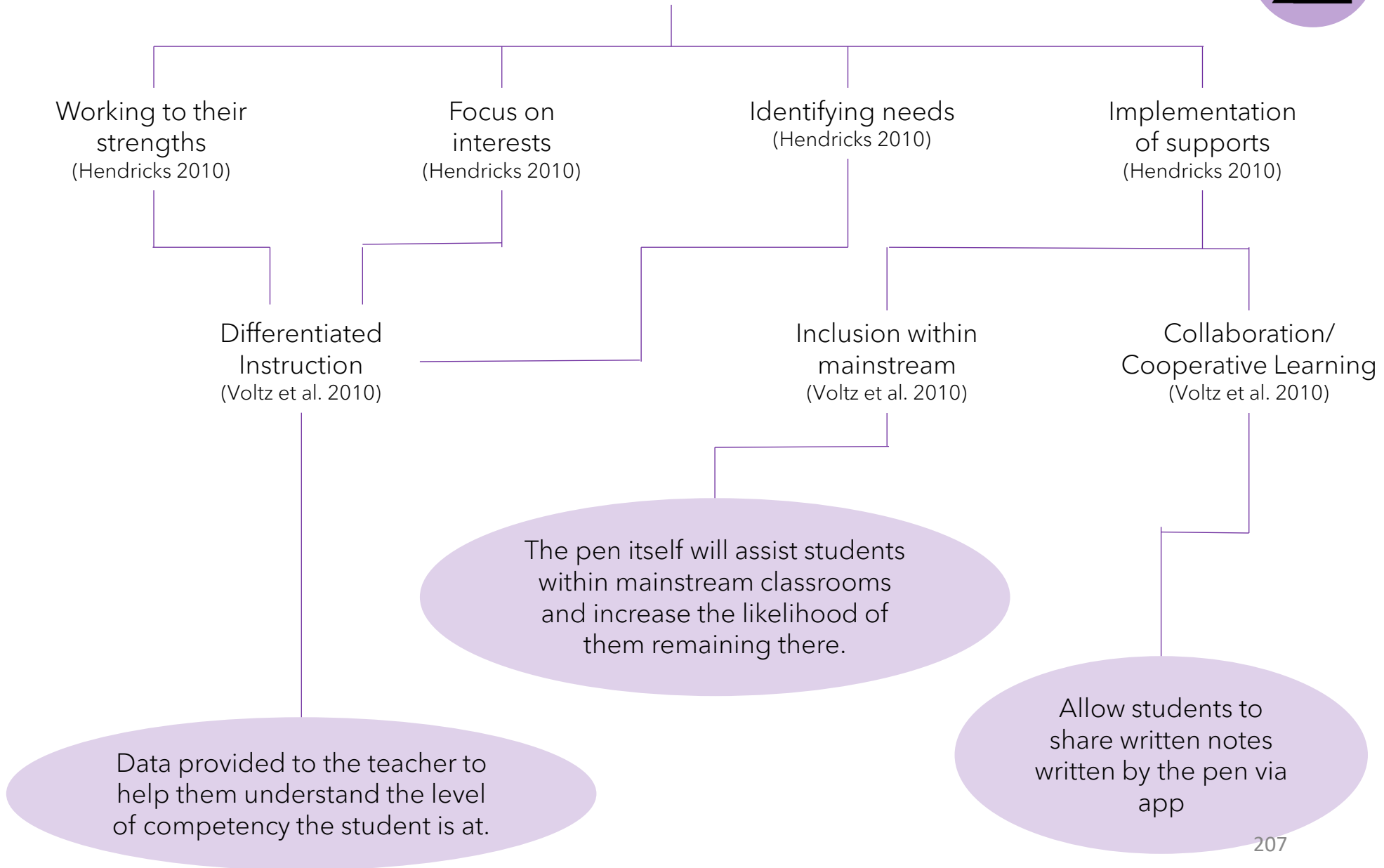
-
- **Behavioural engagement** encompasses participation and involvement in academic, social and/or extracurricular activities and is considered crucial for achieving positive academic outcomes and preventing dropping out.
 - **Emotional engagement** relates to positive and negative reactions to teachers, classmates, learning, and school and is presumed to influence willingness to do the work.
 - **Cognitive engagement** constitutes one's willingness to exert the effort necessary to comprehend complex ideas and master difficult skills.

(Fredricks et al. 2004; Klem and Connell 2004)

Increasing Engagement



Improve Likelihood for Success



Handwriting



Poor fine motor skills are major contributors to poor legibility of handwriting. Visual perception and visual-motor integration are other potential contributors but these need to be explored further (Kushki et al. 2011).

Large letters
small letters

Students with autism may write larger letters to compensate for poor fine motor skills (Fuentes et al. 2009).

Handwriting

Letter formation is the main issue surrounding legibility among students with ASD (Kushki et al. 2011).

Improving Dexterity and Fine Motor Skills



<https://youtu.be/YkoB49Q5lfo>
(Key point at 3.00 in pencil grip)



https://youtu.be/Dlf_nbPxSUK
(Simulate flipping the coin)



A mechanism for improving dexterity and fine motor skills could be integrated as a fidget to regulate senses as requested as the field expert in computer science.

Pen Ergonomics and Grip



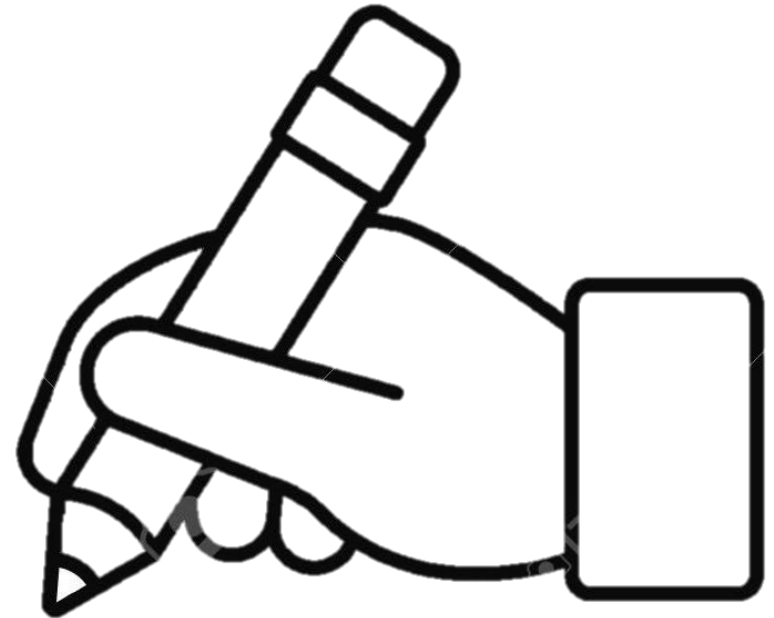
- A pen thickness of 8mm proved the most accurate but slowest in a test to assess the efficacy of shank thickness in pens (Goonetilleke et al. 2009) whereas other studies found that a lower diameter of 4mm was more suitable for writing to provide more stability (Ren and Zhou 2011). These were based on neuro-typical students. There is a clear lack of evidence exploring the pen grip of individuals with ASD.
- This contradicts a previous study where drawing time and errors were lower in pen shanks of 11-15mm (Wu and Luo 2006)
- Thicker pencils/pens allows for easier grip for those with arthritis and/or fine motor skills.



<https://nationalautismresources.com/abiligrips-foam-grips/>

Pen Ergonomics and Grip

- The profile of the pen does not significantly impact on the drawing or handwriting performances of adults or children (Goonetilleke et al. 2009; Lou 2005) but the hexagonal shape is the most comfortable (Lou 2005).
- Dynamic tripod grip is most likely to produce quick and quality handwriting without causing pain or fatigue (Naus 2000).



Test to Explore Users Grip of a Pen



Gender: Female
Age: 17
Occupation: Student



Gender: Male
Age: 28
Occupation: Student



Gender: Female
Age: 62
Occupation: Secretary

Each user was asked to pick up the pen as if they were to write to explore the different grips people use. Key finding from this experiment is that users tended to grip the pen using the tripod grip with an open web space.

Pencil Grip Development



Stage 1. Palmer-Supinate Grasp

The user grasps the pencil in a fist with full movement coming from the arm and shoulder.



Stage 2. Palmer or Digital-Pronate Grasp

The user holds the pencil with the full hand wrapped around the device with the thumb facing towards the tip. Movement is provided by the full arm and shoulder.



Stage 3. Four finger and Thumb Grip

The user removes their palm from the grip and holds the pencil between all five tips of the finger. Movement now comes from the elbow and the wrist.

Pencil Grip Development



Stage 4. Static Quadruped or Tripod Grip

The user grips the pencil using their thumb and 4 fingers. The narrow web space means that the user is still providing movement to the pencil via the wrist.

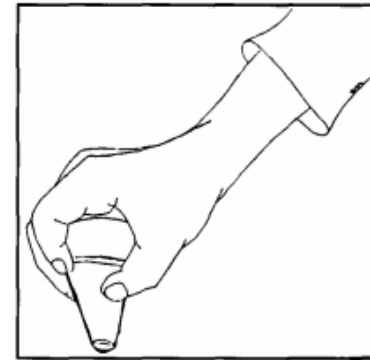


Stage 5. Mature/Dynamic Tripod Grip

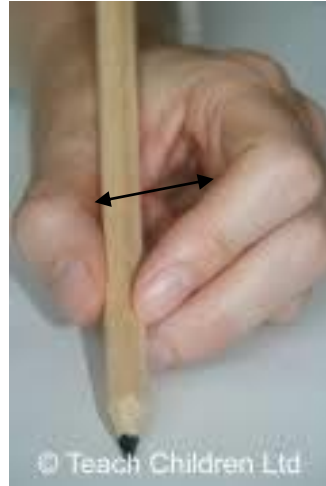
This is traditionally considered the optimum pencil grip. The user grips the pencil between the thumb and index finger and is resting on the middle finger. The last two fingers are curled back to avoid obstruction. The wide web space means that movement is now coming from the fingers.

Pen Ergonomics and Grip

Failure to maintain an open web space indicates weak hand muscles when trying to maintain the grasp. Providing the child with a small piece of crayon/chalk to write with will help improve their pincer grasp and naturally open their web space. Where the child is unable to use the pinch grasp for long periods, they should be encouraged to use preschool crayons where the open web space is maintained (Naus 2000).



Note: From "Therapeutic Fine-Motor Activities for Preschoolers" by C. A. Myers, 1992. In Development of Hand Skills in the Child (p. 54), by J. Case-Smith, & C. Pehoski (Eds.), Rockville, MD: American Occupational Therapy Association. Copyright 1992 by The American Occupational Therapy Association, Inc. Reprinted with permission.



Open Web Space



Pincer Grasp

Keeping the Web Space Open

It is clear from the research that the web space between the thumb and index finger needs to be kept open to ensure the movement of the pen comes from the fingers using the correct tripod grip and to operate a pen/pencil correctly.



ARK's Butter Pencil Grip

- o Specially designed to open up the web space
- o Fingers grasp around and "hug" the grip
- o Fingertips rest on the pencil just below the grip
- o Developed by an occupational therapist
- o Diameter 1 inch



Weighted Pencils/Pens

I explored weighted pens based on the feedback received from tutors in the presentations.

- Weighted pencils reduce muscle fatigue.
- Pen weighs approximately 100g.

https://nationalautismresources.com/weighted-pencil/?sscid=51k5_qeulb



- Creates more of a presence in the users hand allowing them more control.
- Using a weighted pencil has many advantages for individuals with ASD.

Some of these include:

- Developing gross and fine motor skills
- Improving handwriting
- Helping aid in academic performance
- Encouraging the child to write more often
- Decreasing frustration and promoting self-confidence
- Making writing a positive experience

<https://www.autismparentingmagazine.com/benefits-weighted-pencils-for-autism/>

Communication of Notifications

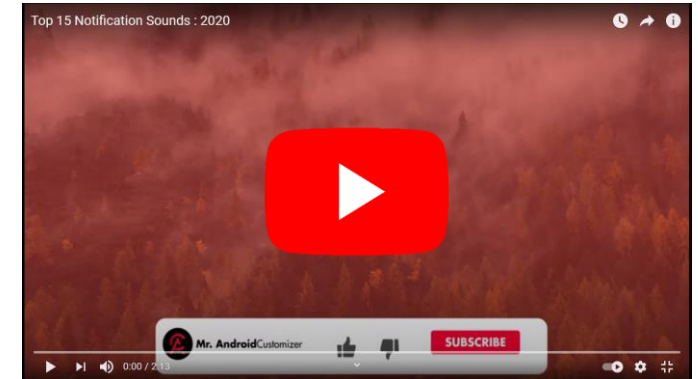


It would be beneficial if the sound could be motivational while not be too disruptive to the class.

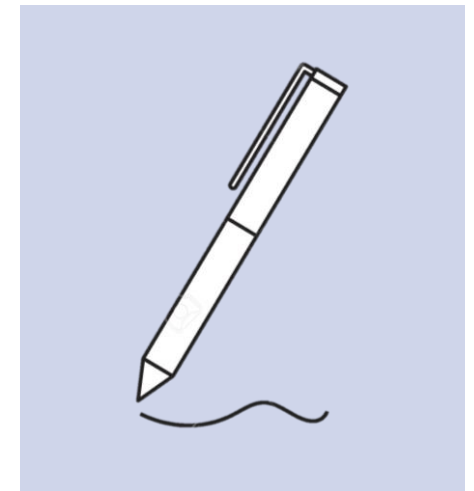
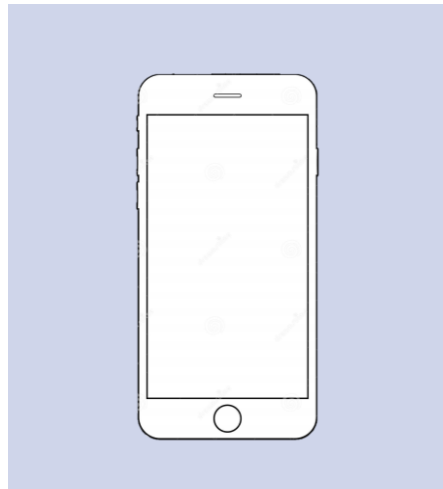


Push notifications is a technology that lets you send messages to Smartphones which have the App of your company installed on their devices even when the user is not actively using the application.

<http://www.mobileui.org/innovaportal/v/181/1/innova.front/push-notifications:-knowing-the-technology.html>



Types of sounds for notifications
<https://youtu.be/Xc1ulaOO4Ow>



Communication through a watch, phone (app), ear piece or through the pen itself.

Sensory Regulation

Ark's Sensory Bookmark / Fidget

- 4 different textured sections
- Soft and bendy
- Discreet for any setting
- Full of fidgety fun



Run your fingertips across 4 different textured sections - small bumps, larger bumps, straight lines, and diagonal lines. The lines have a more mild feel while the bumps have a more pronounced feel for different levels of tactile input.



Possible Design Features for Inclusion from Research

The pen itself will assist students within mainstream classrooms and increase the likelihood of them remaining there.

Strava-like app to share results

How many questions can be answered in a minute?

Audio Playback?

Direct from the pen according to activity

Data provided to the teacher to help them understand the level of competency the student is at.

Send data from the pen to the teacher at the end of each class.

Allow teachers and peers comment/provide feedback on students work

Automation voice to encourage the user

Fidget that can improve fine motor skills and regulate senses

Create a medium to allow students from the school to share their pen activity

Communicate notifications.

Create a platform where students with ASD can share data/scores from their pen performance which may lead to connections

Pen sets targets for student according to previous work.

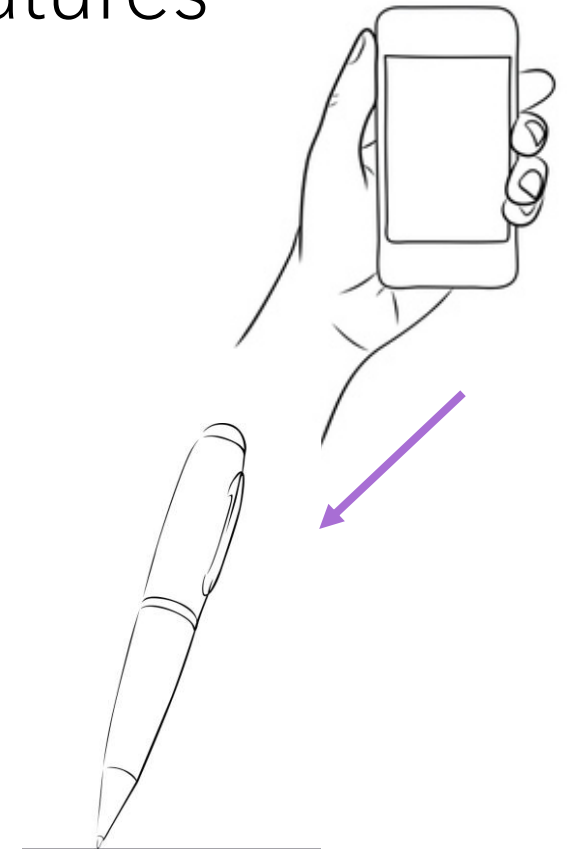
Allow students to share written notes written by the pen via app

Fit ergonomically into the users hand

Weighted pencil

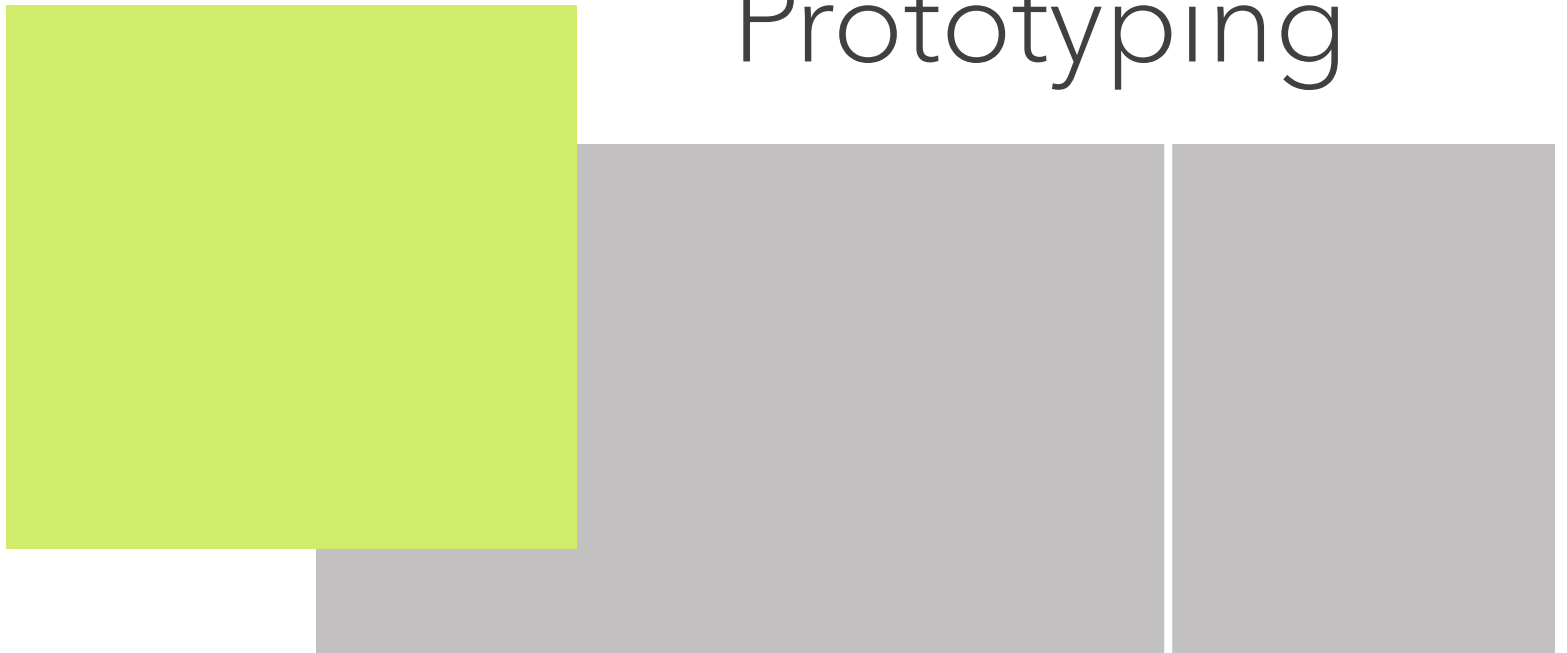
Hierarchy of Design Features

- Strava-like app to share results
- Create a medium to allow students from the school to share their pen activity
- Allow students to share written notes written by the pen via app
- Fit ergonomically into the users hand
- How many questions can be answered in a minute?
- The pen itself will assist students within mainstream classrooms and increase the likelihood of them remaining there.
- Create a medium to allow students from the school to share their pen activity
- Fidget that can improve fine motor skills and regulate senses
- Allow students to share written notes written by the pen via app



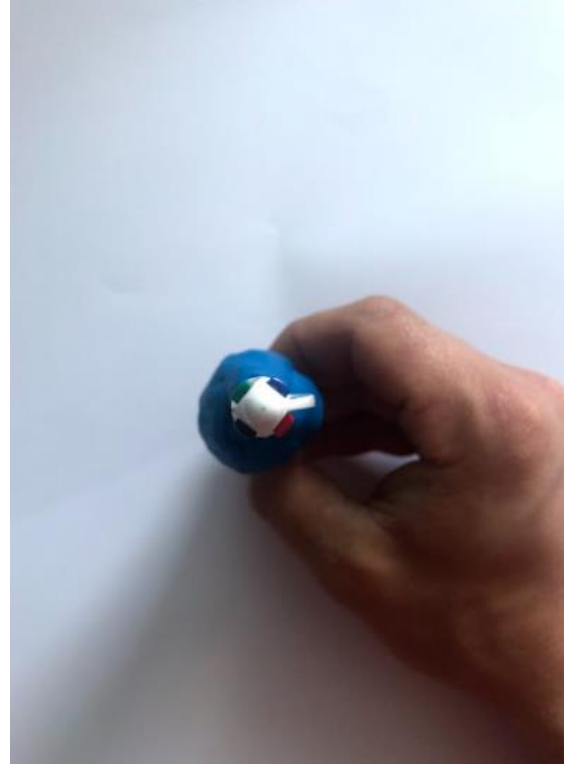
The focus will be initially on the pen and then followed by the app.

Concept Development & Prototyping



Exploring Ergonomics

Plasticine was used to establish the optimum shape and geometry.



The weight of the pen was very comfortable to use but the cylindrical shape did not fit comfortably into the hand. The device needs to be symmetrical/flexible to allow for left and right hand users.



Exploring Ergonomics

Plasticine was used to establish the optimum shape and geometry.



The weight of the pen remained very comfortable to use and the added curvature to the back section made the device much more comfortable.

Exploring Ergonomics

Plasticine was used to establish the optimum shape and geometry.



Curvature was added to the tip of the pen to increase comfort for the middle finger and increase stability.

Exploring Ergonomics Design 1

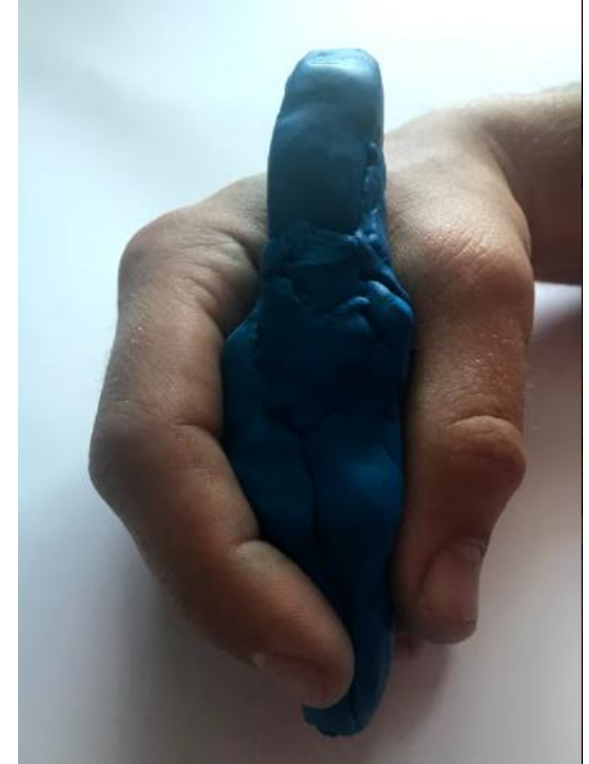
Plasticine was used to establish the optimum shape and geometry.



Extra curvature was added to the end of the pen to increase support and reduce stress on the hand of the user. It is understood that this curvature will not suit every hand but this will be flexible to fit each individual.

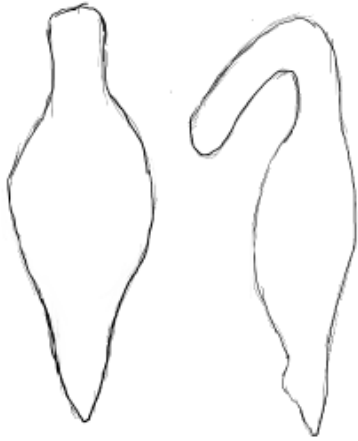
Exploring Ergonomics

Plasticine was used to establish the optimum shape and geometry.

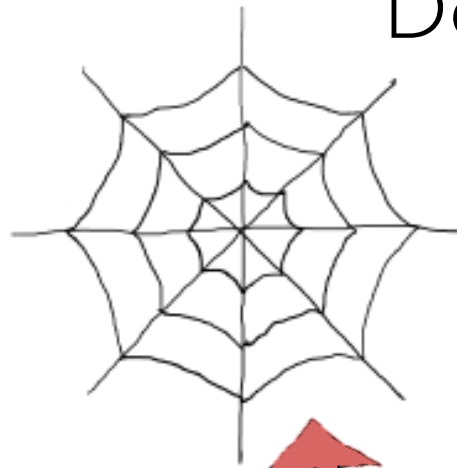


The pen mould is weighted and fits ergonomically into the users hand.

Design 1



Front and end view of the device



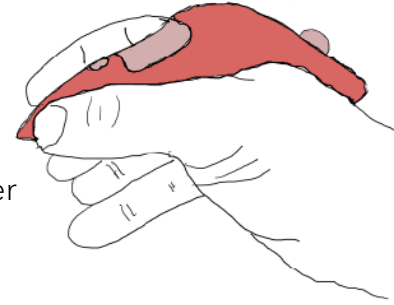
Cobweb design to improve aesthetics and reduce sweat



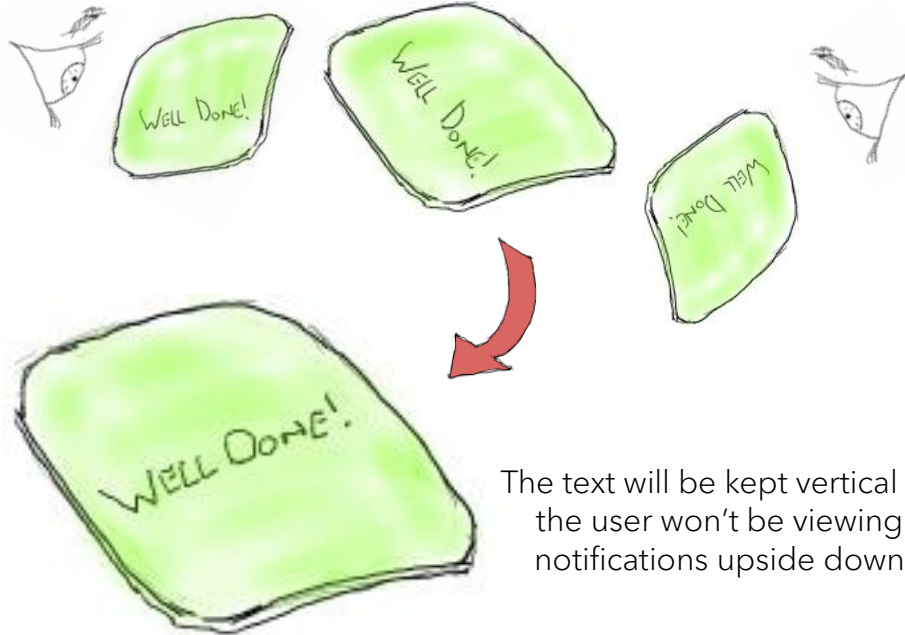
Flexible to wrap around the users hand.

Fidget for sensory regulation

Curvature to fit between index finger and thumb



Thicker diameter for easier grip



The text will be kept vertical so the user won't be viewing notifications upside down

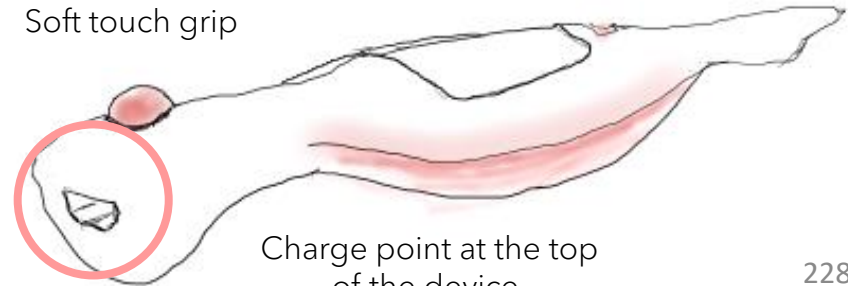


Soft touch grip

Curvature for middle finger

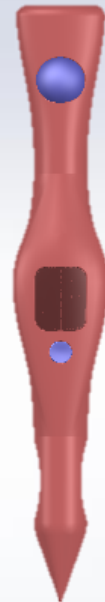
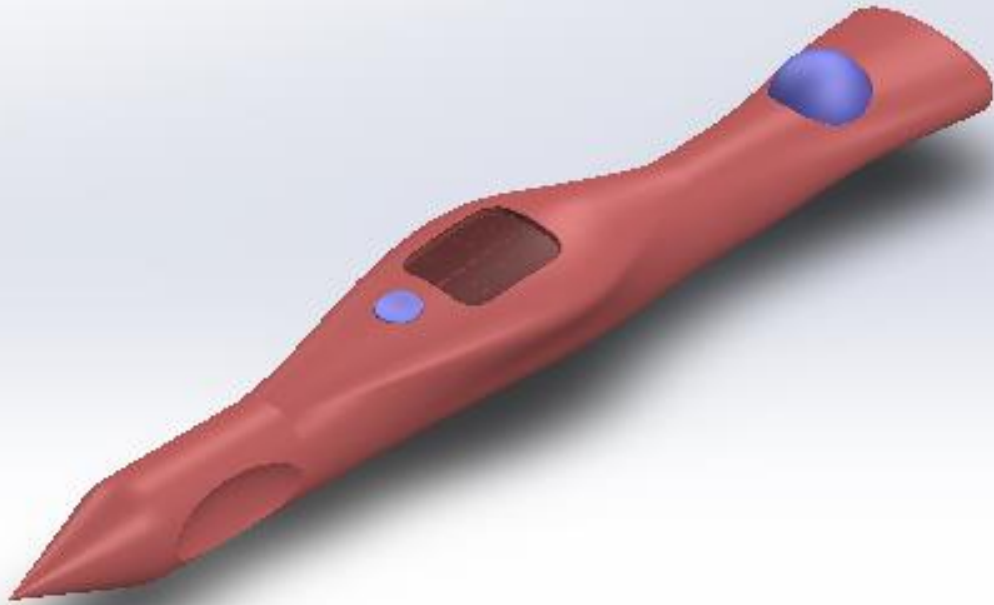


Power button on top to avoid accidental power on/off



Charge point at the top of the device.

Iteration 1



Design 1 Iteration 1 3D Printed



- This prototype appeared very sleek and was one of the more aesthetically pleasing designs.
- The thick shank felt comfortable
- The curvature dents to allow for the positioning of the index finger and thumb proved very effective.

Design 1 Iteration 1 3D Printed



- The intended flexible feature to wrap around the users hand was removed as it was found to limit the movement of the pen.
- The curvature needs to be thicker to provide more stability in the users hand.
- May need to provide support to the middle finger.

Exploring Ergonomics of Alternative Design

Plasticine was used to establish the optimum shape and geometry.

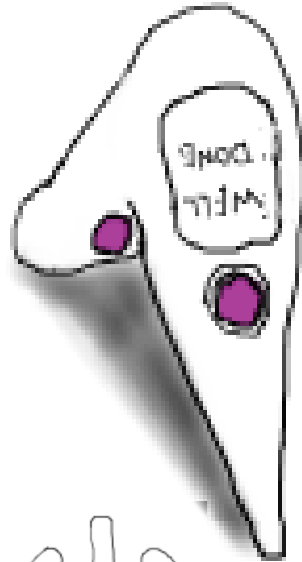


An alternative design was explored where the hand is supported with the palm partially resting on the pen.

Design 2



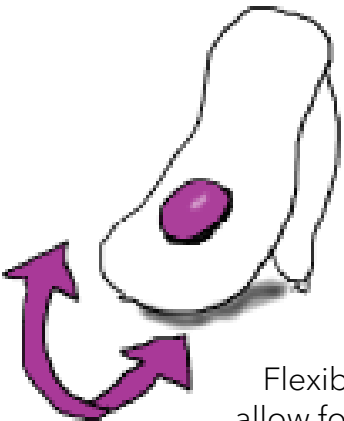
Orientation of text is essential for easy viewing.



Front view and end view of the device



Share button to share data with teachers and others on the app



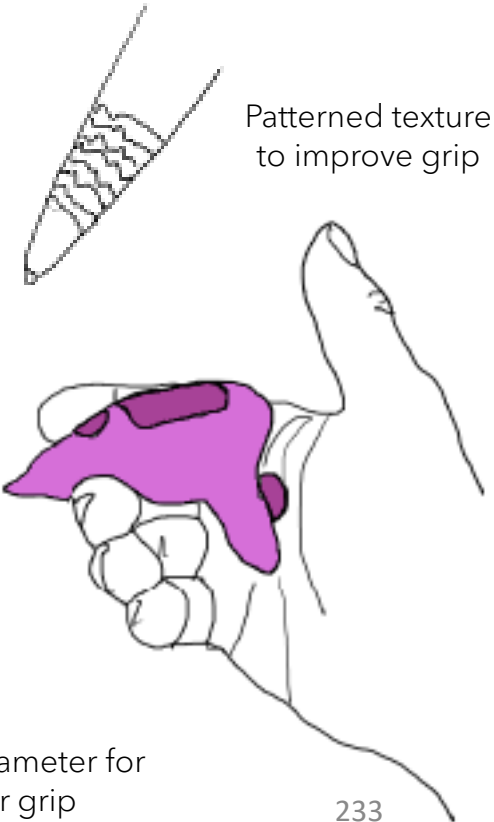
Flexible handle to allow for different size hands.



Power button to switch on/off the device

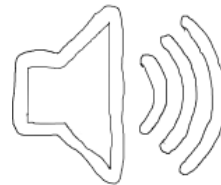


USB charging point on the side of the device



Patterned texture to improve grip

Fidget ball for sensory regulation. Could it be used as a control?



Speaker to communicate notifications



Thicker diameter for easier grip

Iteration 2



Design 2 Iteration 1 3D Printed



- The design is novel and looks very modern.
- The positioning of the “bumps” were well positioned to improve their efficacy.
- A user tried to grasp the pen incorrectly as shown in image 1.
- There was a position for the vacant fingers to rest and so may assist the user in mastering the tripod grip.

Design 2 Iteration 1 3D Printed



- The grip doesn't allow for easy scribing.
- The device would need to be flexible to accommodate different hand sizes.
- The device may hinder the user when using more traditional pens.

Exploring Ergonomics of Alternative Design

Plasticine was used to establish the optimum shape and geometry.

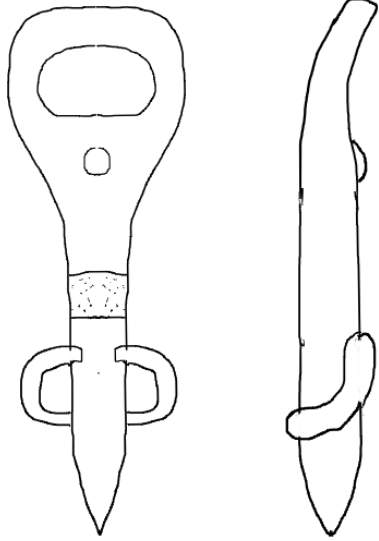


Exploring Ergonomics of Alternative Design

Plasticine was used to establish the optimum shape and geometry.



Design 3



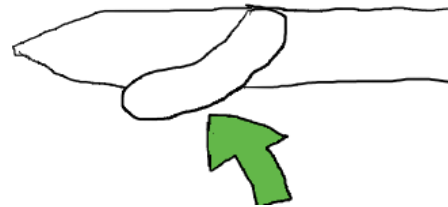
Front view and end view of the device



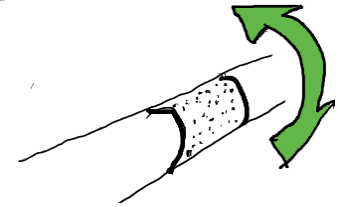
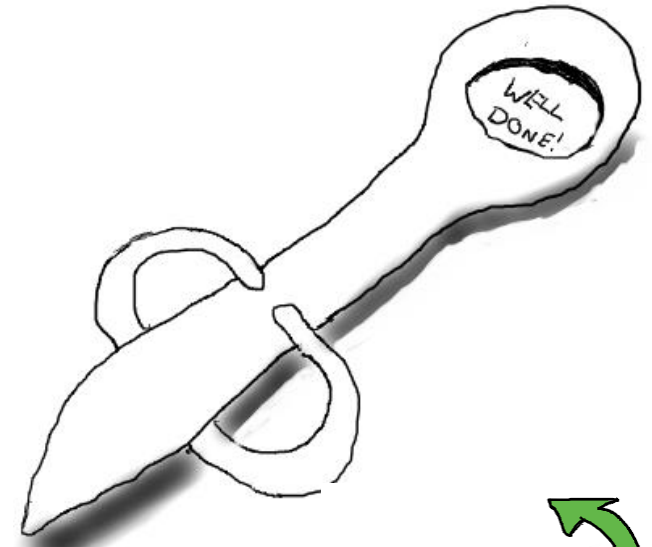
Soft touch grip



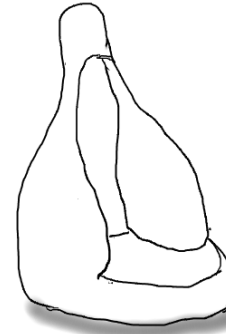
Finger supports will be elastic.



Curvature of finger supports provides support to middle finger also.



Control can rotate and double up as a control switch



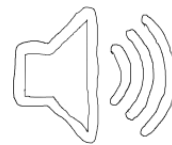
Charging port for the device.



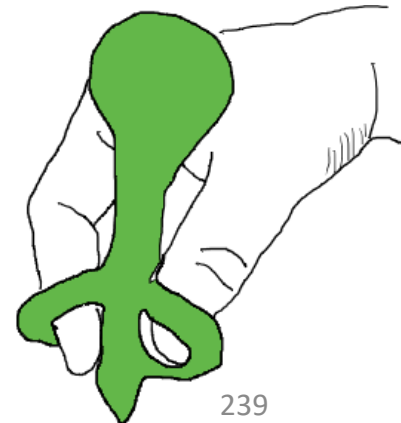
Power button to switch on/off the device



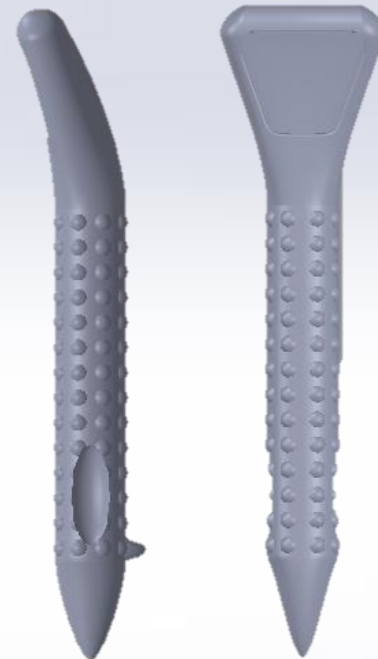
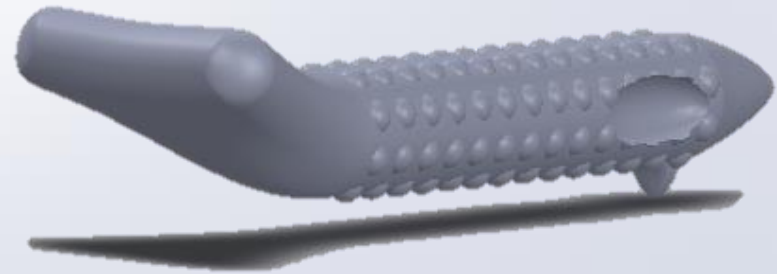
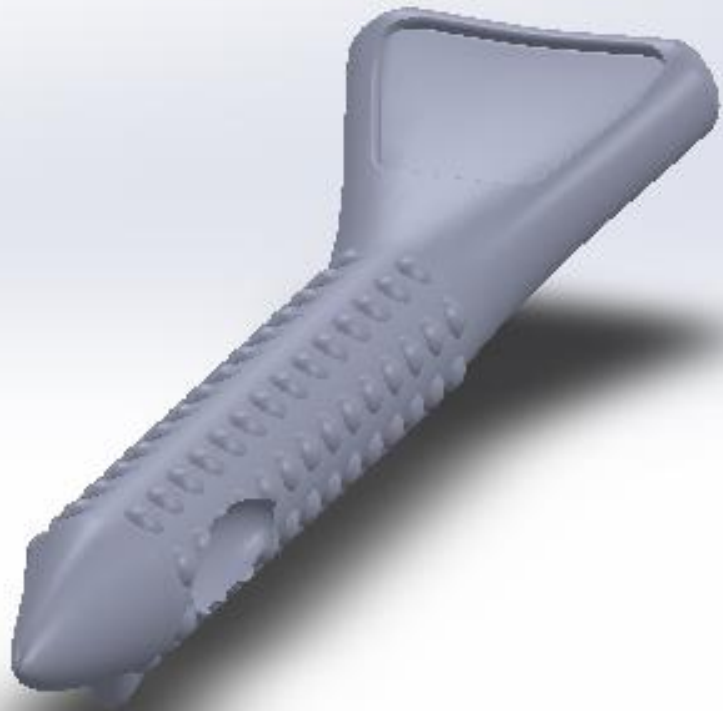
Share button to share data with teachers and others on the app



Speaker to communicate notifications



Iteration 3



Design 3 Iteration 1 3D Printed



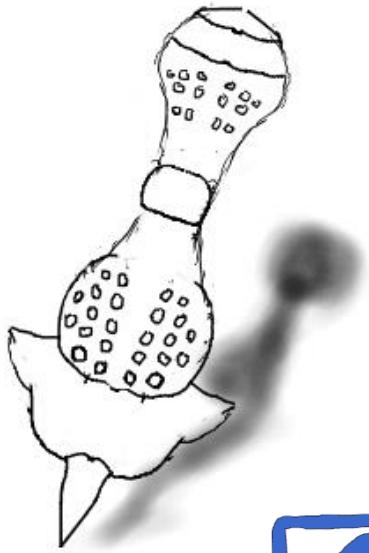
- Simplistic design means that the grip can be transferable to a traditional pen.
- The “bumps” are subtle and may be effective in sensory regulation.
- The indents in the shank encourages that tripod grip.

Design 3 Iteration 1 3D Printed



- Curvature similar to the first concept would improve stability for the user.
- The curvature for the middle finger needs to be more comfortable.

Iteration 4



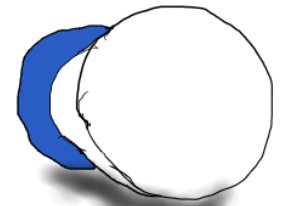
Power button to switch on/off the device



Bumps to assist in sensory regulation



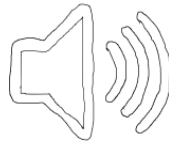
Screen on top of the interface



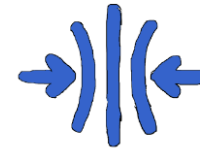
Fidget ball integrated to regulate senses and control the pen.



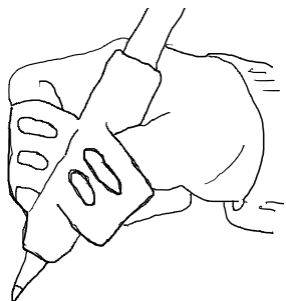
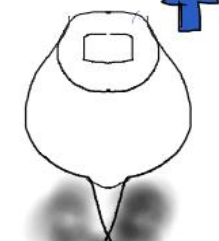
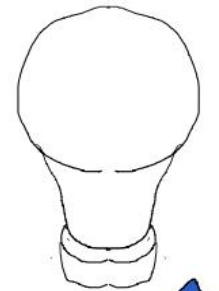
Speaker to communicate notifications



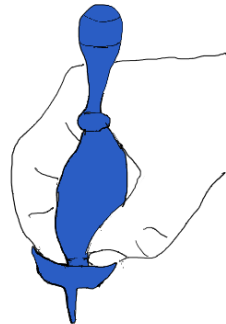
Speaker to communicate notifications



Finger supports will be elastic.



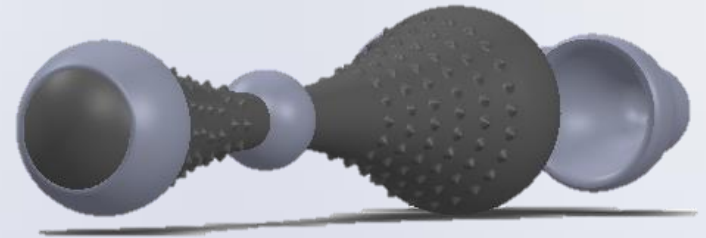
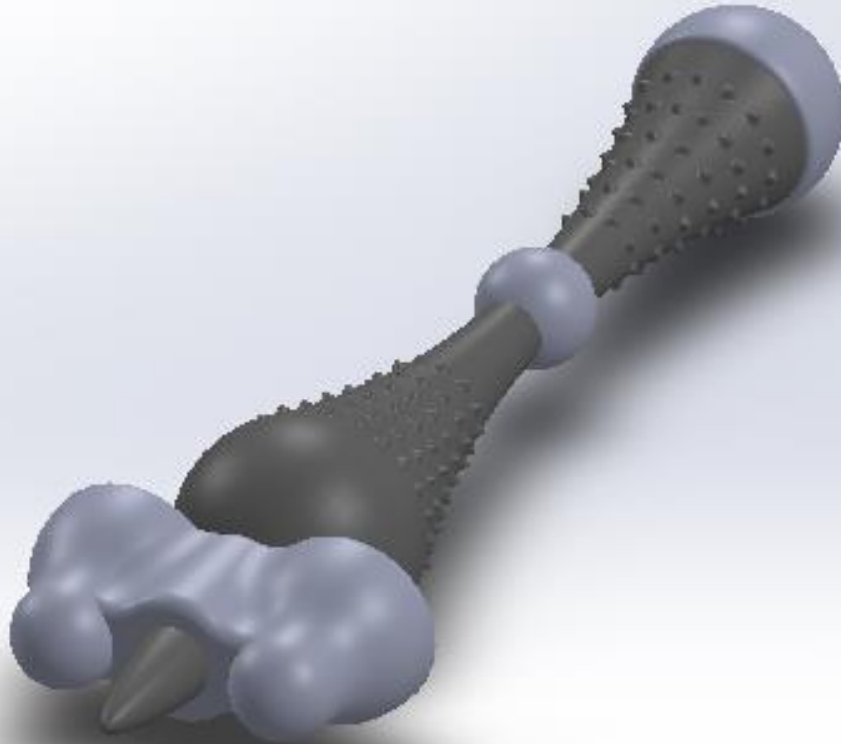
The finger grip was inspired by the grip on the left which is recommended to help children's hand writing.



Front and end view of the device.

The pen separates to expose the hidden charging port when charging.

Iteration 4



Design 4 Iteration 1 3D Printed



- The design looks modern and attractive.
- The surface texture may help provide sensory regulation.

Design 4 Iteration 1 3D Printed



- The positioning of the fingers is effective but needs to be more universal and subtle.
- The curvature needs to be larger and further up the pen to keep the open web.
- It is difficult to see the writing point due to the scale of the finger guide.
- There needs to be a more gradual slope from the spherical curvature of the pen to allow for better grip.

Feedback on Designs from Field Experts

Public Health Nurse (12 years Experience)

"First glance I'm like why is just a pen? Like one single pen. It's confining. Could it not be an adaption to a pen e.g. remember the pen grips we had as a child. This way it can be used for colouring, writing etc. All info would be in the bit attached to the pen. As in the pen fits into the cool ergonomic shape device. The device is like a fit bit and feeds it all back? Just my initial thought."

She Shared with Friends...

- It needs to come in different sizes.
- If a child has ADHD etc it needs to give a prompt to move. This burns energy and then allows for periods of concentration to write in between movement.
- A few ppl said it needs to be an application to a pen/pencil.
- It would be very handy if it could link in with her white board, stop her having to call children out of there desk and specially with covid. She teaches a regular class.
- Someone said about pressure points on the pen, as some pen grip is very tight and writing is slow. This is with dyslexic/dyspraxia child.
- The rounded shape was not really liked. The last option that looks like a chopstick trainer wasn't aesthetically positive. They all commented on that.
- The red one that was long, very like a pen was most discussed.

Background of Field Experts

Public Health Nurses

Occupational Therapists

Special Education Teachers

Intellectual Disability Nurses.



Evaluating Feedback from Field Experts

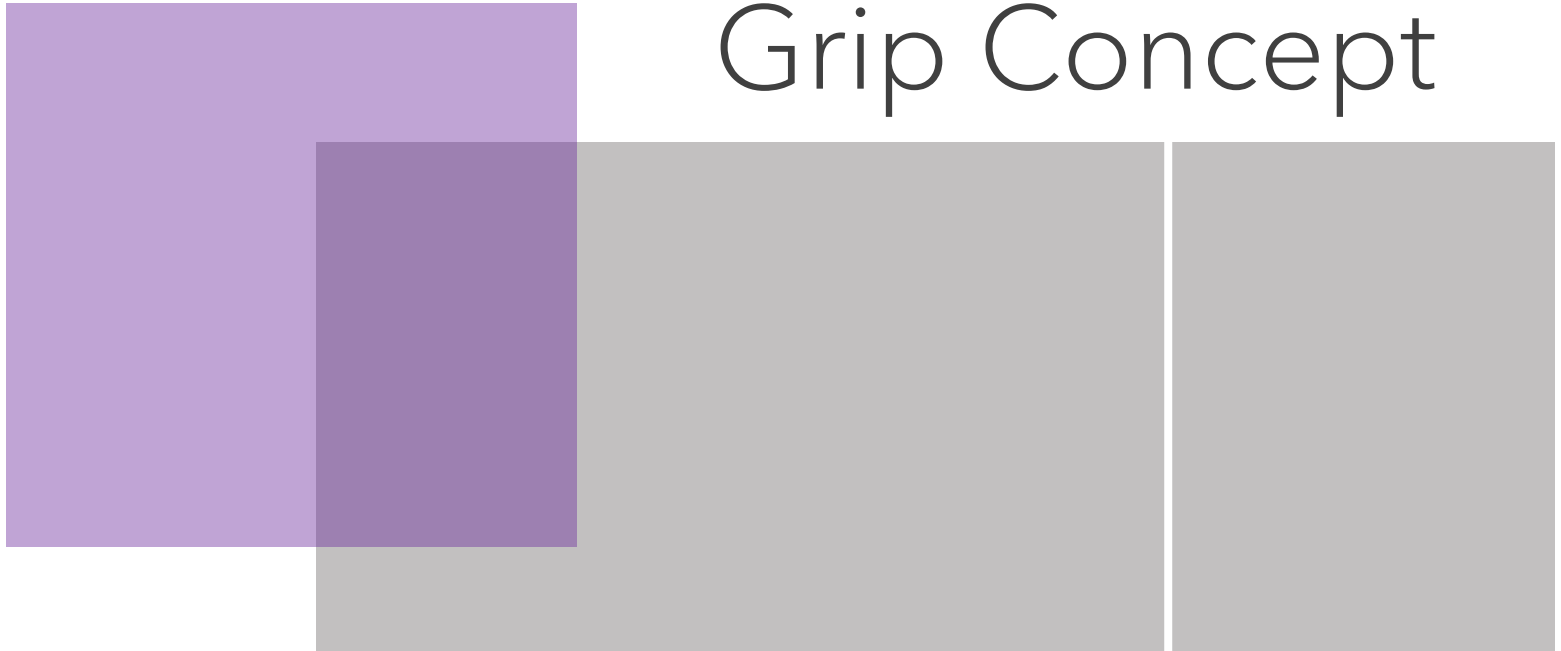
Feasible and Worth Exploring Further

- Changing to a grip
- It needs to come in different sizes
- Encourage a student with ADHD to move and burn energy to help them focus when writing.
- Pressure points to avoid injury from gripping the pen too tight.
- Design one was most discussed.

Not Feasible/Not Within the Scope of the Project

- Connecting the pen to a whiteboard.

Grip Concept



Exploring the Grip Concept

Different size pens. How do I ensure it grips all sizes?

- First thoughts:
 - Velcro
 - Flexi silicone/rubber
 - Pneumatic Pressure
 - Clamp
- Will I remove the option of recording the writing and audio playback?
 - Could the pen record the writing
 - Could the playback be incorporated within the app?
- How will the pen accommodate all pen sizes?
 - Curvature
 - Malleable Materials



Pneumatic Clamp



Securement Methods



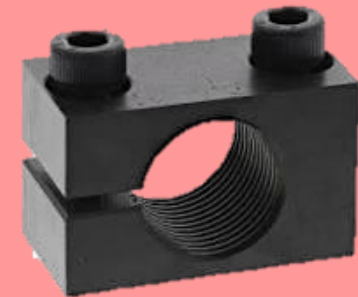
Physical Clamp



Velcro Clamp



<https://youtu.be/2E1km-qDkq4>
Video shows how a single diaphragm pump works. This could be used to inflate the device creating a compression between the grip and the pen.

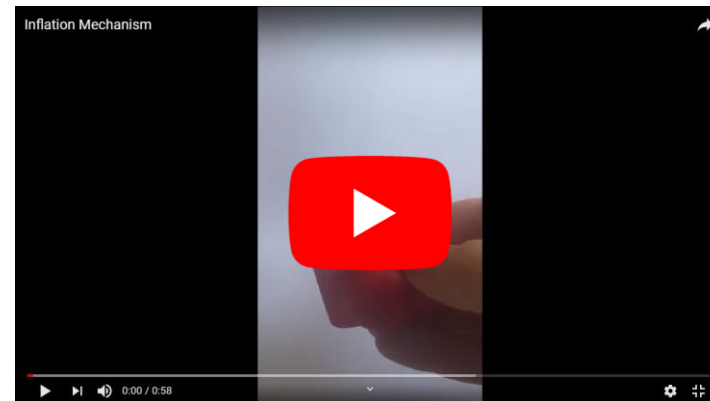


Inflation Mechanism

While spending time in a hospital as a patient, I found inspiration from a blood pressure monitor to secure the device. The nurse uses the latex blood pressure bulb to inflate the cuff around the patients arm. The same principle could be applied to the grip by inflating a film within the grip to compress the pen/pencil.



Image of the blood pressure bulb taken within the hospital



The video shows a **prototype** explaining how the inflation mechanism will work within the device.

<https://youtu.be/mfehe8nQgsI>

Recording Writing and Audio Playback

Many pens need special paper with indented dots which records the writing as an audio or a tablet. This would significantly increase the cost of the product which would reduce its accessibility to those who need it the most. I will not be progressing with this feature.



<https://www.youtube.com/watch?v=4uOSmRfBvdY>

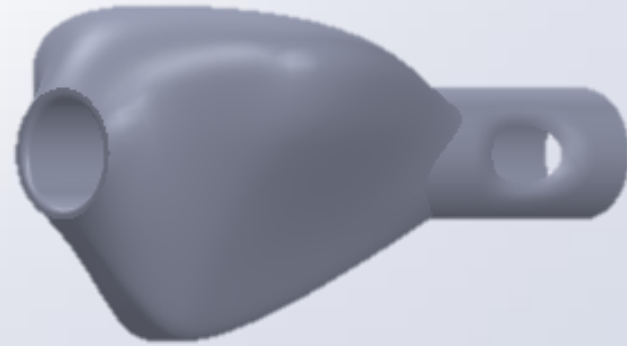
Video tutorial on how the recording pen works



Livescribe pen with specialised paper that converts written words into audio.

Implementing the research into the design of a pen/pencil grip.

Grip Iteration 1



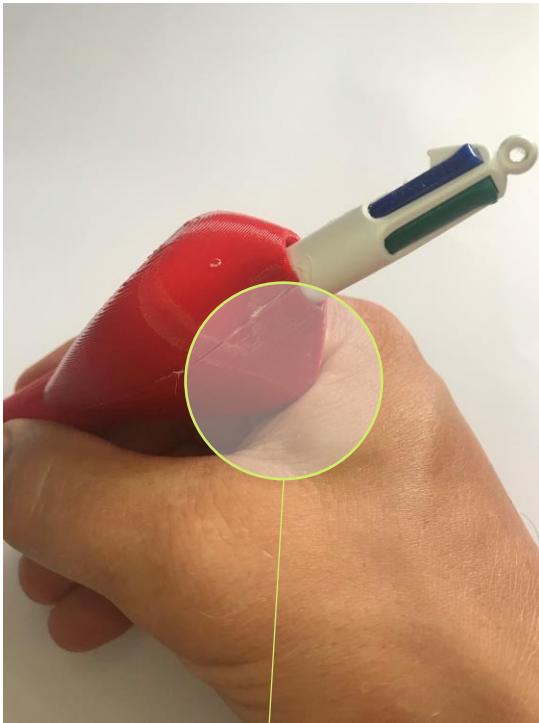
Grip Iteration 1



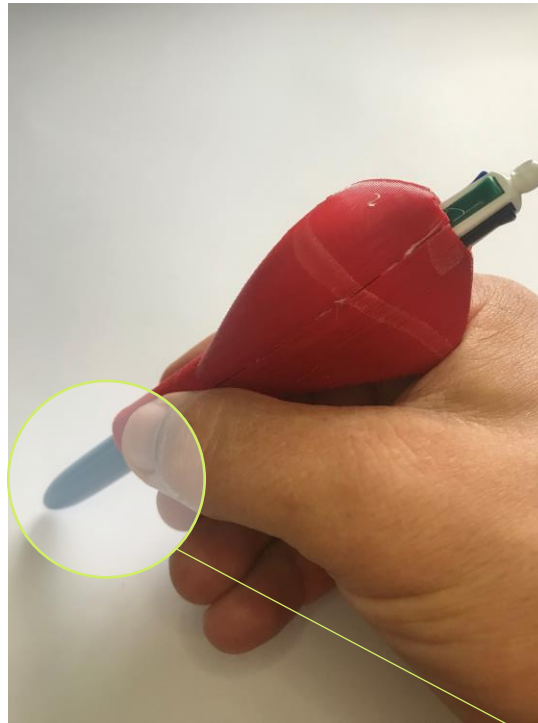
- The wider bulb shape makes the pen more stable in the users hand.
- The dome indent identifies the finger positioning for the correct dynamic tripod grip to reduce fatigue.
- The curvature was added underneath to improve stability and comfort when in use.

Grip Iteration 1 Testing

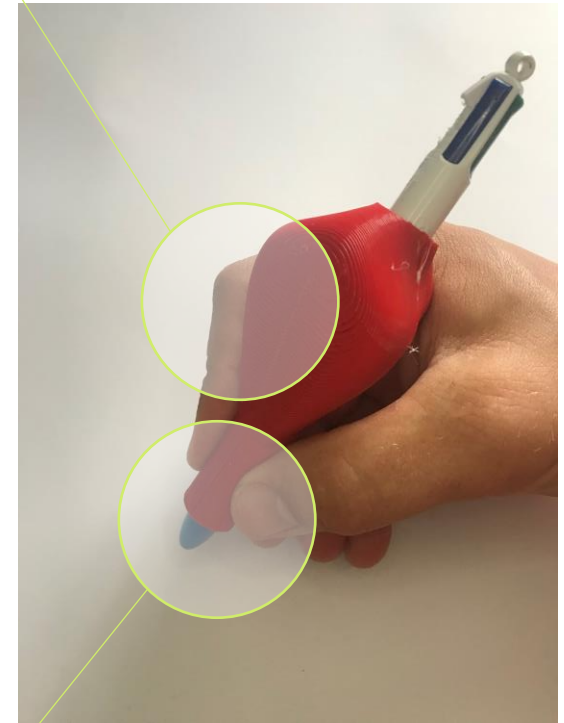
The bulb shape maintained the opening of the web between the thumb and index finger.



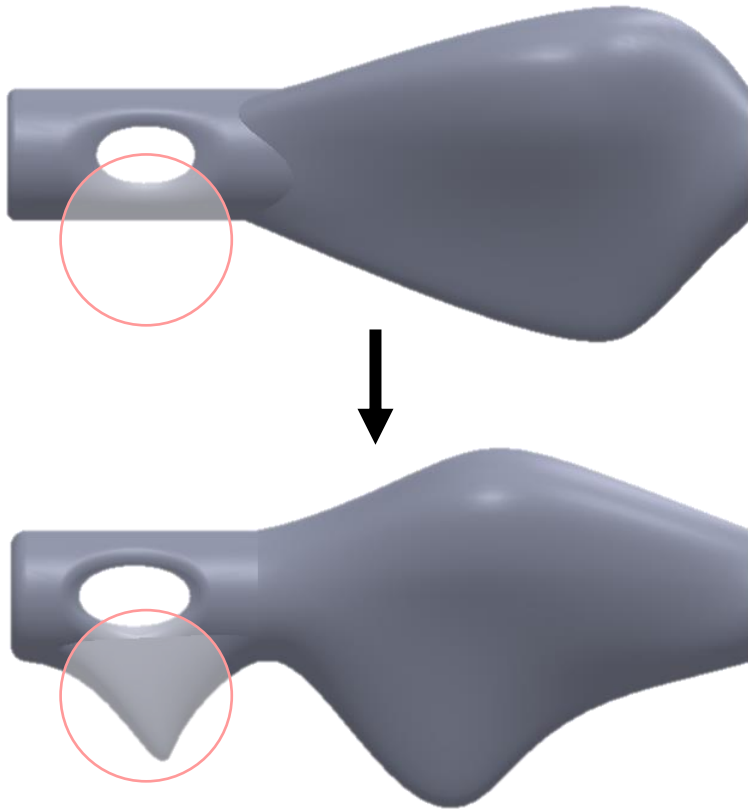
The curvature underneath did not allow for the form of the hand.



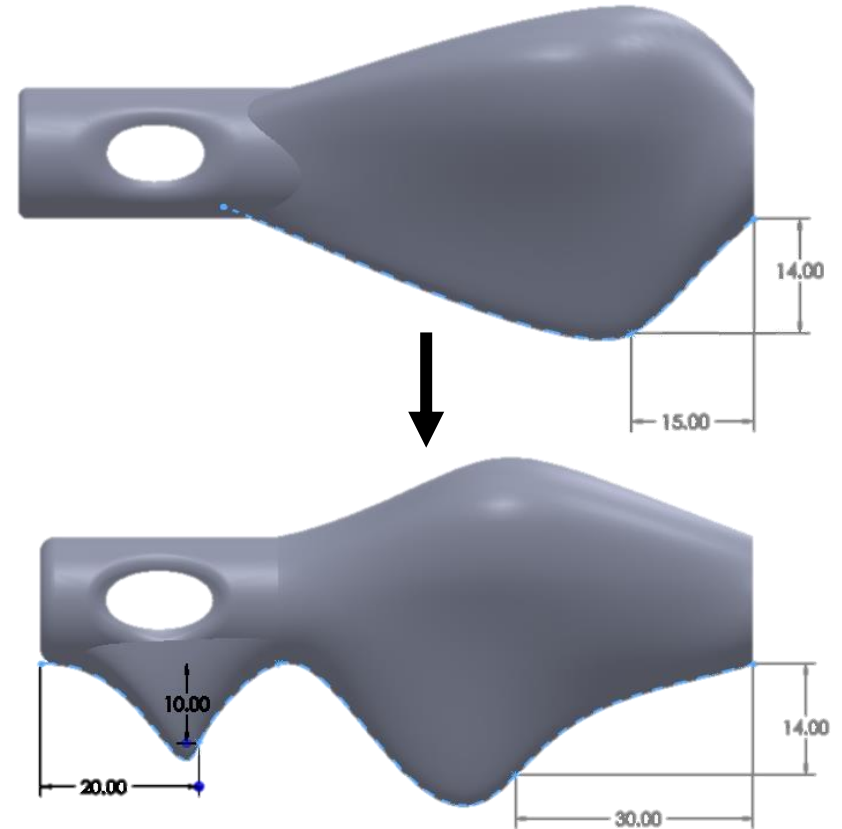
The grip could be moved up and down the pen to a position that is comfortable to the user.



Design Alterations for Grip Iteration 2

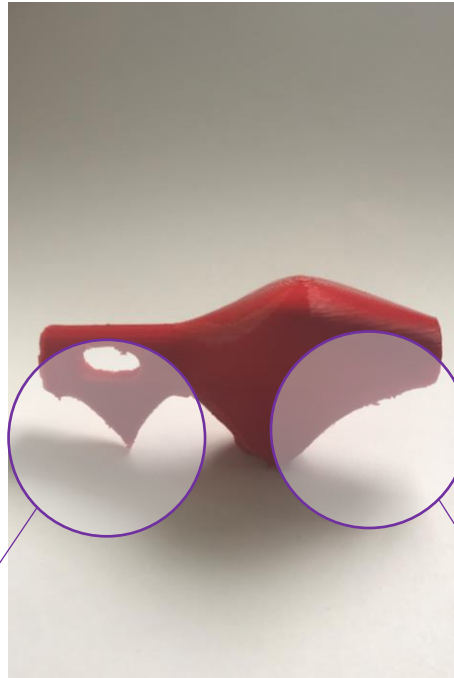


Curvature was added to the front of the device to support the middle finger.



A concave curve was added to the back. The concave curve allows different users to place their hand in different positions along the curve according to their hand size.

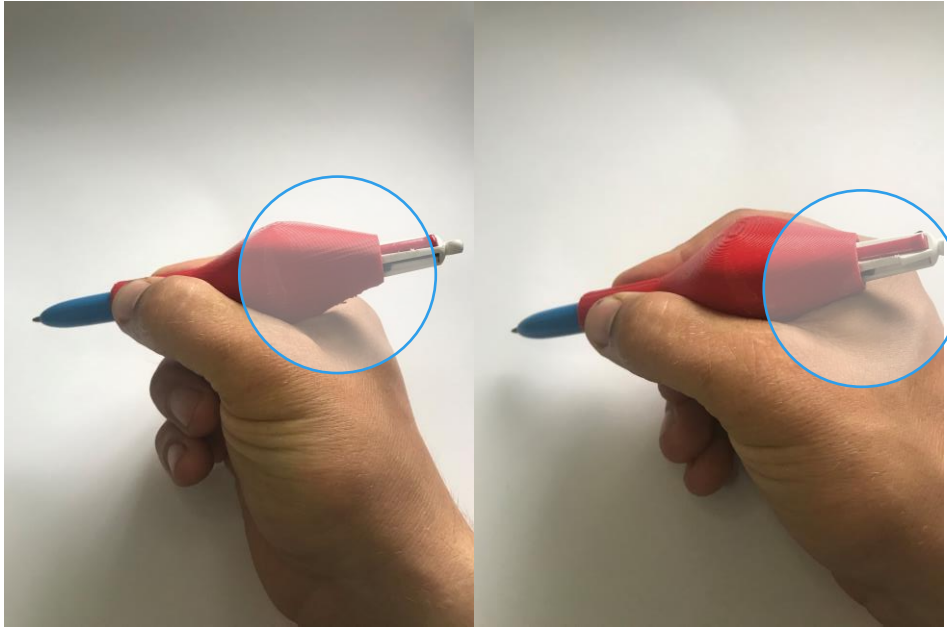
Grip Iteration 2 Testing



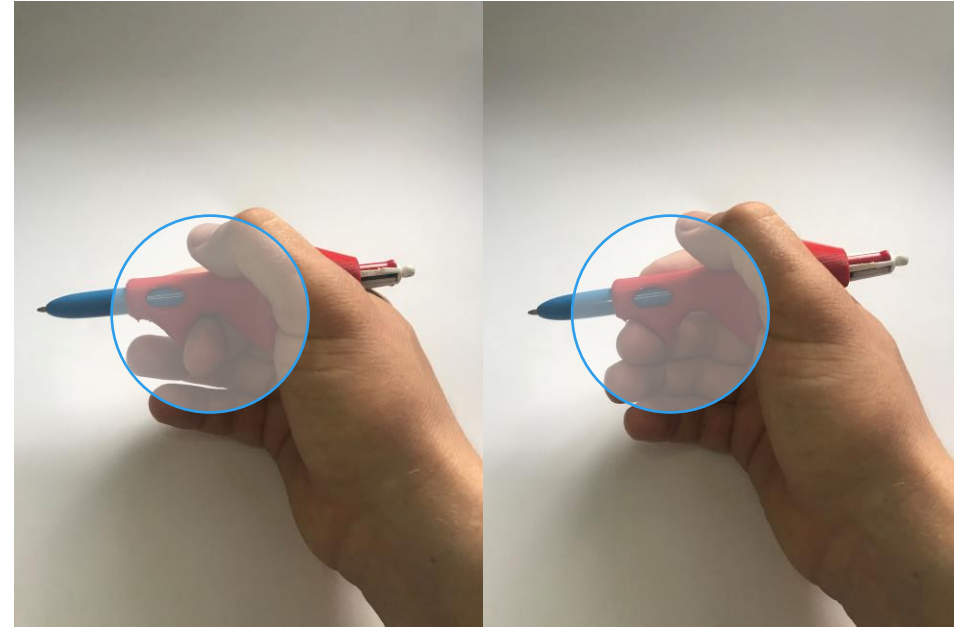
Curvature was added to the front of the device to support the middle finger.

A concave curve was added to the back.

Grip Iteration 2 Testing



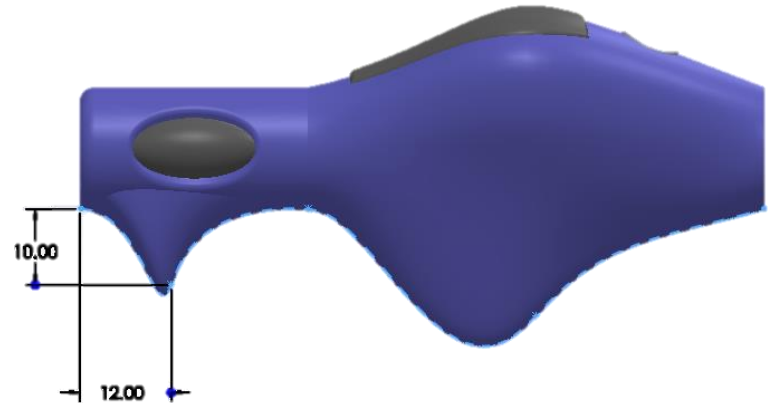
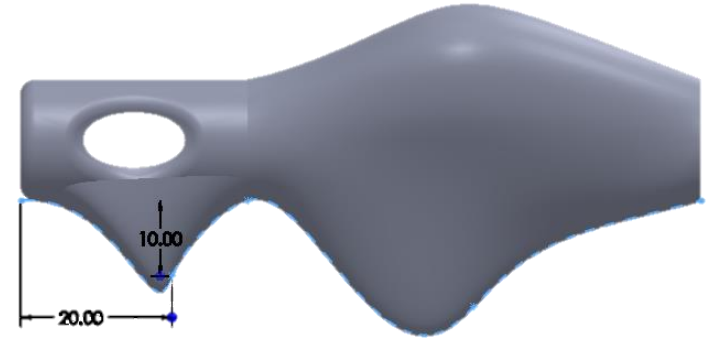
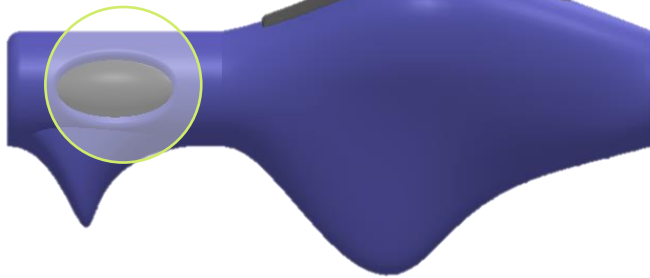
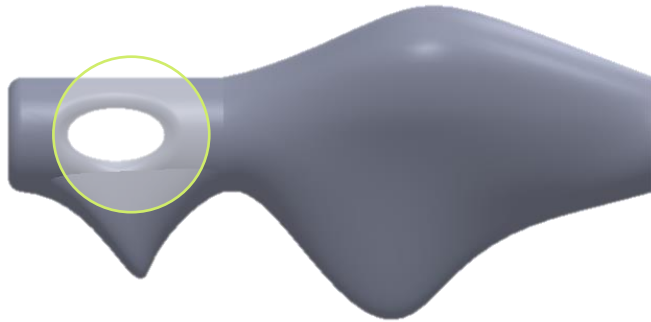
The concave curve allows different users to place their hand in different positions along the curve according to their hand size.



Curvature was added to support the middle finger underneath. The user has the option to rest their finger at the front or the back for optimal comfort.

On testing, It was identified that the curvature needed to be pushed away from the palm of the hand to allow for a more natural position.

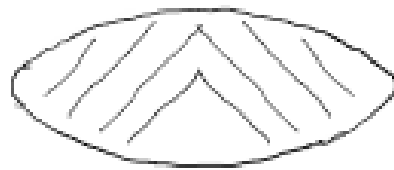
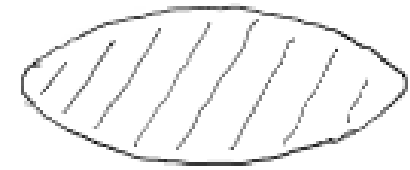
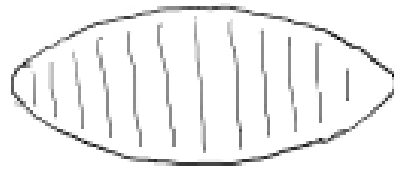
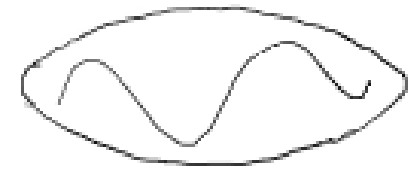
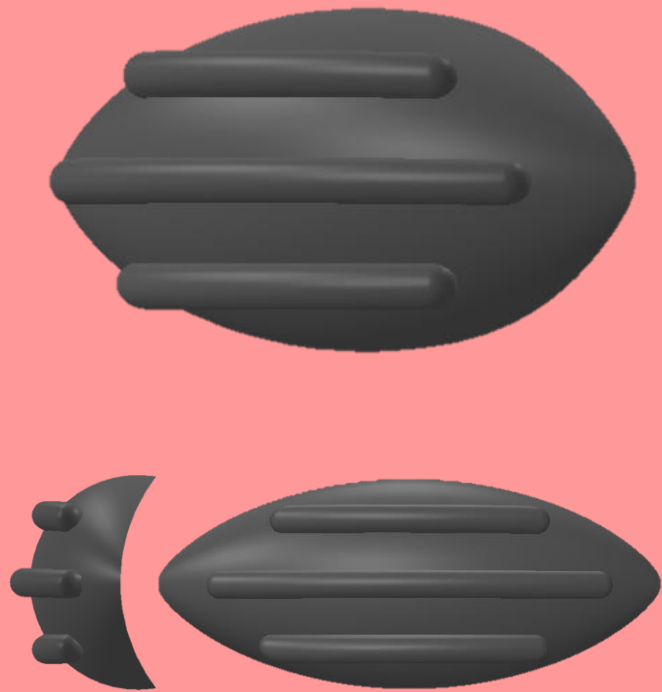
Design Alterations for Grip Iteration 3



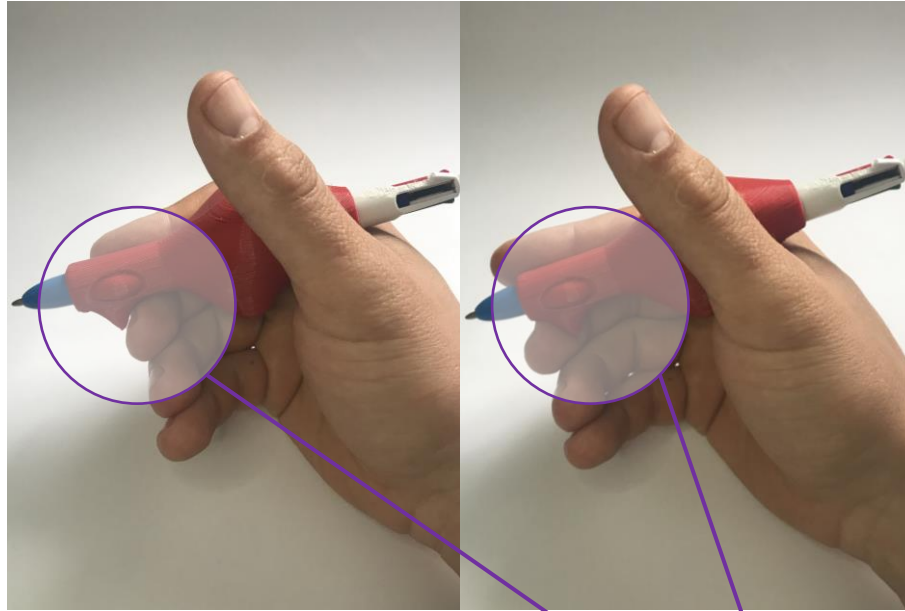
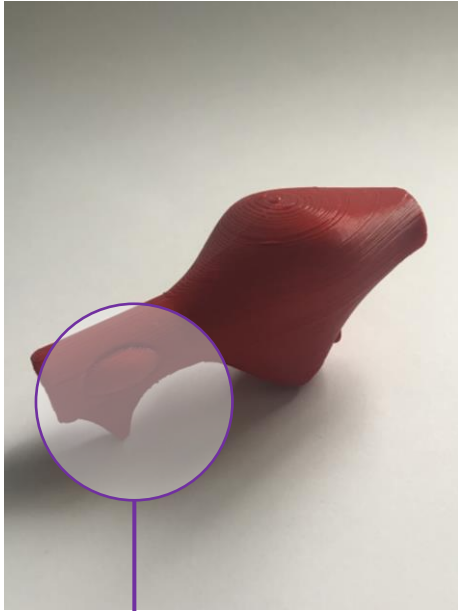
There is some padding added to the pressure points to try reduce the risk of injury. Some of those who gave feedback felt that they may grip the pen too tight.

The distance was increased between the curvature to allow for a more natural positioning of the middle finger.

Pressure Point Design



Grip Iteration 3 Testing



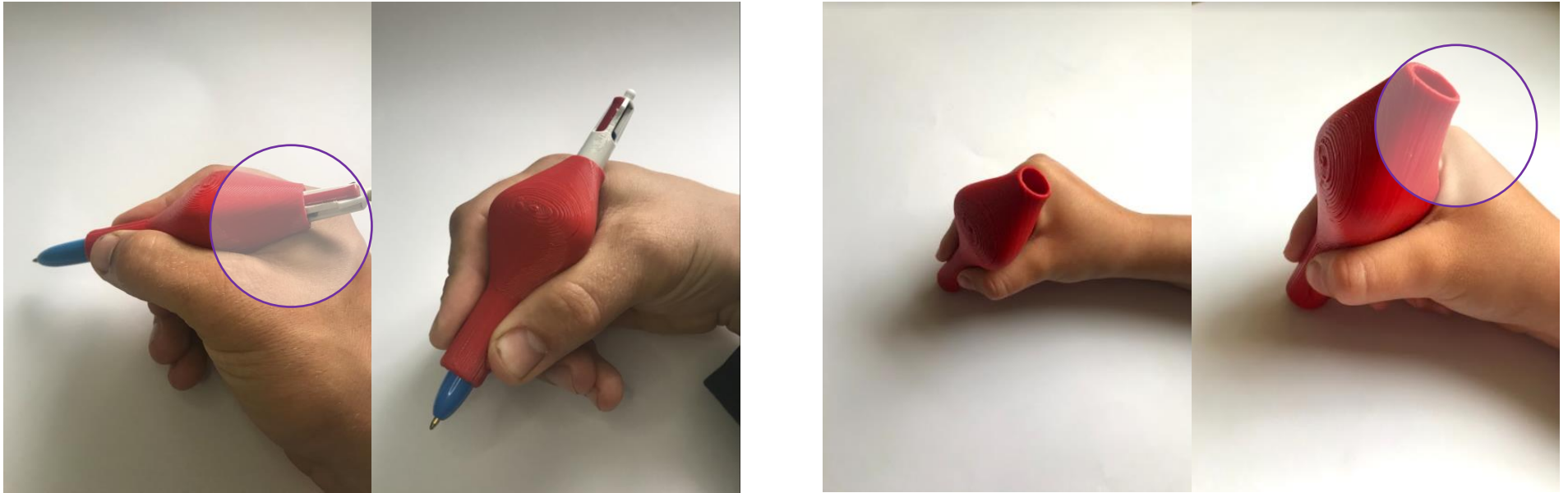
The padding was added at the pressure points to reduce the risk of injury.

The middle finger was also pushed forward a bit more to improve the comfort for the user.

The user can leave their finger resting at the front or the back of the support.

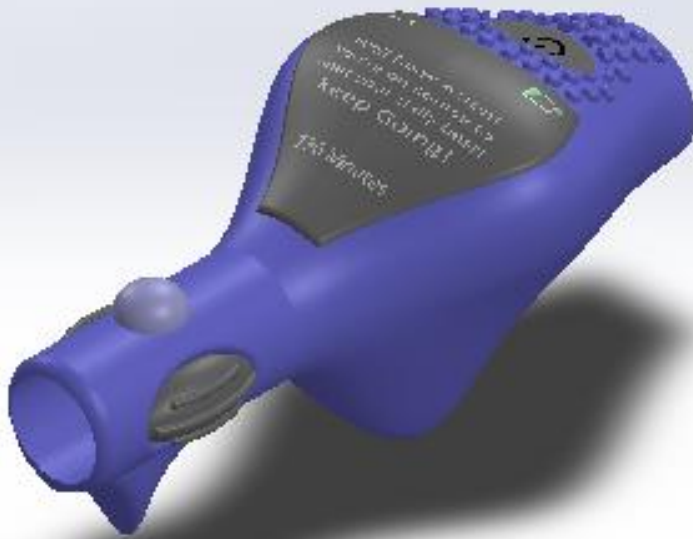
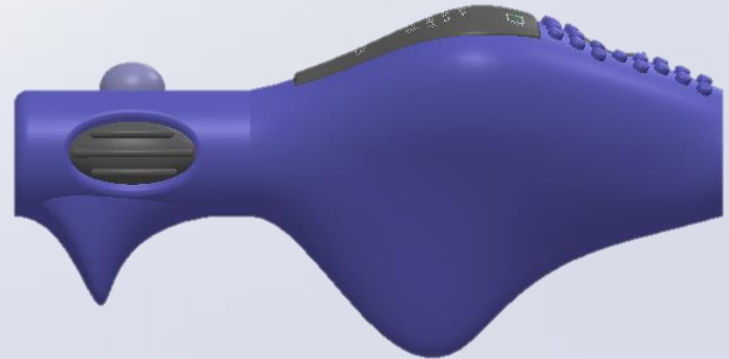
Grip Iteration 3 Testing

Various Hand Sizes



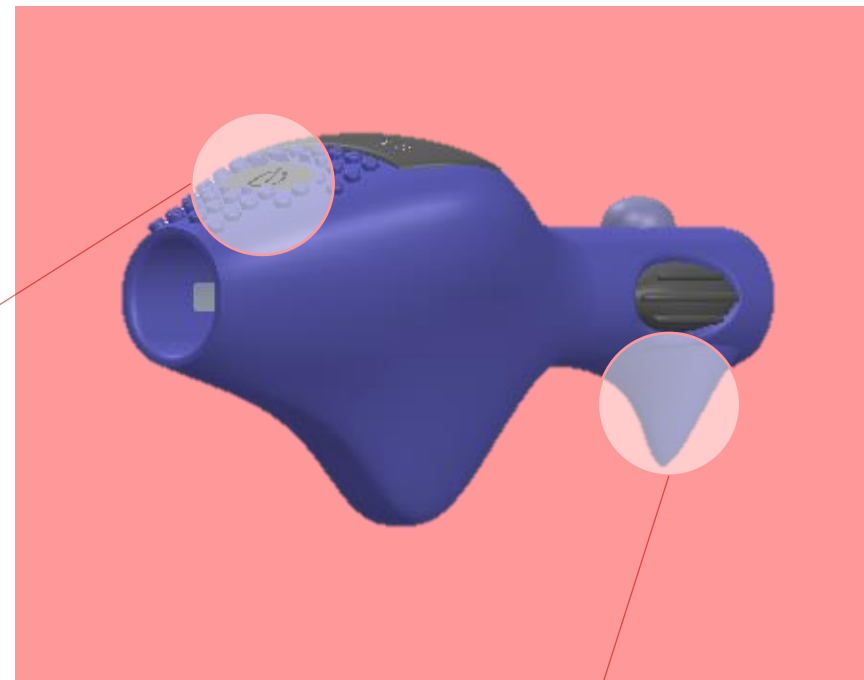
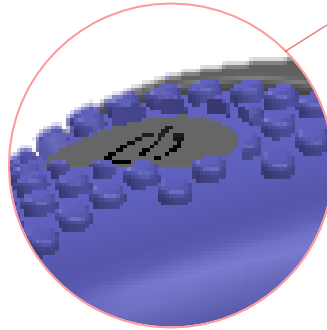
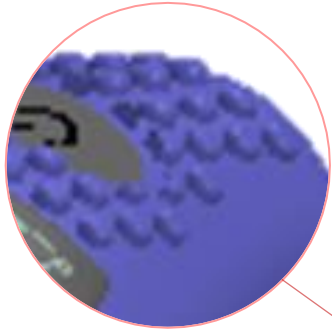
The images on the left show a male (28) hand gripping the device while the image on the right show a male (6) hand gripping the same device. Both users can be clearly seen gripping the device comfortably due to its curvature. The circles highlight the position of the device in the hand of each user allowing for various hand sizes.

Design Iteration 3

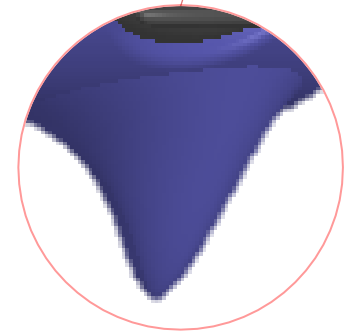


Key Design Features

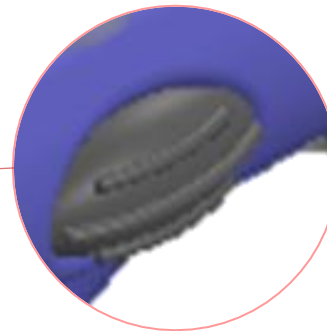
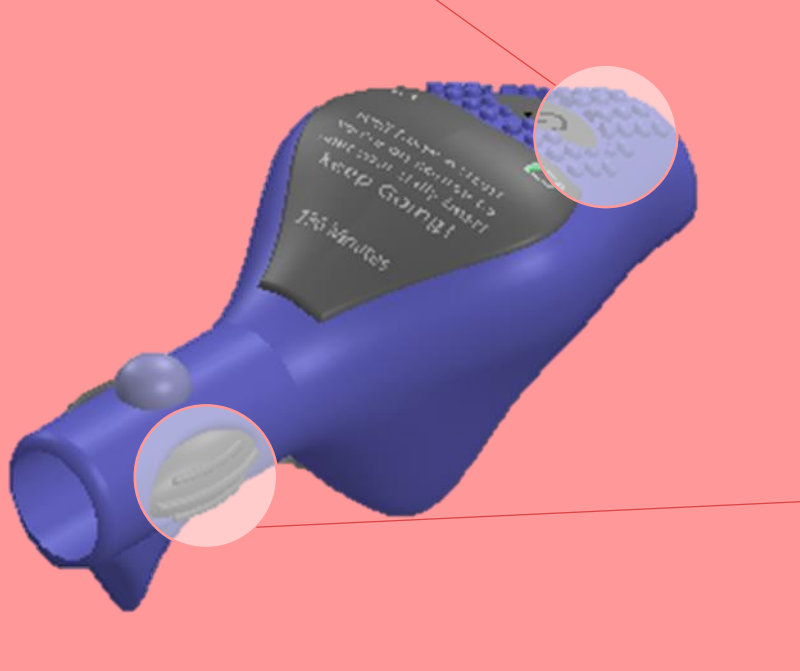
There is a textured finish on the top of the pen to assist in sensory regulation.



A power button is incorporated to switch on/off the device. It is located at the top of the grip to avoid accidental power on/off.



Middle finger support



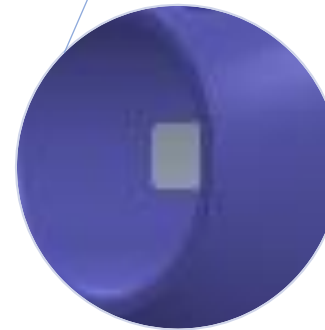
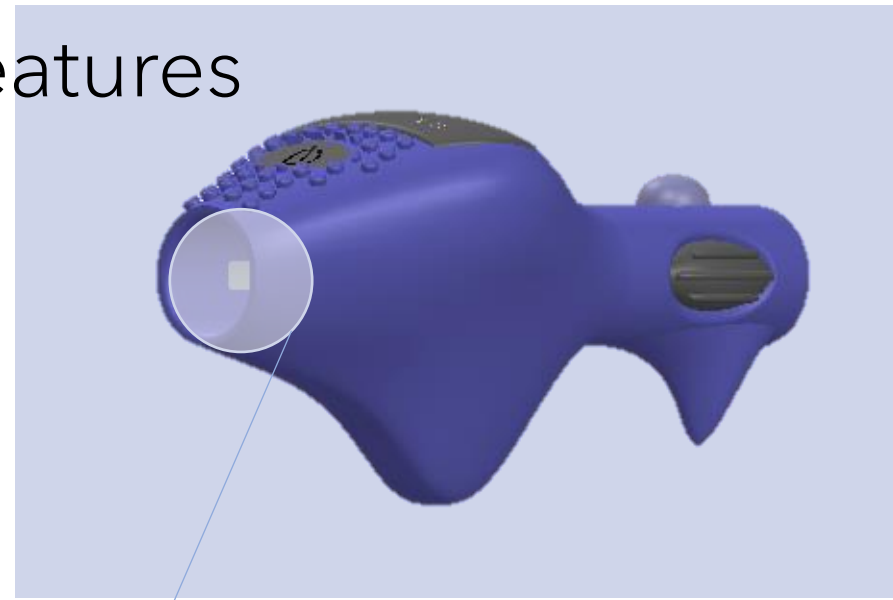
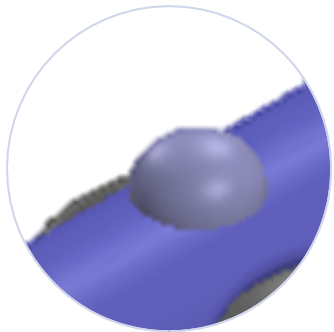
Cushioned pressure points to reduce the risk of injury and a textured surface to improve grip.

Key Design Features

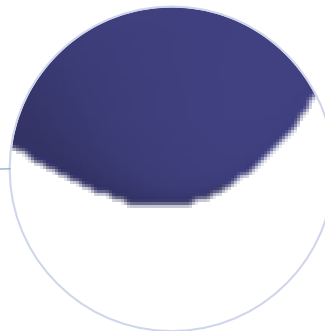
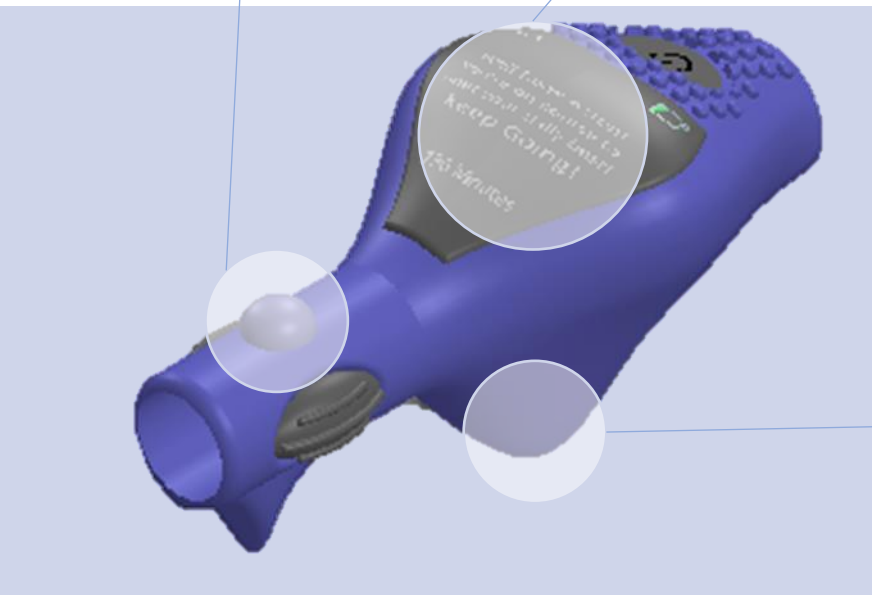
Release valve to release the pneumatic pressure when removing the grip from the pen.



Screen on the top of the device displaying data from the device.

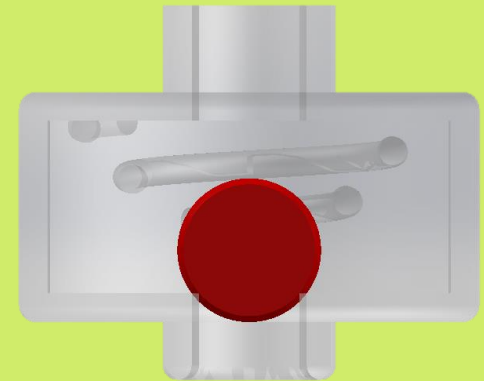
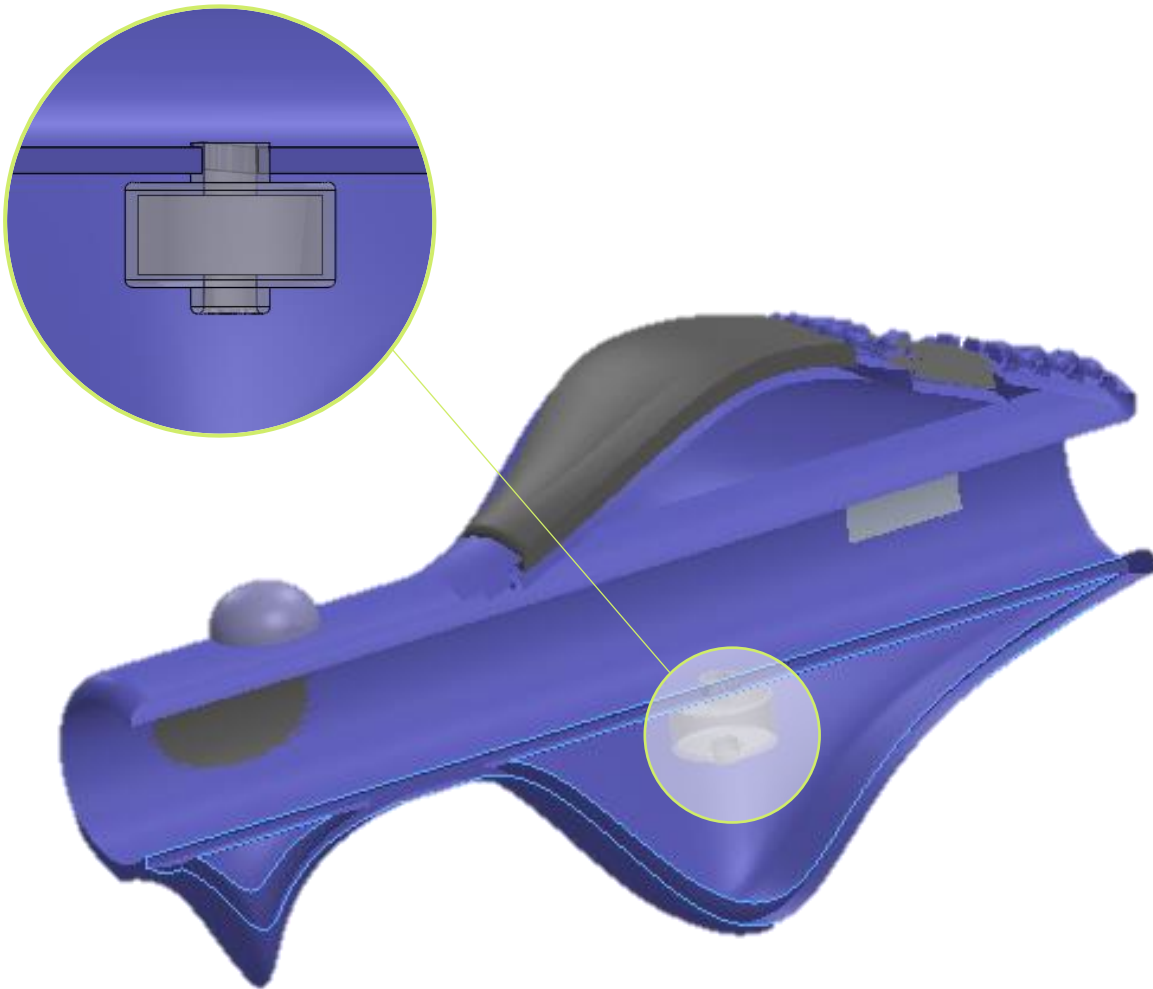


Charging contact point inside the pen to fit on charging port.



Bulb diaphragm used to inflate the film inside the grip to secure it on the pen.

Key Design Features



Section through the one way air valve.

When the air is being forced through, it will push up the ball. When the air stops, the spring will push the ball back down trapping the air.

The Display Screen

Displaying the time on the screen allows the student to monitor the time that has elapsed in the class.

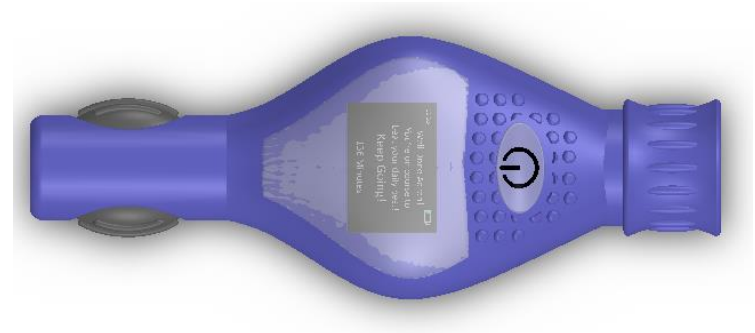
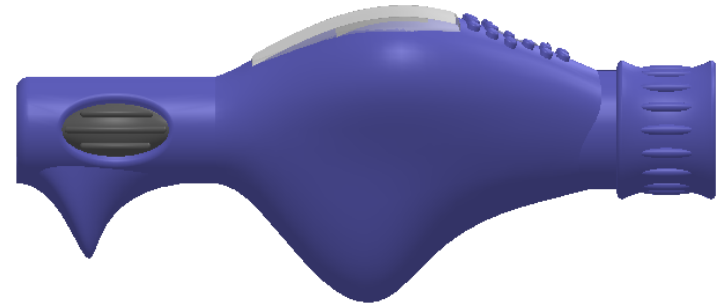
The user will be able to monitor the battery life of the device via the icon in the corner.



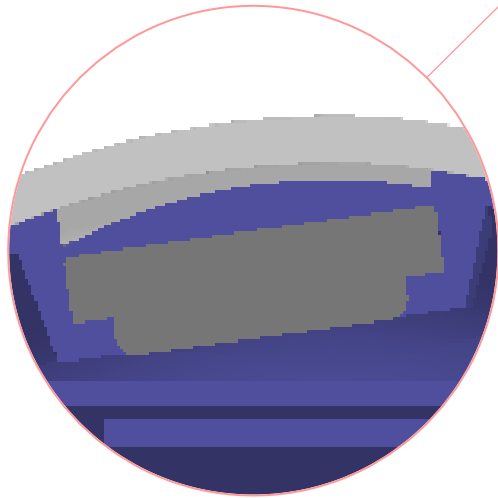
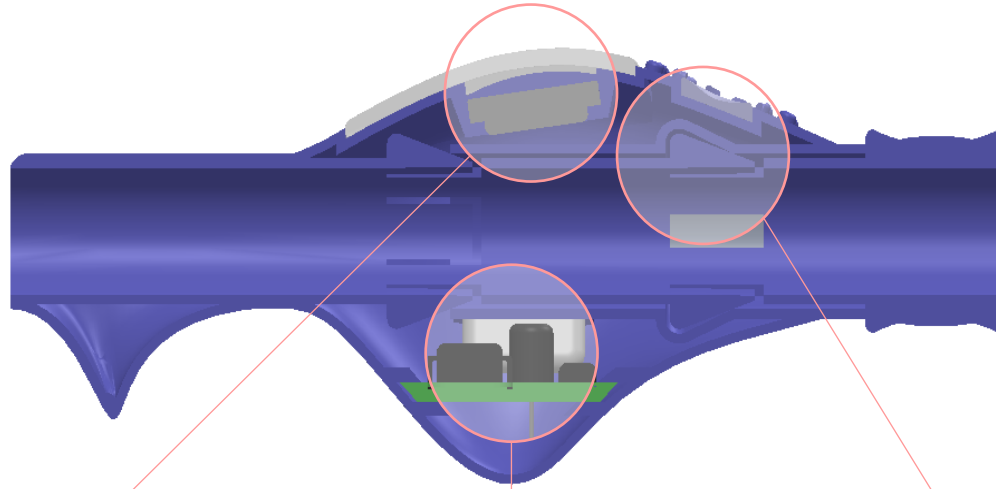
The active minutes on the screen allows the user to monitor their performance throughout the day.

Motivational messages will be displayed in the middle of the screen where it is easily visible to the user.

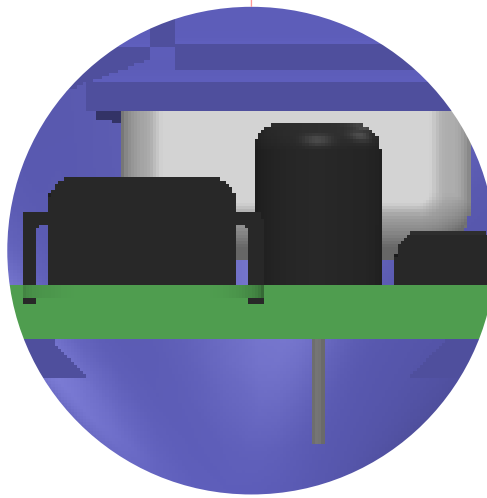
Final Iteration



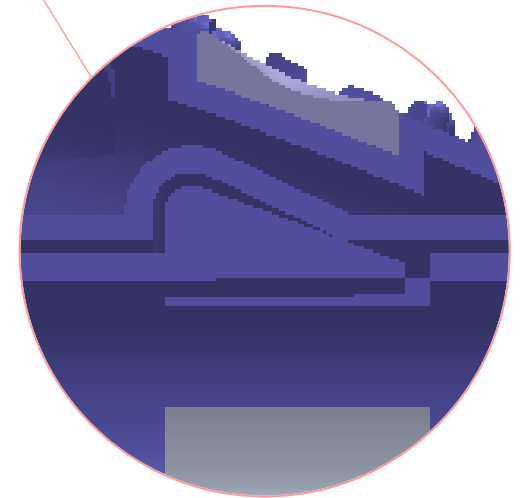
What's New?



Flat Rectangular Display Screen

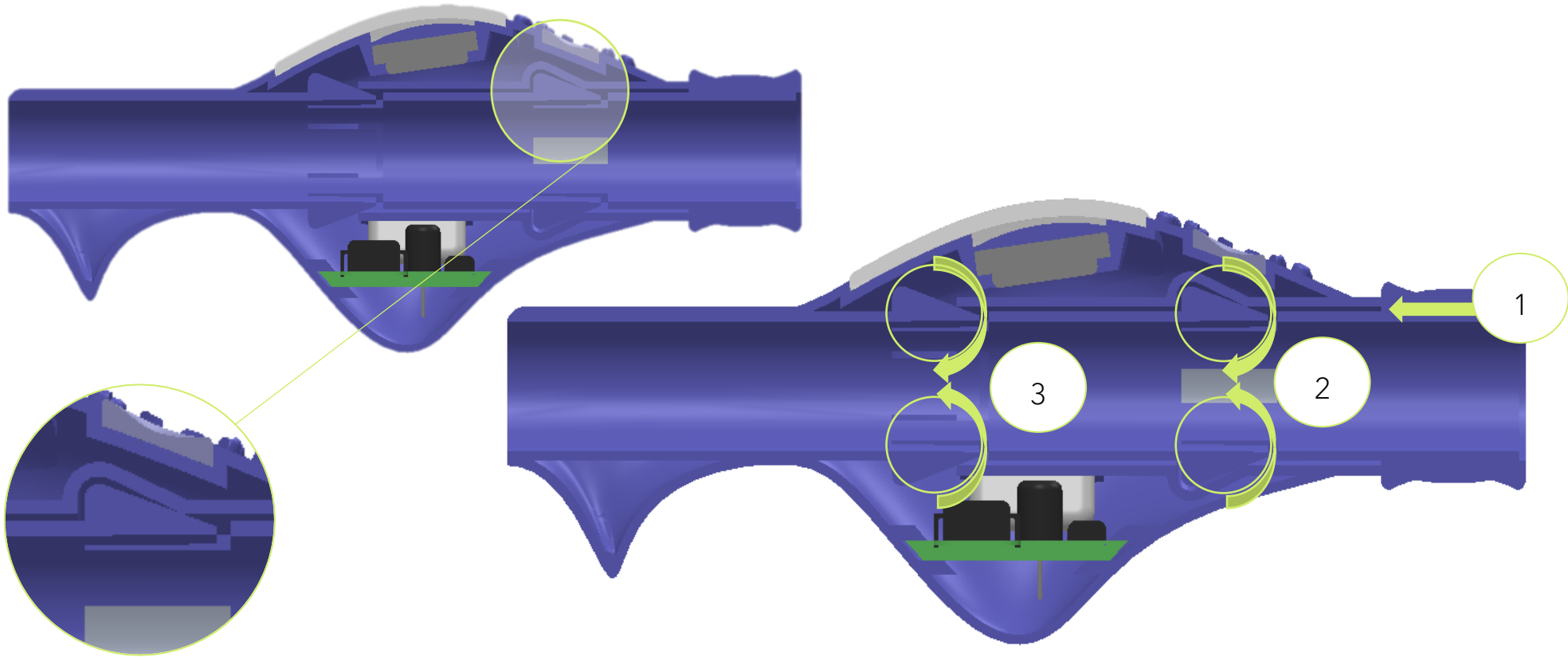


Electrical Components



New Clamping Mechanism

New Clamping Mechanism



1. The head at the back will be threaded and will push the cylinder along the shaft.
2. The two contact points will be pushed down to compress the pen
3. There are four contact points at point 3.

Device Evaluation with Technicians

- Air compression mechanism may not be secure enough.
- Evaluate weight and balance
- Curvature and bespoke screen will increase manufacturing costs

Potential solutions to securement mechanism.



Clamp for extendable mop handle



Water joiner mechanism



Tripod leg clamp mechanism

Clamping Mechanism Details

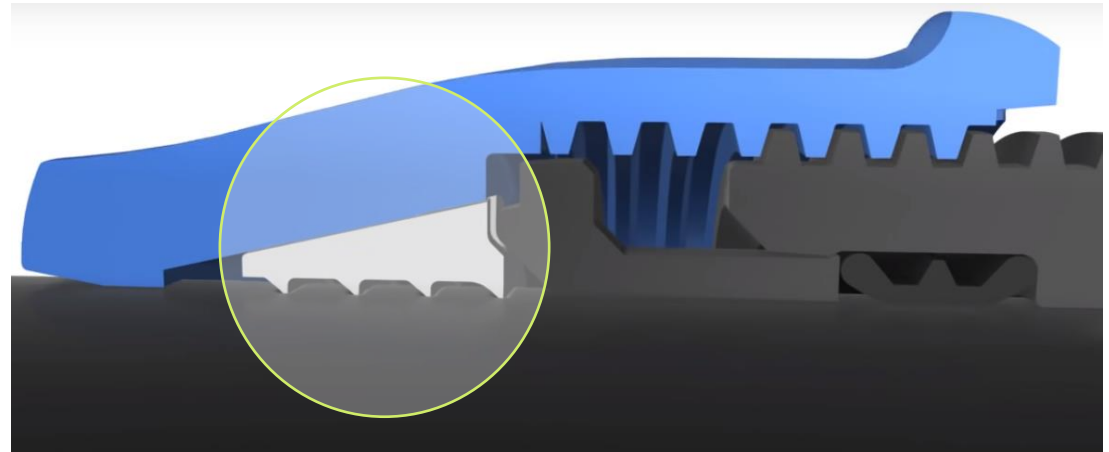


<https://www.youtube.com/watch?v=bNMQ-MGbTwM>

Video explains how the mechanism works.

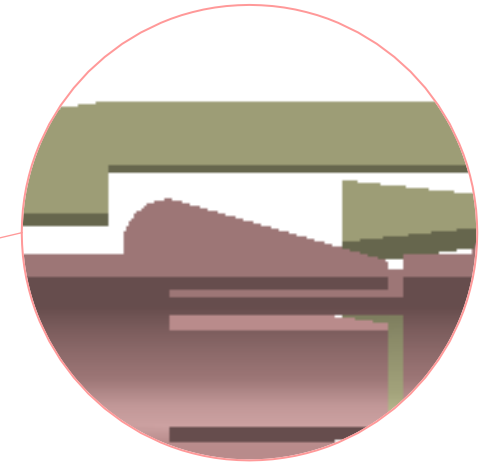
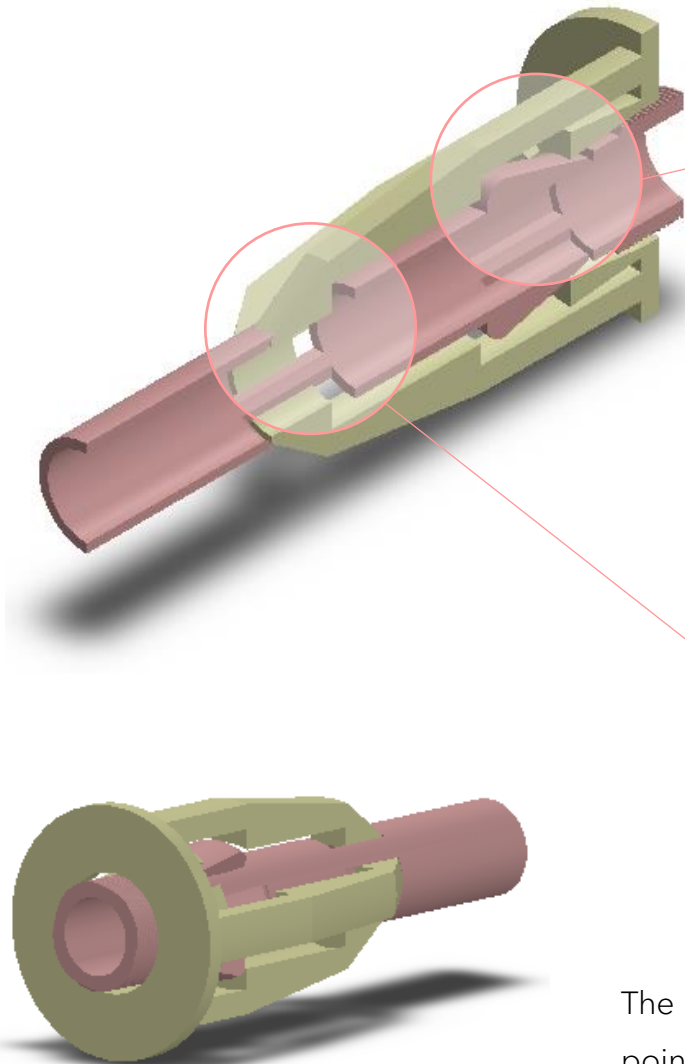


Push Fit Water Joiner

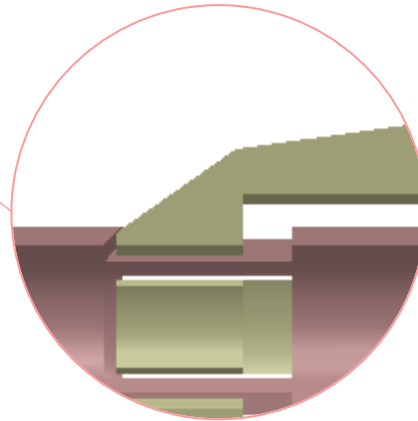


When the blue head is threaded in, it squeezes the white component to grip into the pipe with its teeth. The teeth will be unable to sink into the pipe so a not slip tip will be used.

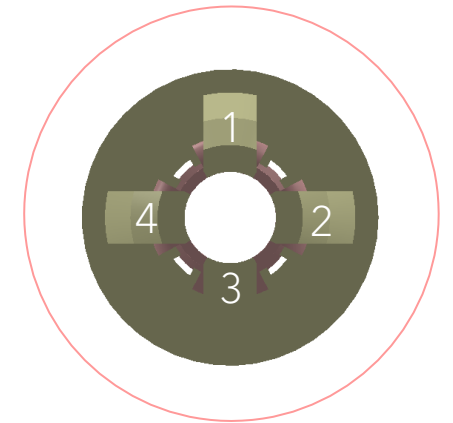
Clamping Mechanism Iteration 1



The tab will be pushed downwards to close up the opening when threaded in.

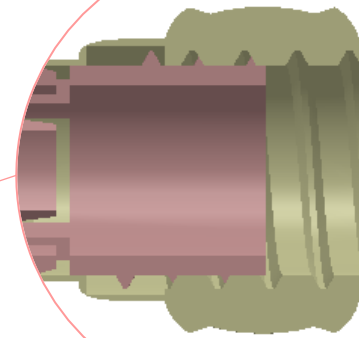
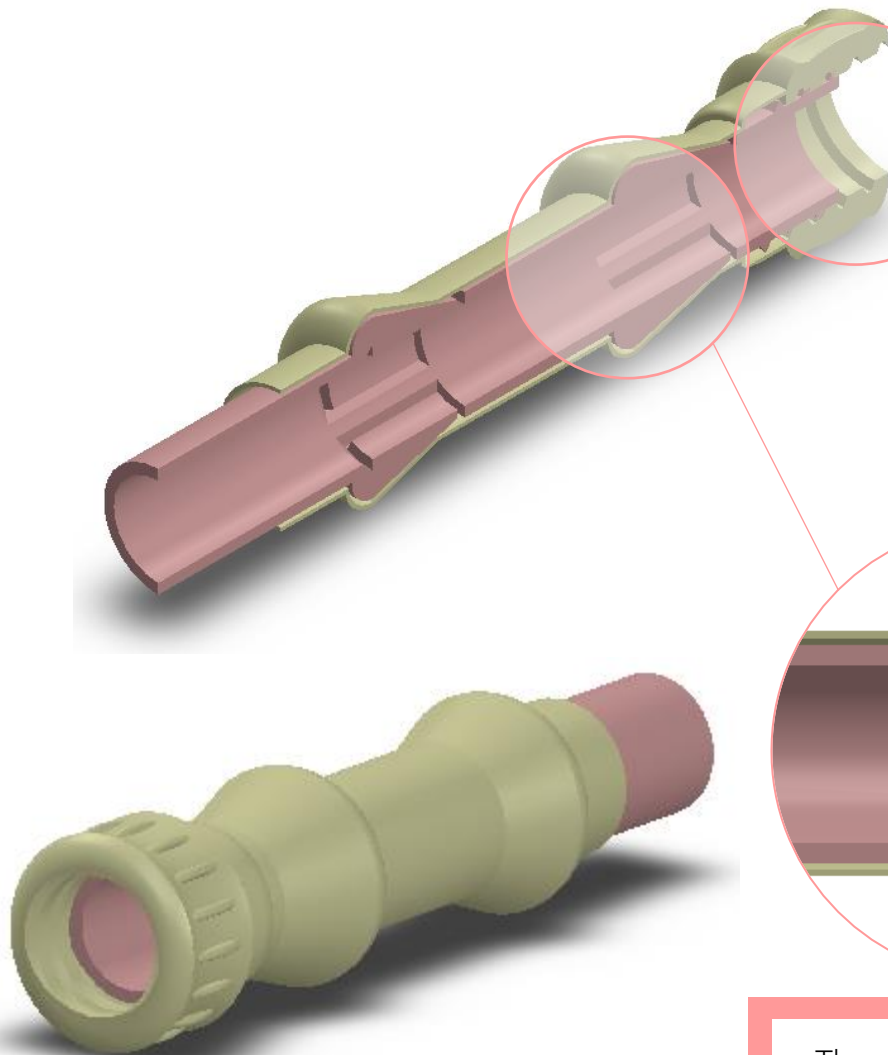


The pen will be gripped at 4 extra points further along the shaft.

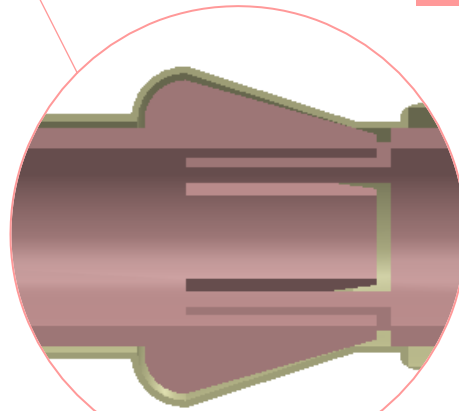


The pen will be gripped at 4 points around the circumference to ensure the pen is evenly gripped

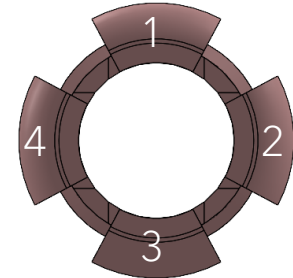
Clamping Mechanism Iteration 2



The tab will be pushed downwards to close up the opening when threaded in.

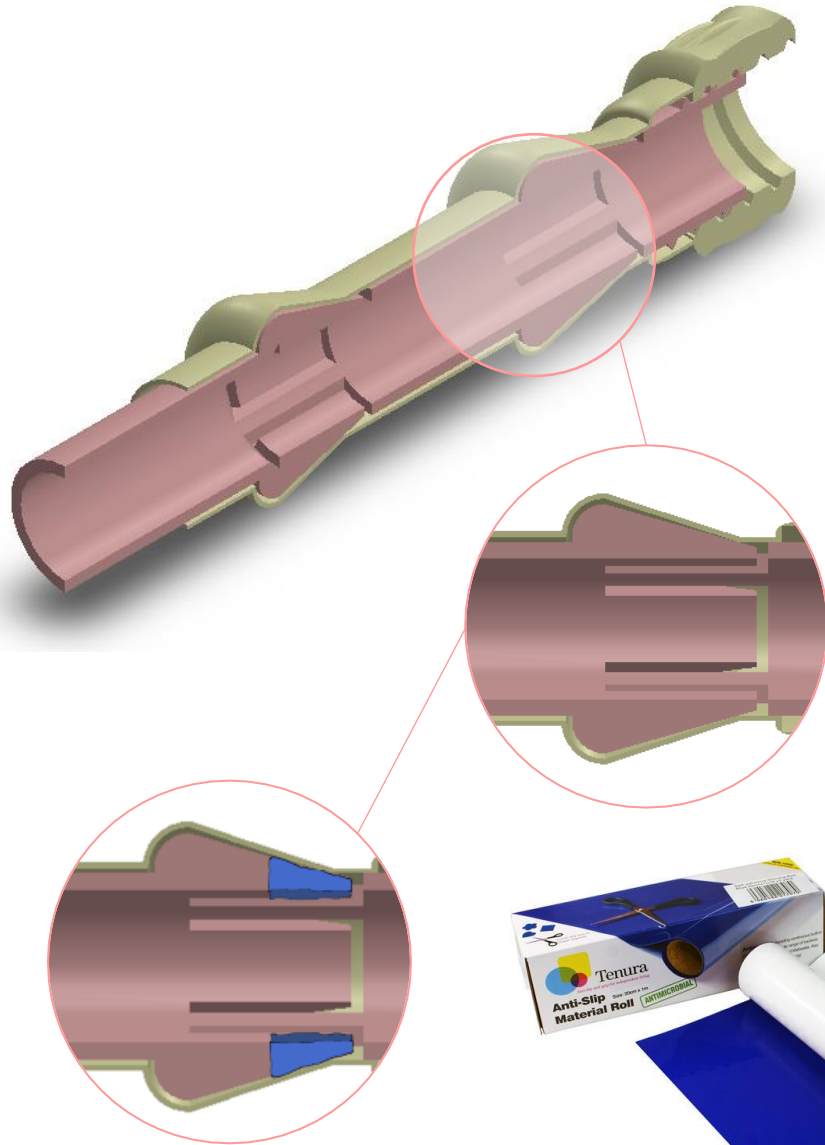


The points where the pen will be gripped

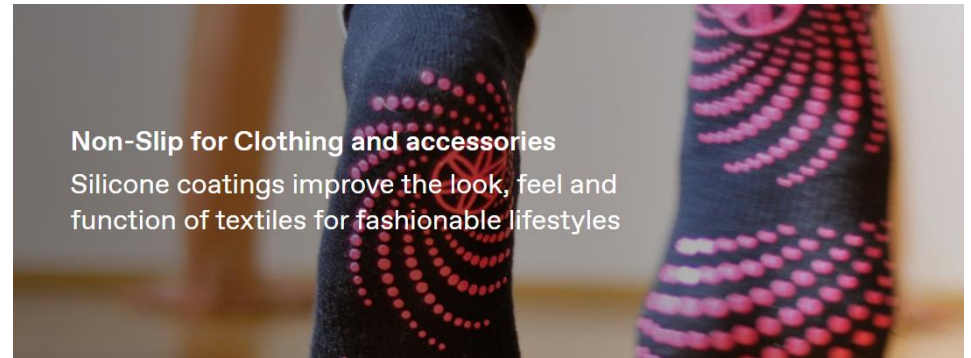


The pen will be gripped at 4 points to ensure it is gripped evenly

Non-Slip Tips



The tips will be coated with a non-slip material such as a silicone rubber that is also used for appliances such as cup coasters and non-slip clothing.



Non-Slip for Clothing and accessories

Silicone coatings improve the look, feel and function of textiles for fashionable lifestyles

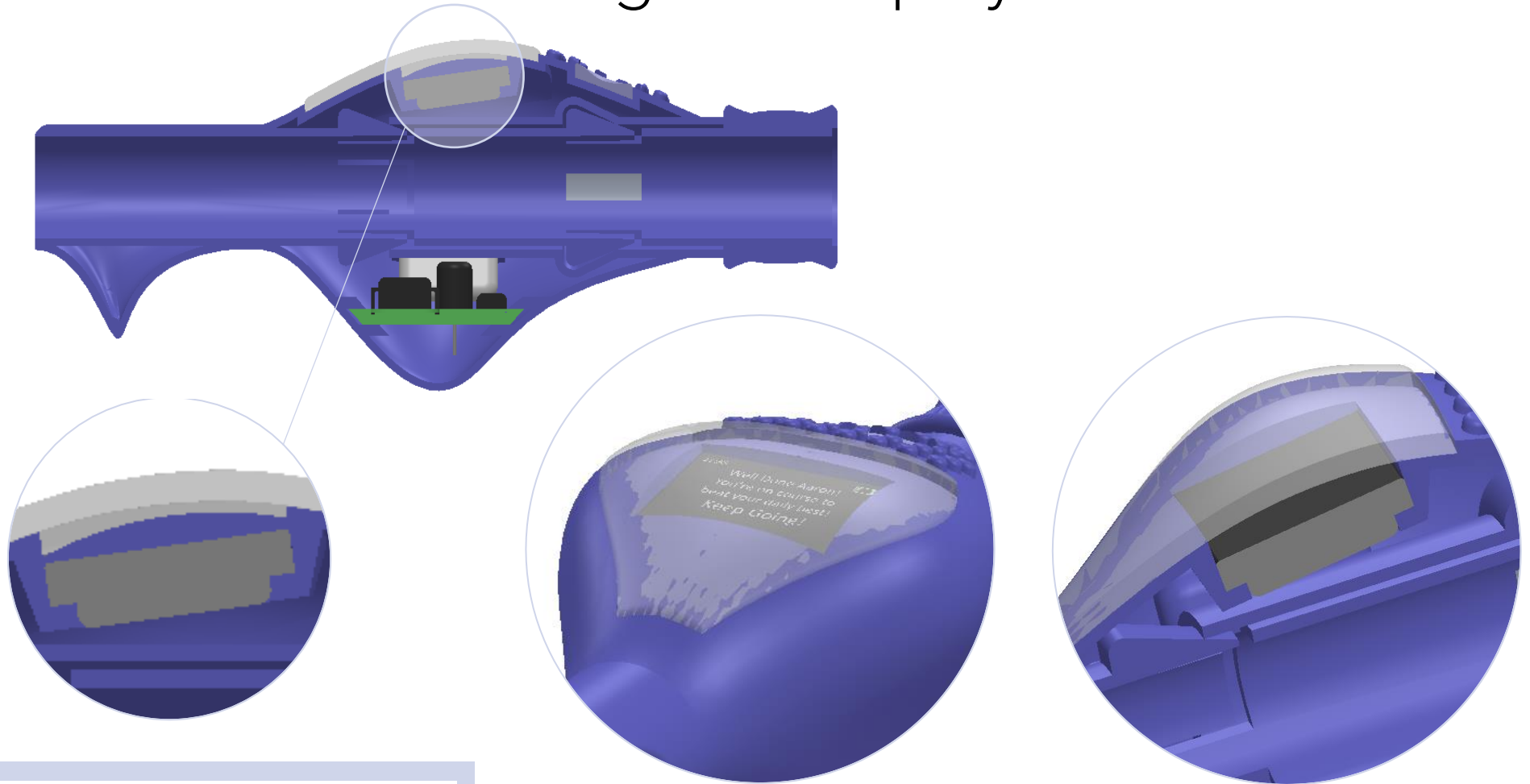


Tenura Self Adhesive Non-Slip Silicone Reel

Strong self-adhesive backing

- o Excellent non-slip properties
- o Can be used as a permanent non-slip surface
- o Comes in a roll format allowing a diverse range of applications
- o Available in a 1m x 20cm roll, with a material width of 0.5mm

Flat Rectangular Display Screen

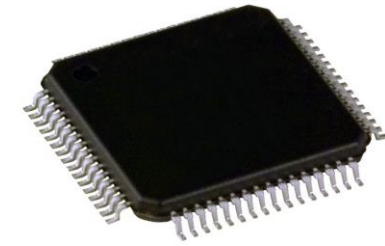


Following a discussion with a technician advised me that a flat rectangular screen would reduce manufacturing costs.

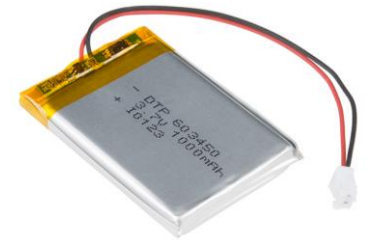
A rebate is cut into the body of the pen to house the rectangular flat screen

The clear glass will still remain to maintain the flowing curvature.²⁷⁸

Electrical Components



Micro Controller



Rechargeable polymer lithium battery



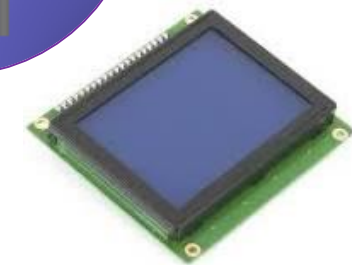
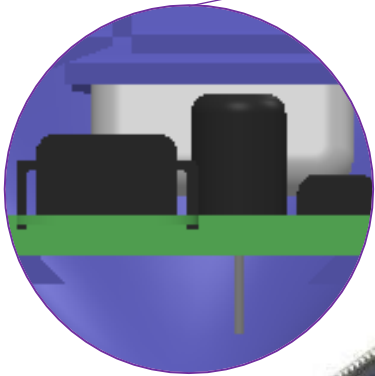
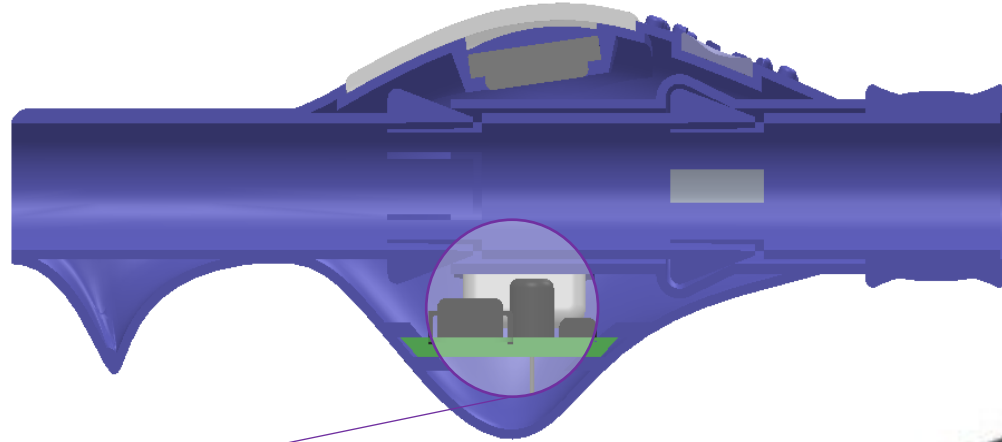
Tilt Switch to measure device activity



Transmitter to send data to the app

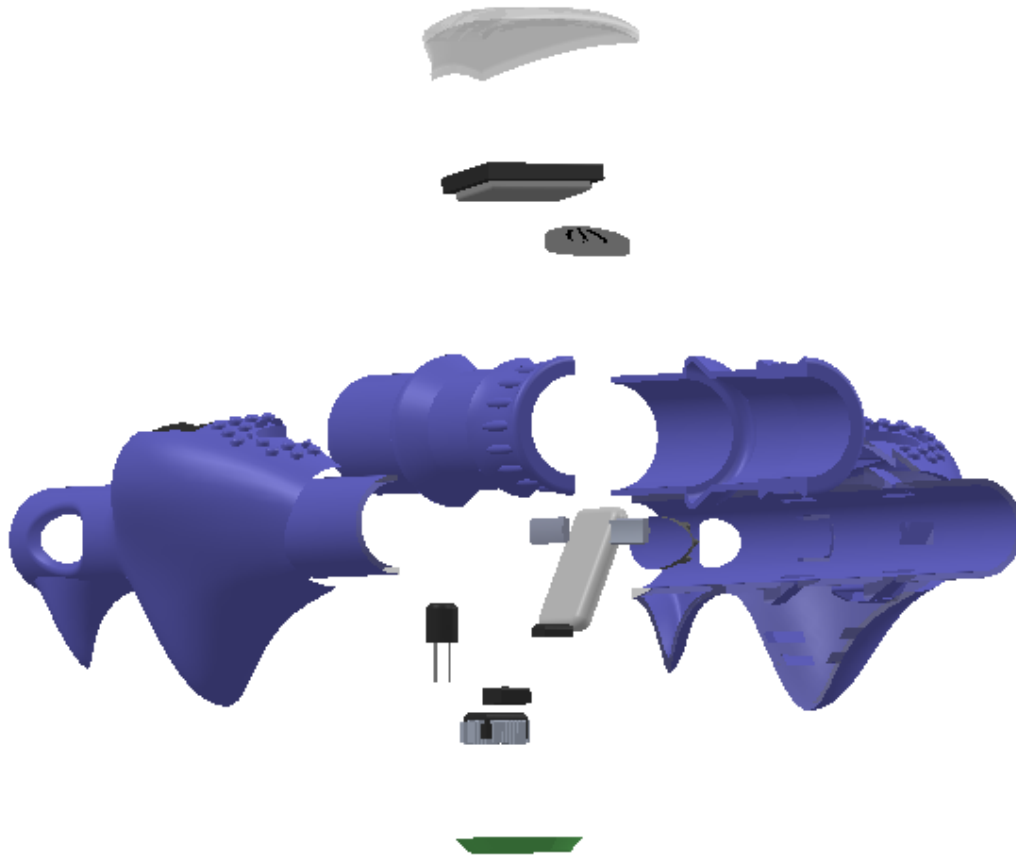


Bluetooth IC Component



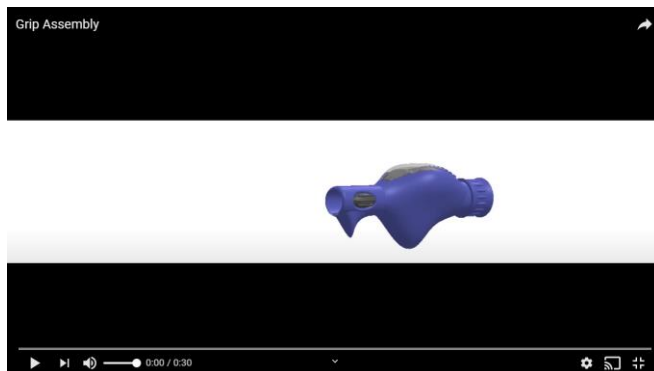
OLED display screen

Exploded View



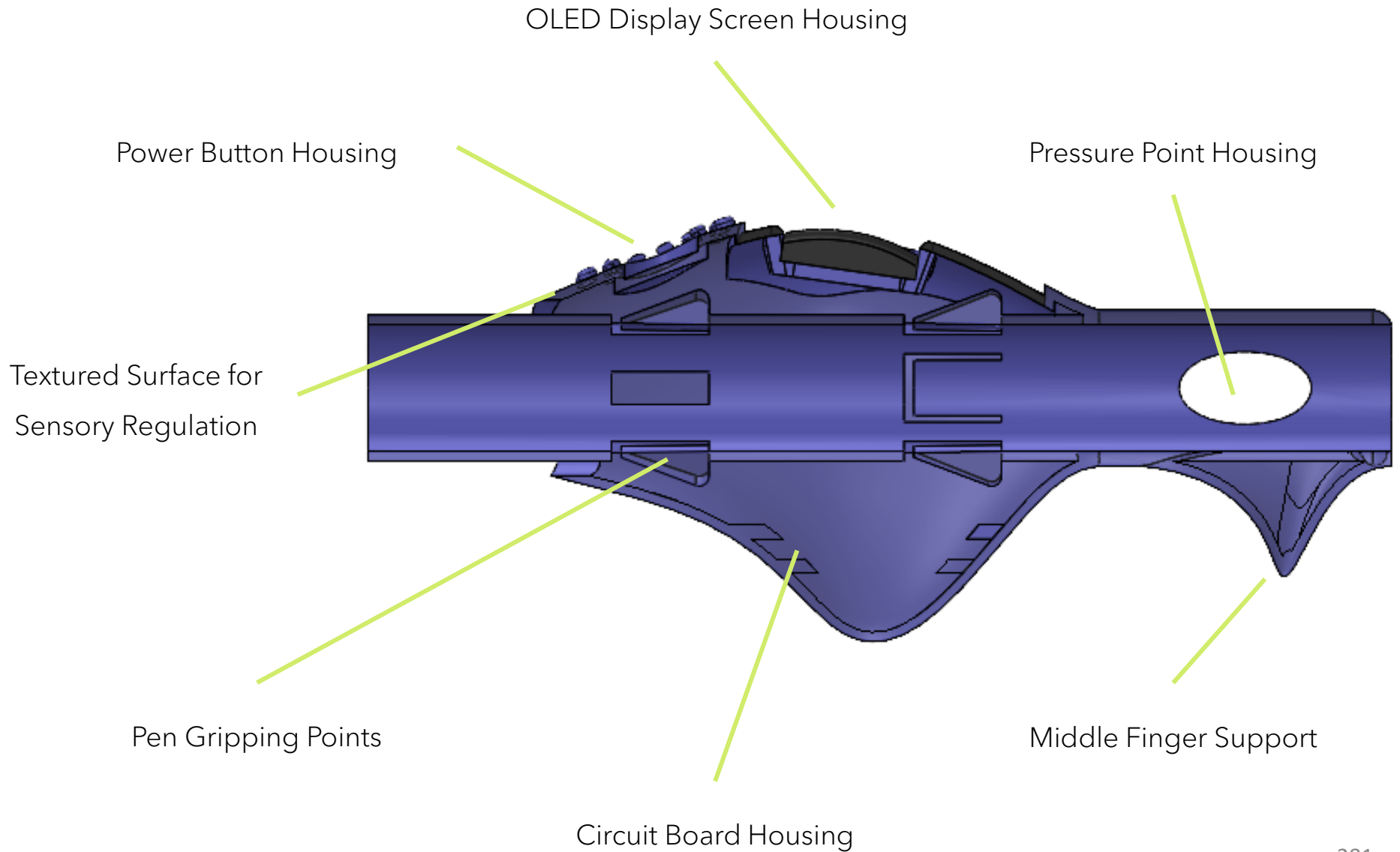
List of Components

1. Sides (X2)
2. Gripping mechanism sides (X2)
3. Power Button
4. OLED Screen
5. Clear Glass Cover
6. Charging Contact Points (X2)
7. Lithium Battery
8. Tilt Switch
9. Transmitter
10. Microcontroller
11. Bluetooth IC Component
12. Circuit Board
13. Pressure Gripping Points (X2)



<https://youtu.be/T4BGSSEY8kc>

Side of Main Body

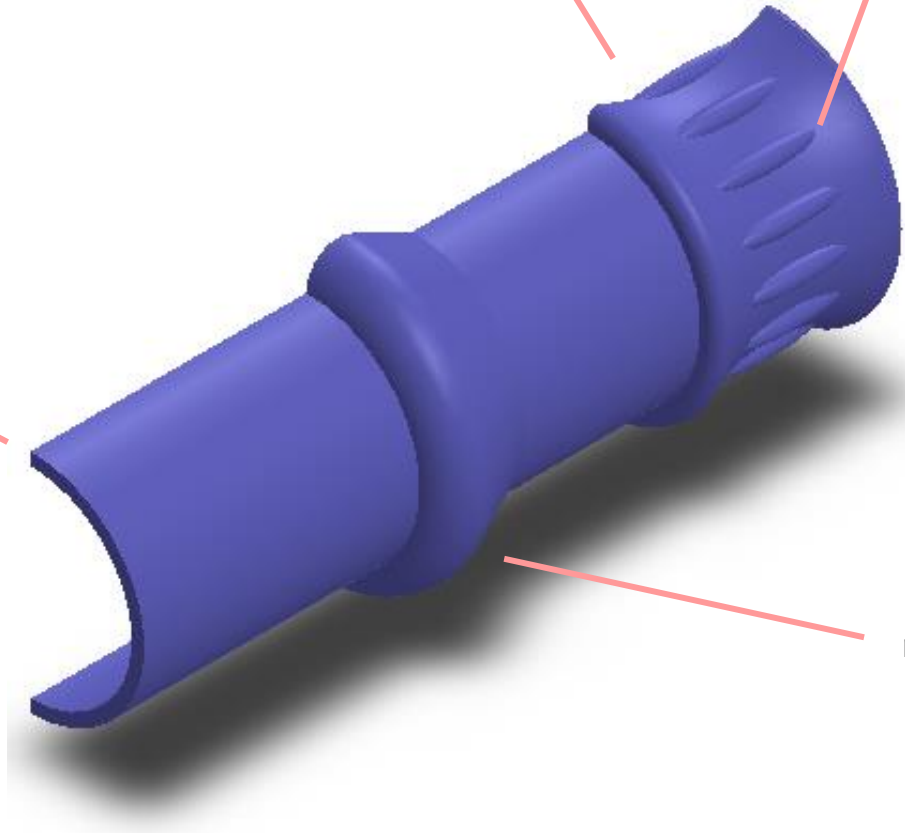


Side of Compression Mechanism

Threaded surface to provide a secure grip.

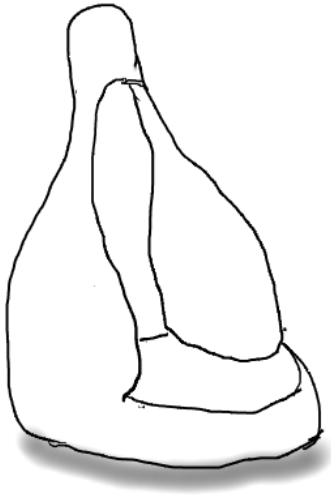
Textured Head for optimal grip when rotating.

Front edge will compress the latter gripping points.

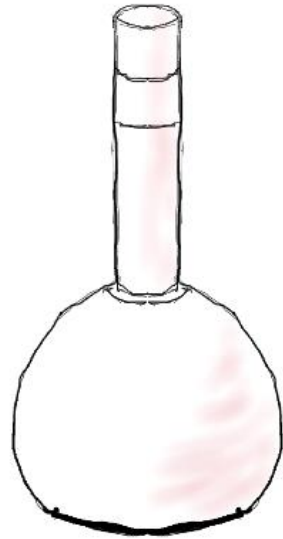


Curvature to allow the mechanism continue to the latter contact points

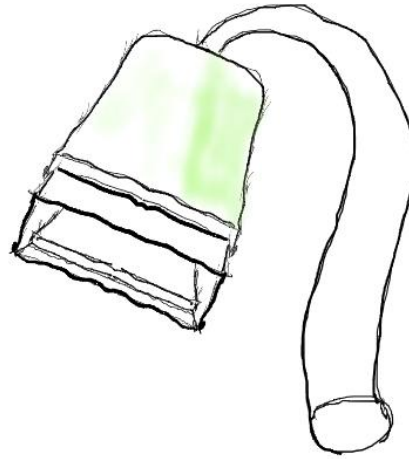
Device Charging



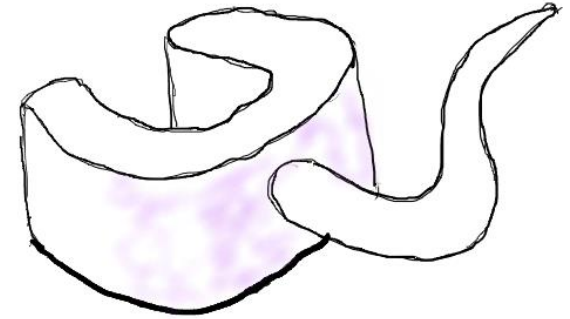
"Sit-in" Charging Port



Grip Charging Port

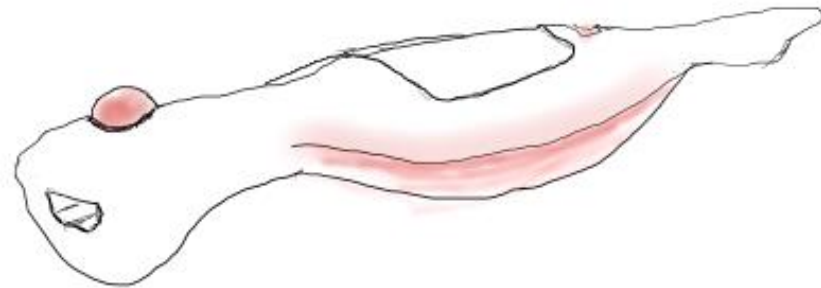


USB Charging Plug-in



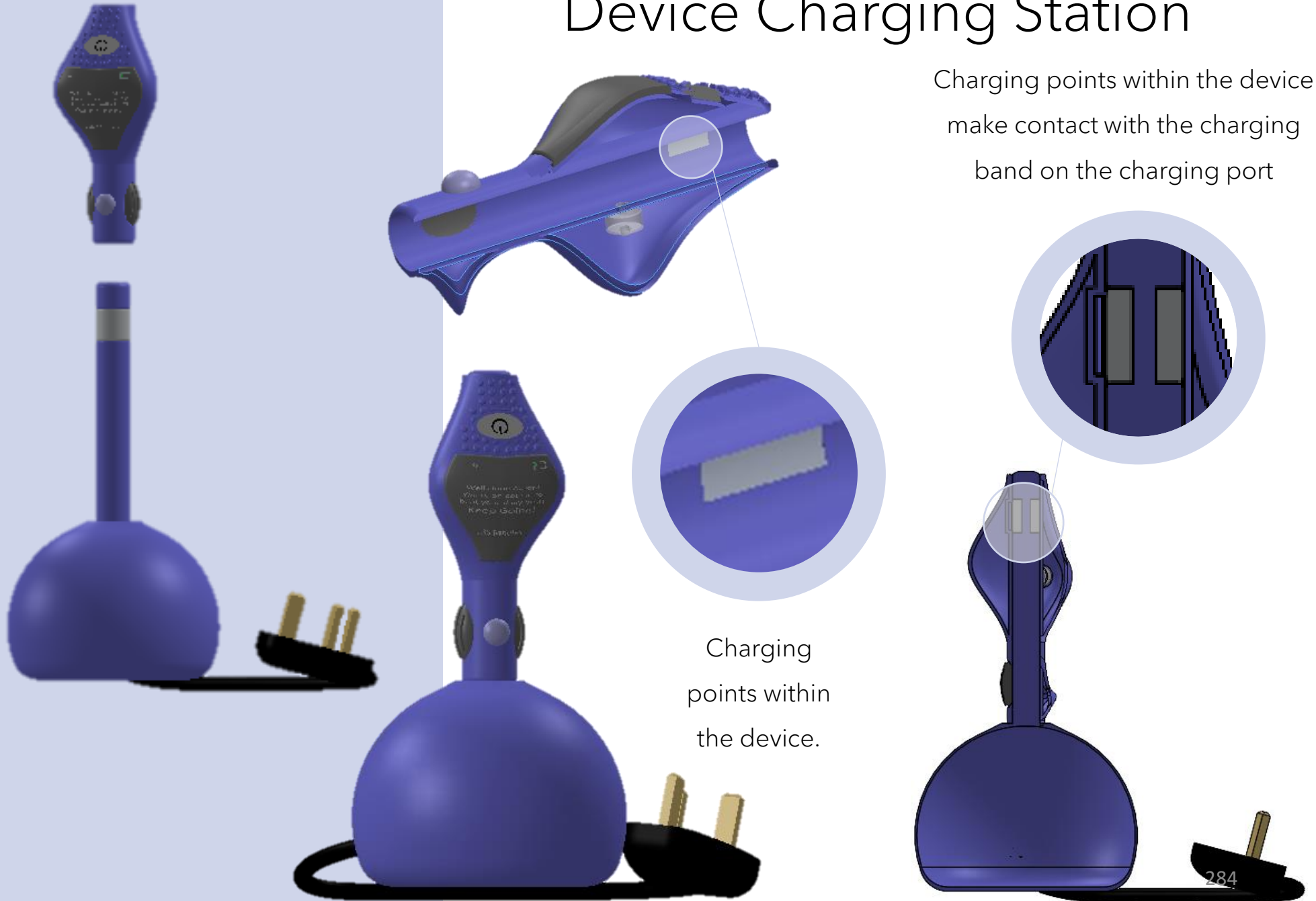
Clip Around Charger

Using the charging ports would camouflage the opening in the device required for a USB plug in



Device Charging Station

Charging points within the device make contact with the charging band on the charging port



Charging points within the device.

Device Charging Station Prototype



The device is simple in shape and would not look out of place on a table as an ornament.

Device in place on Charging Station Prototype



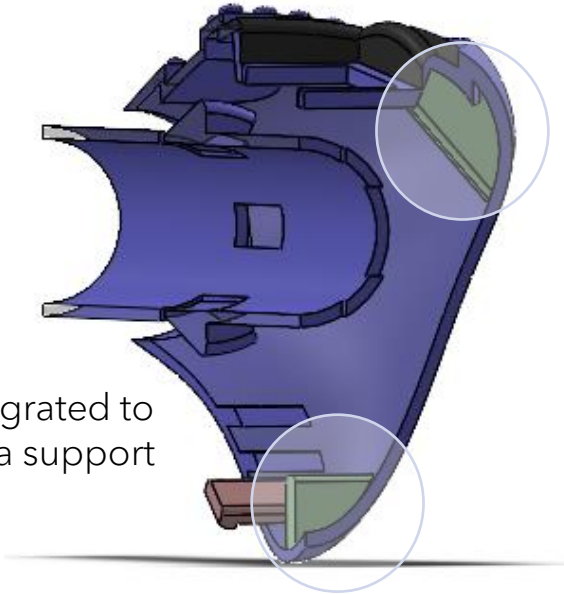
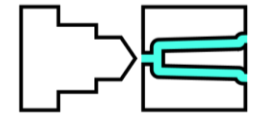
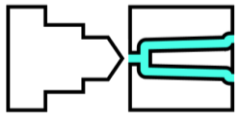
The device slips on easily over the charging port to be in the charging position. The charging port matches the proportions of the grip and it does not look out of place when charging.

Manufacture and Assembly

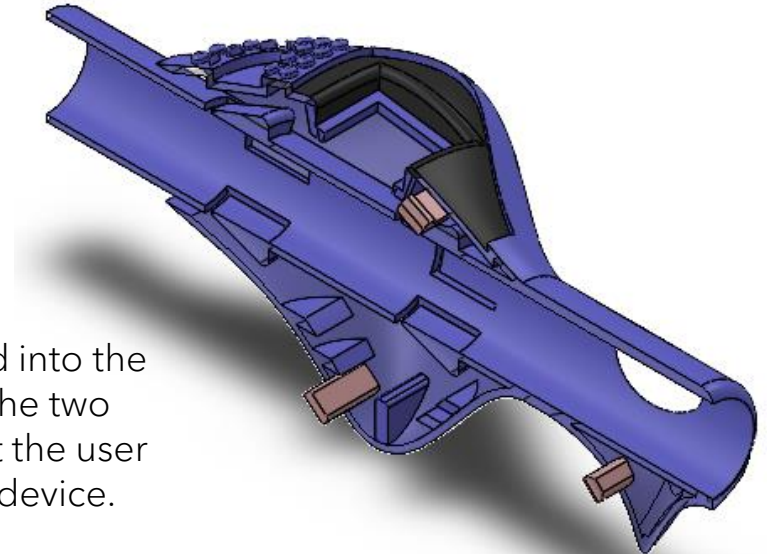


Design for Manufacture

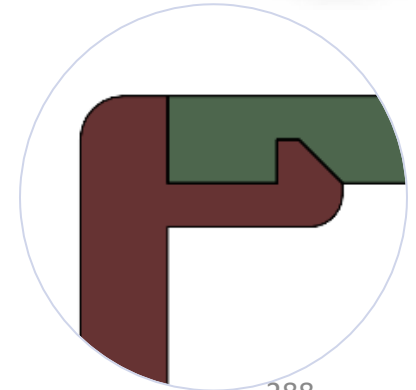
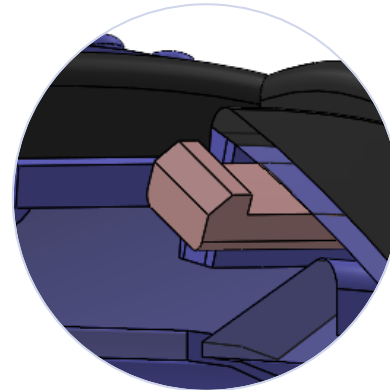
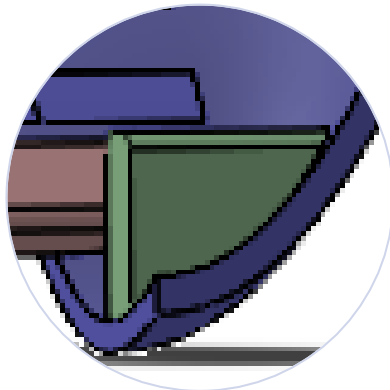
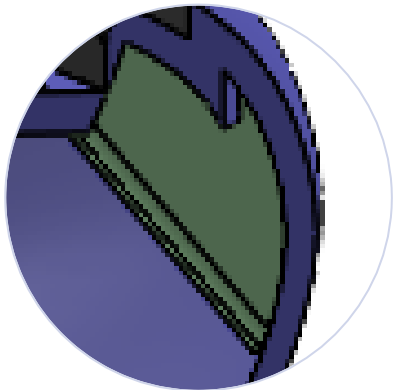
Injection Moulding



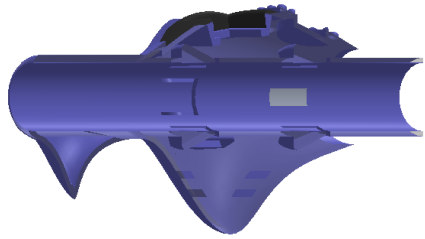
Ribs are integrated to provide extra support



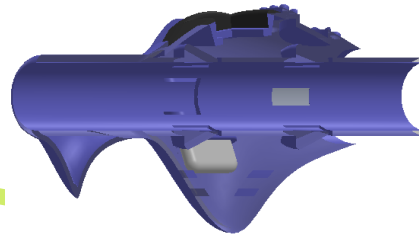
Snaps are integrated into the design to secure the two sides and to prevent the user from opening the device.



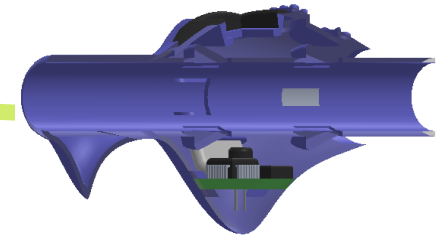
Assembly Process



Side 1



The battery is installed in the side



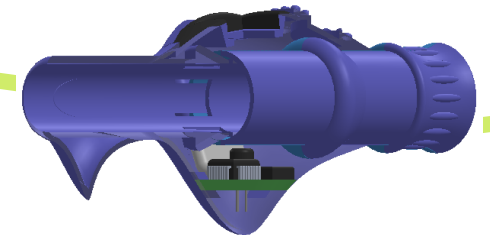
Electrical components are installed on a circuit board and positioned.



The display screen is inserted into the housing.



The second side is slipped into place with the integrated snaps.



The compression mechanism is added into place.

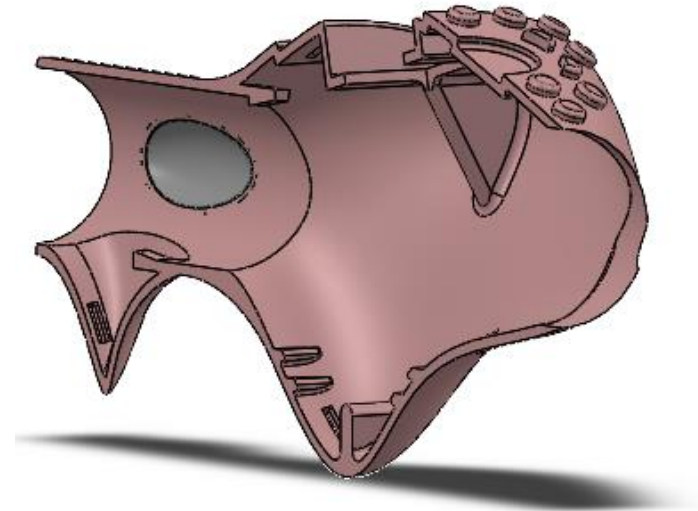
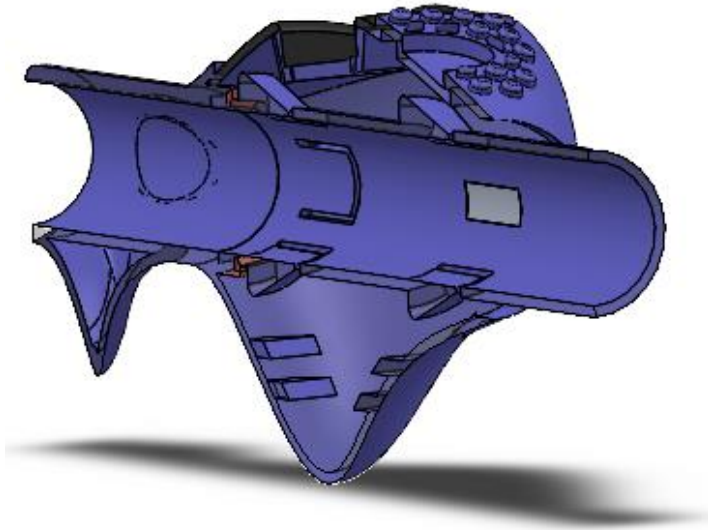


The glass screen is installed into place over the display screen



The power button is the last component to be inserted.

Reflection of the Manufacturing Process

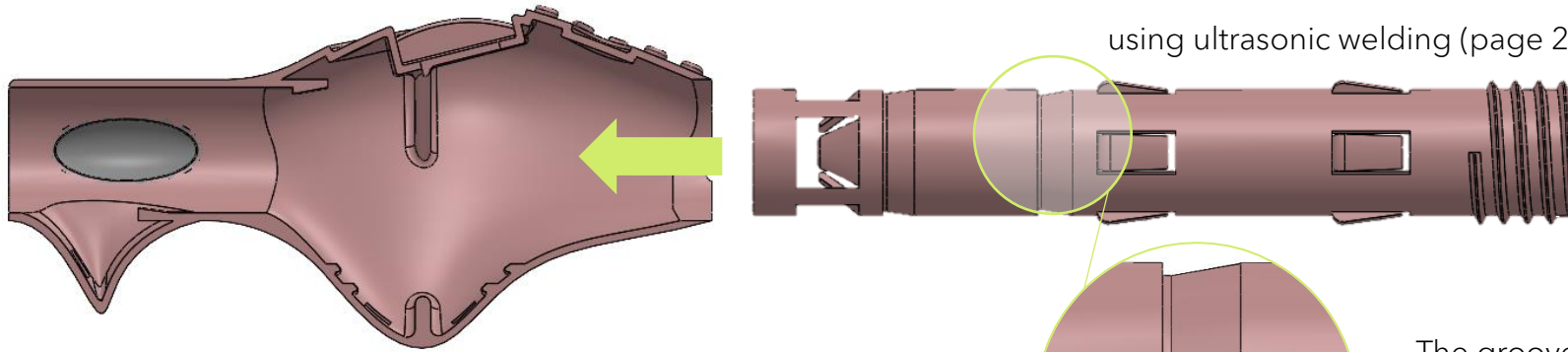


On reflection, I recognised that it is not feasible to manufacture the main body using injection moulding due to the cylindrical tube through the middle of the component. The solution is to manufacture the components separately.

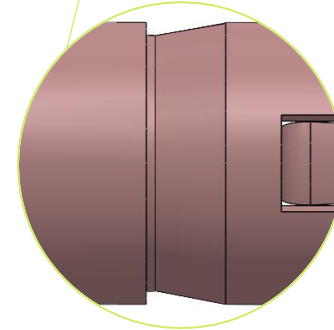
New Assembly Technique

Injection moulding the parts and combining them

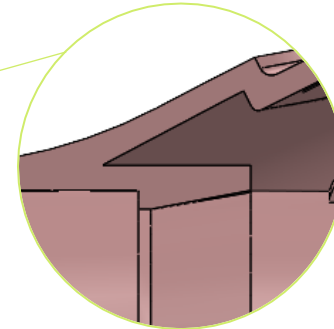
using ultrasonic welding (page 296)



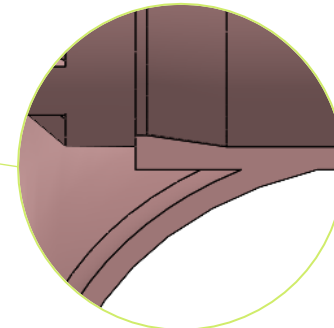
The tight fit will increase the strength of the fitting between the two components.



The groove to catch the snap is cut all around the cylinder to reduce the need for accurate positioning when assembling.

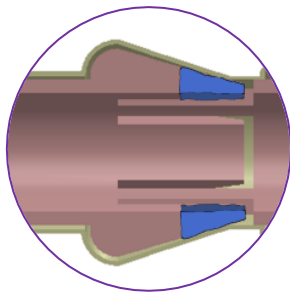
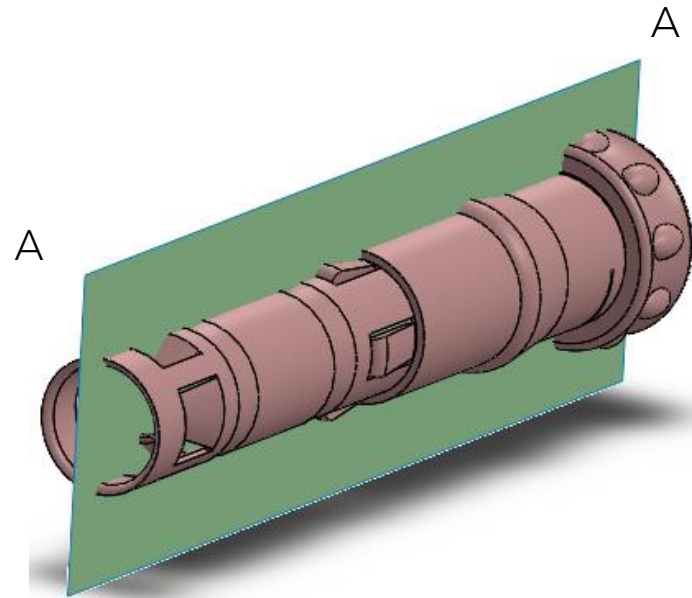
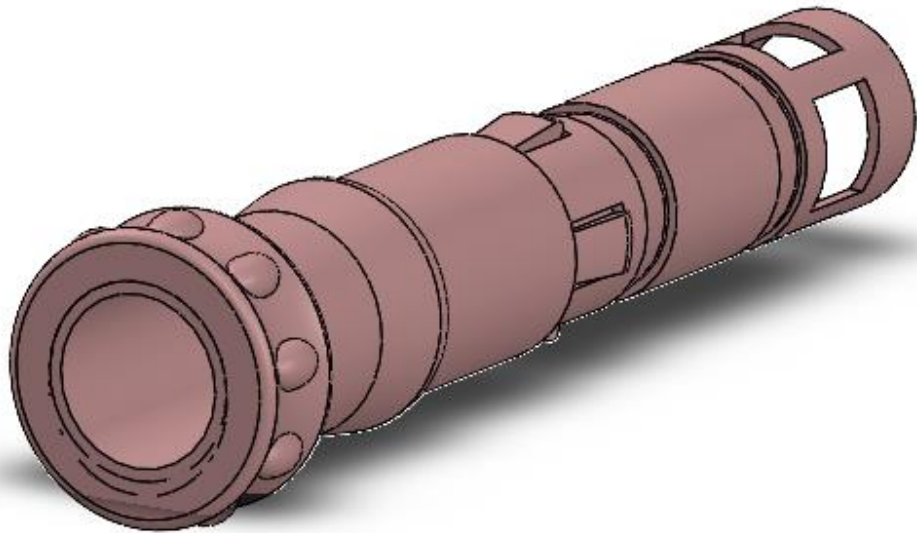


The snap fits into the cut groove the prevent it from pulling back out.

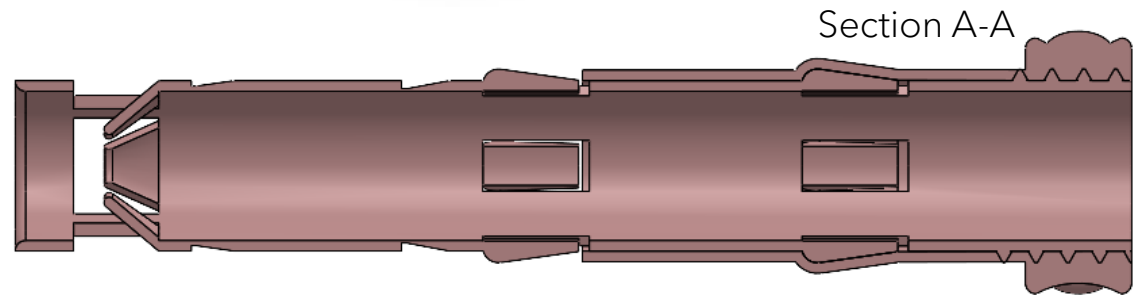


The cylinder will be caught at two points to prevent it from separating and increase the strength..

Gripping Mechanism

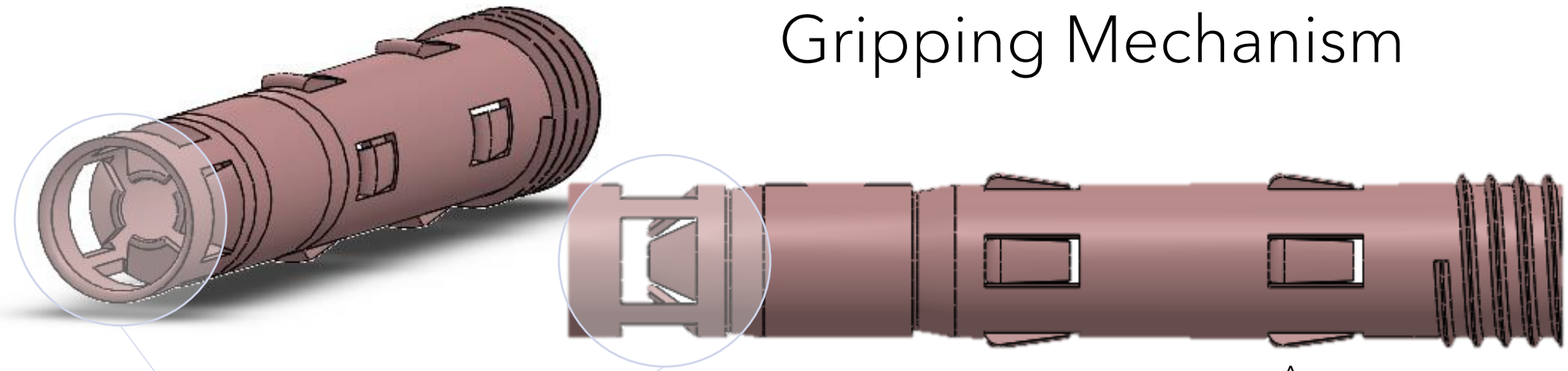


The gripping points will still be covered in silicone to increase its gripping and non slip capacity.

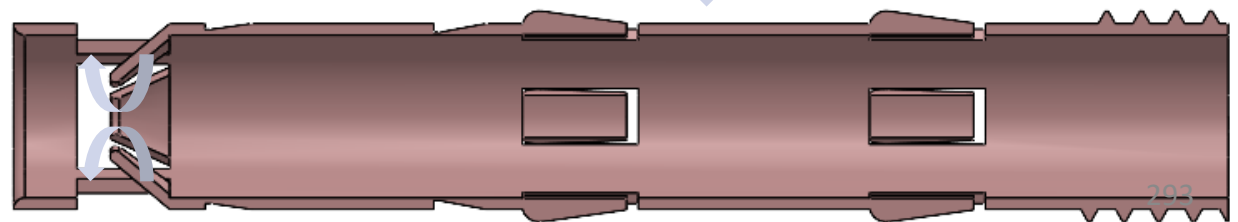
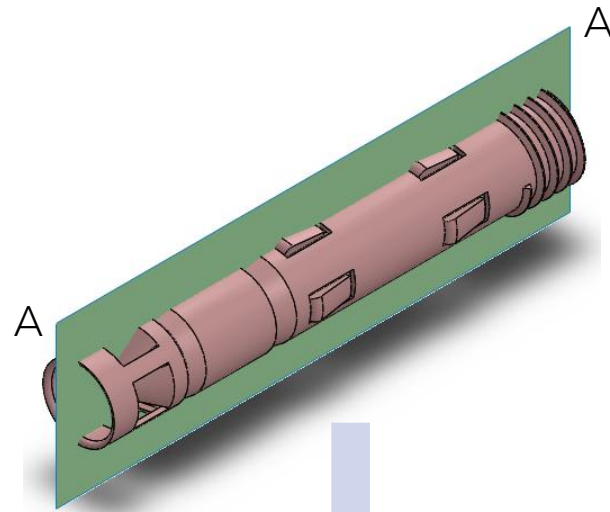


The mechanism cylinder will be threaded on to a concentric cover which will converge the gripping points to compress and grip the pen.

Gripping Mechanism

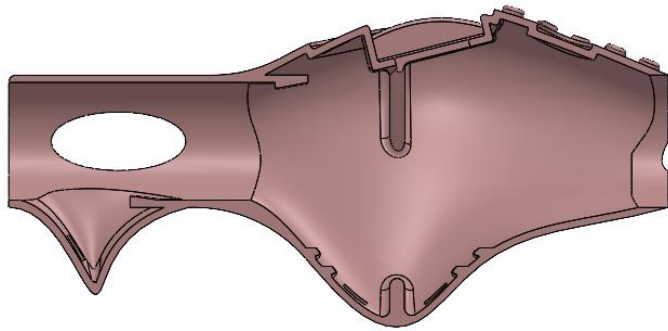


The pen will be supported at the top of the grip by flexible supports to allow for various size pens.

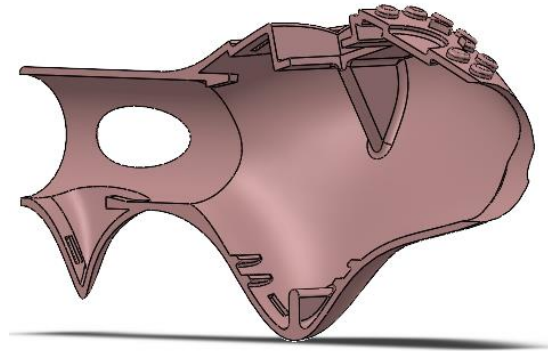


Design for Manufacture

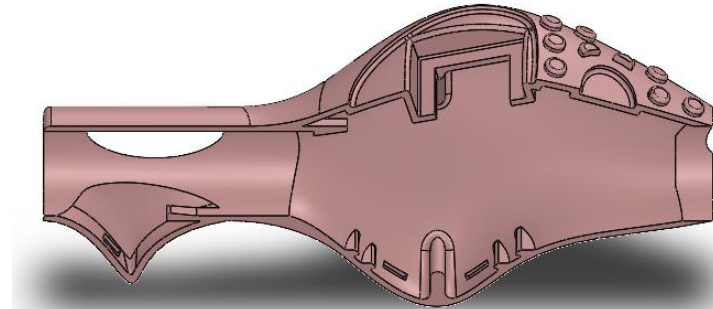
Injection Moulding



The component is a clean hollow shape with no complicated corners or cervices.



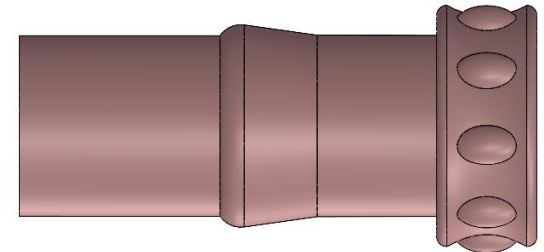
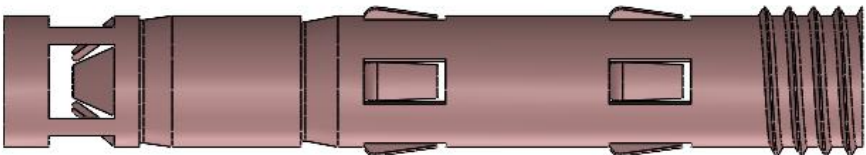
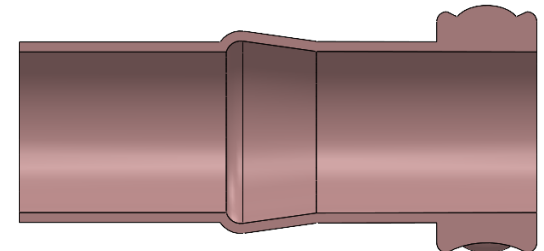
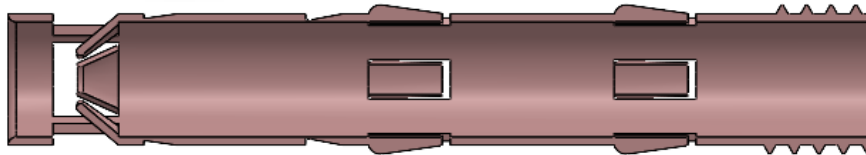
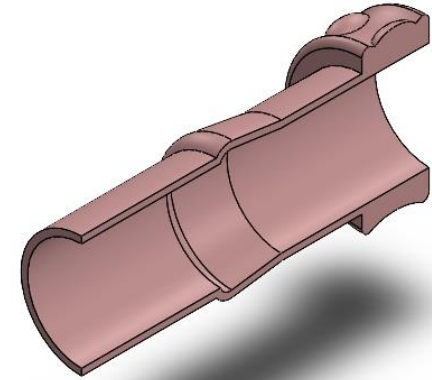
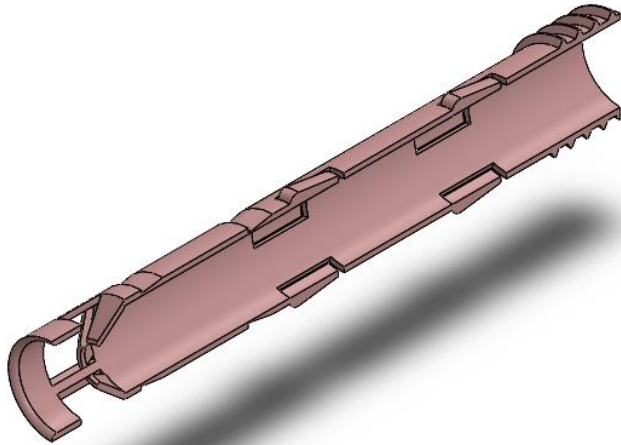
Ribs are included in the components to provide strength and support.



All edges are filleted making the component suitable for injection moulding.

Design for Manufacture

Injection Moulding



The clamping mechanism will also be manufactured using injection moulding in four separate components. The curvature of the components make them suitable for this manufacturing process.²⁹⁵

Gripping Mechanism Manufacture

Ultrasonic Welding



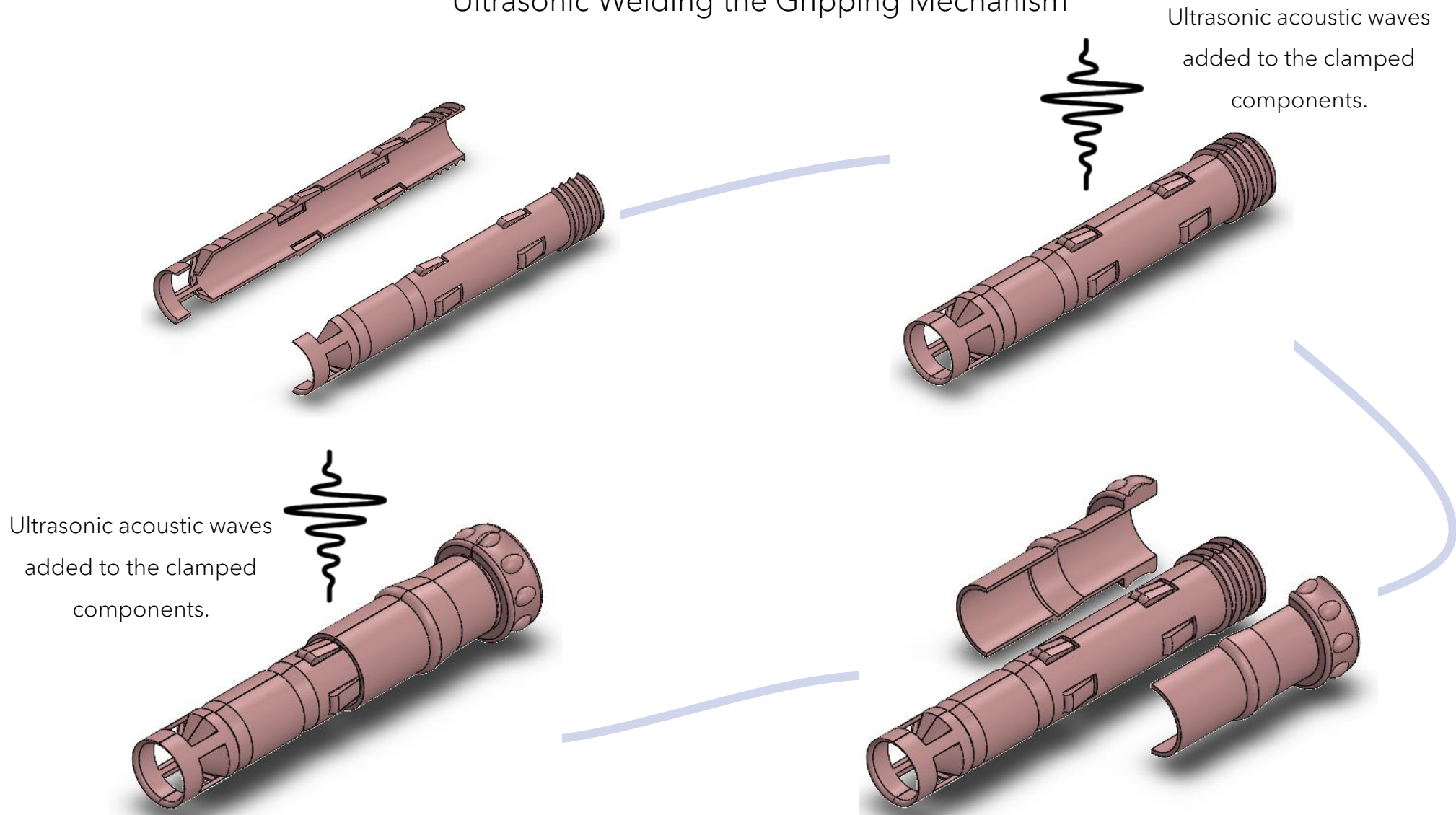
<https://www.youtube.com/watch?v=BQT29VaFcO4&t=44s>

Ultrasonic welding will be used to join the pieces of the gripping mechanism together.

High-frequency ultrasonic acoustic vibrations are locally applied to workpieces being held together under pressure to create a solid-state weld. It is commonly used for plastics and metals.

Gripping Mechanism Manufacture

Ultrasonic Welding the Gripping Mechanism

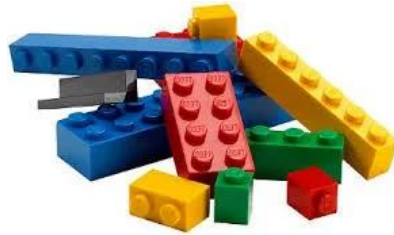


Injection Moulding

Plastics that can be injected moulded:



Polyethylene



Acrylonitrile Butadiene Styrene (ABS)



Polycarbonate



Polyamide (Nylon)



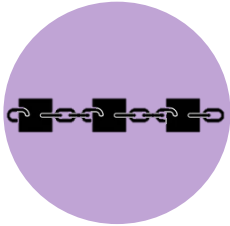
Polypropylene

Polyethylene

Polyethylene has high levels of **ductility**, **tensile strength**, **impact resistance**, **resistance to moisture absorption**, and **recyclability**. The higher the density of the polyethylene material used the stronger, **more rigid**, and more **heat resistant** the plastic is.

Rigid

Will maintain shape



Ductile

Easy to shape in the manufacture



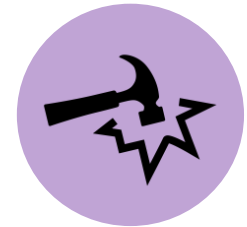
Moisture Resistant

Won't be damaged if a drink spills in the users bag.



Impact Resistant

The device will be more durable.



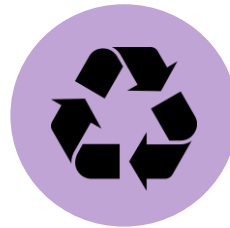
Heat Resistant

Not necessary for this device.



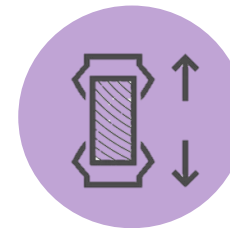
Recyclable

The device will be more sustainable



Tensile Strength

Not necessary for this device.

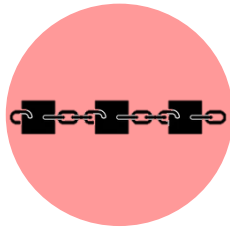


Acrylonitrile Butadiene Styrene

ABS is a **hard, shiny surface** and is **lightweight, tough, rigid thermoplastic** that has **high impact** and **high mechanical strength**.

Rigid

Will maintain shape



Shiny Surface

Would contribute to aesthetics.



Thermoplastic

Sustainable



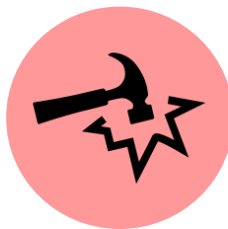
Hard

Will not scratch easy when in a pencil case with other utensils.



High Impact

Will not break in the school bag when dropped on the floor.



Lightweight

Would keep the pen lightweight and easy to use.



Polycarbonate

Polycarbonate plastics are a naturally transparent amorphous **thermoplastic**. They are used to produce a variety of materials and are particularly useful when **impact resistance** and **transparency** are a requirement.

Impact Resistant

The device will be more durable.



Thermoplastic

Sustainable



Transparent

Not necessary for this device.

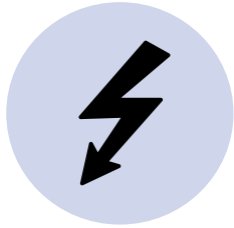


Polyamide

Nylon is used in a range of different applications because of its **electrical properties**, **toughness**, **wear resistance** and **chemical resistance** being quite impressive. Nylon has a high level of **stability** (helps with strength) and is resistant to many external factors like **abrasion**, **impact**, and chemicals.

Electrical Properties

Not necessary for this device.



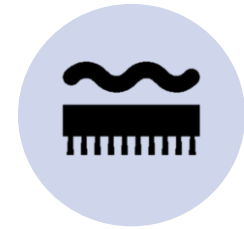
Chemical Resistant

Not necessary for this device.



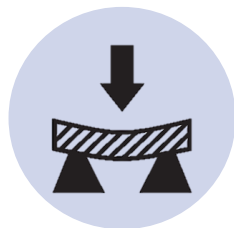
Wear Resistant

Increased durability when in contact with other utensils



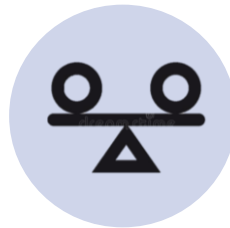
Toughness

Increased durability



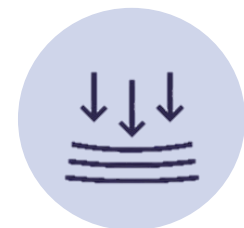
Stability

Increased strength



Impact Resistant

Increased durability



Polypropylene

Some characteristics of polypropylene are its **high melting point**, **high resistance to stress** and **cracking**, **excellent impact strength**, **flexibility** and does not break down easily from reactions with **water, acids, and detergents**.

Flexibility

Increased durability



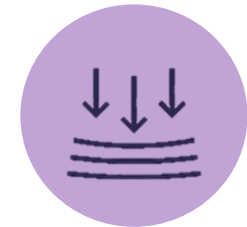
Stress Resistance

Increased durability



Impact Resistant

Increased durability



Chemical Resistant

Not necessary for this device.



High Melting Point

Not necessary for this device.



Material Evaluation

ABS Material

	Rigid	Ductile	Impact Resistant	Moisture Resistant	Sustainable	Tensile Strength	Aesthetics	Lightweight	Durable	Flexible
Polyethylene	✓	✓	✓	✓	✓	✓				
ABS	✓		✓		✓		✓	✓	✓	✓
Polycarbonate			✓		✓					
Polyamide			✓						✓	
Polypropylene									✓	✓

ABS material covers the most of the characteristics necessary for this device.



Life Cycle Analysis

The device is made of ABS which is a thermoplastic and so can be reheated and reused to manufacture another product.



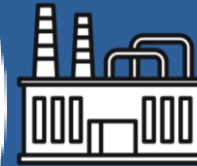
Oil needs to be extracted to manufacture plastic.
Oil is a fossil fuel and burning it has a major impact on the environment.



The device is reusable and is much more environmentally friendly than single use products made from plastics.



The manufacture of plastic requires a lot of energy to convert the oil into a useable product. The addition of chemical additives such as plasticizers, flame retardants are highly hazardous.



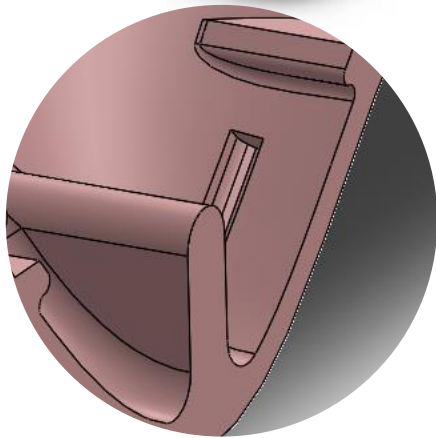
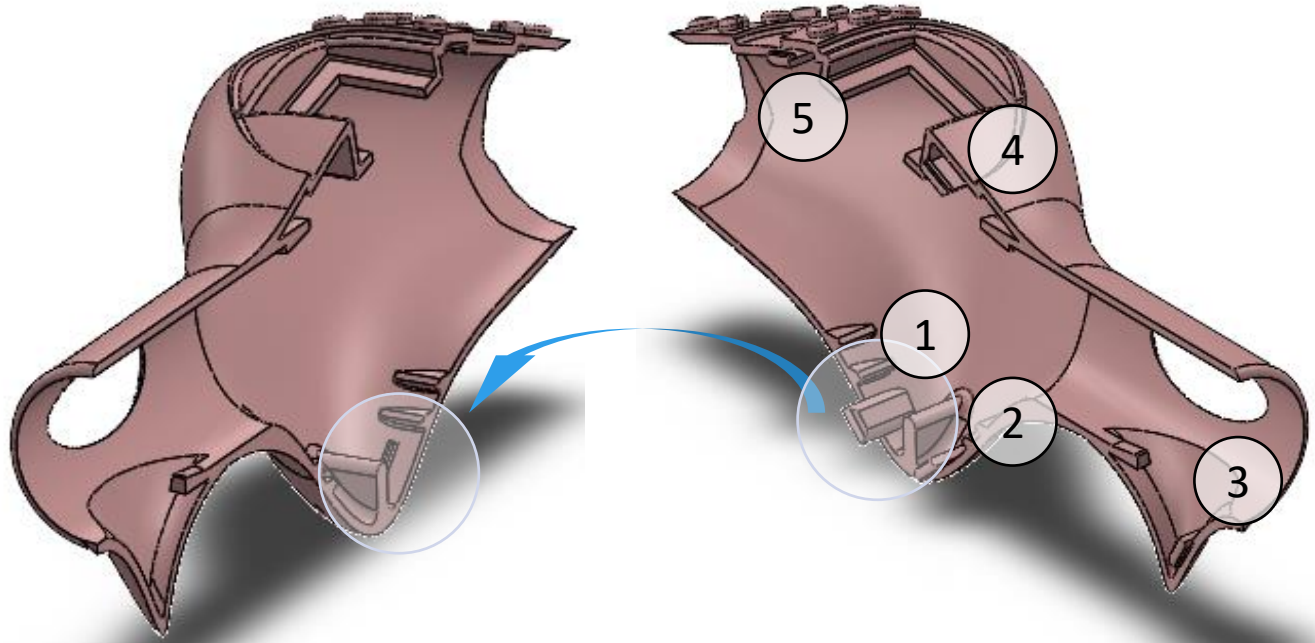
The environmental impact of transport is significant because it is a major user of energy, and burns most of the world's fuel. This creates air pollution, including nitrous oxides and particulates.



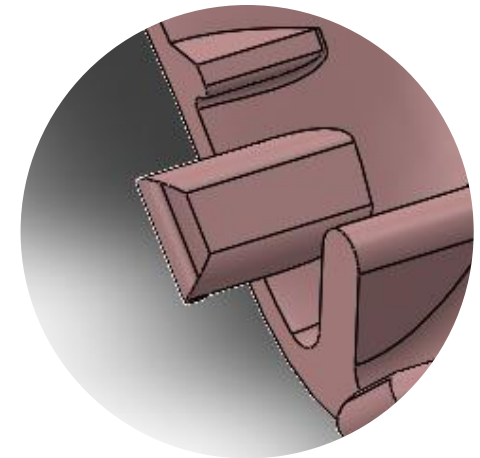
Injection moulding now uses 20%-50% less energy than 10 years ago..



Snap Feature Assembly



The two sides of the device will be assembled using snapping features at five different points around the circumference of the body. This snap feature will prevent users from interfering with internal components.



Pressure Points and Comfort

Liquid Silicone Rubber

- Malleable
- Biocompatible
- Flexible
- Good for cushioning
- Washable
- Low deformation



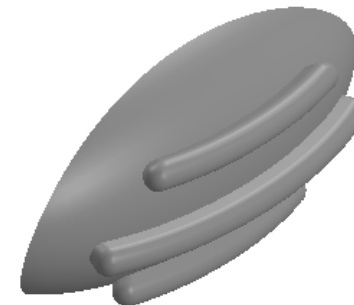
Vinyl/Nitrile Sponge

- Flexible
- Lightweight
- Low water absorption rate
- Comfortable
- Cushioning
- Returns to original shape

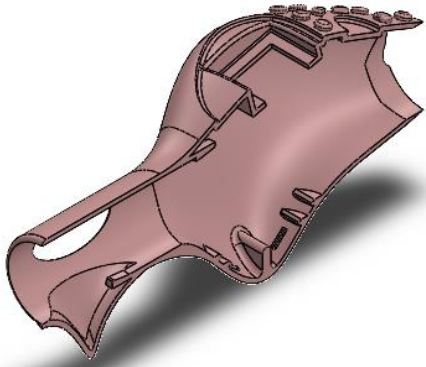


Liquid Silicone Rubber

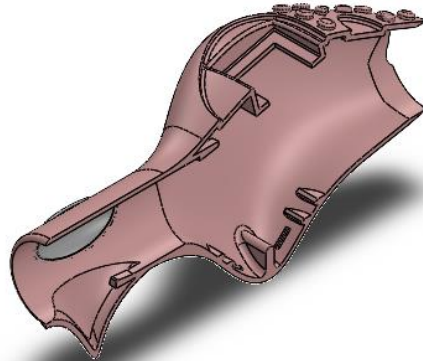
Liquid silicone rubber is chosen to manufacture the pressure points using injection moulding.



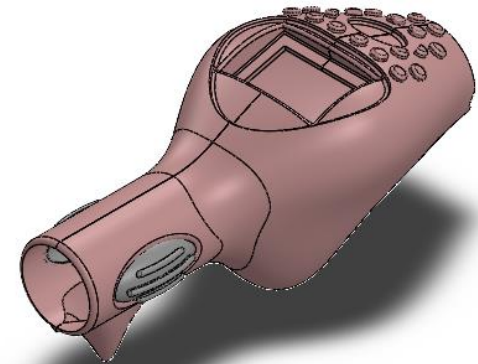
Assembly Process



The first side is taken.



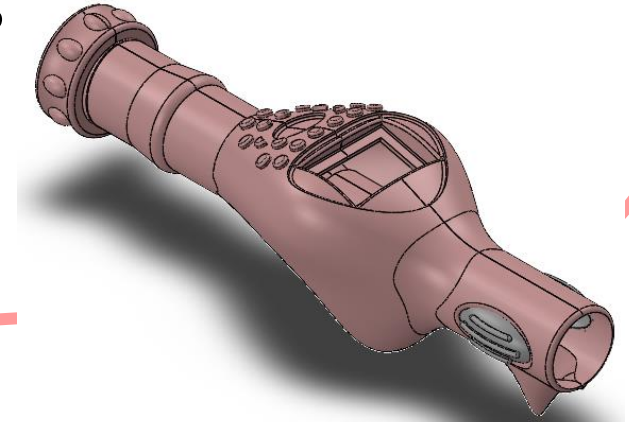
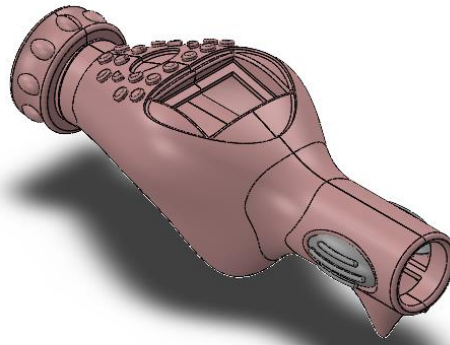
The pressure point is inserted into the side component.



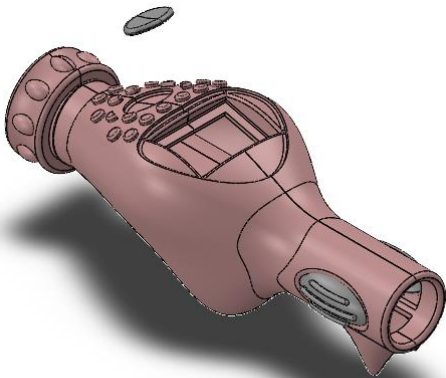
The second side with the second pressure point is attached to the first side.

Assembly Process

The gripping mechanism is inserted until it is gripped by the snaps at the front of the grip.

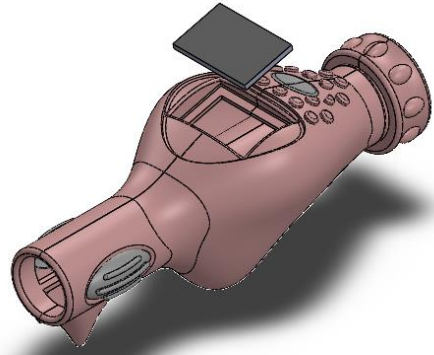


The gripping mechanism is inserted from the rear after being assembled using the ultrasonic wave process.

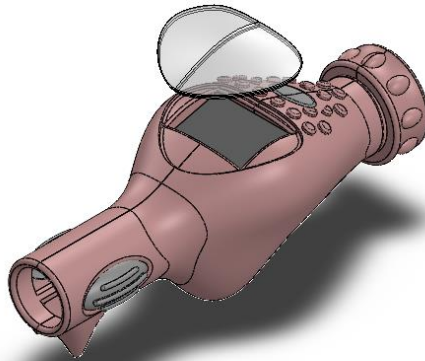


The power button is inserted.

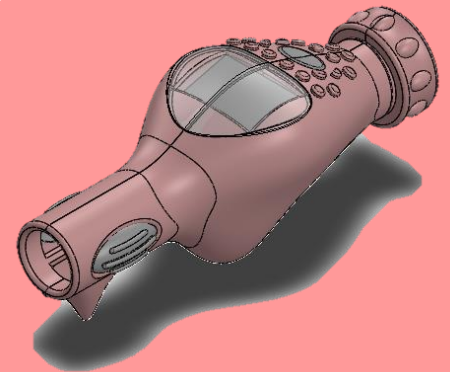
Assembly Process



The display screen is inserted.

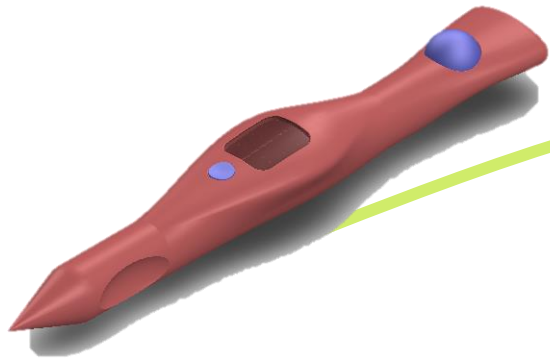


The cover glass is inserted.



The assembled device.

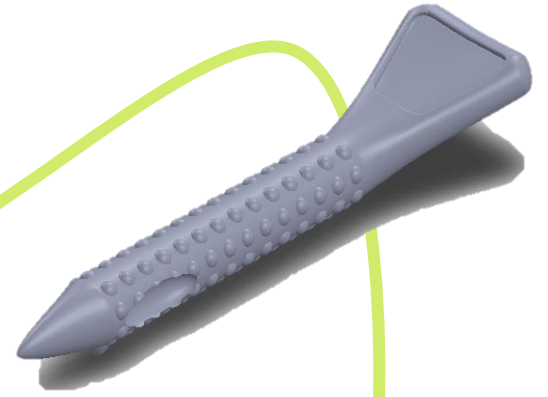
Various Iterations



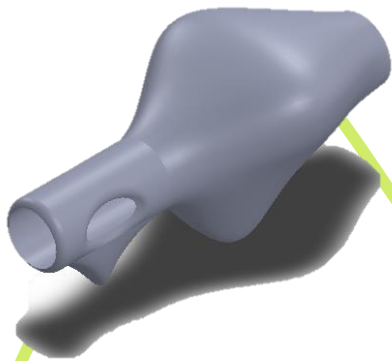
Iteration 1



Iteration 2



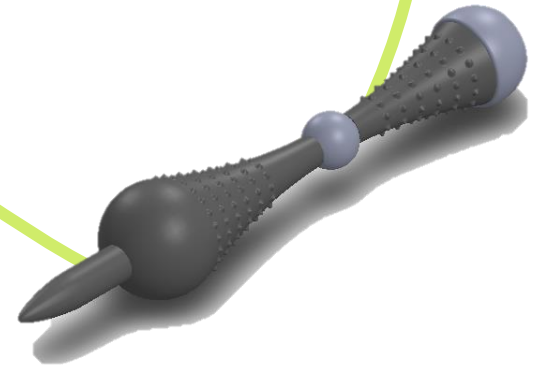
Iteration 3



Iteration 6



Iteration 5

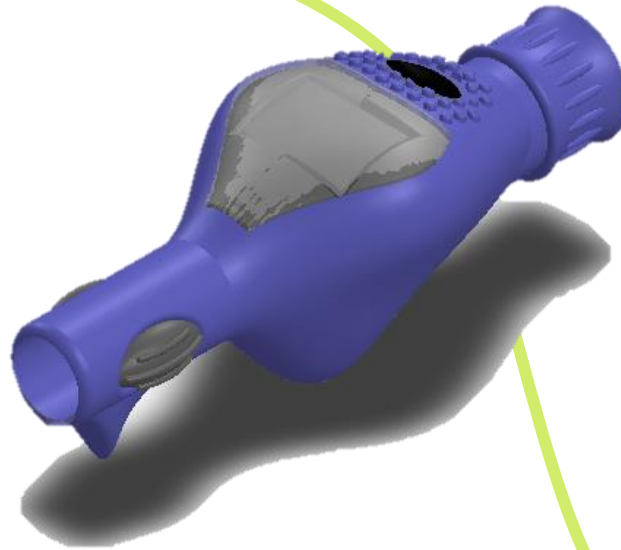


Iteration 4

Various Iterations



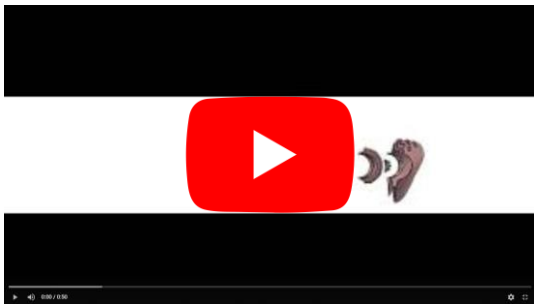
Iteration 7



Iteration 8



Iteration 9 312



<https://youtu.be/N6HJzHuSRIE>

Video of device exploded view

User Storyboard



Gain a firm grasp of the grip.



Insert the pen from the top.



Position the pen to a position that's comfortable.

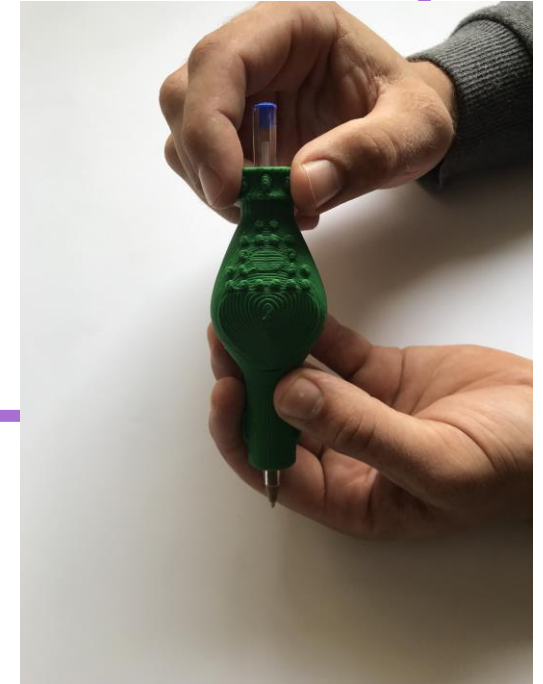
User Storyboard



The pen is ready to be gripped.



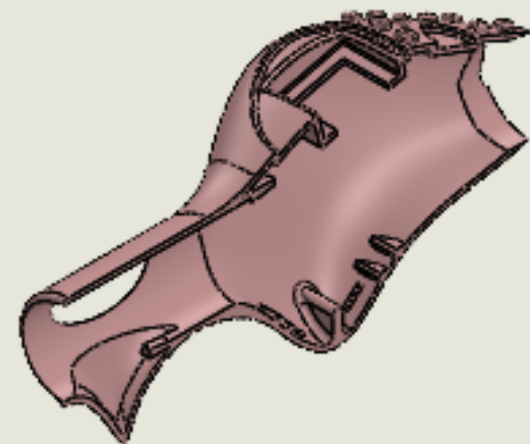
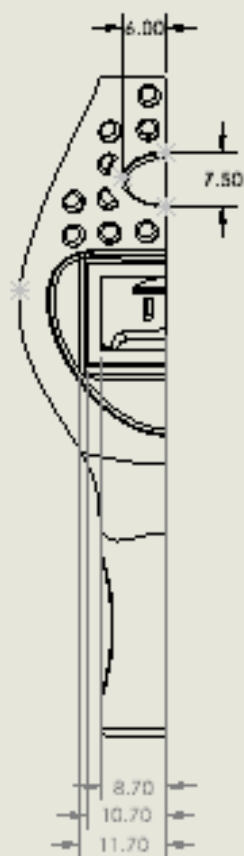
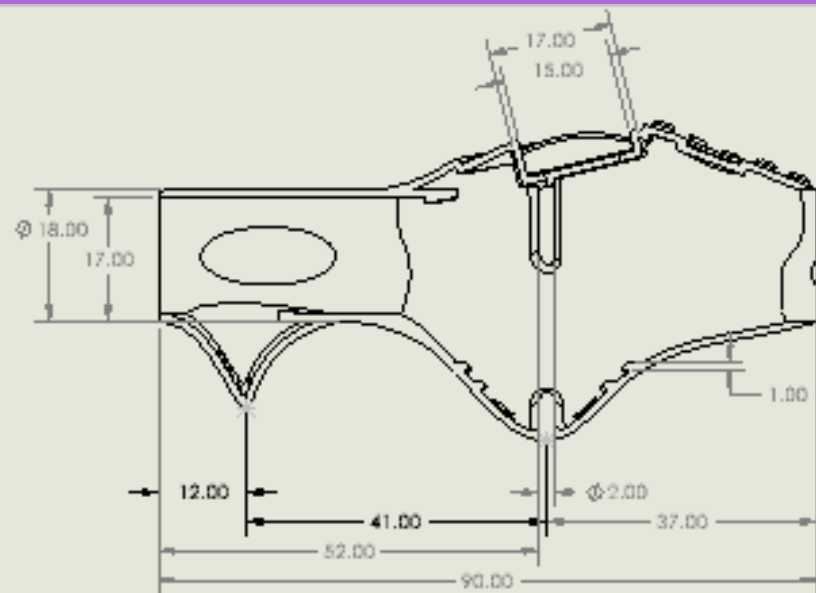
Power on the button.



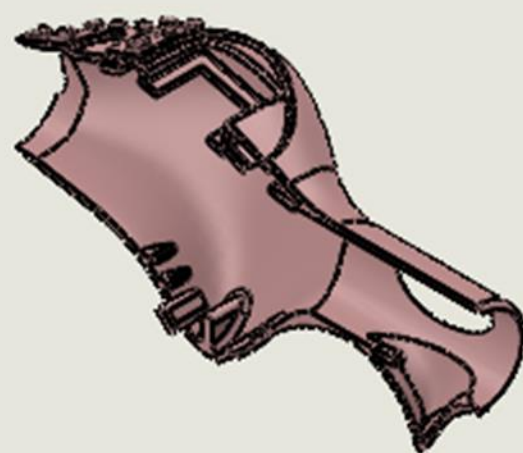
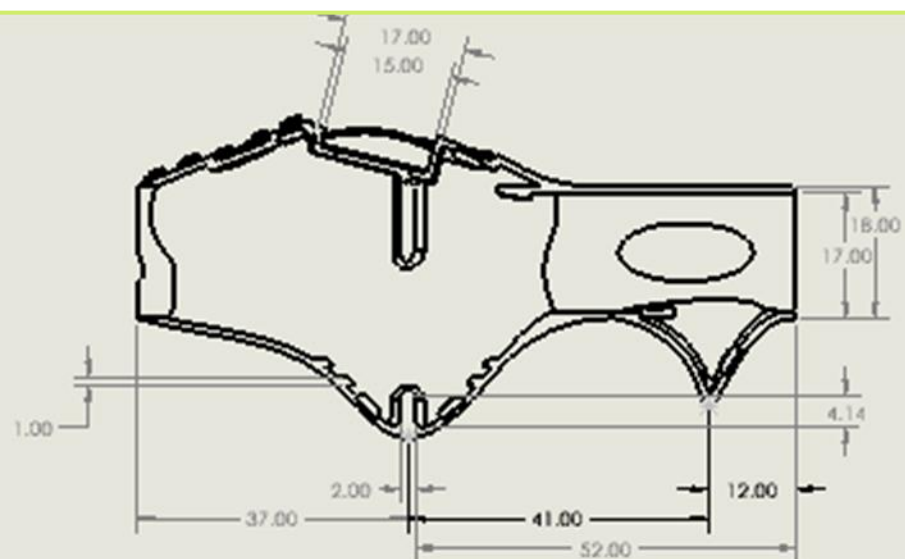
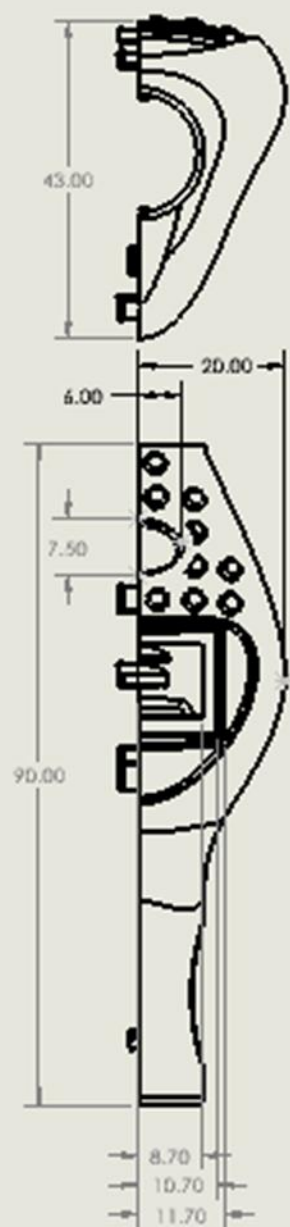
Turn the nut at the top to grip the pen.



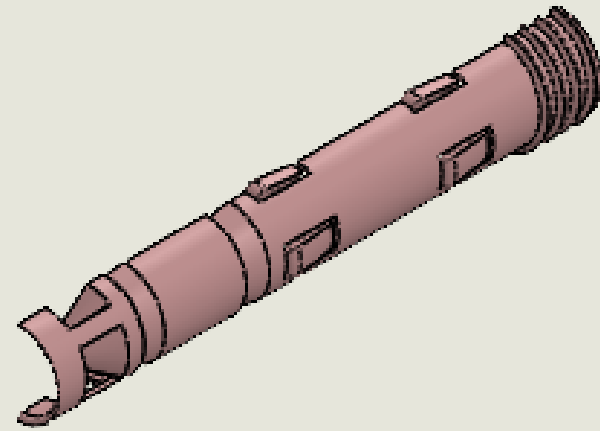
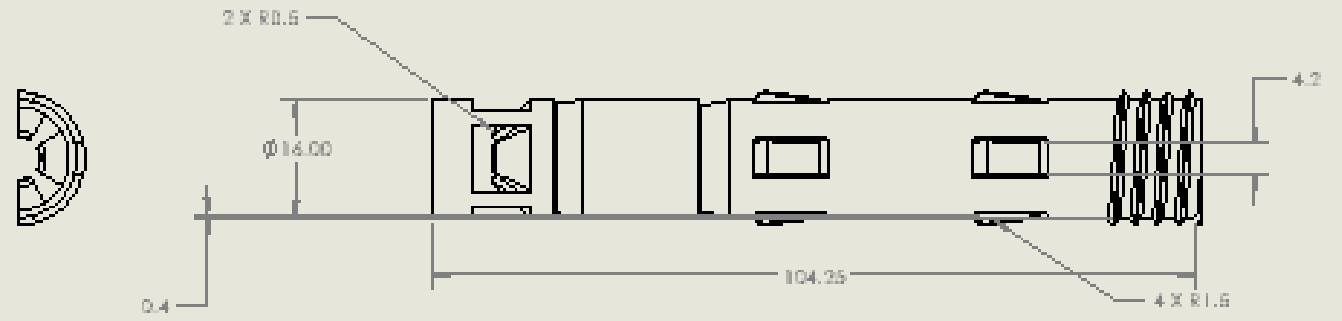
Part Drawings



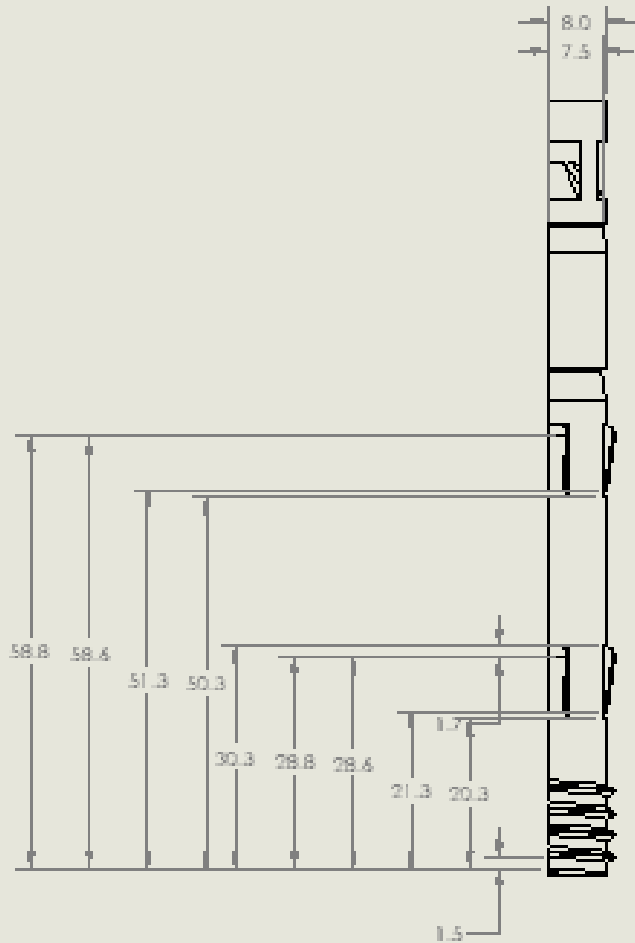
Side 1 (Quantity 1)

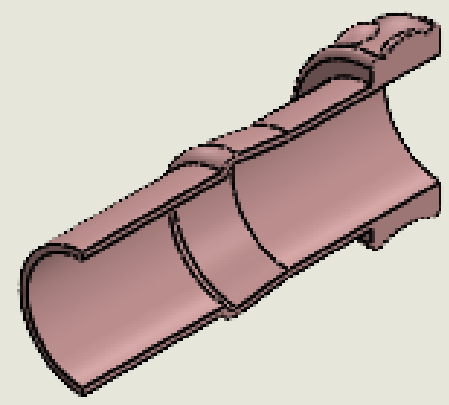
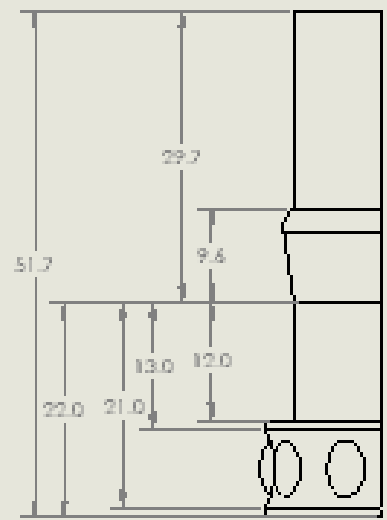
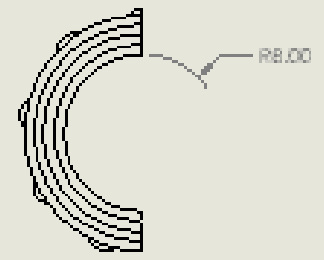
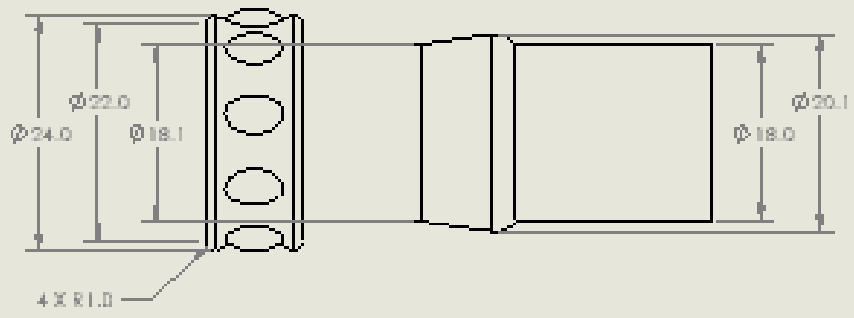


Side 2 (Quantity 1)

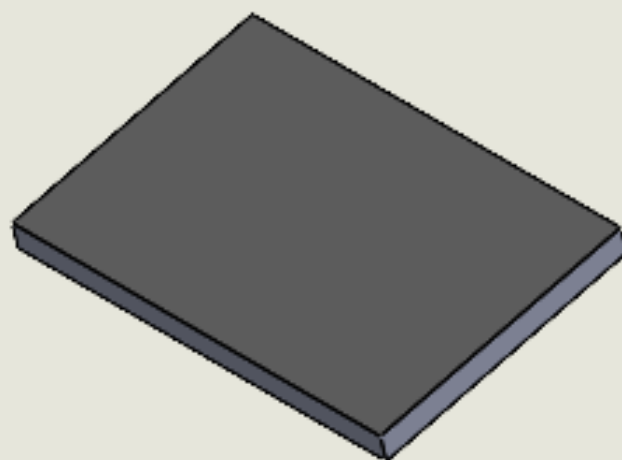
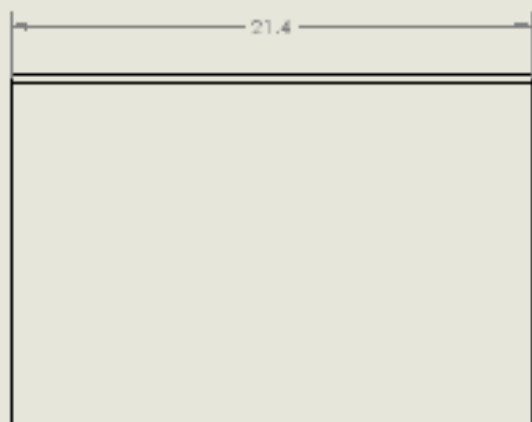
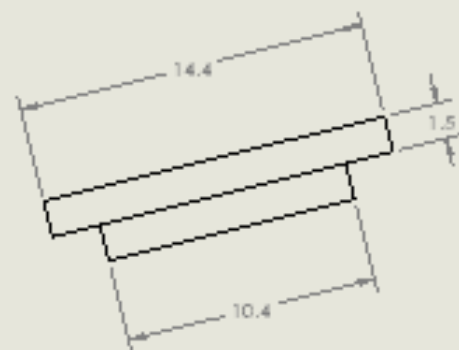
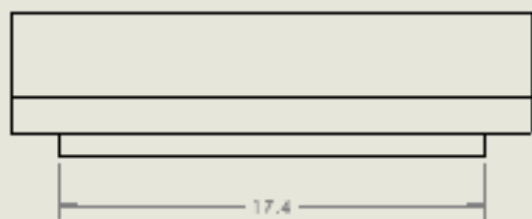


Compression Mechanism (Quantity 2)

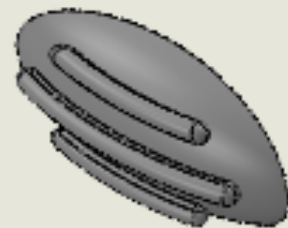
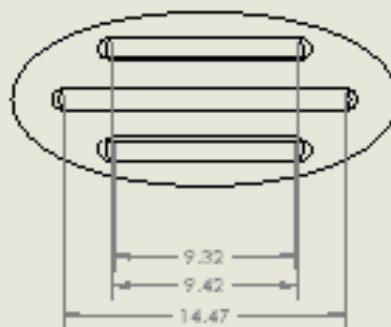
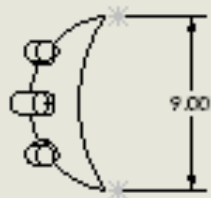




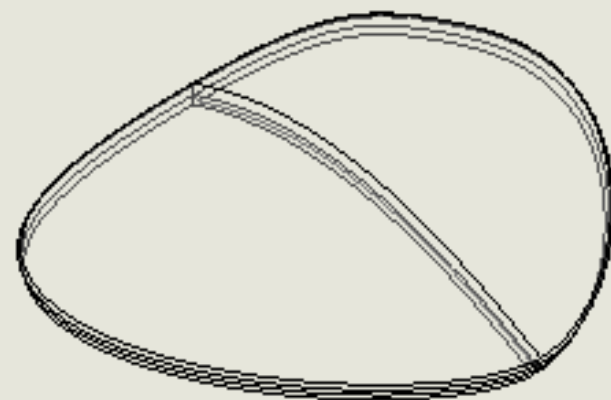
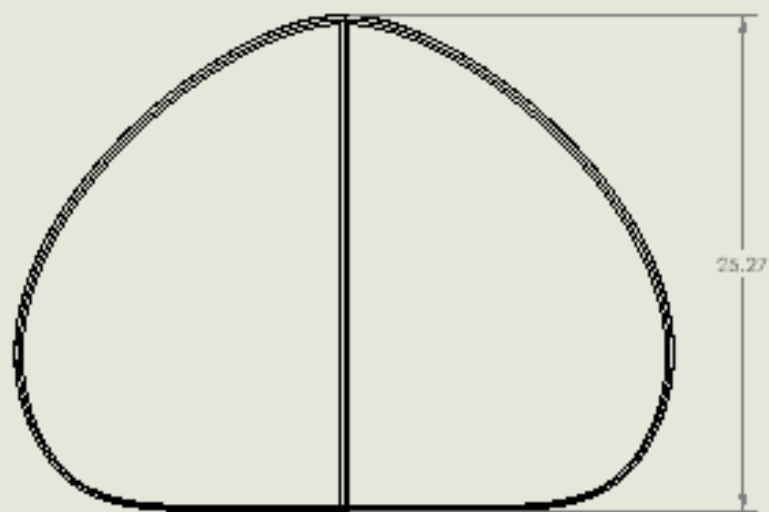
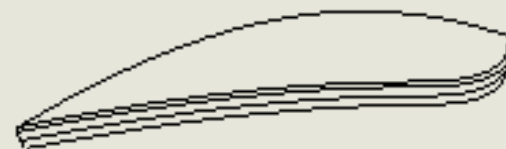
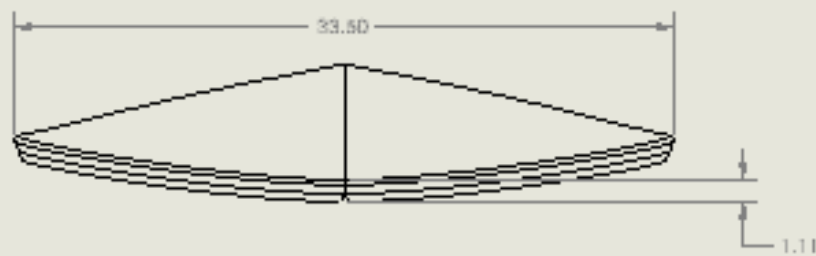
Compression Cover (Quantity 2)



Display Screen (Quantity 1)



Pressure Points (Quantity 2)



Glass Cover (Quantity 1)

The App



Possible Design Features for Inclusion from Research

The pen itself will assist students within mainstream classrooms and increase the likelihood of them remaining there.

Strava-like app to share results

How many questions can be answered in a minute?

Audio Playback?

Direct from the pen according to activity

Data provided to the teacher to help them understand the level of competency the student is at.

Send data from the pen to the teacher at the end of each class.

Allow teachers and peers comment/provide feedback on students work

Automation voice to encourage the user

Fidget that can improve fine motor skills and regulate senses

Create a medium to allow students from the school to share their pen activity

Communicate notifications.

Create a platform where students with ASD can share data/scores from their pen performance which may lead to connections

Pen sets targets for student according to previous work.

Allow students to share written notes written by the pen via app

Fit ergonomically into the users hand

Weighted pencil

Why Include an App?

- Increased functionality.
- Larger storage space for data.
- All data is stored in one place.
- Enables users to share data with others.
- Allows users to monitor their progression.
- Improve their social experiences through creating connections with others.
- Improved mental health and wellbeing.
- Creates a sense of achievement through friendly competition.

- Supports the academic development of the user.
- Instils confidence in the user through monitoring performance.
- Allows users to encourage and support each other.
- Provides a medium for teachers to communicate with students.

Application Functions

Sharing of Data (Motivation & Performance)

- Allow teachers and peers comment/provide feedback on students work
- Data provided to the teacher to help them understand the level of competency the student is at.
- Send data from the pen to the teacher at the end of each class.

Sharing of Data (Social Connections and Support)

- Create a platform where students with ASD can share data/scores from their pen performance which may lead to connections
- Allow students to share written notes written by the pen via app
- Strava-like app to share results
- Create a medium to allow students from the school to share their pen activity

Competition, Motivation and Engagement

- How many questions can be answered in a minute?
- Daily activity targets.
- Challenge a friend.

Sharing of Data

(Motivation & Performance)

- Allow teachers and peers comment/provide feedback on students work
- Data provided to the teacher to help them understand the level of competency the student is at.
- Send data from the pen to the teacher at the end of each class.
- Feedback section separate and more private to peer comments.
- Graph showing the fluctuations in writing activity.
- Select a subject prior to recording.
- Compare with previous classes in the same subject and other subjects.
- Share option on the app.
- Data automatically synchronised to the app from the device.
- The student could share their tests and homework they completed privately with the teacher.

Sharing of Data

(Social Connections and Support)

- Create a platform where students with ASD can share data/scores from their pen performance which may lead to connections
- Allow students to share written notes written by the pen via app.
- Create a medium to allow students from the school to share their pen activity
- Like/Love option
- Prescribed comments to reduce the risk of cyber bullying.
- Add friends (sync contacts/Facebook)
- Suggested friends
- Scan notes on the app
- Private notes storage
- Could the app read the notes aloud?
- Subject/Topic?
- Search the subject and topic to find notes.
- Share tests that allow the student sat for their connections to use when studying.
- Profile
- Profile picture
- Share button
- School/University

Competition, Motivation and Engagement

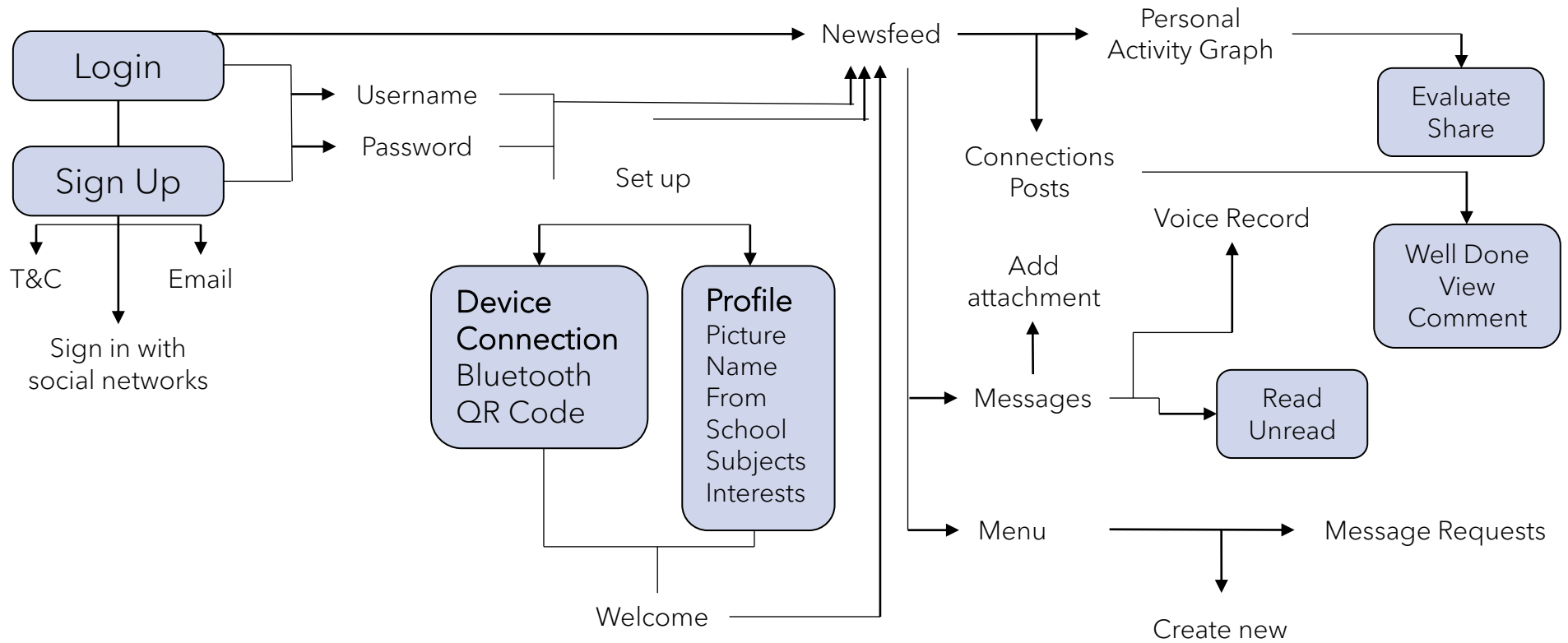
- Challenge a friend.
- How many questions can be answered in a minute?
- Daily activity targets.
- Send a challenge request
- Competitors scores
- Virtual trophies
- Set various challenges
- Timer
- Count up timer
- Countdown timer
- A button to click when a question is answered
- How long can the user keep the pen active for?
- Reward? Break for a certain number of minutes?
- Reminder notifications to inform the user of their position in meeting their target.
- Notification when the grip has been inactive for a period of time.
- Praise when reaching targets.
- Encourage to try again tomorrow when failed to meet the target.

App Concept

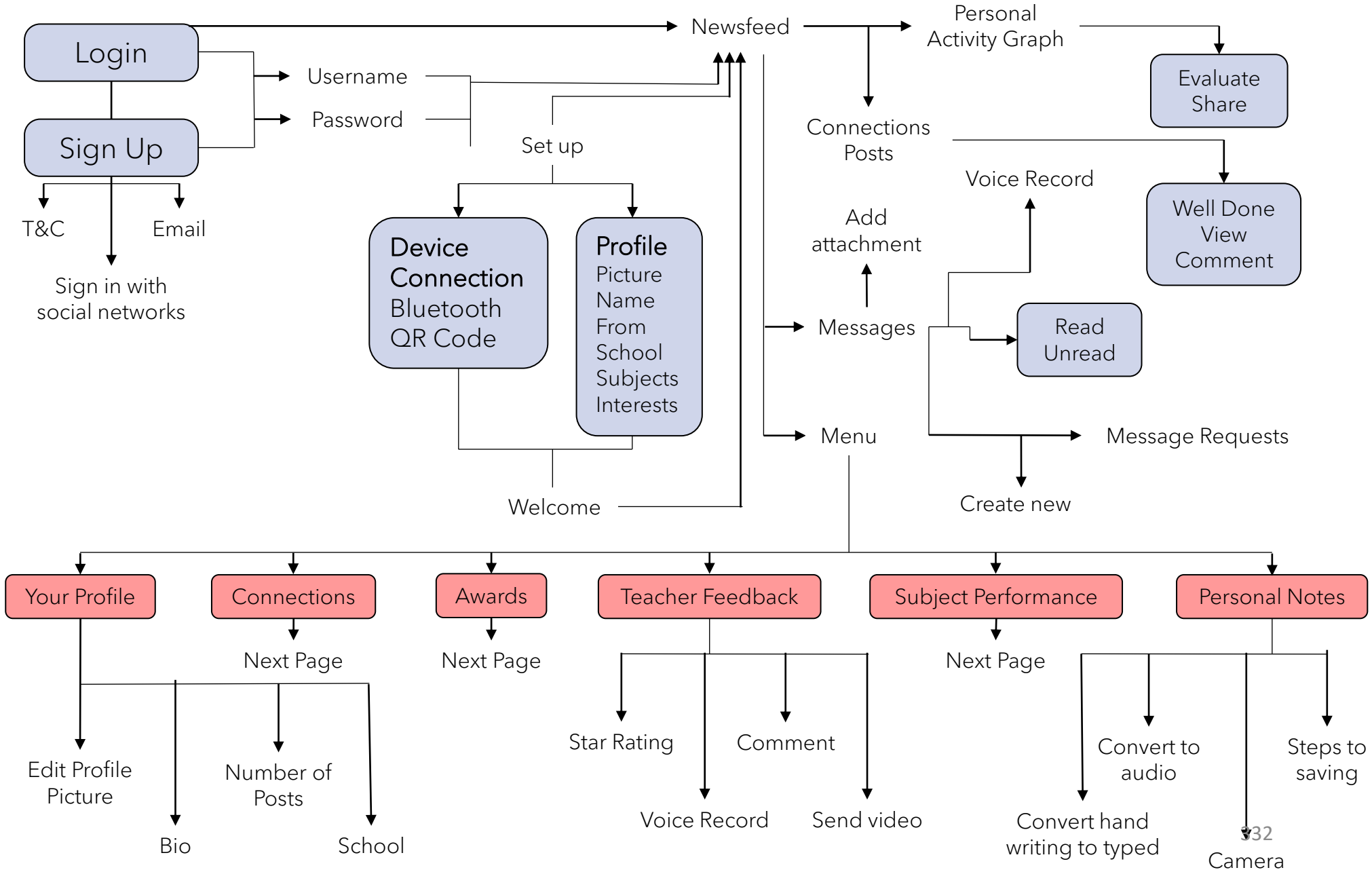
- A platform for users with ASD to share and monitor their writing activity while interacting and connecting with other users from the ASD community.
- Users will be able share experiences that others with ASD can empathise with.
- The app will support students both academically and socially.

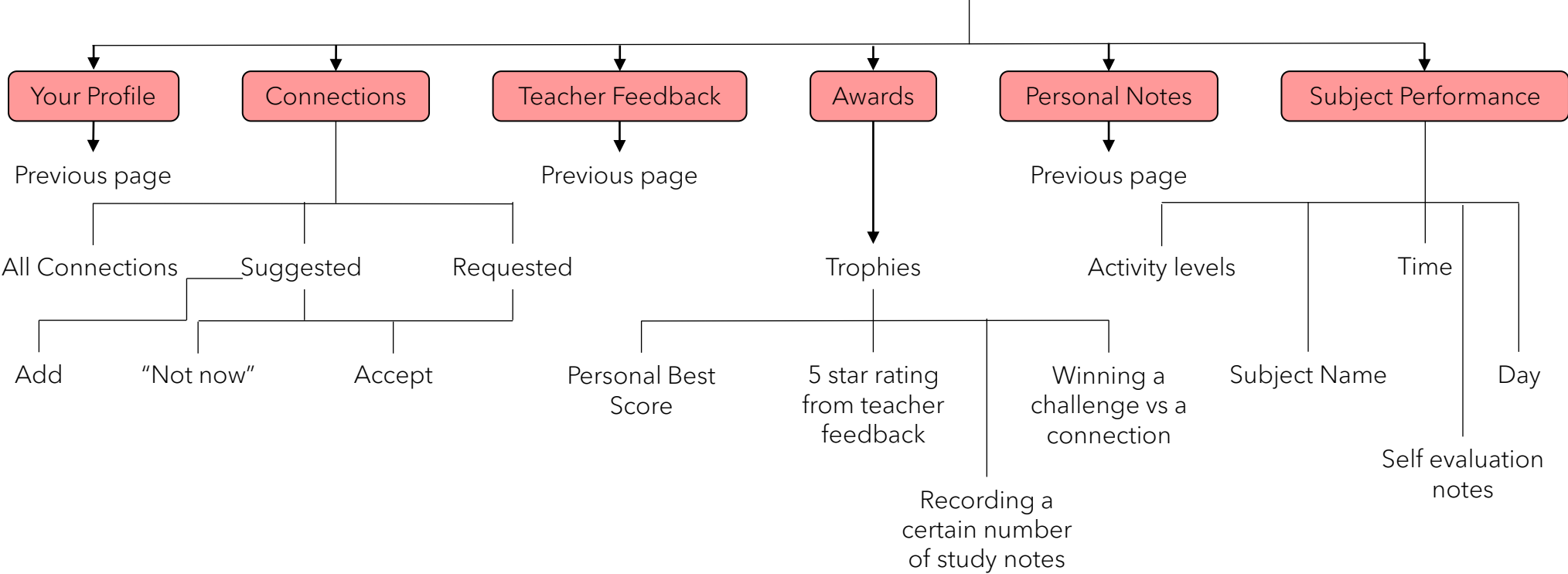


Task Flow Iteration 1

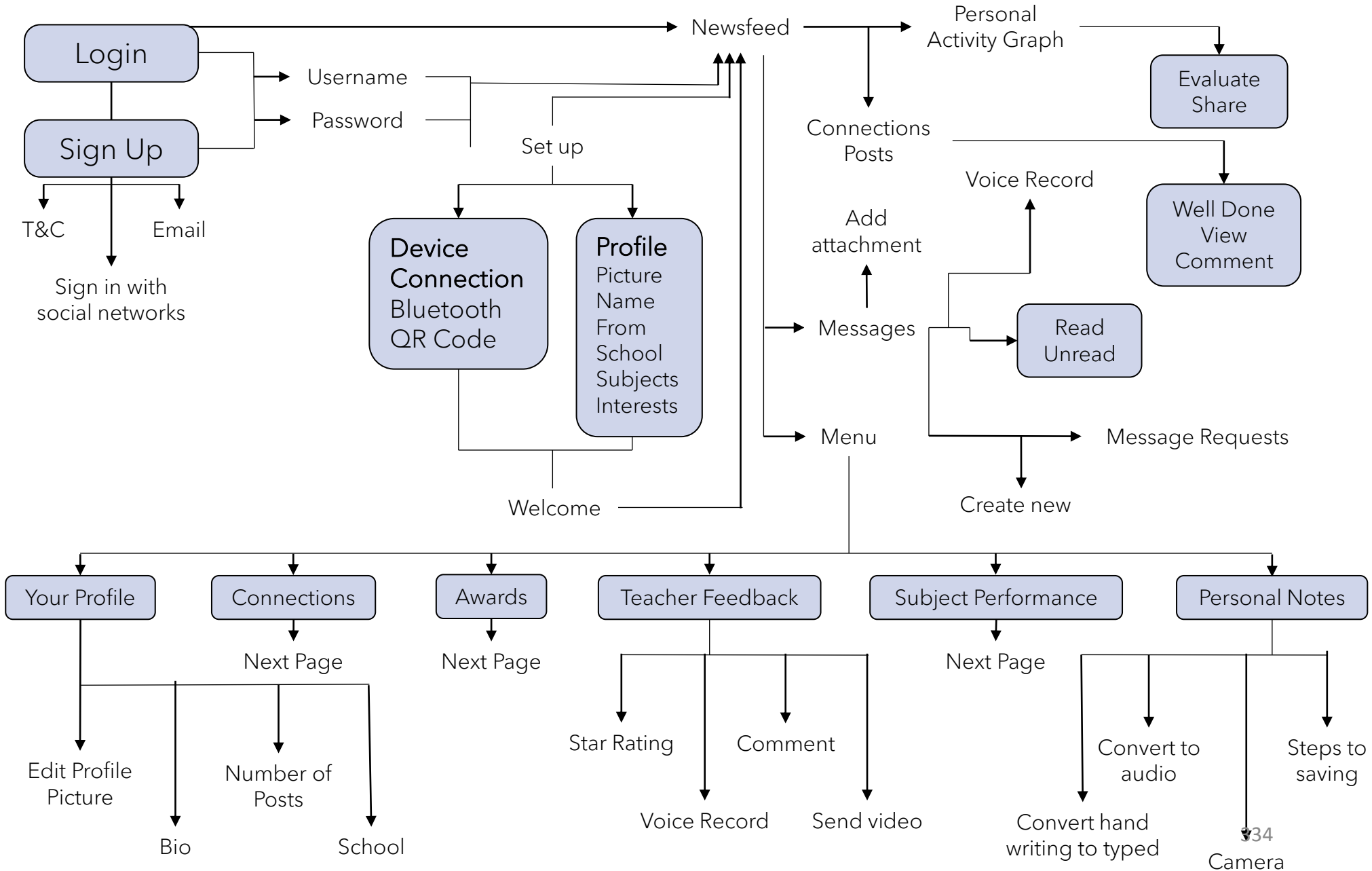


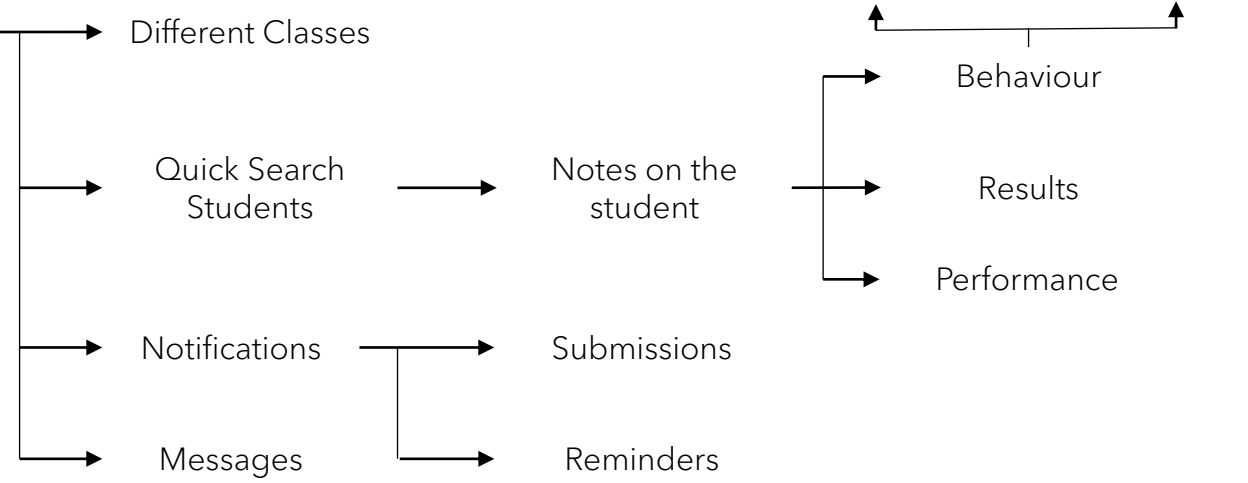
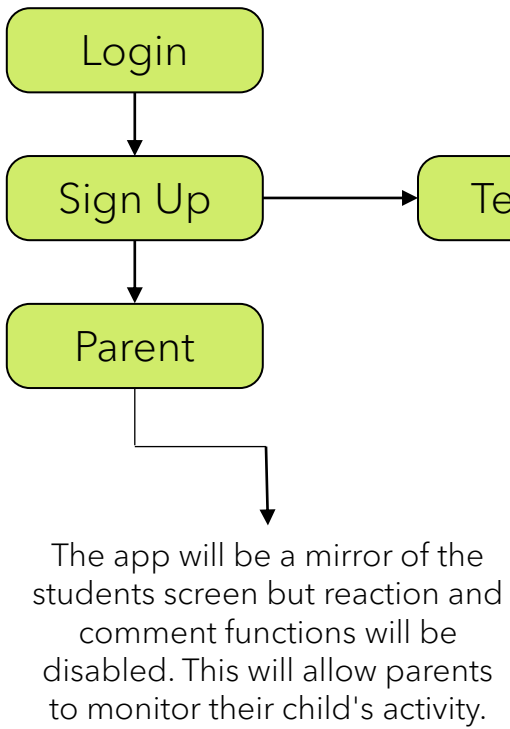
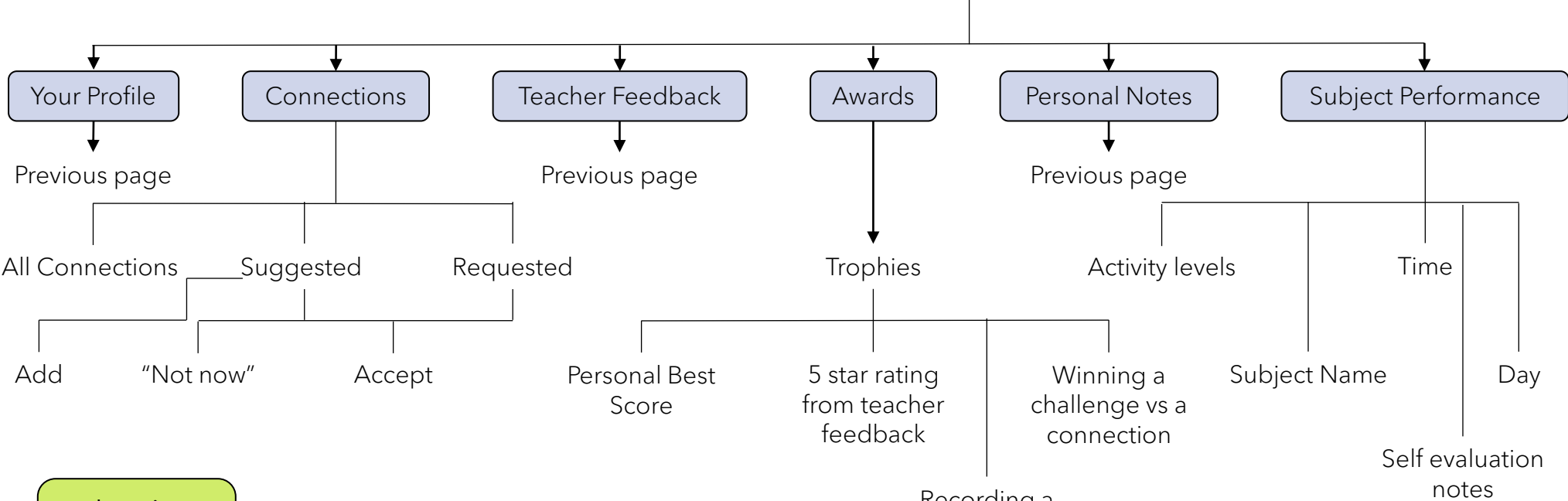
Task Flow Iteration 2





Task Flow Iteration 3





App Graphics

Font

Open Sans

Playfair Display

Arial

Roboto

Montserrat

Comic Sans

Proxima Nova

Roboto

I began with comic sans as research has shown that sans fonts are deemed more legible.

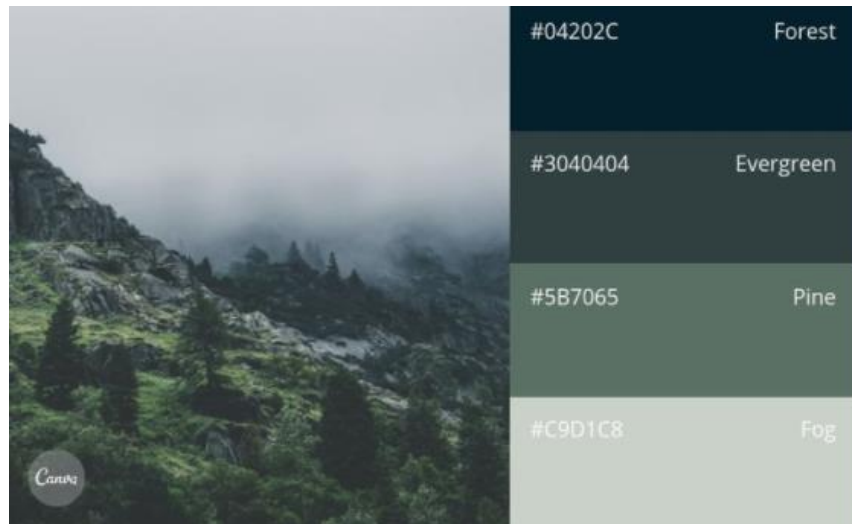
I changed the font according to feedback I received on the app.

I researched the most popular fonts used in apps and many of the different websites deemed "Roboto" to be a popular font.

<https://medium.muz.li/top-5-ui-fonts-for-website-mobile-apps-d78829e58f7e>

App Graphics

Colour Schemes



App Graphics

Logo

Motivation



Hand



Social



Creative



Writing



Pen



Education



Support



Sketching





Logo Designs



Motivation/Determination



Social



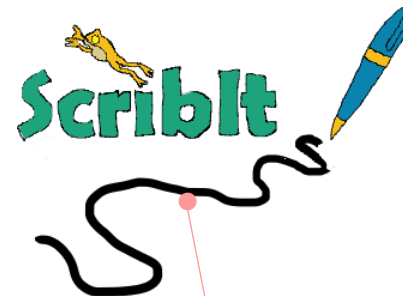
Pen grip/Support



Hand writing



Hand writing

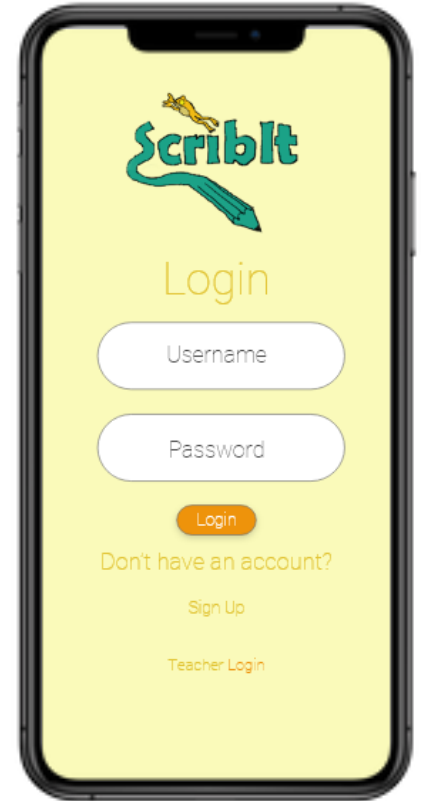
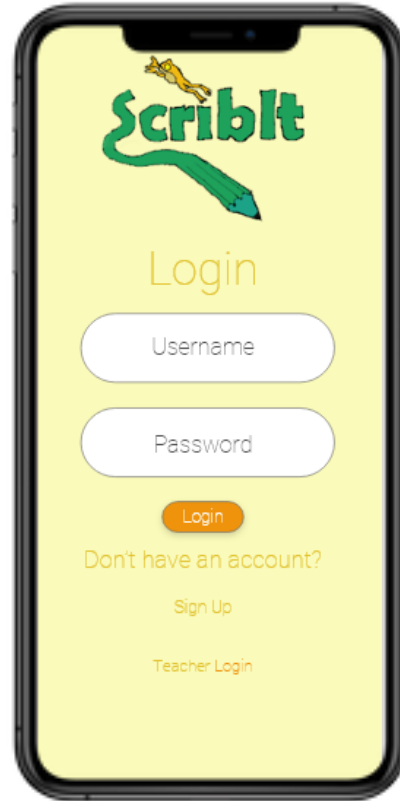
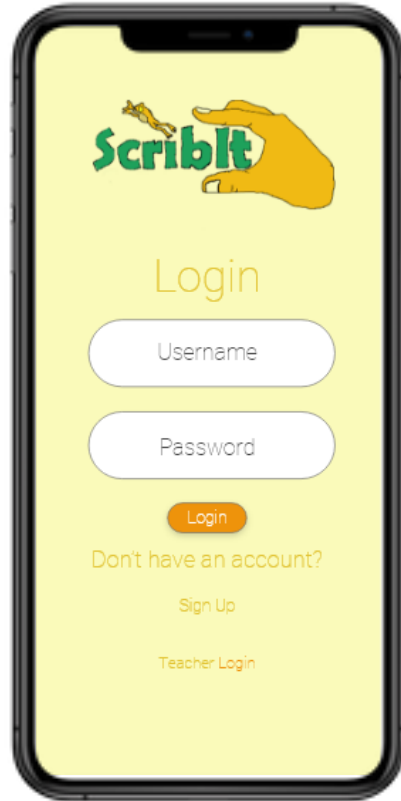
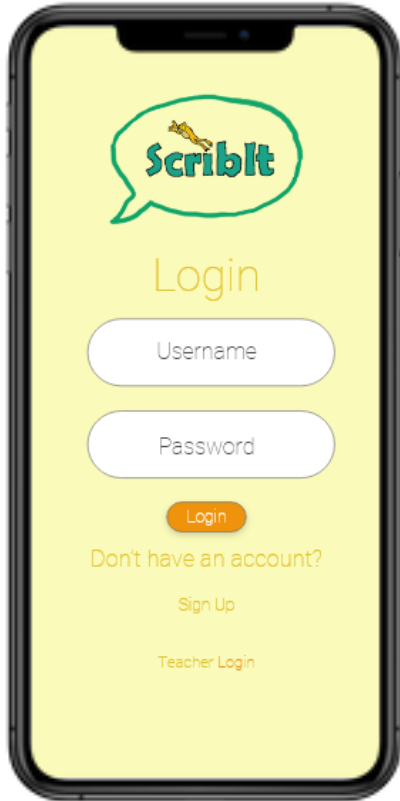


Hand writing

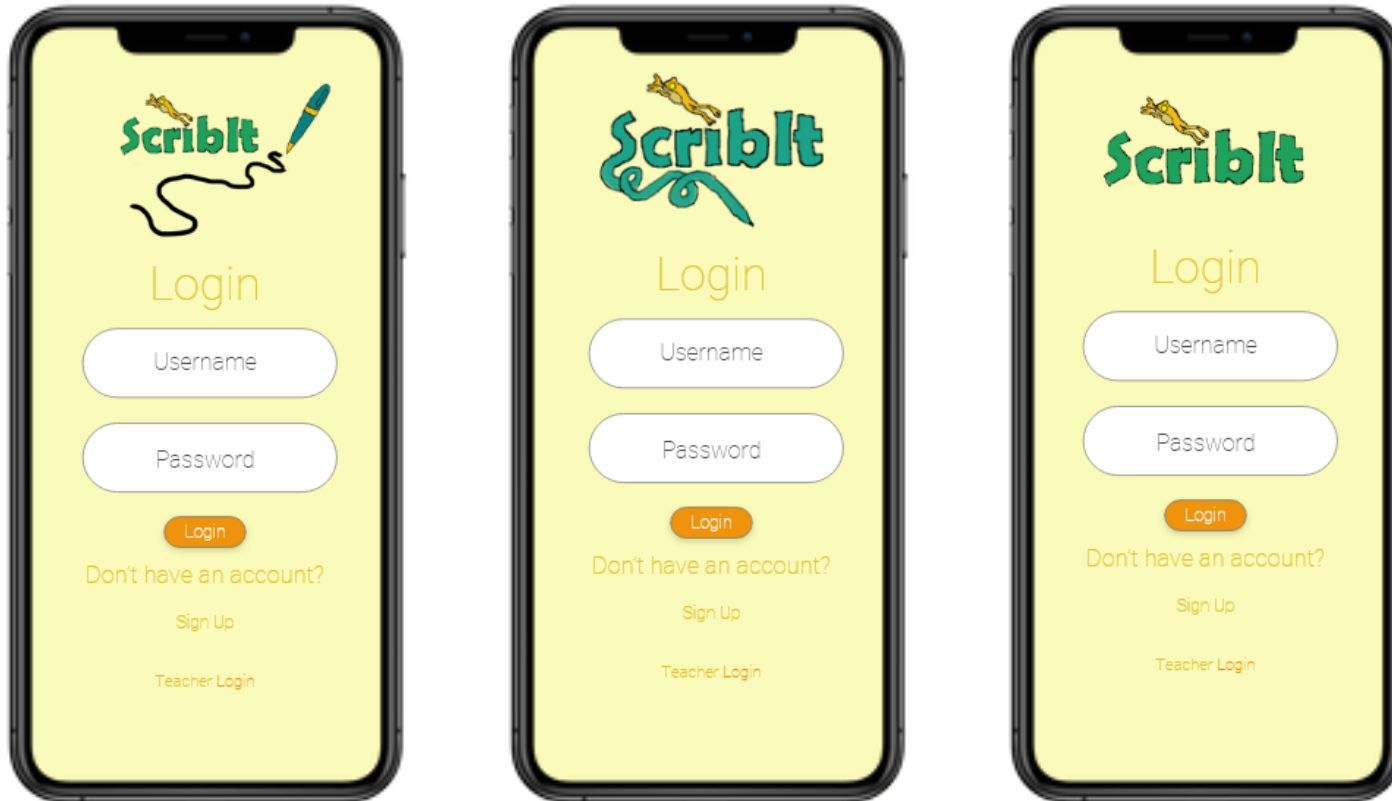


Hand writing

The Logo on the App



The Logo on the App



Final Logo

Motivation/Determination

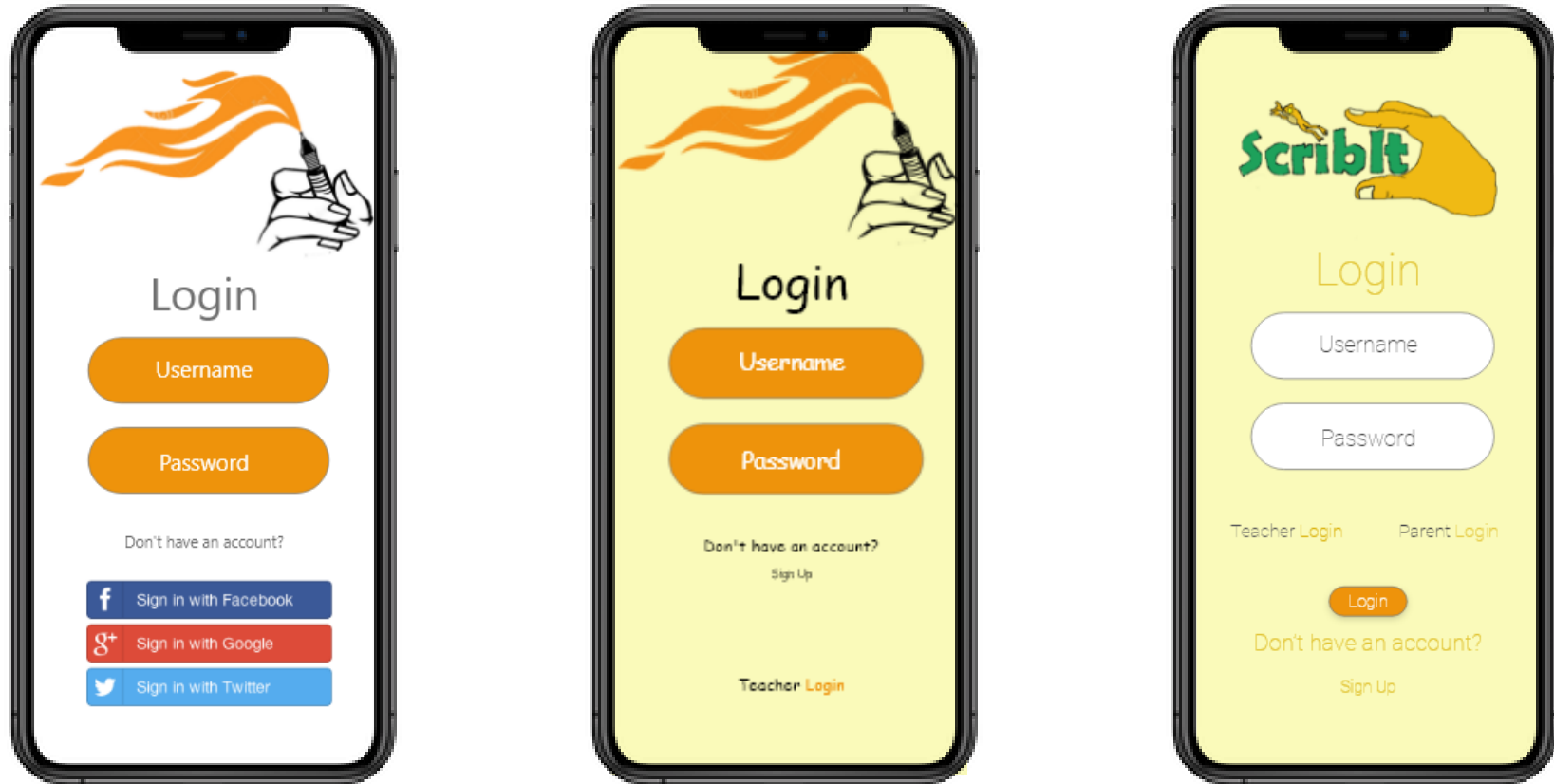
Pen grip/open web



Name (scribing = writing)
Pronounced "Scribe-it" or "Scrib-it"

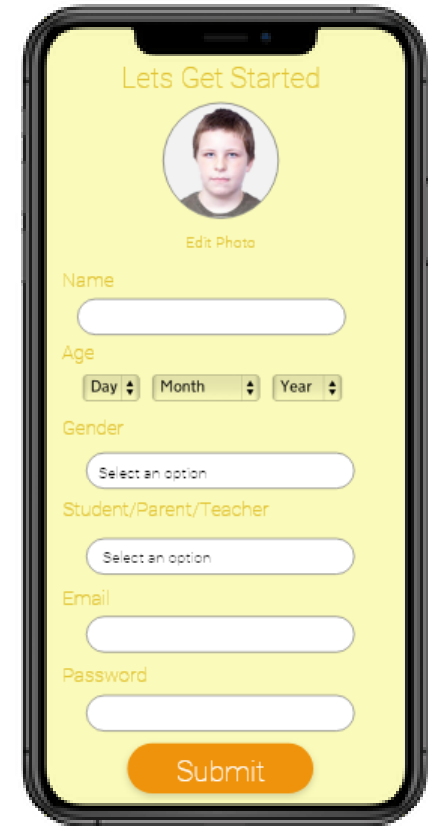
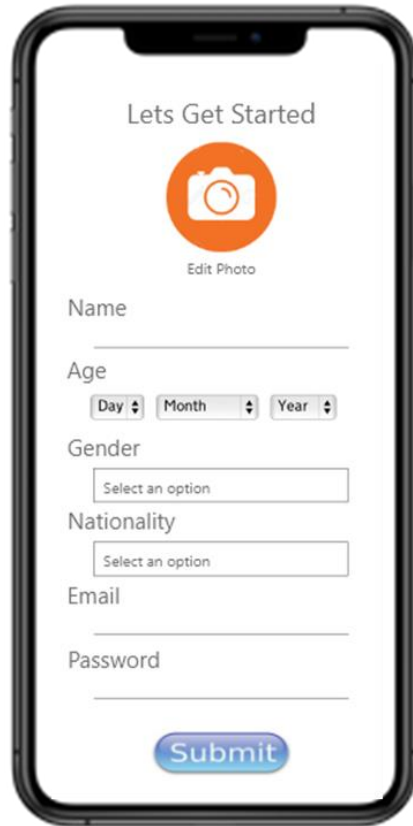
Support from others
(teachers/peers/self)

Login Screen Development



- o The font changed from arial to comic cans to roboto.
- o More of an emphasis is put on teacher and parent login by moving it more central.
- o The "Scribit" logo is used to ensure consistency throughout the app.
- o Signing in through social media was removed to ensure Scribit remained an independent and isolated app.

Start-up Screen Development



- o The font changed from arial to comic cans to roboto.
- o The colour of the font was changed from a strong black to a softer gold colour which fits in with the colour scheme.
- o The profile picture is included to increase the personalisation of Scribit.

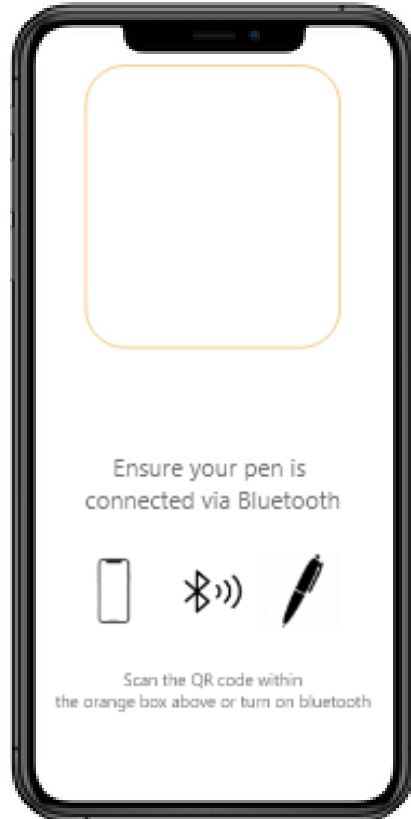
Welcome Screen Development



- The font changed from arial to comic cans to roboto.
- The colour of the font was changed from a strong black to a softer gold colour which fits in with the colour scheme.
- The "Scribit" logo was included to maintain consistency throughout the app.

Device Pairing Screen Development

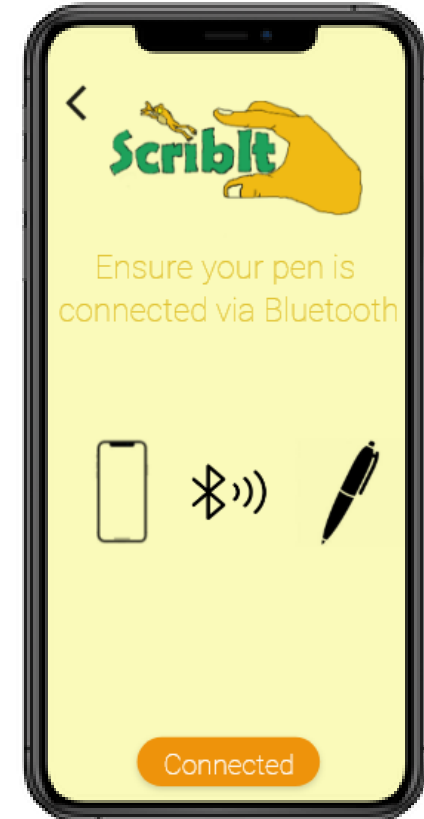
Iteration 1



Iteration 2



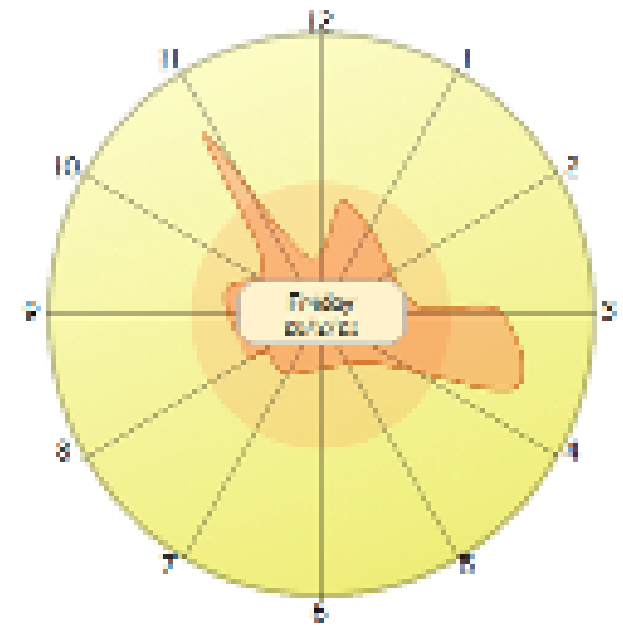
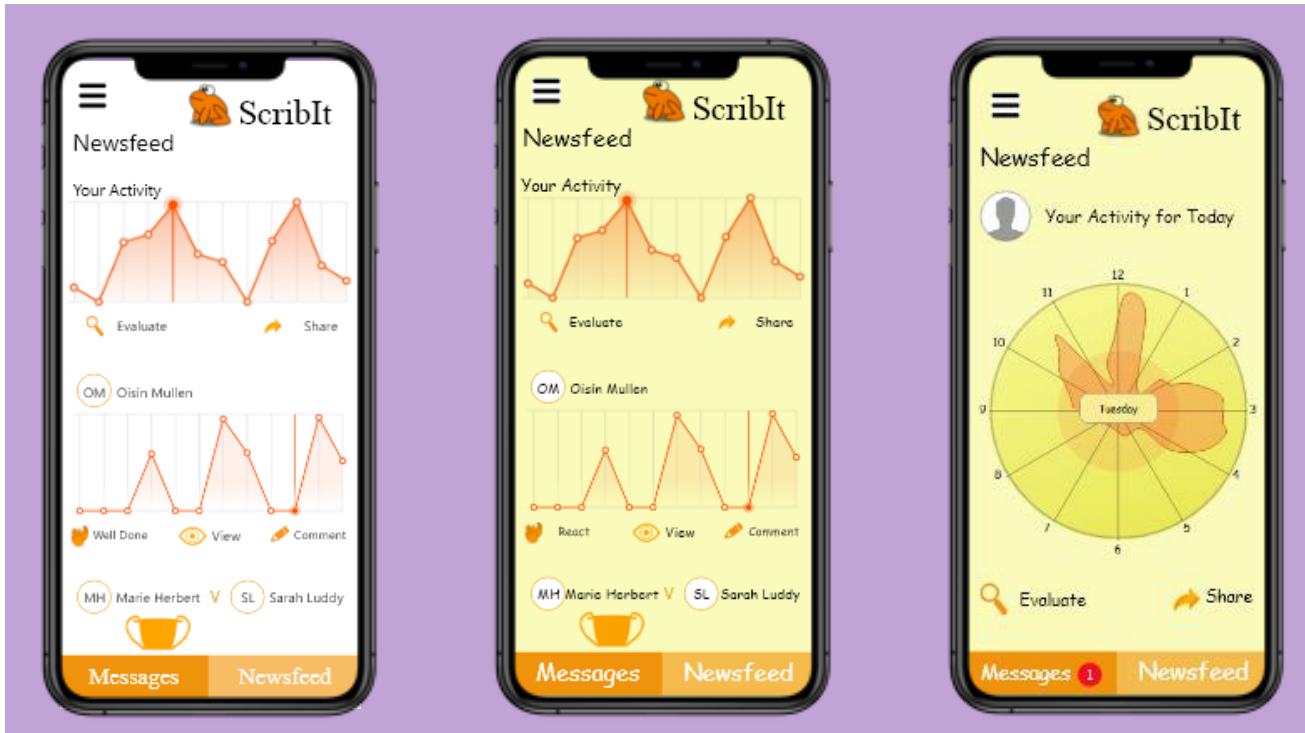
Iteration 3



- The font changed from arial to comic sans to roboto.
- The colour of the font was changed from a strong black to a softer gold colour which fits in with the colour scheme.
- The "Scribit" logo was included to maintain consistency throughout the app.
- After further research, I realised that the device cannot be connected to the app via QR code so it was removed.

Newsfeed Screen Development

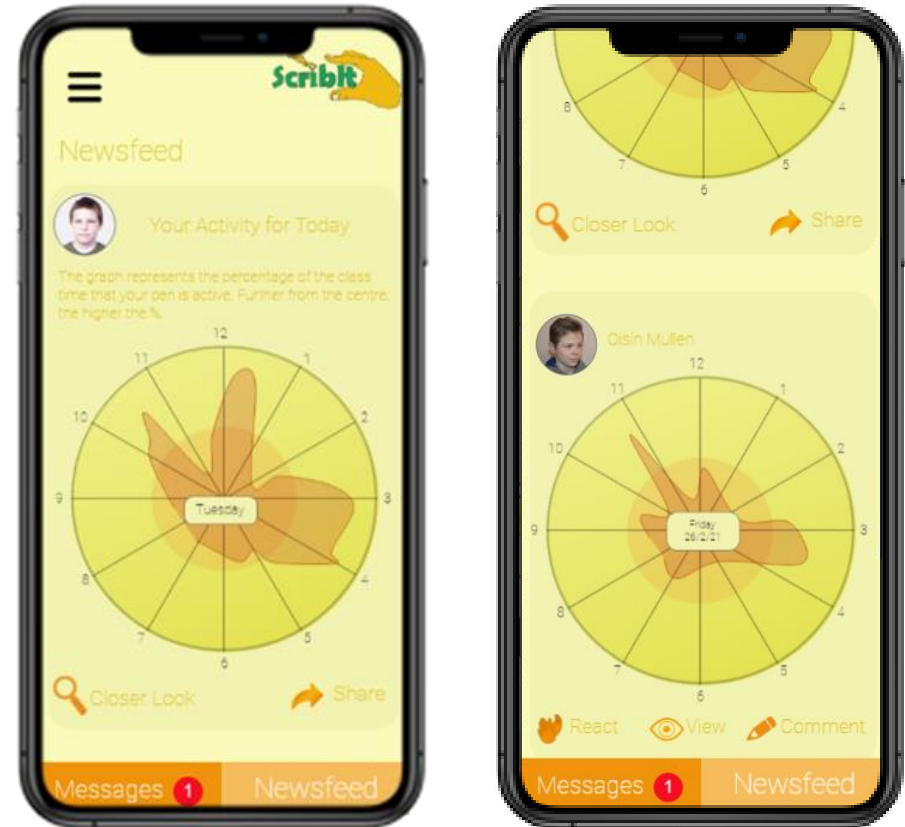
Activity Graph



- The graph represents the activity of the pen at various stages throughout the day. Each point on the graph represents a subject.
- The user's activity will be the first graph to appear in the newsfeed. This will be private to them unless they decide to share with their connections.
- The aesthetics of the app have been improved by changing the background colour and the font to comic sans which is proven to be more legible.

- Reviewers of apps found that one post per screen is best for user experience as it avoids distraction.
- The graph design has changed to a more attractive design to make draw the users attention to their activity.
- The user can access the newsfeed via the "newsfeed" button at the bottom of the screen.
- The further the graph moves out from the centre point the more the activity is increased. The time is represented around the circumference.

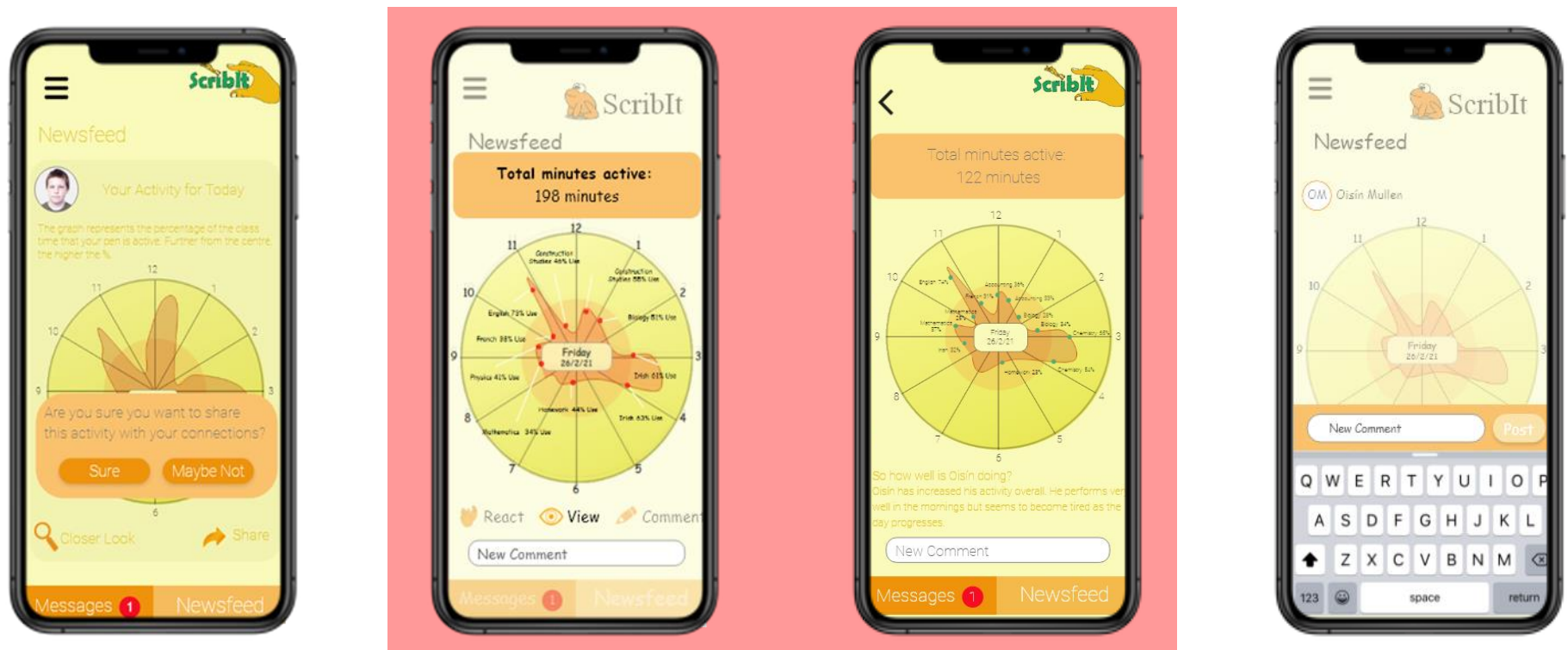
Newsfeed Screen Development



- There are only 3 reactions to a post and all are positive to help avoid bullying and negativity.
- "React but if you have nothing positive to say then say nothing at all" is included in the reaction box to make users aware of online bullying.
- A lighter colour font was used as it has less impact on the users eye.

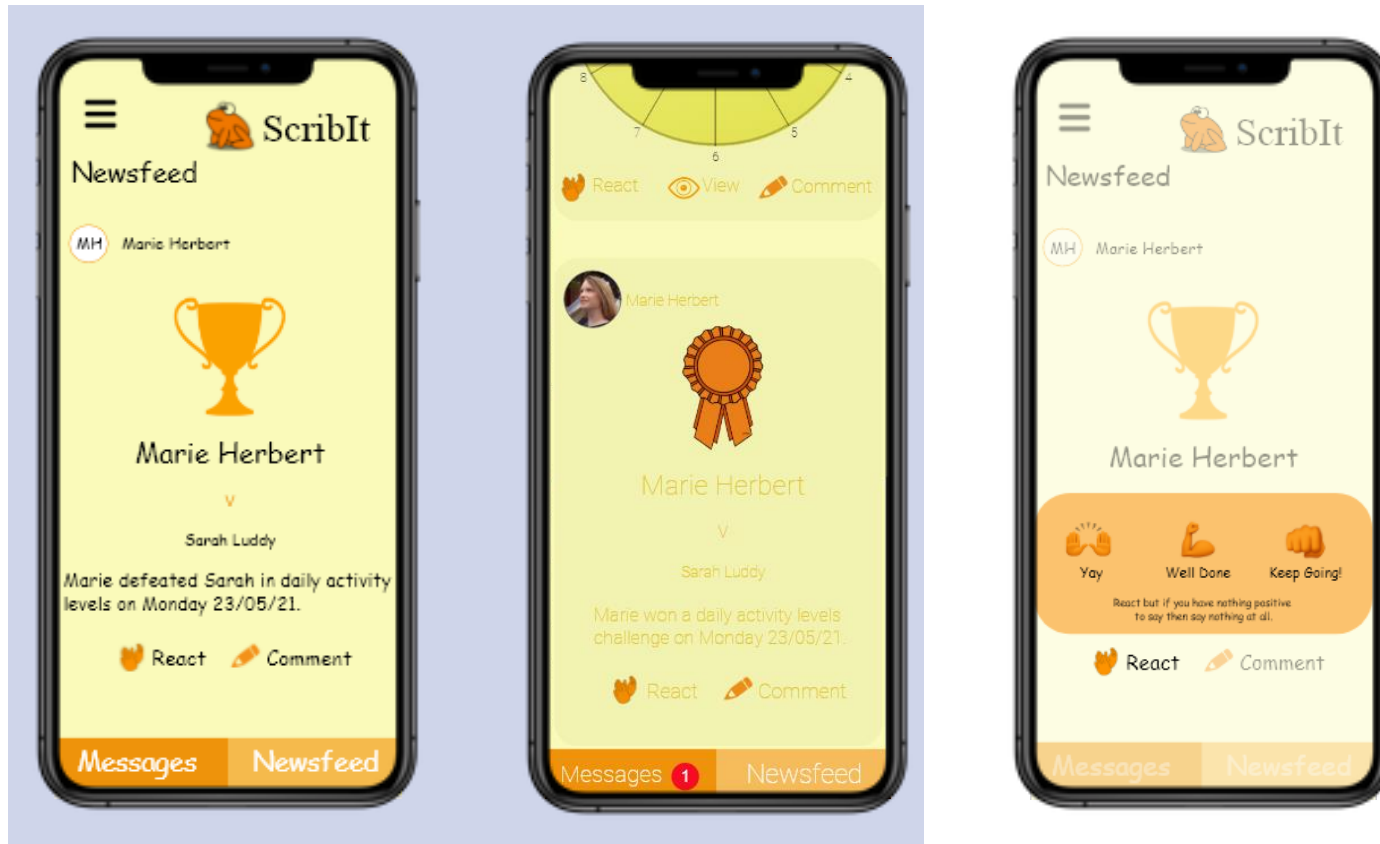
- A brief explanation of how the graph is read is included to make it easier for the user to understand their data.
- There were a number of posts on one screen. Instagram and TikTok only have one post per screen to avoid distraction. ScribIt moved from 2.5 posts on a screen to one post.
- Each post is tabulated to ensure that they are isolated from each other.

Newsfeed Screen Development



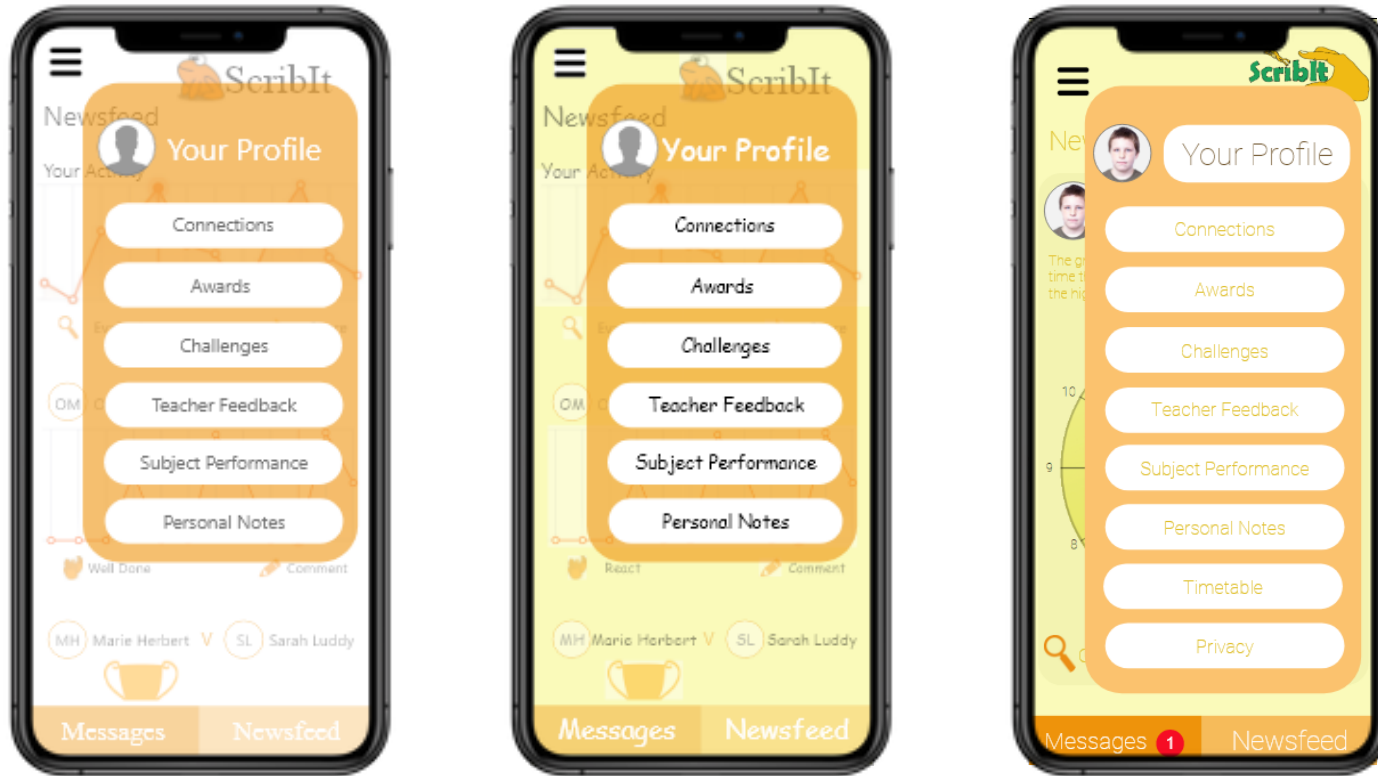
- o There is a more casual language used when sharing posts.
- o The user can view the graph in more detail when they click the view button. It shows the subjects, levels of activity at various intervals and the total minutes that the pen is active throughout the day.
- o The app has been developed to give a summary of the collated data underneath the graph to make it easier for the user to understand the graph.
- o The "Scribit" logo was also included as the iterations developed.

Newsfeed Screen Development



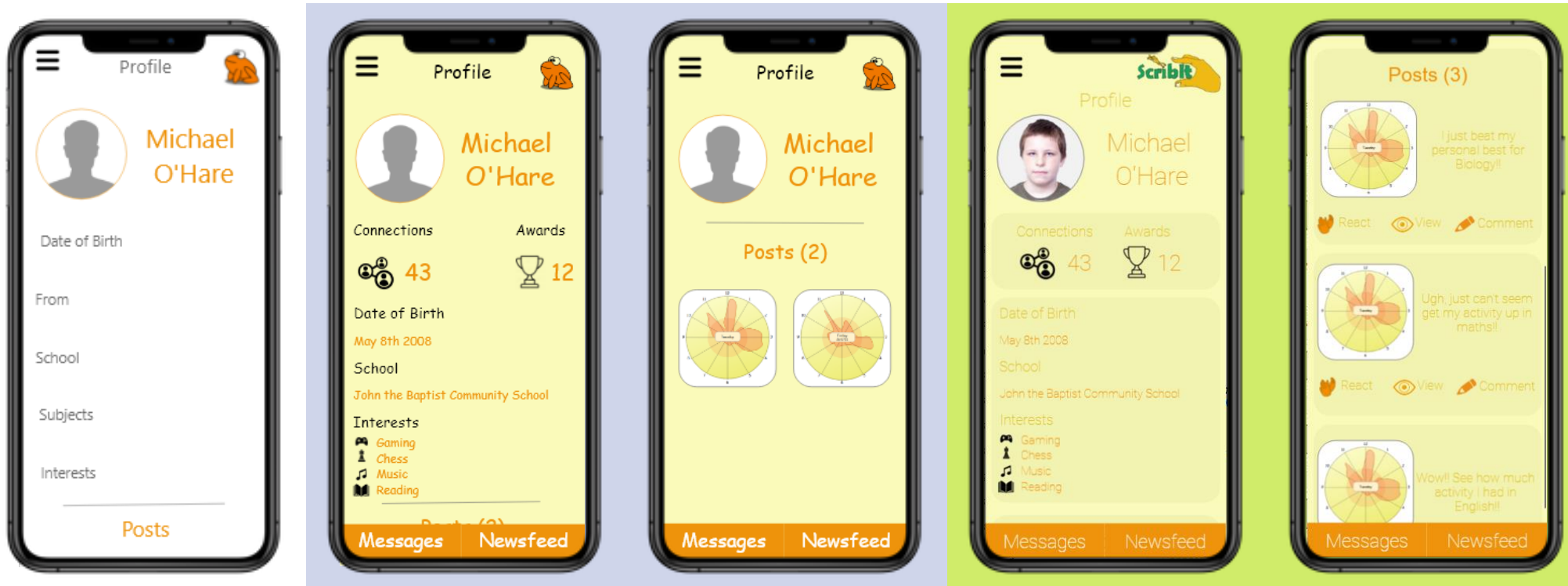
- The winners name is written in a larger font.
- The results will remain private to avoid embarrassment for the loser.
- There are only 3 reactions to a post and all are positive to help avoid bullying and negativity.
- “React but if you have nothing positive to say then say nothing at all” is included in the reaction box to make users aware of online bullying.
- A ribbon was used instead of a trophy to make is less in the face of the individual who does not win.

Menu Screen Development



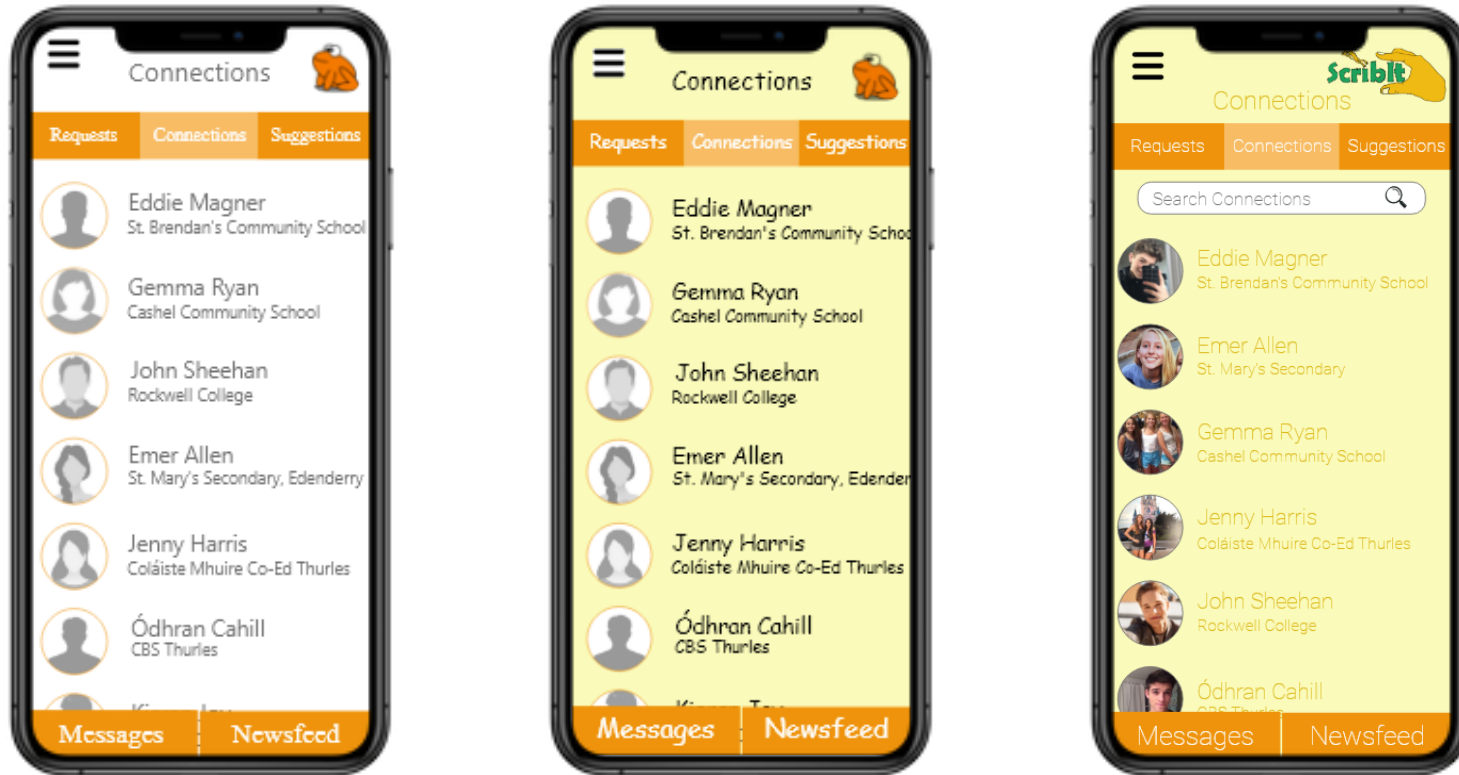
- The font and the colour of the font changed as the iterations developed.
- Extra functions were added to the menu as the app was developed as they were needed for other functions to operate.
- Each of these functions will be discussed in the next number of slides.

Profile Screen Development



- o The aesthetics of the app has been improved by changing the background colour and the font to comic sans to roboto.
- o "From" (area where they live) was removed for child protection from predators.
- o Profile gives an overview of the users app activity.
- o The users posts will be organised in a tiled format.
- o There is a comment beside each post to allow the user share their thoughts on their activity.
- o Once a post is clicked on, the user can scroll up and down to view other posts in the large screen.

Connections Screen Development



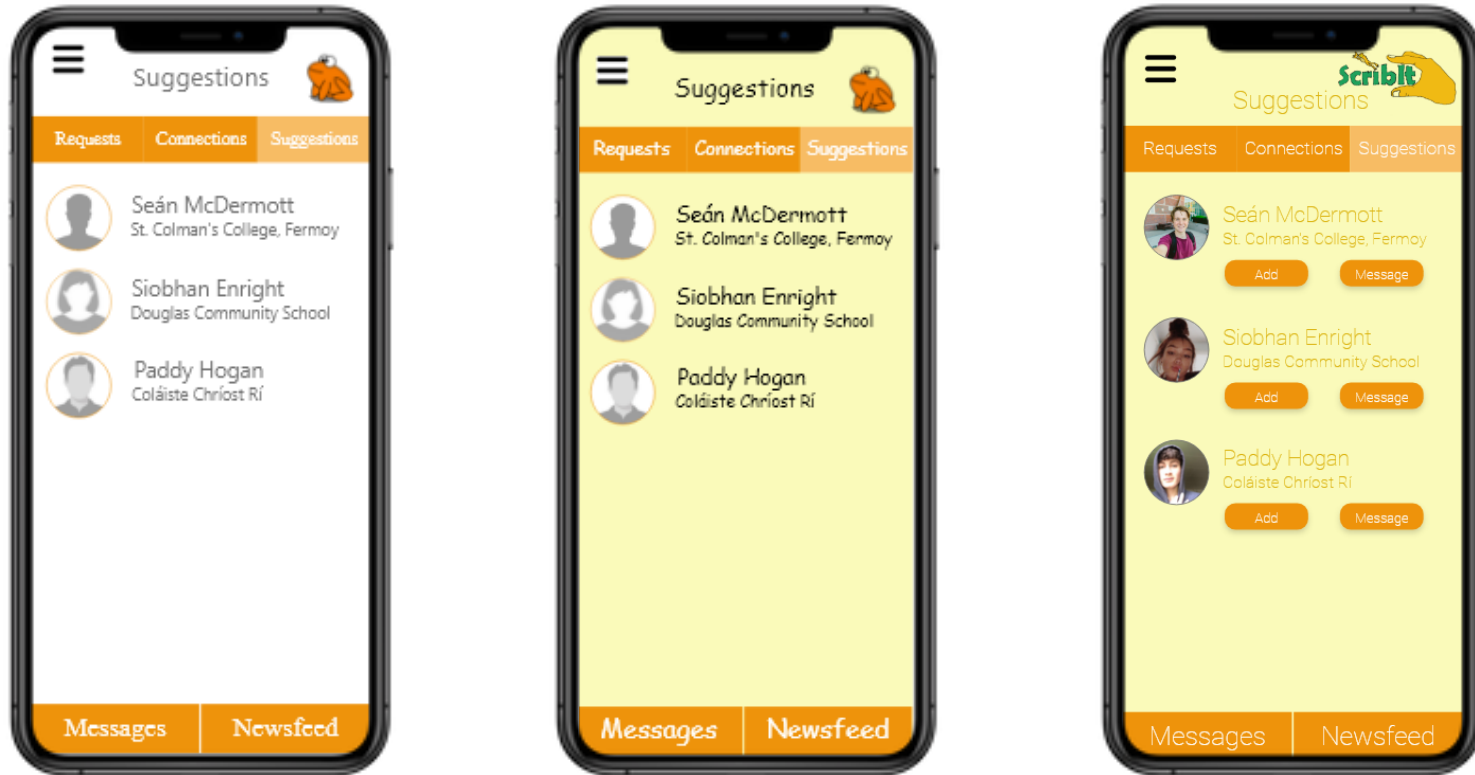
- o The aesthetics of the app has been improved by changing the background colour and the font to comic sans to Roboto. The font colour was also changed to improve aesthetics.
- o A search bar is included for the user to find their connections much easier.
- o The list of connections is in alphabetical order to make the search easier for the user.
- o The “connections” tab is a lighter shade of orange to show that the connections requests feature is active.
- o Profile picture can be seen beside the name so the user may be able to recognise who they are connecting with.

Connection Requests Screen Development



- o The aesthetics of the app has been improved by changing the background colour and the font to comic sans to roboto.
- o "Accept" and "Decline" options were added to the screen to reply to connection requests.
- o The "Requests" tab is a lighter shade of orange to show that the connections requests feature is active.
- o Profile picture can be seen beside the name so the user may be able to recognise who they are connecting with.

Connection Suggestions Screen Development



- The aesthetics of the app has been improved by changing the background colour and the font to comic sans which is proven to be more legible.
- There were a number of posts on one screen. Instagram and TikTok only have one post per screen to avoid distraction. ScribIt moved from 2.5 posts on a screen to one post.

- "Add" and "Message" options were added to the screen to add connections or message individuals without adding them.
- The "Suggestions" tab is a lighter shade of orange to show that the connections requests feature is active.

Awards Screen Development



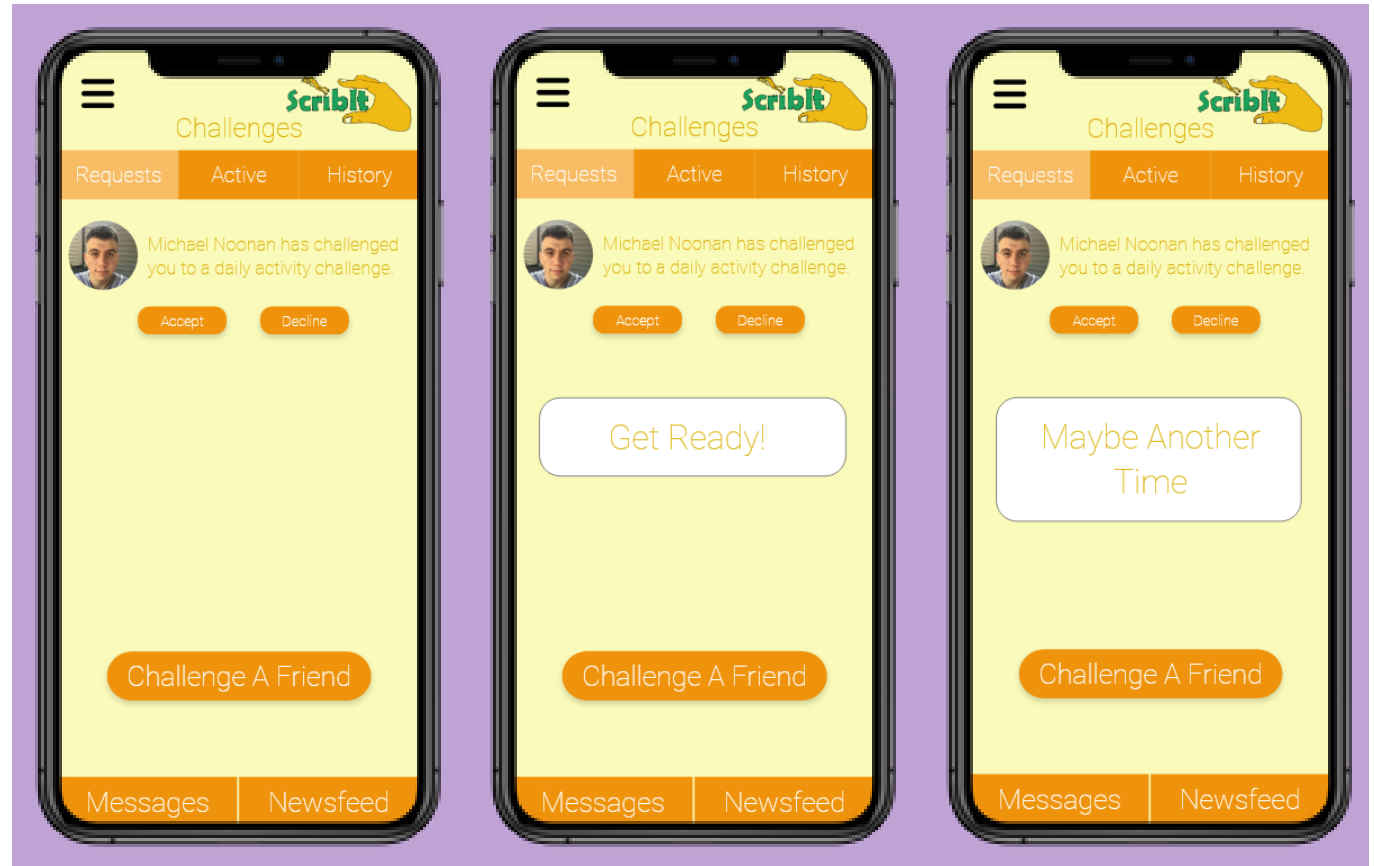
- o The aesthetics of the app has been improved by changing the background colour and the font to comic sans which is proven to be more legible.
- o The user can receive a reward on anything they achieve in the app. These include a new personal best for daily activity, highly rated feedback on school work they have done and defeating a connection on a challenge.

- o There was a graphic included at the top of the screen with the users profile picture at the top of the podium. Their picture will remain at the top of the podium whether they perform well or not to encourage them to be confident and happy in themselves.
- o Trophies were changed to ribbons for aesthetics.

Challenges Screen Development

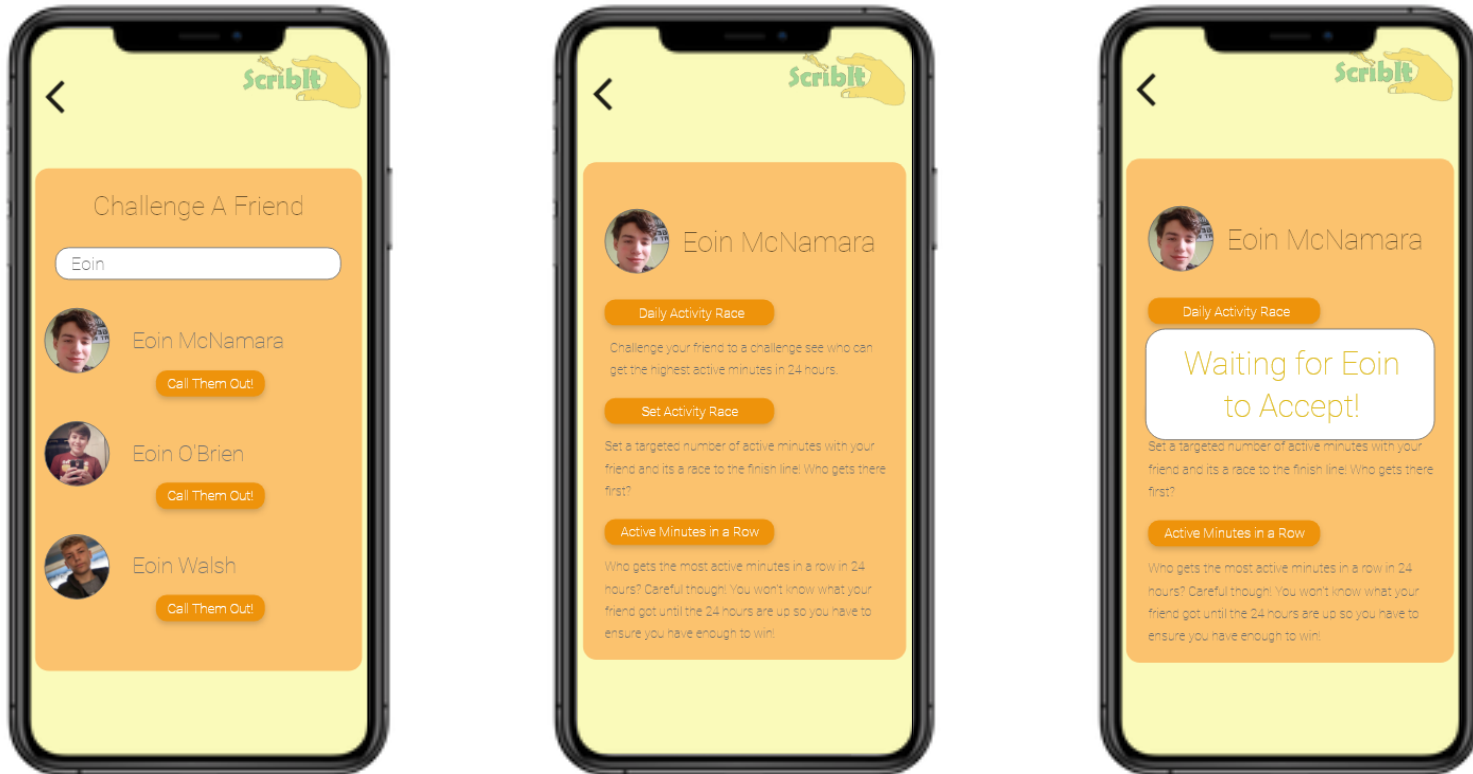


- o The user can view their performances in past challenges.



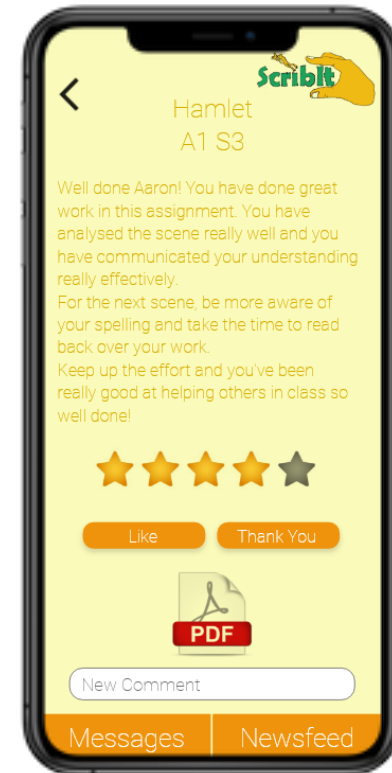
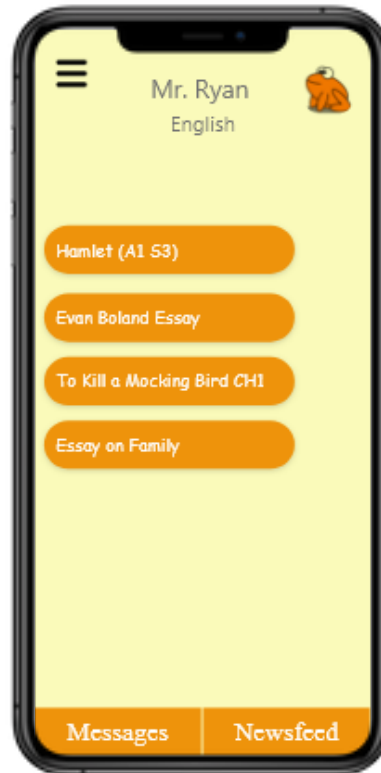
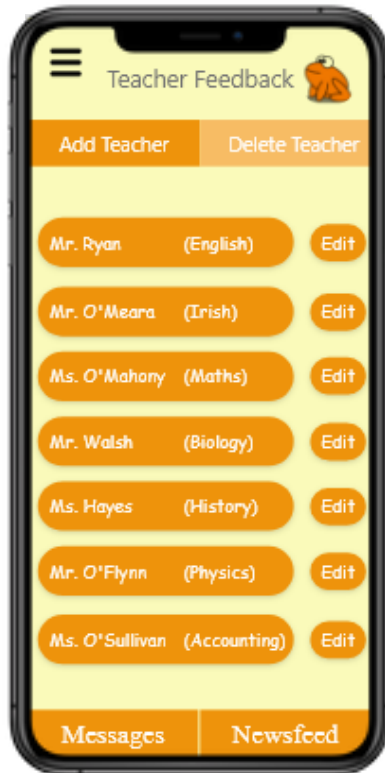
- o The user can accept or decline challenge requests from others.
- o The "get ready" message is motivational when the user accepts the challenge rather than just using "accepted".
- o Should the user decline the challenge, a message appears saying "maybe another time" which may keep the user open to a potential challenge with this connection in the future.

Challenging a Friend Screen Development



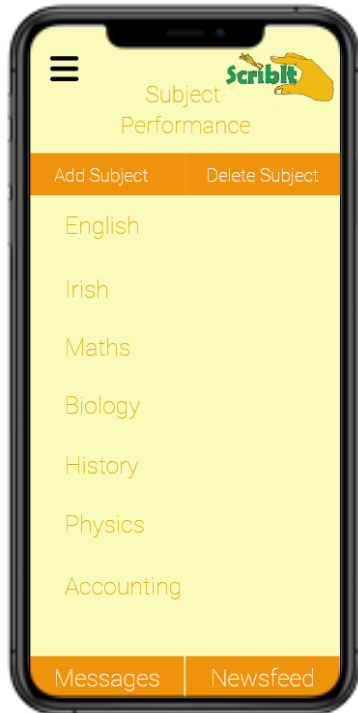
- o The user can search a name and all connections with that name will appear and you can "call them out".
- o A paragraph describing each challenge is included to help the user understand what challenge they are requesting.
- o When the challenge request has been sent, the user must wait for the connection to accept.

Teacher Feedback Screen



- o Access the "Teacher Feedback" via the main menu. A list of teachers and their subject will appear. There is an option to edit/add/remove teachers should subject teachers change.
- o The user selects a subject and the feedback to each topic will be listed for the student to access.
- o The user will be able to read the feedback and see the star rating their work received. Their document will be available in PDF format. They can also "like" or comment on their feedback.
- o The student has the option to delete a teacher should they change teacher for a specific subject or decide to discontinue studying the subject.
- o As identified in the primary research, teachers found it difficult to meet all students needs due to time limitations so this provides an avenue for teachers to apply feedback to their students outside class times.

Subject Performance Screen

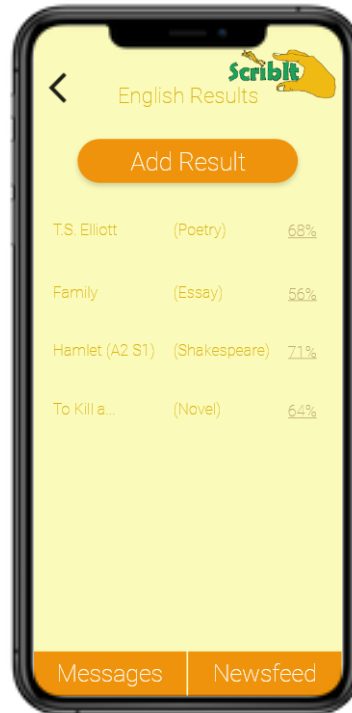


Access the subjects via the main menu where they will be listed.

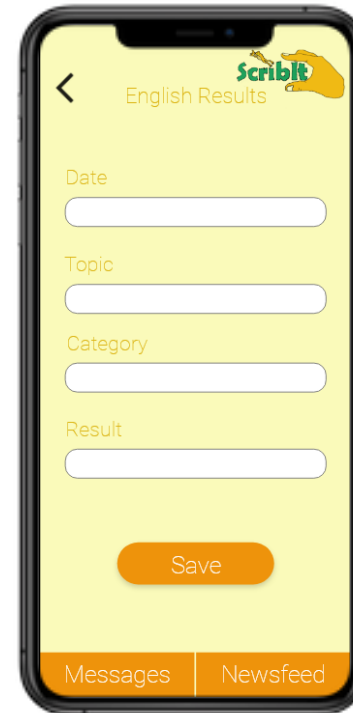


Click on the subject and grip activity graph and option to view previous results will be available.

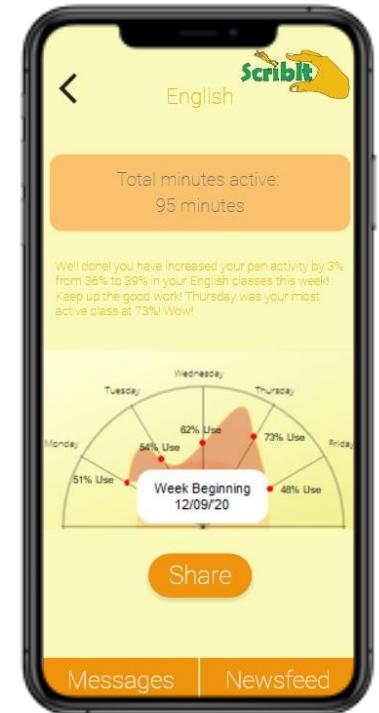
Explanation of graph included.



The users can view previous results and can also add results.



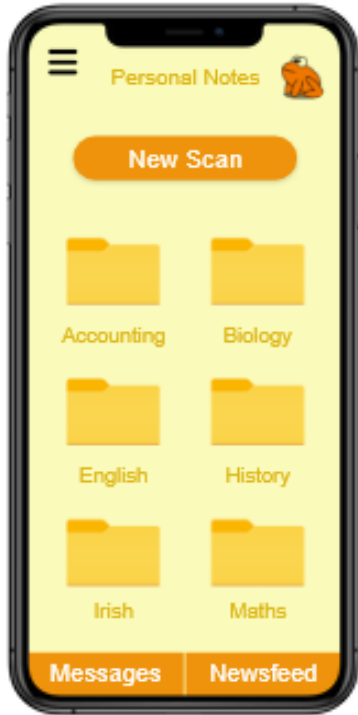
The user can add in results and the app will keep them organised according to subject and topic.



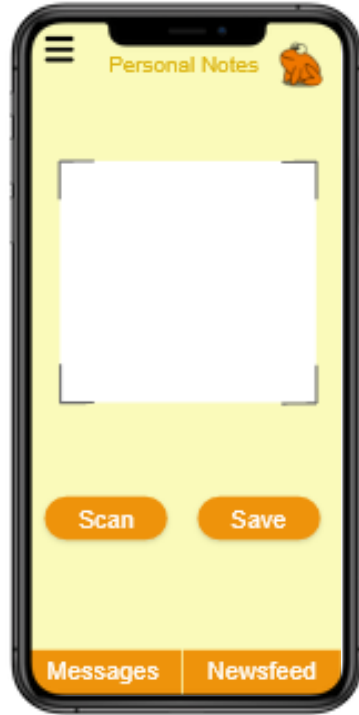
The user can view their grip activity for that subject on a weekly basis and they can choose to share this if they would like to do so.

Summary of data included.

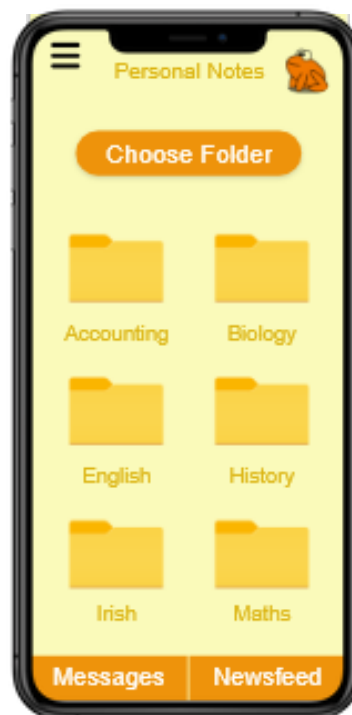
Personal Notes Screen



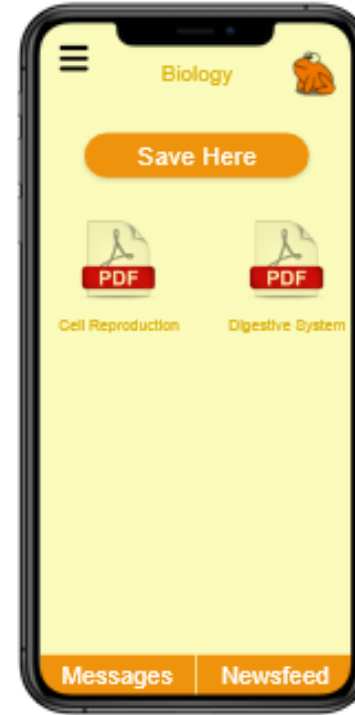
Access the “Personal Notes” via main menu. The subjects that the student is studying will appear in folders.



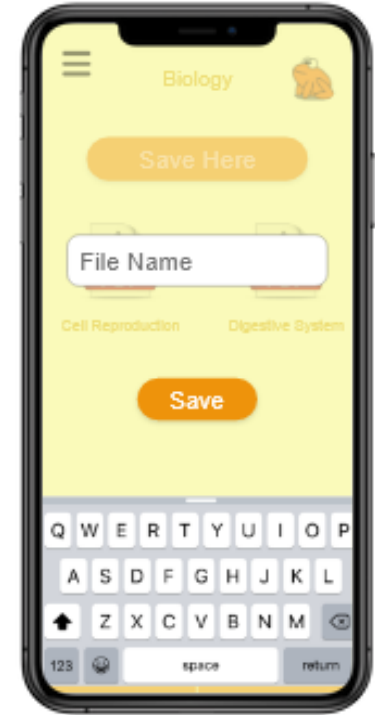
The user can scan a handwritten document that will convert it to PDF and audio format to make studying easier for the user.



The user can select a folder to save their scanned document in.



The user can view documents already saved.



The user types the name of the scanned document and saves it in the relevant folder.

Timetable Screen



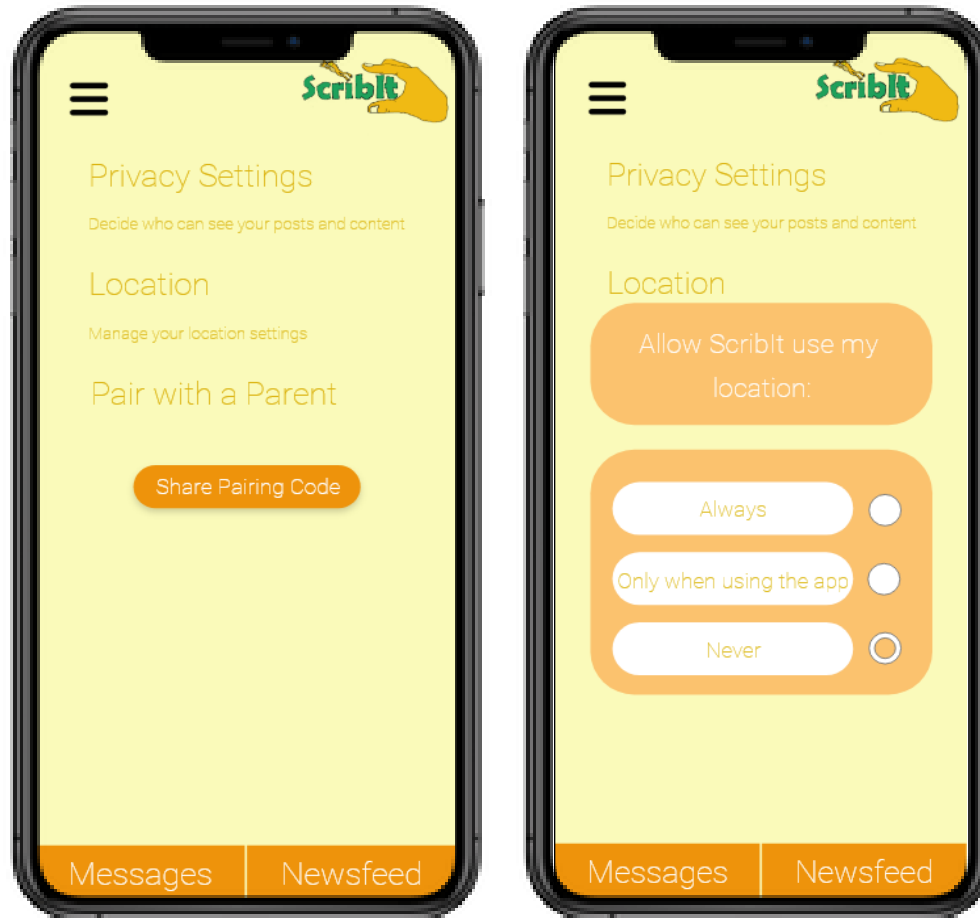
- The user must manually enter their timetable into the app.
- The timetable will be able to let the grip know what class the activity is happening in.
- There is a horizontal scroll to allow the user to view the entire timetable.
- The user will also be able to use this timetable when they are unsure where to go in school. This will reduce anxiety for the user.

Privacy Screen



- The user can control who can see and comment of their posts.
- If the user chooses only "specific connections" can see their posts they can select the connections by tapping their names.
- The screen will tell the user how many connections they have chosen.
- There is an option to view the selected connections in one single list isolated from the other connections.

Location Settings Screen



- o Users can allow the app and others see their location if that is their preference.
- o They can choose "always", "only when using the app" or "never".

Change in Terminology



Evaluate

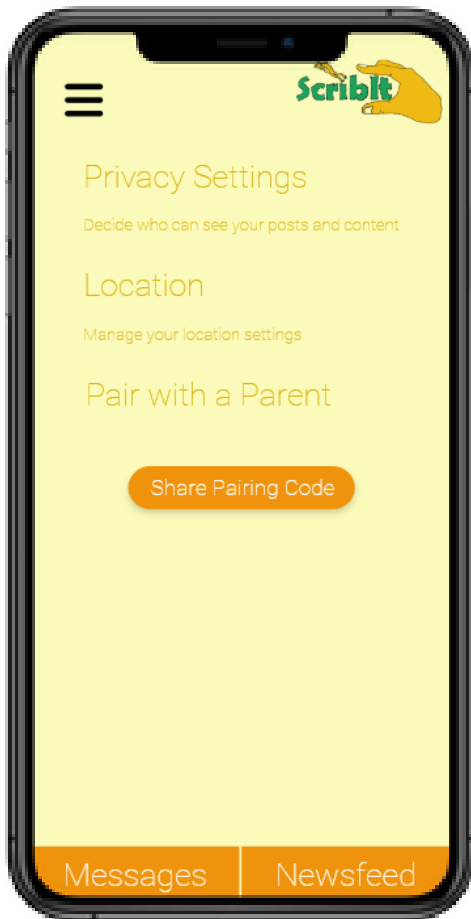
Closer Look

Marie defeated

Marie won

Terminology simplified and more positive.

Parent Monitoring



- o To further protect the user from predators, the user can pair the app with a parent. This will allow the parent to monitor their child's activity.
- o The app will be mirrored on the parents' phone but commenting and sharing functions will be disabled for parents so control of the app will remain with the user.



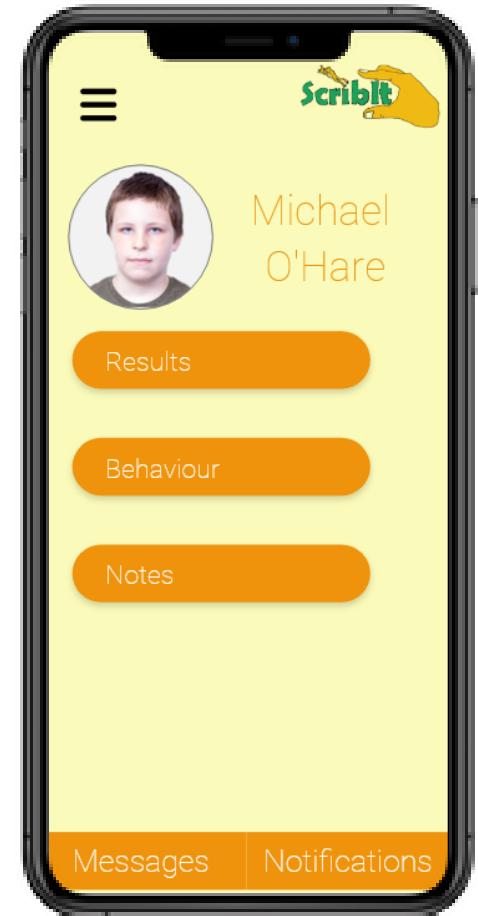
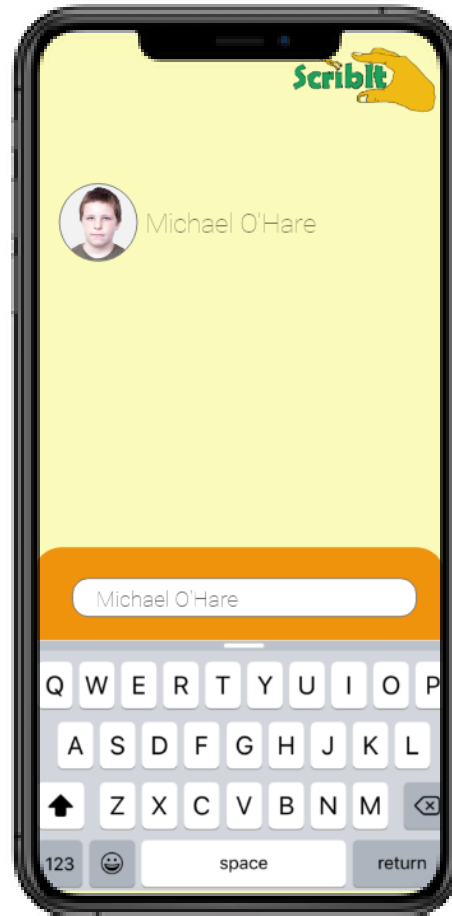
The App (Teacher)

Notifications Screen



- o The teacher main screen will be notifications where they will be informed of student assignment submissions or can make reminders for activities they need to carry out during the day.

Quick Search Function



- o The teacher has the option to quick search a student to add notes on them.
- o The teacher cannot see grip activity graphs as it allows students feel more comfortable sharing their opinions and challenges with others.

Adding Student Results Function



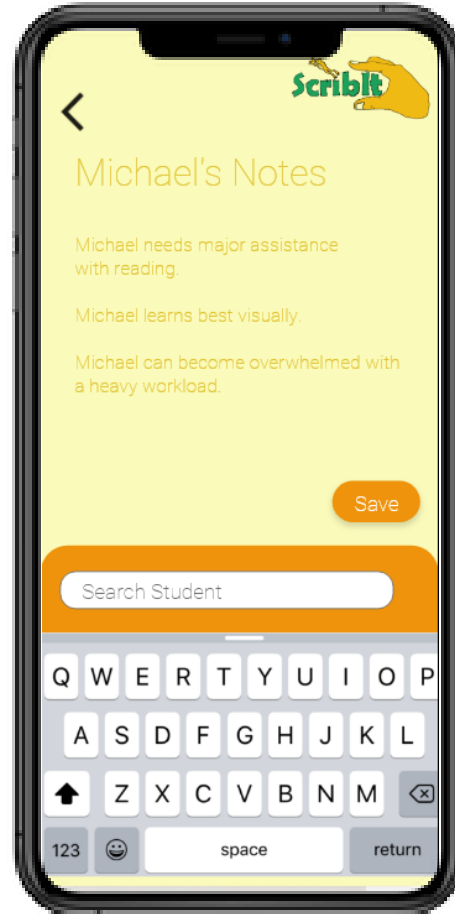
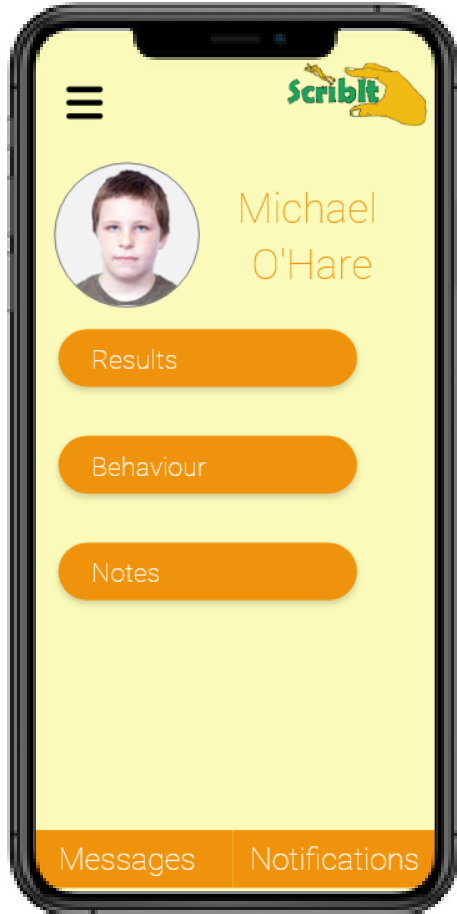
- o Teachers can add results to a students profile in the same process that a student would add it.

Adding Student Behaviours Function



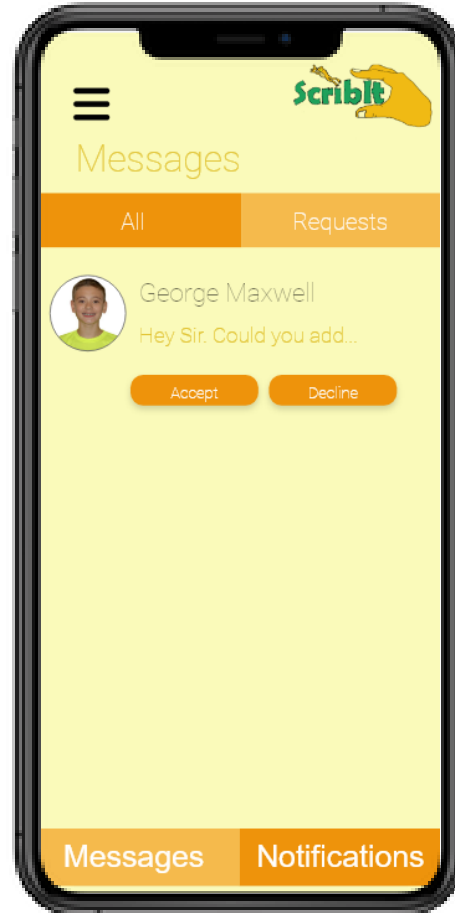
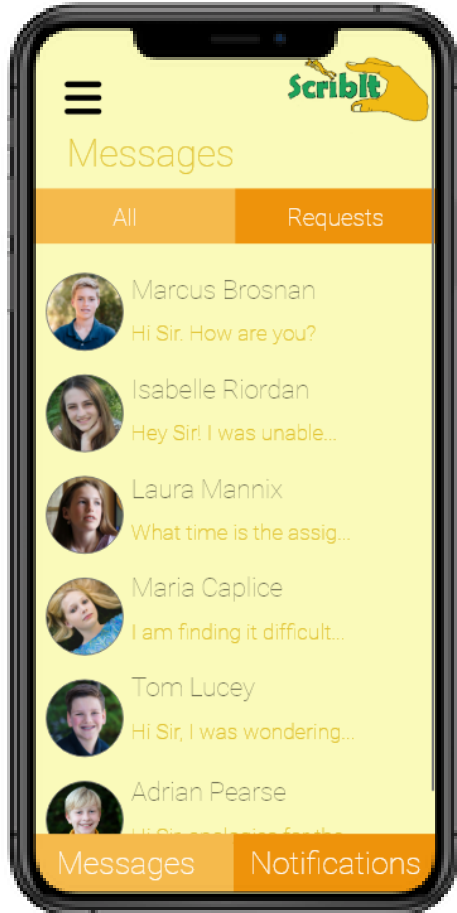
- o Teachers can comment on the students behaviour and give them a +1 or -1 score.
- o Green means that it is a positive behaviour and red is a negative behaviour.
- o A positive score means that the student has good behaviour overall whereas a negative score means they have poor behaviour overall.

Adding Student Notes Function



- o Teachers can add notes on the student on how best to meet their needs.
- o This will be accessible to all teachers to try and support them in their teaching of the student.

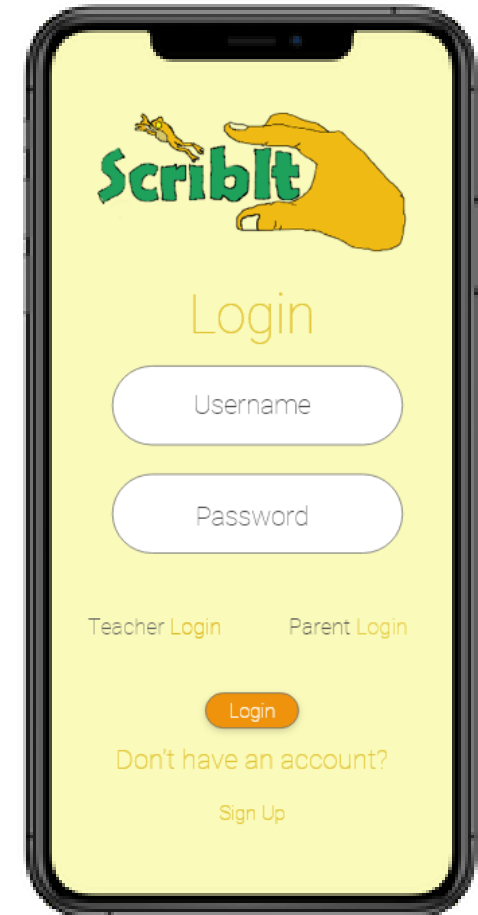
Messages Function



- o The messages are the same as the student version.
- o There is an all messages section and a requests section.
- o There is a preview of the message under each name.

Adobe Xd App Prototype

<https://xd.adobe.com/view/27dd87b3-dc18-4765-8a89-cfaf91510105-728e/?fullscreen&hints=off>




Motivational Messages on Grip Screen

Personal Activity




Motivational Messages on Grip Screen

Subject Performance




You were writing for 12 mins last week! Lets go!




You have written 30 secs more this week!




Wow! You wrote performed really well in English this week!



You're 2 minutes from last weeks time!



English was your busiest subject this week!



This week was not as good at last week but next week is a new week!


Motivational Messages on Grip Screen

Challenges




Motivational Messages on Grip Screen


Keeping the student on task




Does what you
have written
make sense?



What are the
key points on
what you have
written?



Set a goal on
what you would
like to improve
on today



Have you
answered the
question asked?



Risk Analysis

PCA Analysis

Task	Perception	Cognition	Action	Potential Use Error	Potential Harm	Essential Task (Y/N)
Hold the device firmly	The user must see the device in their pencil case	The user needs to recognise the top and bottom of the grip.	The user must grasp and hold the device in the correct orientation.	The user may not grasp the device tightly enough and upside down.	The device could slip, fall and be damaged.	N
Insert the pen/pencil	The user must see the opening where the pen/pencil should be inserted.	The user needs to distinguish between the top and bottom of the grip.	The user will insert the pen/pencil into the grip from the top down.	The user may force the pen/pencil in the incorrect opening (bottom – up)	The pen/pencil could slip and harm the user or damage the device.	Y
Align the pen/pencil in a comfortable position in the grip.	The user needs to see that the pen/pencil can be moved up and down the grip.	The user must identify the position of the pen/pencil that is comfortable to them.	The user aligns and holds the pen in the comfortable position in the grip.	The user may not be align the pen/pencil into a position that is comfortable to them.	The user may not be comfortable when writing which may lead to hand strain.	Y
Clamp the pen/pencil in the grip.	The user must see the gripping screw.	The user must recognise that the gripping screw must be turned.	The user must thread the gripping screw until the pen is secure.	The user may not thread the gripping screw tight enough to secure the pen securely enough.	The pen could slip from the grip.	Y

PCA Analysis

Task	Perception	Cognition	Action	Potential Use Error	Potential Harm	Essential Task (Y/N)
Power on the device	The user must see the power button.	The user must identify the pressure needed to be applied to the button to turn on the device.	The user must press the button to turn on the device.	The user may forget to press the button to turn on the device.	The grip may not record the activity.	Y
Download the app.	The user must see to download the app for the device to function	The user must know how to download the app.	The user must download the app from the Google Play Store or App Store.	The user may not know that an app needs to be downloaded.	The grip may not record the activity.	Y
Sign up to the App	The user must see where to sign up to the app	The user must understand how to sign up to the app.	The user must insert and submit their details on the app.	The user may not download to app to sign up to it.	The grip may not record the activity.	Y
Connect the app to the grip.	The user must see the connect button via Bluetooth.	The user must identify the need to connect the app to the device	The user must connect the app to the grip via Bluetooth	The user may not connect the app to the device.	The grip may not record the activity.	Y

Task Analysis

Task Description	Success Means	Purpose Use Issues	Critical/ Essential
Hold the device firmly	The device is held firmly in the users hand with little/no risk of slipping/falling.	The user may not hold the device securely and it may fall/become damaged.	N
Insert the pen/pencil	The pen/pencil is inserted in the correct orientation to the grip	The user may insert the pen in the incorrect direction.	Y
Align the pen/pencil in a comfortable position in the grip.	The user aligns the pen/pencil into the correct position that is comfortable to them.	The user may position the pen/pencil incorrectly	Y
Clamp the pen/pencil in the grip.	The user threads the gripping nut so the pen/pencil is held securely in the device.	The user may not grip the pen/pencil securely enough.	Y
Power on the device	The user pushes the button to turn on the device.	The user may not turn on the device.	Y
Download the app.	The user must access and install the app on their phone.	The user may not install the app.	Y
Sign up to the App	The user signs up to the app and has access to all features.	The user may not sign up to the app.	Y
Connect the app to the grip.	The user must connect the app to the grip via Bluetooth.	The user may not connect the app to the device.	383

Risk Analysis

Ranking	Severity	Description
S1	Negligible	Inconvenient and annoying but no harm
S2	Minor	Injury which may require medical treatment but is unlikely to require hospitalisation.
S3	Serious	Injury which could result in the need for medical treatment and hospitalisation
S4	Significant	Injury which could result in permanent handicap
S5	Severe	Injury which could result in death

Ranking	Likelihood	Description
L1	Very Unlikely	$<10^{-6}$
L2	Unlikely	$\leq 10^{-5}$ and $\geq 10^{-6}$
L3	Possible	$\leq 10^{-4}$ and $\geq 10^{-5}$
L4	Likely	$\leq 10^{-3}$ and $\geq 10^{-4}$
L5	Very Likely	$\geq 10^{-3}$

		Impact →				
		Negligible	Minor	Moderate	Significant	Severe
Likelihood ↑	Very Likely	Low Med	Medium	Med Hi	High	High
	Likely	Low	Low Med	Medium	Med Hi	High
	Possible	Low	Low Med	Medium	Med Hi	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium	Med Hi
	Very Unlikely	Low	Low	Low Med	Medium	Medium

Risk Analysis

Task Error	Severity	Likelihood	Risk	Risk Elimination/Reduction
The user may not hold the device securely and it may fall/become damaged.	Negligible	Possible	Low	Training and include in IFU
The user may insert the pen in the incorrect direction.	Minor	Possible	Low Med	Training and include in IFU
The user may position the pen/pencil incorrectly.	Negligible	Possible	Low	Training and include in IFU
The user may not grip the pen/pencil securely enough.	Negligible	Possible	Low	Training and include in IFU
The user may not turn on the device.	Negligible	Possible	Low	Training and include in IFU
The user may not install the app.	Negligible	Possible	Low	Training and include in IFU
The user may not sign up to the app.	Negligible	Unlikely	Low	Training and include in IFU
The user may not connect the app to the device.	Negligible	Unlikely	Low	Training and include in IFU



User Testing

Testing Protocol

Dynamic Tripod Grip



Identify the position of the index finger, thumb and middle finger. Ensure that the open web is achieved.

Weight



Ensure that the grip does not cause fatigue when in operation.

Balance



Ensure that the grip is easily balanced and is not leaning to one side while being used.

Comfort



Ensure that the pen can fit comfortably in hands of all sizes. Try identify if the pressure points are effective when the grip is held too tightly.

Ease of use



Ensure that the app is easily navigated and meets the needs of the user.

Testing Procedure

The Grip

Three different prototypes of the device will be printed. Each of the prototypes will have different predetermined weights.

Users will be asked to write out a passage using the grip.

The user will be asked to complete a questionnaire collating feedback on their experience.

The user will be video recorded while writing the passage for later analysis.

The App

The users will be given the app prototype on the laptop.

They will be asked to think aloud to try gain a clearer understanding of the user experience.

The user will be video recorded for later analysis.

The user will also evaluate the app on the questionnaire provided.



Sample Questionnaire Questions

What gender do you recognise as?

- Male
- Female
- _____ (Other)
- Prefer not to comment

What is your age?

- 5-10 years
- 11-15 years
- 16-20 years

Are you in primary school and secondary school?

- Primary School
- Secondary School

What year or class are you in school?

How comfortable did you find the grip to hold?

Uncomfortable Comfortable
1 2 3 4 5

How well did the grip fit in your hand?

Poorly Very well
1 2 3 4 5

Which weight did you find most comfortable?

1 2 3

How easy did you find the app to use?

Difficult Very Easy
1 2 3 4 5

How well did you think the app looked?

Needs Work Very Nice
1 2 3 4 5

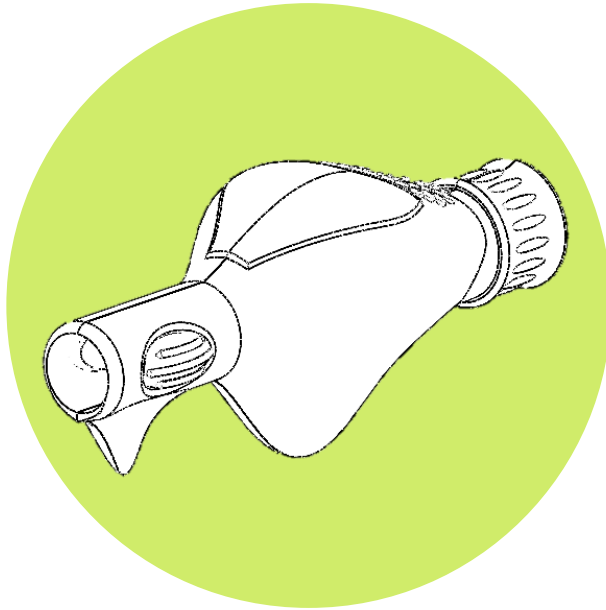
Although it is a prototype, how likely would you be to use the grip and app?

Not Likely Likely
1 2 3 4 5

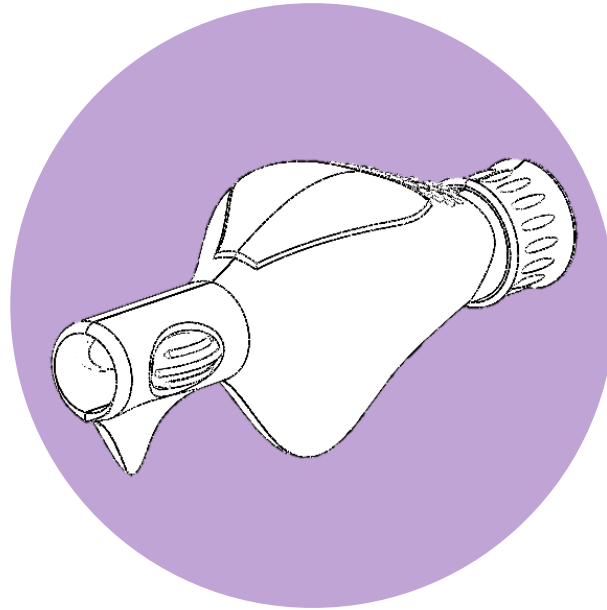
Any further comments?

Grip Weights

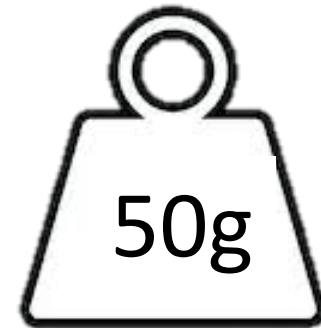
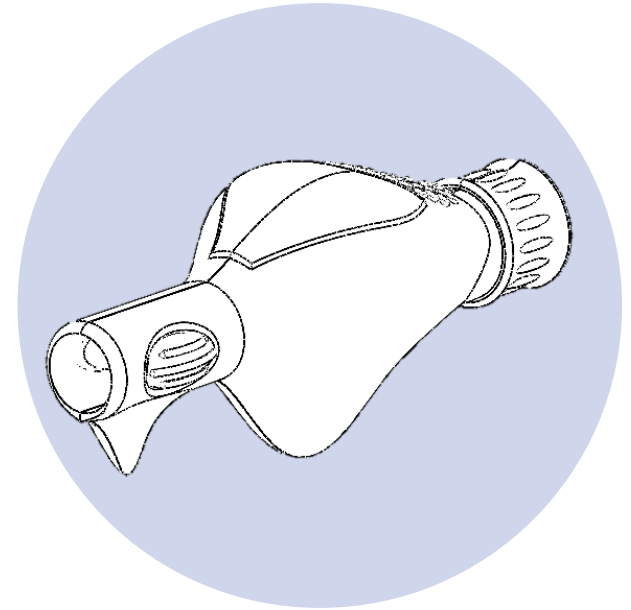
Grip 1



Grip 2



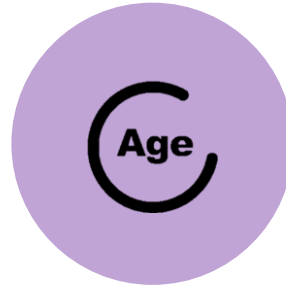
Grip 3



User 1



Female



16-20 years



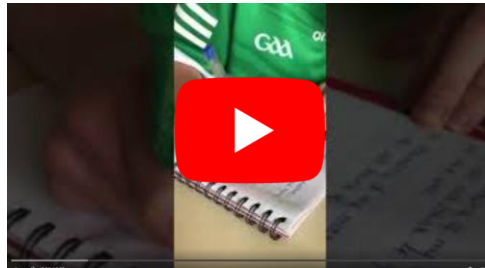
1st Year College

Grip 1



<https://youtu.be/d-anp0vThk4>

Grip 2



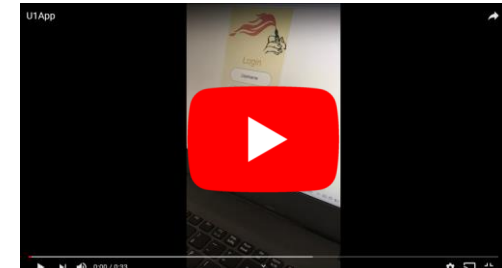
<https://youtu.be/Xn26Znv-Cv4>

Grip 3



<https://youtu.be/8WboKzplPbl>

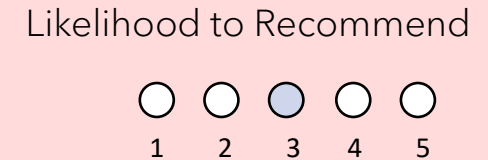
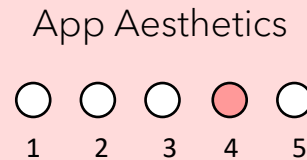
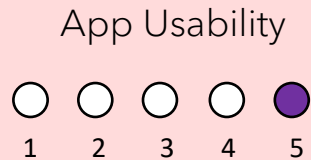
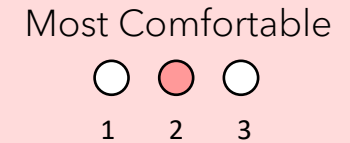
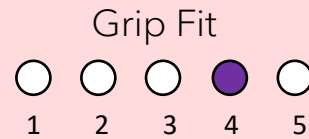
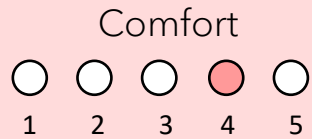
App



https://youtu.be/h_o617IUYWo

User 1 Testing Results

User 1



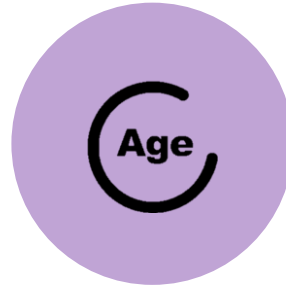
Comments:

- Right-handed user
- User 1 held the grip further down the curvature and did not seem to fit perfectly yet she gave a score of 4 in grip fit.
- This user did not use the dynamic tripod grip when writing with a regular pen. She commented that this grip would “force” you to use the correct grip.
- The although she felt “forced” to use a different grip compared to what she was used to, she still seemed to perform quite well and hand writing was neat.

User 2



Female



16-20 years



5th Year Post-Primary

Grip 1



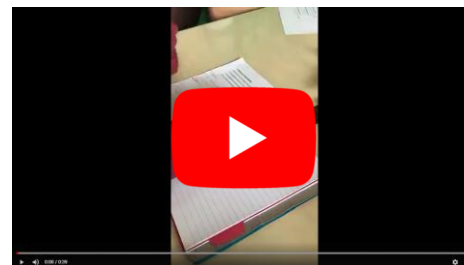
https://youtu.be/SIBtOa_BqR0

Grip 2



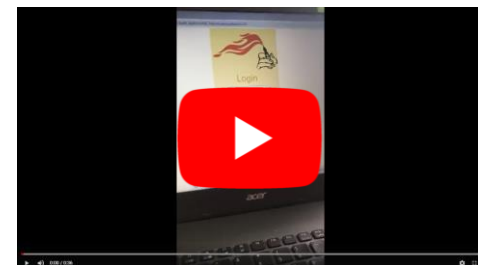
<https://youtu.be/81LzNW9aWeA>

Grip 3



<https://youtu.be/B1QSbqoJggE>

App

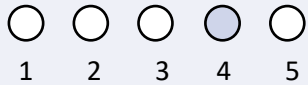


<https://youtu.be/vN2z1hSMfrQ>

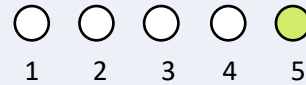
Testing Results

User 2

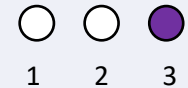
Comfort



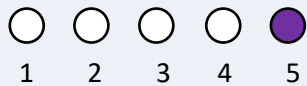
Grip Fit



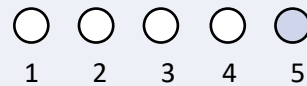
Most Comfortable



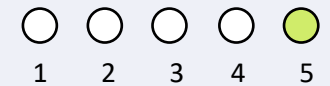
App Usability



App Aesthetics



Likelihood to Recommend



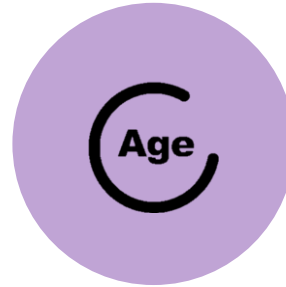
Comments:

- o Right-Handed user.
- o From comparing the results from the user questionnaire with the video analysis, the user had the correct grip and the pen fitted much better than user 1. This is reaffirmed by the user feedback when she gave the grip fit a score of 5.
- o This user felt that the pressure points made the grip a lot more comfortable to write with as opposed to a grip that with no pressure points.

User 3



Female



15-20 years



3rd Year Post-Primary

Grip 1



<https://youtu.be/6N-cVSsfWM0>

Grip 2



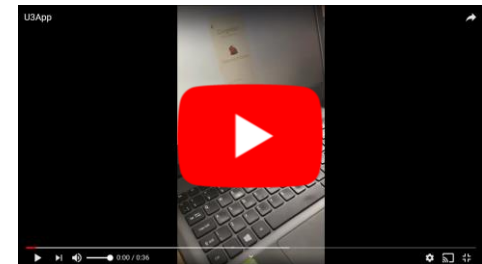
<https://youtu.be/uXexF9IAEHl>

Grip 3



<https://youtu.be/2XnRPWLASzE>

App



<https://youtu.be/wBgcvSsfAGM>

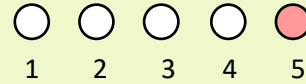
Testing Results

User 3

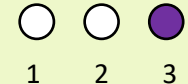
Comfort



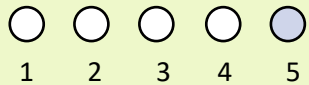
Grip Fit



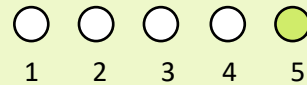
Most Comfortable



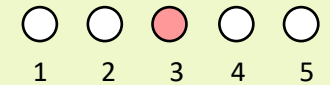
App Usability



App Aesthetics



Likelihood to Recommend



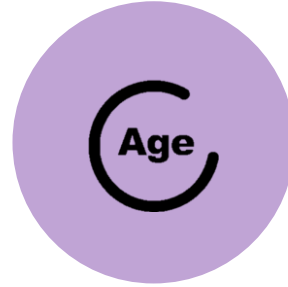
Comments:

- o Left-Handed User
- o This user did not use the pressure points on the pen for the tips of her index finger and thumb but instead she wrapped her thumb around the shaft of the pen.
- o She rated the comfort of the pen a score of 3 but this may be due to the choice of material from the 3D print.

User 4



Male



10-15 years



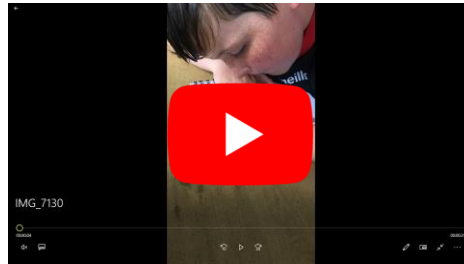
6th Class Primary

Grip 1



<https://youtu.be/1qouqu3OuQ4>

Grip 2



<https://youtu.be/68FiLn3vS6E>

Grip 3



<https://youtu.be/eDUhcF19vew>

App

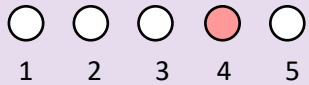


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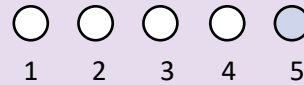
Testing Results

User 4

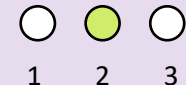
Comfort



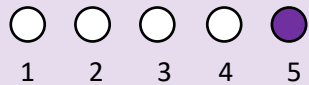
Grip Fit



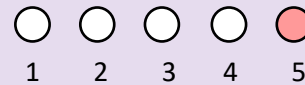
Most Comfortable



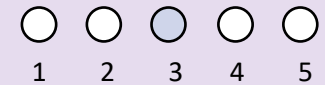
App Usability



App Aesthetics



Likelihood to Recommend



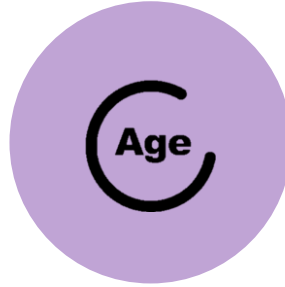
Comments:

- Left-Handed User
- The device seemed to fit well into the users hand and he gave the grip fit a score of 5 even though he is left handed. The device is suitable for both left and right hands.
- The user admitted they did not have the correct grip normally but felt they were able to use the correct grip after some practice with the device.

User 5



Male



5-10 years



Senior Infants
Class Primary

Grip 1



<https://youtu.be/HaaEpSpJgPo>

Grip 2



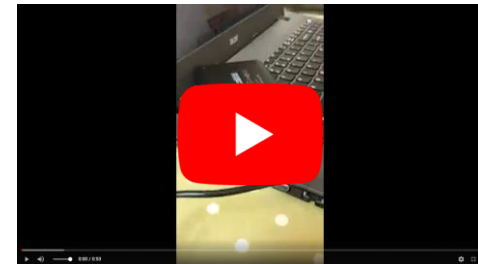
<https://youtu.be/vH6eSmQHPXc>

Grip 3



<https://youtu.be/TDdOefBhfaY>

App

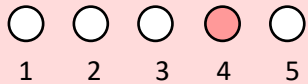


<https://youtu.be/NuckEAq4VMQ>

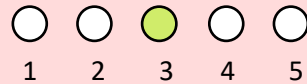
Testing Results

User 5

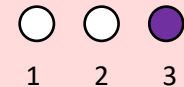
Comfort



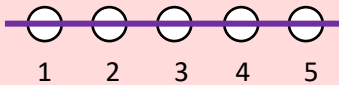
Grip Fit



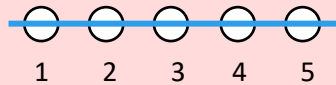
Most Comfortable



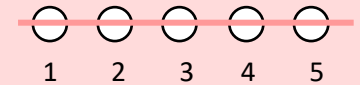
App Usability



App Aesthetics



Likelihood to Recommend



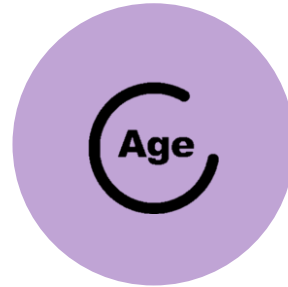
Comments:

- Right-handed user
- This user did not grip the pen in the correct orientation and was trying to manoeuvre it in his hand while he was writing.
- He performed much better with the grip when he was shown the correct orientation with the pen.
- This user is very young and did not have the digital literacy or the reading ability to use the app therefore it was not tested sufficiently. This app is designed for adolescents but it was deemed worthwhile to explore the possibility of younger individuals using the pen.

User 6



Male



5-10 years



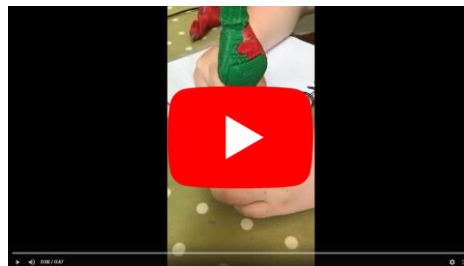
2nd Class Primary

Grip 1



<https://youtu.be/RhTzRVQ-Bw0>

Grip 2



<https://youtu.be/tlhKlfPYifw>

Grip 3



<https://youtu.be/m1ozcDqM2hM>

App

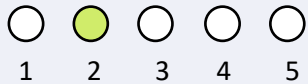


<https://youtu.be/VZw42thd2JM>

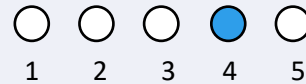
Testing Results

User 6

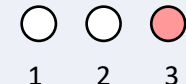
Comfort



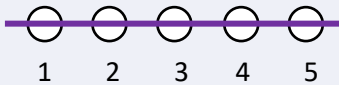
Grip Fit



Most Comfortable



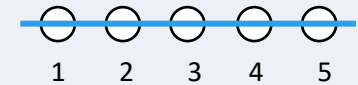
App Usability



App Aesthetics



Likelihood to Recommend



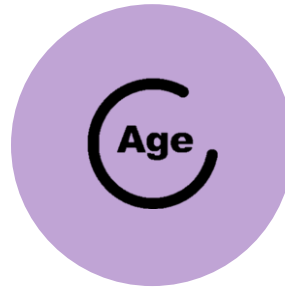
Comments:

- Right-handed user
- Although this user was also young, he is 2 years older than user 5 and this greatly benefitted him in using the pen. He had the correct grip in using the device without any advice/help.
- He held the device very vertical which made it difficult for him to see at times.
- This user is very young and did not have the digital literacy or the reading ability to use the app therefore it was not tested sufficiently. This app is designed for adolescents but it was deemed worthwhile to explore the possibility of younger individuals using the pen.

User 7



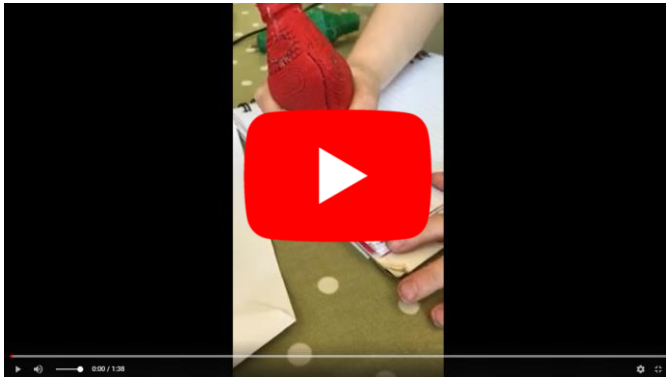
Female



5-10 years



Pre-School



<https://youtu.be/K7-JxHZPrKE>

Comments:

- Right-handed user
- I explored the possibility of using the grip to teach children of a pre-school age how to write with the correct grip.
- Although the user was moving outside the lines to write, she was able to write with the correct grip when shown.
- It is difficult to confirm that the grip would work for every individual when teaching them how to right, but the potential is there for it to work and is possibly worth further exploration.

Overall Findings from User Testing

- The grip is suitable for both left and right hands.
- All users picked the heavier grips which aligns with research on weighted pens (page 217).
- The grip encouraged users to use the dynamic tripod grip.
- The entire solution is only suitable for users from approximately 12 years of age as they would have more technology literacy.
- The grip has the potential to teach children how to use the dynamic tripod grip when learning how to write. More exploration is needed for this.
- The app is easy to navigate as users were able to perform functions easily.
- Users liked the aesthetics and colour schemes.
- The pressure points are essential for user comfort.
- The grip fits many different size hands.



- Evaluation using:
- Personas
 - Design Guide
 - Needs Statements

The Evaluation



Personas

Paul



Age: 14

Year: 2nd Year

Diagnosis: Autism

About Paul:

Paul is a quite boy. He keeps to himself but sometimes teachers notice that he would be looking around for some company. Unfortunately, Paul doesn't know how to approach people for conversation. Others find him a little bit "weird" so make very little effort with him. He has full access to the ASD unit so he receives help from support teachers in learning and acquiring these social skills.

He leaves the unit to join some mainstream classes but he is within the unit 40% of the time. Teaching staff fear that he may become overwhelmed by the volume of information to be learned so he engages in a shortened curriculum. He finds it difficult to communicate how he is feeling and when he doesn't understand something and becomes frustrated.

Simon



Age: 19

Year: 6th Year

Diagnosis: Asperger's Syndrome

About Simon:

Simon is a quite boy. He performs very well in school. He has a strong desire to be successful in education. He becomes very frustrated and overwhelmed when he can't understand something, if he has a lot of work to do or if he fails an exam. He requires a lot of structure to his day and does not take it well when surprises pop up. He doesn't communicate this with his teachers but they have observed these behaviours occasionally.

Simon doesn't like crowded corridors or loud noises and so spends much of his time in the ASD unit. As a result, he does not have many friends. Teachers are keen to get him integrating but he is reluctant to do so as he is fearful that he will say or do the wrong thing and his peers will see him as strange.

Paul and Simon's Evaluation



Paul

The app will help Paul address some of the daily social challenges he faces as it supports him in creating connections with others online which may transfer into the school environment. It will also create topics of conversation such as individual grip activity and app challenges for him to have with his peers.

Paul becomes overwhelmed in class due to the volume of school work he may have and leaves the mainstream class to get extra support. The textured surface on the grip can assist Paul in regulating his senses when he has high anxiety.

The capacity to share work and receive feedback via the app will provide extra support which will assist him academically and may make him feel more comfortable communicating with his teachers. The motivational messages on the grip will motivate and encourage Paul to engage with his work resulting in higher academic performance and achievement.



Simon

Simon becomes overwhelmed when he struggles to understand some concepts or topics. He will be able to communicate any difficulties and questions he has on the challenging concepts with his teachers via the app. The textured surface would help reduce his anxiety levels. The textured surface combined with communication via the app could result in higher engagement and higher academic performance due to his calmer mindset.

The app will help Simon to interact with others and build friendships with others through sharing activity and engaging in challenges. Simon may have more confidence in conversing with others when behind a screen as this will allow him to take the time to analyse the comment before he sends it. The use of emojis rather than comments in the challenges feature in the app reduces the risk of social embarrassment rather than having to construct a socially acceptable comment.

Personas

Katie



Age: 29

Profession: Special Needs Assistant

Years in her Position: 5 years

About Katie:

Katie is an SNA in her school where she is predominantly responsible for students with ASD. She knows a lot of these students very personally and they come to her when they need help. A lot of her students come to her when they feel overwhelmed from workload, sensory overload or just company. She encourages them to interact with their peers but they seem to feel more comfortable with her.

She sees many of her students when they have their meltdowns and how much of a toll it takes on them. They are physically tired after it and are embarrassed with the way they acted. She reassures them that they can't control their actions when they experience a meltdown but it doesn't seem to make a difference to them. She has concerns for their mental health.

John



Age: 16

Year: Transition Year

Persona Type: Neuro-Typical Student

About John:

John is a transition year student and is considered a popular student within the school. He is liked among his peers and is very outgoing.

John likes talking to people but doesn't know how to interact with the autistic students. He tries his best but finds them frustrating at times when they tell him how to act. Sometimes he finds that they make no sense in the conversation and he doesn't understand it.

When John is on his break from class, he wants to be able to relax with his friends and not feel uncomfortable at the risk of upsetting the students with ASD with something that he says.

Katie and John's Evaluation



Katie

This grip could provide some of the social supports required by Katie's students and reduce their dependency on her. This could be a useful resource for Katie when meeting the needs of the students in her care.

The app may make students feel more comfortable interacting with others on their own and this may reduce Katie's stress levels when trying to encourage her students to interact with others.

Katie can use the grip and its activity as a resource to reassure the students of their academic progression. It will allow her to monitor her students performance and support them in areas where they are struggling.



John

The app will provide an avenue for John to interact with students with ASD. He will be able to challenge his peers and it will make it less awkward for him to communicate. The use of emojis rather than comments will make it easier for them to communicate and understand each other.

John can be more confident while interacting with his peers with ASD without running the risk of upsetting them.

John can also use this app to improve his own academic performance by using it to store notes and share school work with his teachers.

Personas

Mr. Hayes



Age: 37

Years Teaching: 16 years

Subjects: Geography and History

About Mr. Hayes:

Mr. Hayes is an experienced teacher in History and Geography. He predominantly teaches mainstream classes where some students from the ASD unit participate. He also teaches some of these students one to one in the unit. He enjoys teaching them but sometimes finds it difficult to meet their needs. He finds it challenging trying to understand how they are feeling so he can approach them accordingly.

Mr. Hayes spends much of the class in mainstream with the student with ASD and the mainstream students are missing out as a result. He does not know how to deal with a student during a meltdown and seeks help from other teaching staff.

Mary Higgins



Age: 43

Relationship to the Student: Parent

Profession: Industrial Designer

About Mary:

Mary has a son in 2nd year of secondary school. She finds it difficult some mornings to convince her son to go to school as he is anxious about going into the unpredictable and crowded environment.

She often finds that her son is tired and exhausted when he returns from school and sometimes he can be very anxious. She has learned to leave him alone and give him time but it is upsetting for her as she feels she can't do anything for him.

She tries very hard to get her son involved in activities outside of school but he fails to make any close friends.

She gets upset as she sometimes doesn't understand how to help her son.

Mr. Hayes and Mary's Evaluation



Mr. Hayes

This grip can help Mr. Hayes monitor his students and support him in organising class activities for them. He will be able to monitor the activity of his students and how well they are engaging with the classwork he has set out.

The students will have the option to submit their work and receive feedback via the app. This will allow Mr. Hayes more time to teach his students during class time and provide feedback on their work outside of class time.

This solution will instil more confidence in teachers like Mr. Hayes as it will help them get a better understanding of all their students and provide them with more time in class to meet all their needs.















Mary Higgins

This solution would support Mary in encouraging her child with ASD to go to school. Her child may be more motivated to go to school to win challenges and improve on their daily grip activity.








The app will help her child to form friendships and reduce Mary's stress in assisting her son in forming friendships.

This solution would help Mary by observing the holistic development of her child giving her hope and encouragement for her child's future.






Needs Statements from Primary Research

Needs Statement	
There needs to be a method where students are able to explain how they are struggling	
There needs to be a way to assist students with integration at an earlier stage of secondary school	
There needs to be a way to support students and their social skills	
There is a need for people to recognise when a student with ASD wants to be left alone	
Students need to be protected from bullying	
There is a need to help students with ASD memorise topic information better	
There is a need to assist students in managing anxiety and frustration levels	
Solutions need to be affordable to schools so they can invest.	
There is a need to encourage communication and collaboration among teachers to understand and implement the best strategies to the best of their ability	
There's a need to incorporate Neuro-typical students into the unit to remove stigma and normalise it.	
There needs to be a way for students with ASD to feel more comfortable sharing their experiences with their peers.	
There needs to be a way for others to differentiate between a meltdown and a tantrum	

Must Have's Evaluation

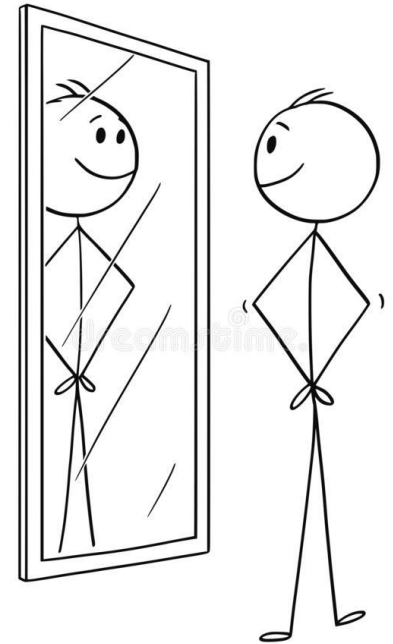
Must Have	Features	
The solution must improve the overall school experience of the student with ASD.	The device supports the student academically, socially and emotionally.	
The solution must address as much of the student's school life as possible.	The student can use the pen throughout the school day and at home when completing their homework.	
The solution must make the student feel more included.	The student may form friendships with peers through competition in various challenges.	
The solution must make the student feel safer within the school environment.	The student can regulate their senses when they have high anxiety levels using the textured surface and it will provide them with more confidence in the classroom.	
The solution must not cause any harm to the user or those around them.	The solution has been user tested and is deemed safe for use.	
The solution must be easily operated.	Once the grip is fitted to the pen, it is relatively easy to use. The user must use the pen the same as they would use any other.	
The device must be reusable.	The grip is rechargeable and can be used on a variety of different writing utensils.	

Nice to Have's Evaluation

Nice to Have	Features	
The design to be universal.	The device can be used by students with ASD and neuro-typical students	
It would be nice to have a solution that's subtle.	The device could fit into the users' pencil case.	
It would be nice for the solution to raise awareness of autism.	The device may make neurotypical students more aware of the characteristics of ASD and what people with ASD have to offer.	
It would be nice to design a solution that is sustainable.	The device can be recharged and reused.	
To keep the student with ASD in the classroom as often as possible.	The student will be able to regulate their senses thus reducing levels of anxiety. The teacher will also be able to meet the students needs easier as there would be more communication between both parties.	

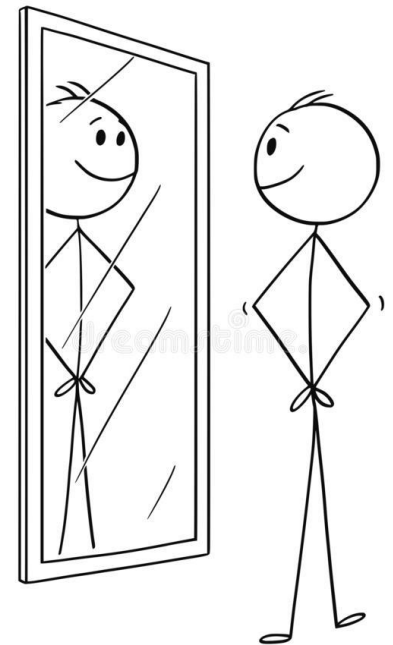
Reflection

- I found choosing the final concept to take forward very challenging and found it really beneficial to seek the opinion of experts in the field. While it was an overall positive experience, I found it difficult to receive some of the feedback at times as it affected my enthusiasm and morale after such effort was put into some of the ideas.
- I found the concept development to be the most exciting part of the project. I started out with what was to be a pen and through collaboration and discussion, it developed into a grip and progressed in a direction I never imagined that it would.
- The most challenging part of this project was trying to grip the pen. It was not until the final weeks did I realise that the mechanism would not work and so I felt really excited and determined to have a solution to the problem formulated before the deadline. It was unexpected problems like these that needed to be solved made the project most enjoyable for me.
- I felt that I explored information much more in this concept development than previous projects and feel I have learned much more about materials, manufacturing, assembly and other subject areas such as handwriting and motivation.
- This was quite a successful concept development for me. I feel exploration and keeping an open mind are key ingredients for this as the project can take on a journey of its own. At the beginning of this chapter I set out to design a motivational pen for students with ASD to improve engagement. At the end I have done so much more. I have a solution that encourages engagement but I have also learned about the importance of discussion, how to wireframe, how to deal with criticism, how to address setbacks, the importance of bringing the design back to the user and the importance of recognising feedback from users that they might not directly say.



Final Reflection

- This has been a most enjoyable project overall. I has taught me so much on researching literature, ethics, interviewing skills, presentation, sketching and prototyping. Collaboration was the main driver of this project and it was field experts and interview participants were the individuals who guided the overall journey of the solution.
- There were a rollercoaster of emotions experienced throughout the entire thesis. There was disappointment when receiving criticism from field experts, frustration when faced with setbacks, elation when a mechanism worked, pride when receiving positive feedback from users, intrigue when learning new manufacturing techniques and fear when the deadline was looming.
- The main point I will take away from this project is that a brief can take on a life of its own. At the beginning of this thesis, I could not have forseen that I would be designing a motivational pen that encouraged engagement at the beginning of concept development. From there, there was no way I could have predicted a grip and app that motivated students with ASD, supported them in creating friendships, improve their pen grip, support them in communicating with teachers, improve collaboration between teachers, reduce anxiety levels and remove stigma around individuals with ASD.
- While these are all positive, I am still aware that I need to improve on my interview skills, presentation and sketching skills.
- Overall it was a very worthwhile experience and a one that I really enjoyed and learned so much from.



Acknowledgements



Thank you to the participants and field experts who contributed so enormously to this project. Your honesty and willingness guided this solution to where it is now and certainly would not have reached this stage without your contribution.

Thank you to the lecturers of the MSc. in Design for Health and Wellbeing. Firstly, congratulations on such a successful first year of the course. It has been so engaging, enjoyable and practical and I wish ye all the best with it in the future. There is such a vast array of expertise on your team but your willingness to help and support is one characteristic ye have in common and it did not go unnoticed.

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References

- Cresswell, L., Hinch, R. and Cage, E. (2019) 'The experiences of peer relationships amongst autistic adolescents: A systematic review of the qualitative evidence', *Research in Autism Spectrum Disorders*, 61, 45-60.
- Pearson, A. (2004) 'Balancing the evidence: incorporating the synthesis of qualitative data into systematic reviews', *JBI reports*, 2(2), 45-64.
- Hughes, C., Schumaker, J., Deshler, D. and Mercer, C. (1988) 'Learning strategies curriculum: The test-taking strategy', *Lawrence, KS: Edge*. doi, 10, 106342669300100307.
- Songlee, D., Miller, S.P., Tincani, M., Sileo, N.M. and Perkins, P.G. (2008) 'Effects of test-taking strategy instruction on high-functioning adolescents with autism spectrum disorders', *Focus on Autism and Other Developmental Disabilities*, 23(4), 217-228.
- McKeithan, G.K. and Sabornie, E.J. (2020) 'Social-behavioural interventions for secondary-level students with high-functioning autism in public school settings: A meta-analysis', *Focus on Autism and Other Developmental Disabilities*, 35(3), 165-175.
- Carter, E.W., Asmus, J., Moss, C.K., Cooney, M., Weir, K., Vincent, L., Born, T., Hochman, J.M., Bottema-Beutel, K. and Fesperman, E. (2013) 'Peer network strategies to foster social connections among adolescents with and without severe disabilities', *Teaching exceptional children*, 46(2), 51-59.
- Sreckovic, M.A., Hume, K. and Able, H. (2017) 'Examining the efficacy of peer network interventions on the social interactions of high school students with autism spectrum disorder', *Journal of autism and developmental disorders*, 47(8), 2556-2574.
- Hebron, J.S. (2018) 'School connectedness and the primary to secondary school transition for young people with autism spectrum conditions', *British Journal of Educational Psychology*, 88(3), 396-409.
- Edgington, L., Hill, V. and Pellicano, E. (2016) 'The design and implementation of a CBT-based intervention for sensory processing difficulties in adolescents on the autism spectrum', *Research in developmental disabilities*, 59, 221-233.

Dunn, W. (1999) *Sensory profile*, Psychological Corporation San Antonio, TX.

Sreckovic, M.A., Brunsting, N.C. and Able, H. (2014) 'Victimization of students with autism spectrum disorder: A review of prevalence and risk factors', *Research in Autism Spectrum Disorders*, 8(9), 1155-1172.

Whitehouse, A.J., Durkin, K., Jaquet, E. and Ziatas, K. (2009) 'Friendship, loneliness and depression in adolescents with Asperger's Syndrome', *Journal of adolescence*, 32(2), 309-322.

Richard, J.F. and Schneider, B.H. (2005) 'Assessing friendship motivation during preadolescence and early adolescence', *The Journal of Early Adolescence*, 25(3), 367-385.

Parker, J.G. and Asher, S.R. (1993) 'Friendship and friendship quality in middle childhood: Links with peer group acceptance and feelings of loneliness and social dissatisfaction', *Developmental Psychology*, 29(4), 611.

De Jong-Gierveld, J. and Kamphuls, F. (1985) 'The development of a Rasch-type loneliness scale', *Applied psychological measurement*, 9(3), 289-299.

Hochhauser, M., Weiss, P. and Gal, E. (2015) 'Negotiation strategies of adolescents with high-functioning autism spectrum disorder during social conflicts', *Research in Autism Spectrum Disorders*, 10, 7-14.

Kimsey, W.D. and Fuller, R.M. (2003) 'Conflictalk: An instrument for measuring youth and adolescent conflict management message styles', *Conflict Resolution Quarterly*, 21(1), 69-78.

Nakkula, M. and Nikitopoulos, C. (1999) 'Scoring manual for the five factor negotiation scale', *Unpublished manual, Harvard University Graduate School of Education, Cambridge, MA*.

Reutebuch, C.K., El Zein, F., Kim, M.K., Weinberg, A.N. and Vaughn, S. (2015) 'Investigating a reading comprehension intervention for high school students with autism spectrum disorder: A pilot study', *Research in Autism Spectrum Disorders*, 9, 96-111.

Scott, F.J., Baron-Cohen, S., Bolton, P. and Brayne, C. (2002) 'The CAST (Childhood Asperger Syndrome Test) Preliminary development of a UK screen for mainstream primary-school-age children', *Autism*, 6(1), 9-31.

Weissman, M.M., Orvaschel, H. and Padian, N. (1980) 'Children's symptom and social functioning: Self-report scales', *Journal of Nervous and Mental Disorders*, 168(12), 736-740.

Daly, B.P., Shin, R.Q., Thakral, C., Selders, M. and Vera, E. (2009) 'School engagement among urban adolescents of color: Does perception of social support and neighborhood safety really matter?', *Journal of youth and adolescence*, 38(1), 63-74.

Wagner, M., Cadwallader, T.W., Garza, N. and Cameto, R. (2004) 'Social Activities of Youth with Disabilities. NLTS2 Data Brief. Volume 3, Issue 1', *National Center on Secondary Education and Transition, University of Minnesota (NCSET)*.

Whitehouse, A.J., Durkin, K., Jaquet, E. and Ziatas, K. (2009) 'Friendship, loneliness and depression in adolescents with Asperger's Syndrome', *Journal of adolescence*, 32(2), 309-322.

Bauminger, N., Shulman, C. and Agam, G. (2003) 'Peer interaction and loneliness in high-functioning children with autism', *Journal of autism and developmental disorders*, 33(5), 489-507.

White, S.W., Keonig, K. and Scahill, L. (2007) 'Social skills development in children with autism spectrum disorders: A review of the intervention research', *Journal of autism and developmental disorders*, 37(10), 1858-1868.

Laursen, B., Hartup, W.W. and Koplas, A.L. (1996) 'Towards understanding peer conflict', *Merrill-Palmer Quarterly* (1982-), 76-102.

spectrum disorder: A systematic review of the literature', *Education and Training in Autism and Developmental Disabilities*, 67-75. ⁴²¹

Cappadocia, M.C., Weiss, J.A. and Pepler, D. (2012) 'Bullying experiences among children and youth with autism spectrum disorders', *Journal of autism and developmental disorders*, 42(2), 266-277.

Carter, S. (2009) 'Bullying of students with Asperger syndrome', *Issues in comprehensive pediatric nursing*, 32(3), 145-154.

Hendricks, D.R. and Wehman, P. (2009) 'Transition from school to adulthood for youth with autism spectrum disorders: Review and recommendations', *Focus on Autism and Other Developmental Disabilities*, 24(2), 77-88.

Humphrey, N. and Symes, W. (2010) 'Responses to bullying and use of social support among pupils with autism spectrum disorders (ASDs) in mainstream schools: A qualitative study', *Journal of Research in Special Educational Needs*, 10(2), 82-90.

Gulec-Aslan, Y., Ozbey, F. and Yassibas, U. (2013) "' I Have Lived an Autism Experience. Autism Is an Interesting Disease": The Life Story of a Young Man with Autism', *International Education Studies*, 6(1), 74-84.

Penney, S.C. (2013) 'Qualitative investigation of school-related issues affecting individuals diagnosed with autism spectrum disorder and co-occurring anxiety and/or depression', *Autism Insights*, 2013(5), 75-91.

Saggers, B., Hwang, Y.-S. and Mercer, K. (2011) 'Your voice counts: Listening to the voice of high school students with autism spectrum disorder', *Australasian Journal of Special Education*, The, 35(2), 173-190.

Howe, F.E. and Stagg, S.D. (2016) 'How sensory experiences affect adolescents with an autistic spectrum condition within the classroom', *Journal of autism and developmental disorders*, 46(5), 1656-1668.

- Cowan, N. (2014) 'Working memory underpins cognitive development, learning, and education', *Educational psychology review*, 26(2), 197-223.
- Paas, F. and Ayres, P. (2014) 'Cognitive load theory: A broader view on the role of memory in learning and education', *Educational psychology review*, 26(2), 191-195.
- Zhang, H., Smith, M.R. and Witt, G.J. (2006) 'Identification of real-time diagnostic measures of visual distraction with an automatic eye-tracking system', *Human factors*, 48(4), 805-821.
- Chow, C.M., Ruhl, H. and Buhrmester, D. (2013) 'The mediating role of interpersonal competence between adolescents' empathy and friendship quality: A dyadic approach', *Journal of adolescence*, 36(1), 191-200.
- Scattone, D. and Mong, M. (2013) 'Cognitive behavior therapy in the treatment of anxiety for adolescents and adults with autism spectrum disorders', *Psychology in the Schools*, 50(9), 923-935.
- South, M. and Rodgers, J. (2017) 'Sensory, emotional and cognitive contributions to anxiety in autism spectrum disorders', *Frontiers in Human Neuroscience*, 11, 20.
- Nadeau, J., Sulkowski, M.L., Ung, D., Wood, J.J., Lewin, A.B., Murphy, T.K., May, J.E. and Storch, E.A. (2011) 'Treatment of comorbid anxiety and autism spectrum disorders', *Neuropsychiatry*, 1(6), 567.
- White, S.W., Oswald, D., Ollendick, T. and Scahill, L. (2009) 'Anxiety in children and adolescents with autism spectrum disorders', *Clinical psychology review*, 29(3), 216-229.
- Healy, S., Haegele, J.A., Grenier, M. and Garcia, J.M. (2017) 'Physical activity, screen-time behavior, and obesity among 13-year olds in Ireland with and without autism spectrum disorder', *Journal of autism and developmental disorders*, 47(1), 49-57.
- Parsons, S., Guldborg, K., MacLeod, A., Jones, G., Prunty, A. and Balfe, T. (2011) 'International review of the evidence on best practice in educational provision for children on the autism spectrum', *European Journal of Special Needs Education*, 26(1), 47-63.

- Afshar, M.A., Jafari, A., Heshmati, F., Movahedzadeh, F. and Cherif, A.H. (2019) 'Instructional strategies for motivating and engraining generation z students in their own learning process', *J. Education and Practice*, 10(3), 1-20.
- Gilman, R. and Anderman, E.M. (2006) 'The relationship between relative levels of motivation and intrapersonal, interpersonal, and academic functioning among older adolescents', *Journal of School Psychology*, 44(5), 375-391.
- Gottfried, A.E., Fleming, J.S. and Gottfried, A.W. (2001) 'Continuity of academic intrinsic motivation from childhood through late adolescence: A longitudinal study', *Journal of educational psychology*, 93(1), 3.
- Hennessey, B., Moran, S., Altringer, B. and Amabile, T.M. (2015) 'Extrinsic and intrinsic motivation', *Wiley encyclopedia of management*, 1-4.
- McGeown, S.P., Putwain, D., Simpson, E.G., Boffey, E., Markham, J. and Vince, A. (2014) 'Predictors of adolescents' academic motivation: Personality, self-efficacy and adolescents' characteristics', *Learning and Individual Differences*, 32, 278-286.
- Roddy, Á. and O'Neill, C. (2020) 'Predictors of unmet needs and family debt among children and adolescents with an autism spectrum disorder: Evidence from Ireland', *Health Policy*, 124(3), 317-325.
- Alsaker, F.D. and Kroger, J. (2020) 'Self-concept, self-esteem, and identity' in *Handbook of adolescent development* Psychology Press, 90-117.
- Compte, O. and Postlewaite, A. (2004) 'Confidence-enhanced performance', *American Economic Review*, 94(5), 1536-1557.
- Geiger, J.M., Cheung, J.R., Hanrahan, J.E., Lietz, C.A. and Carpenter, B.M. (2017) 'Increasing competency, self-confidence, and connectedness among foster care alumni entering a 4-year university: Findings from an early-start program', *Journal of Social Service Research*, 43(5), 566-579.
- Han, H.-C. (2015) 'Gamified pedagogy: From gaming theory to creating a self-motivated learning environment in studio art', *Studies in Art Education*, 56(3), 257-267.

- Öztürk, E.Ö. (2012) 'Contemporary motivation theories in educational psychology and language learning: An overview', *The International Journal of social sciences*, 3(1), 33-46.
- Park, D., Tsukayama, E., Yu, A. and Duckworth, A.L. (2020) 'The development of grit and growth mindset during adolescence', *Journal of Experimental Child Psychology*, 198, 104889.
- Perry, P. (2011) 'Concept analysis: Confidence/self-confidence', in *Nursing forum*, Wiley Online Library, 218-230.
- Pietrabissa, G., Manzoni, G.M., Corti, S., Vegliante, N., Molinari, E. and Castelnovo, G. (2012) 'Addressing motivation in globesity treatment: a new challenge for clinical psychology', *Frontiers in psychology*, 3, 317.
- Tomlinson, C.A., Brighton, C., Hertberg, H., Callahan, C.M., Moon, T.R., Brimijoin, K., Conover, L.A. and Reynolds, T. (2003) 'Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature', *Journal for the Education of the Gifted*, 27(2-3), 119-145.
- Ansong, D., Okumu, M., Bowen, G.L., Walker, A.M. and Eisensmith, S.R. (2017) 'The role of parent, classmate, and teacher support in student engagement: Evidence from Ghana', *International Journal of Educational Development*, 54, 51-58.
- Burkett, E. (2002) *Another planet: A year in the life of a suburban high school*, Harper Collins.
- Fredricks, J.A., Blumenfeld, P.C. and Paris, A.H. (2004) 'School engagement: Potential of the concept, state of the evidence', *Review of educational research*, 74(1), 59-109.
- Klem, A.M. and Connell, J.P. (2004) 'Relationships matter: Linking teacher support to student engagement and achievement', *Journal of school health*, 74, 262-273.

- Schaufeli, W.B., Salanova, M., González-Romá, V. and Bakker, A.B. (2002) 'The measurement of engagement and burnout: A two sample confirmatory factor analytic approach', *Journal of Happiness Studies*, 3(1), 71-92.
- Goonetilleke, R.S., Hoffmann, E.R. and Luximon, A. (2009) 'Effects of pen design on drawing and writing performance', *Applied ergonomics*, 40(2), 292-301.
- Hendricks, D. (2010) 'Employment and adults with autism spectrum disorders: Challenges and strategies for success', *Journal of Vocational Rehabilitation*, 32(2), 125-134.
- Voltz, D.L., Sims, M.J. and Nelson, B. (2010) *Connecting teachers, students, and standards: Strategies for success in diverse and inclusive classrooms: strategies for success in diverse and inclusive classrooms*, ASCD.
- Wu, F.-G. and Luo, S. (2006) 'Performance study on touch-pens size in three screen tasks', *Applied ergonomics*, 37(2), 149-158.
- Fuentes, C.T., Mostofsky, S.H. and Bastian, A.J. (2009) 'Children with autism show specific handwriting impairments', *Neurology*, 73(19), 1532-1537.
- Kushki, A., Chau, T. and Anagnostou, E. (2011) 'Handwriting difficulties in children with autism spectrum disorders: A scoping review', *Journal of autism and developmental disorders*, 41(12), 1706-1716.
- Lou, C.C. , (2005) 'A Study on the Usability of the Outline of a Stylus Cross-Section' TaTung University, Taipei, Taiwan
- Naus, J.M. (2000) 'Helping hands: A world of manipulatives to boost handwriting skills', *Teaching exceptional children*, 32(4), 64-70.
- Ren, X. and Zhou, X. (2011) 'An investigation of the usability of the stylus pen for various age groups on personal digital assistants', *Behaviour & Information Technology*, 30(6), 709-726.

Goodenow, C. (1993) 'The psychological sense of school membership among adolescents: Scale development and educational correlates', *Psychology in the Schools*, 30(1), 79-90.

https://themighty.com/2020/03/autism-spectrum-wheel/?utm_source=engagement_bar&utm_campaign=post_feed.story_card_full.mobile_fixed_engagement_bar&utm_medium=email

what it can actually look like:

what people think the autism spectrum looks like:

