Creative Design Activities Using Visual Communication to Support the Complex Learning Environment of the Classroom for Children with Autism

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Abstract

This PhD thesis presents a case study of children with autism and their teachers at UK primary School. There is a gap in social communication between children with autism and their teachers, which can lead to frustration for the children and significantly hinder the learning process. This PhD thesis applied qualitative research to collect and analyse data (observations, interviews, surveys, and photos of the artwork produced by children with autism) in the complex classroom setting to improve the quality of practice, focusing on adapting teaching styles to support the pupils' needs. The PhD thesis integrated the three key research elements of design thinking, participatory design, and art therapy to develop creative visual communication (2D/3D visual toolkits), which present and explain tasks in a manner that is more compatible with the learning style of children with autism. The visual toolkits aimed to break down lesson plans into more readily understandable components, translate tasks and worksheets into an immersive visual learning experience and employ a variety of visual aids. The visual toolkits employed proper imagery, textures, creative thinking, etc., to bring the lesson to life in a way which allows children with autism to actively engage with the material at hand whilst also ensuring that the visual and tactile experience was not overwhelming to the pupils. Children with autism experience a range of challenges with social communication, language skills, sensory issues, attention problems, executive functioning, and emotional regulation and these challenges often vary between children (e.g. autistic children have varying support needs). Such problems can result in communication problems between teachers and students. There is a growing challenge to meet the requirements of children with autism in school, considering the difficulties they face with some aspects of typical social interaction (e.g. maintaining eye contact, interpreting facial expressions and emotional signals), communication skills (verbal and non-verbal), and repetitive behaviours (e.g. hyper-fixation and a strong need for routine), as well as restricted and repetitive patterns of activities or interests since early childhood, and are often referred to art therapy sessions. Such difficulties require careful attention. One way to do this is to use an innovative design approach to support classroom learning, pivoting away from conventional teaching approaches to a new visual teaching style based on the development of creative visual communication. Hence, this PhD thesis aims to aid teachers (teachers working with special educational needs in general, and with autism in specific) in the adoption of these toolkits help children with autism to understand and take part in classroom activities more easily. The results of this PhD thesis confirmed that this learning approach could be useful as an additional tool to help teachers in supporting children with autism.

Chapter 1: Introduction

This chapter provides a concise synopsis of the overall structure of the thesis. It begins with a thesis overview, followed by the researcher's perspectives and statement, rationale, and research questions to be investigated, aims and objectives, and finally, outlines the research approach and the thesis organisation.

1.1 Overview

Autism spectrum disorder (hereafter autism) refers to a neurodevelopmental condition which manifests as a range of differences compared to the non-autistic population (Pfeiffer et al., 2011), resulting in challenges with communication and social skills. Autism impacts over half a million people in the UK (National Autistic Society, 2019) and is thought to affect 1-2% of individuals around the globe (Roman-Urrestarazu et al., 2021). Incidence rates of autism have been progressively increasing as awareness of the condition has increased. Autism is deemed a hidden disability, especially for those individuals who have low educational support needs (National Autistic Society, 2019). There are presently various educational, emotional, and medical interventions proposed to support autistic people (National Autistic Society, 2019). It is of note that these kinds of assistance are argued to offer the greatest benefit if they are utilised throughout childhood and if art and design activities are seen as an essential part of the intervention strategy (Goldsmith and LeBlanc, 2004).

According to the Australian Bureau of Statistics (2018), 40% of autistic students accessed special tuition, 32% had support from a counsellor or disability support person, and 28% did not receive any support (Australian Bureau of Statistics, 2018). Based on these statistics, autistic students currently require additional support to engage with and be successful at school because the existing educational system does not provide adequate support to nurture all students (Wei et al., 2014).

There are several kinds of intervention strategies with a range of different objectives, some emphasise certain behavioural problems, while others may be driven by features of autism and focus on the core challenges of the condition (Mesibov et al., 2007). As no single solution is proper and effective for all children, the choice of intervention types (e.g. medical-based, behavioural, communication-based, and educational-based interventions) relies on each child's specific requirements (National Autistic Society, 2019).

Educational-based interventions are vital for children with autism as they may have an imbalanced profile of knowledge and skills, being especially able in some areas and having struggles in others

(Milton, 2017). Hence, education is regarded as the most successful therapeutic approach for children with autism (Konstantinidis et al., 2009) and is realised as essential to allowing children with autism to live happy lives (Moore et al., 2000).

Autism influences how individuals observe and connect with others, often providing challenges regarding social skills, language difficulties, sensory issues, attention problems, executive functioning difficulties, and emotion dysregulation (Miller et al., 2019). Such problems require careful attention and the development of an innovative design approach to support learning in the classroom. Complementing the learning process with creative activities (such as using art therapy to facilitate problem-solving and decision-making) in the classroom provides an alternative medium of communication and expression for children with autism (especially useful for non-verbal students) and can help create an environment of controlled stimuli, helping to prevent children from becoming overwhelmed.

Design thinking and participatory design can be utilised to prove the best teaching and learning environment when taking an educational approach. Such design processes will allow for greater insight into the needs, interests and challenges of both students and teachers, as well as for the exploration of several tools and processes that can be used to improve outcomes in an educational setting (Fletcher-Watson et al., 2016). Though there have been studies involving children with autism fully in the design process, the literature remains limited. There remains a need to robustly develop methods that explicitly encourage the participation of children with autism in the design process and within a dedicated design team (e.g. researchers, children with autism, class teachers, and teaching assistants). This research will explore the complexities of the learning environment in the classroom setting in support of children with autism and their teachers. Such complexities include the lack of knowledge, experience, and training. As part of the methodological approach, this research will help teachers explore different learning strategies through creative toolkits to better understand and predict the needs of their pupils.

The overall aim of this research is to create an innovative approach (2D/3D toolkits- visual communication). The participatory design allows the active and productive participation of children with autism within the design process as part of a design team. This will be achieved by discovering ways to properly construct the design sessions and examining how to offer customised support for the children's needs, allowing them to fully engage and contribute as much as possible to the design process. For example, in this study, the researcher uses 2D/3D toolkits to provide opportunities

for children with autism to experiment with different creative tasks and learning techniques and enhance their well-being. They learn new skills such as problem-solving and decision-making, explore new textures and materials, and engage in activities based on their needs and interests. The toolkits provide children with autism with visual instructions, which are easier to understand than oral instructions. Also, the 2D/3D toolkits enhance the children with autism learning environment (learning new skills in separate ways), development (more easily understanding information and knowledge), and well-being (being happier and more relaxed). Finally, the toolkits play a vital role in the children with autism learning process in the classroom, offering a new solution to the challenges they face.

1.2 Researcher's Perspectives and Involvement in the Research Area

In this section, the researcher summarises the rationale behind choosing to investigate the integration of multi-disciplinary fields (e.g. design, art therapy, and education theory) and how such integration will lead to the creation of a new model of visual communication (2D/3D toolkits) to support children with autism and their teachers to communicate and work together in the complex learning environment of the classroom setting.

The opportunity to carry out research regarding the development of an empathetic learning environment for children with autism is especially attractive to the researcher who has a strong interest in the special educational needs (SEN) field. Before beginning this research, the researcher obtained her Bachelor of Fine Arts in Theatre Arts from the Academy of Arts, Egypt, in 1995. Followed by a Diploma in Interior Decorating from Thomson Education Direct, ICS, Canada, in 2004 and a Diploma in Supporting Teaching and Learning in Schools from Sunderland College, the UK, in 2013. Then, the researcher received her Master of Arts in Design from the University of Sunderland, the UK, in 2016. They were followed by a Diploma in The Complete SEND Diploma (levels 2,3&4), New Skills Academy, UK in 2019.

The researcher gained extensive work experience in the SEN field as she worked as a freelance artist/designer (in the education field). Her work has been seasoned by twenty-five years of experience moulded by her residence in various countries, including Egypt, Canada, Japan, and the UK. Such a melting pot of cultures proved to be a fruitful source of innovation. In addition, the researcher has participated in several national and international art workshops and exhibitions. It is worth mentioning that she has been travelling worldwide, and these experiences gave her many

chances to get involved in different research and scholarly activities and to share with others in their culture, which significantly affected her creative thinking ways.

The researcher's experience of working in primary schools around the world over the last 20 years has shown her the importance of teaching children how to communicate with other children of divergent backgrounds. These work experiences, combined with the educational background, support the researcher's work to implement three perspectives such as design, art therapy, and educational theory, to create a new solution for the problems facing children with autism and their teachers in the classroom setting, such as communication (Elmarakbi, 2016 and 2017; Maykut and Morehouse, 1994).

Children need to respect and trust each other and share their life experiences, culture (e.g. festivals, food, fashion, and songs), knowledge and understanding. In the researcher's opinion, such interactions and exchanges can be effectively mediated using visual communication (e.g. 2D/3D toolkits). This approach could be implemented in the learning and work environment in UK schools The researcher believes that creative activities can help children who may struggle with various mental health problems, learning disabilities and depression to communicate their needs more effectively.

The researcher planned to complete her work as an active contributor to the art and design field to support children with autism in their education and encourage the use of art and design to enhance social communication, social interaction, and creative thinking. The researcher aspired to utilise art and design as a catalyst in further understanding the perspectives of children with autism and, in turn, tailoring learning processes to their learning and development. Therefore, she was keen to take a significant step forward in her professional career by completing this PhD research to develop the necessary knowledge and skills, creating a suitable foundation of experience and knowledge to propel her future research.

The researcher has contributed to rigorous learning programmes for children with autism, which helped them gain experience in how social and physical environments affect the learning ability of children with autism. This research programme provided the researcher with a unique chance to examine this crucial area of research in more detail to build a comprehensive understanding of the communication barriers in the learning environment and the ability of children with autism to engage and progress. Even though the researcher is not a teacher, this work was carried out from an

educational standpoint to recognise the best approach to help children with autism participate as active learners. Furthermore, the researcher aspires to work in academia and with the public, supporting the wider community. Such an active position will help her create and implement new tools (such as visual communication) and literature into education systems, thus allowing her to remove barriers and enhance the educational environment of children with autism worldwide.

1.3 Rationale

This research places a solid emphasis on recognising aspects of the learning environment that affect the engagement of children with autism in learning. The motivation behind this research is the need to enhance the efficacy of the learning environment for children with autism using a novel teaching approach tailored to their unique learning requirements, considering the active learning methodology and all stakeholders (e.g. children with autism, teachers and teaching assistants) in the environment (Fromm et al., 2021; Fletcher-Watson et al., 2016).

The natural setting within the classroom environment available for this research offers the chance to carry out hands-on design, working together with children with autism, their teachers, and teaching assistants. This is especially attractive to the researcher who recognises the significance of their engagement as 'co-designers' to carry out the main aim of this research.

1.4 Research Questions

This research aims to discover the participation of children with autism in the design process, guided by the following two research questions, after reviewing relevant literature within the fields of autism and children's involvement in the design process:

1. Does an approach that integrates design thinking, art therapy, and educational theory deliver new forms of visual communication when applied to the challenges of complex classroom situations?

2. What form of design-based practice aids do teachers establish that is suitable for continual design and re-design of their classroom setting as a response to the complex needs of their pupils?

1.5 Research Aims

This research aims to investigate the integration of multi-disciplinary fields (design, art therapy, and education) and applications with children with autism to create a unified theoretical framework that shows the main challenges surrounding communication and interaction and other challenges facing

children with autism in complex classroom settings. It employs design thinking and participatory design play to tackle such challenges, adapting a coherent design-based practice in complex learning environments such as classroom settings. Within this design-based practice, a comprehensive case study will be developed to create a successful learning environment (Merriam, 1998) that helps children with autism to participate as active learners. Effective engagement is a key performance indicator (KPI) of learning. Children's engagement in the learning process has been highlighted as an essential factor in achieving effective learning environments for children with autism (Keen and Pennell, 2010; Carnahan et al., 2009; Ruble and Robson, 2007).

This research will develop a new model of design-based practice to enhance the social perception and communication skills of children with autism, address sensory-sensitive challenges, and support classroom teachers working with them. The model is conceptualised as a learning environment with design-based practice sessions and visual communication (e.g. engagement materials and practices) to aid teachers in making informed choices about the planning and implementation of learning experiences for this student group. The visual communication will consider the participation of stakeholders (e.g. children with autism, teachers, and teaching assistants) in the implementation process within the complex situation of the classroom.

The work plan and objectives will be designed and organised to adapt the approach of dedicated participatory design with the creative process to meet social challenges faced by children with autism and help them communicate effectively and enhance their thinking and imagination skills. Once the impact of integrating the creative design process into autistic learning is comprehended, established, and evaluated, the research will optimise the creative design process. (based on its initial implementation and evaluation outcome by tailoring the design activities to accommodate the children with autism needs and performance) to supplement the curriculum to support children with autism based on their needs and interests.

Many schools need to transform their approach to children with autism, shifting from standardised to personalised learning (Carroll et al., 2017). Visual communication could promote a solution to the misalignment of social skills, language difficulties, sensory issues, attention problems, executive functioning difficulties, and emotion dysregulation problems between children with autism and their teachers in school and at home. In addition, the developed visual communication will be a stepping stone to improving the engagement of children with autism in learning activities both in school and at home.

1.6 Research Objectives

To fulfil the aims and answer the research questions, the following objectives are identified:

1. Define the complex learning environment of the classroom with children with autism and investigate a design-based practice as a potential solution.

2. Determine the proper design-based practice interventions to be used in the classroom in collaboration with stakeholders (to become co-designers).

3. Create a model of creative co-design processes, such as models of visual communication- 2D/3D toolkits (as a tool for data collection, analysis, and interpretation), with a wide range of materials, techniques, and ideas to enhance behaviour challenges for children with autism in the complex classroom setting such as social skills, languages difficulties, sensory issues, attention problems, executive functioning difficulties, and emotion dysregulation.

4. Carry out a comprehensive explanatory case study, using design thinking, participatory design, and art therapy approach to create a productive learning and development environment (to understand children with autism's social and communication behaviour as well as their interactions with the educational-based interventions). Promote equality for children with autism to be fully engaged (using 2D/3D toolkits) in the learning environment within the classroom setting.

5. Conceptualise and engage with innovative design thinking ideas to aid teachers in making informed choices about the planning and implementation of learning experiences and in adopting more creative approaches (with the aid of the developed sessions and visual communication) to their teaching style in the classroom setting.

6. Study, reflect, analyse, and evaluate the impact of creative design process implementation in a complex learning environment on the learning and development of children with autism.

Hence, this research has three critical points to focus on during the participation of children with autism in the creative design activities in the classroom setting: i) kinds of design contribution they are capable of delivering; ii) levels of participation in the design process activities that they are competent to accomplish; iii) identification of their strength and aptitude to cooperate with others as a design team. Several research skills will be used to achieve these points, including interviews,

observations, workshop design, participant feedback, and output assessments. This follows the researcher's earlier work experiences with children with learning disabilities (such as dyslexia), who experience low self-esteem, concentration, imagination, and short-term memory.

The researcher studied the participation of children with dyslexia in creative activities for a full term (six weeks, children aged six to eight years old) in primary school and planned a series of design activities to support their learning, development, and well-being. The researcher also used art therapy as a method of expression of how they feel and who they are. Based on this study, the researcher noticed that their lives had been positively changed and that the children had an improved sense of their value in school and at home (Elmarakbi, 2017).

1.7 Thesis Outlines

The structure of the thesis is presented in six chapters. The literature review is presented in Chapter 2. The research method and design strategy will be presented in Chapter 3, followed by a comprehensive case study, results, and discussion in Chapter 4, followed by thematic analysis in Chapter 5, and finally, conclusions and future work will be presented in Chapter 6.

Chapter 2- Literature review: This Chapter presents a review of the literature in the areas of autism and discusses their relationship to the design process, focusing on social and communication challenges in classrooms, design thinking and participatory design, design thinking and innovation in organisations, social interactions modelling approaches, the effectiveness of creative arts therapy, and educational theory. The first outlines the autistic social communication challenges in classrooms (National Autistic Society, 2020; Schweizer et al., 2019; Elkins and Deaver, 2015). Then, focus on design thinking and participatory design (Fabri et al., 2016; Brown, 2009; Sanders and Stappers, 2008), design thinking and innovation in organisations (Tonkinwise, 2014 and 2011; Kimbell, 2011 and 2012), social interactions modelling approaches (Santos et al. 2021; Hanley et al., 2020), the effectiveness of creative arts therapy (Schweizer et al., 2019; Lee and Liu, 2016; Pfeiffer et al., 2011), and educational theory (Tu et al., 2021; Asbury et al., 2021; Arseven, 2014). Also, the literature review recognises the many challenges faced by children with autism and presents a full understanding of the body of knowledge and current thinking approaches to be implemented in this research. In addition, it also emphasises the benefits of design process engagement within educational interventions and identifies the Autism-specific challenges that may affect the further involvement of children with autism using a participatory design approach.

Chapter 3- Methodology: This chapter defines the theoretical underpinnings of the research and explains the research design process and how it will be performed. This chapter holds important discussions of the research and epistemological positioning. The theoretical framework is also presented, as well as a description of the research model. This chapter also emphasises the importance of design in a complex context as the design-led approach is a unique contribution to knowledge. The case study design; recruitment and selection of participants; and methods for data gathering, analysis, and reporting are also presented. In addition, the standards and principles of reliability and validity as well as ethical consideration are provided.

Chapter 4- Results, discussion, and interpretation of the data: This chapter presents the outcomes of the case study within the school setting, evaluating the children with autism engagement with the learning materials, communication with teachers, and overall performance in the complex classroom environment. This chapter also discusses the added value of the developed design process and toolkits on the children's engagement, from the underlying theory to the final investigation using the developed method. In addition, this chapter presents formative discussions of the crucial findings and contributions to the knowledge and proposes solutions to fill the gap and address problems identified by the literature review using these findings.

Chapter 5- Thematic analysis and discussion: This chapter holds important discussions of the research findings, using evidence from data collected from observations, interviews, questionnaires, and feedback. Additionally, this chapter presents formative discussions of the crucial findings and contributions to the knowledge and will propose solutions to fill the gap and address problems identified by the literature review, using these findings.

Chapter 6- Conclusions, recommendation, and future work: This chapter concludes the research, summarising the main contributions, key outcomes, advantages, and limitations. It also suggests further work regarding the complex learning environment and special educational needs provision that could be carried out in the future. It is expected that class teachers and educators can apply the outcomes and conclusions proved in this work to enhance the social communication and learning skills of children with autism.

Chapter 2: Literature Review

This Chapter presents a review of the literature in the areas of autism and discusses their relationship to the design process, focusing on social and communication challenges in classrooms, design thinking and participatory design, design thinking and innovation in organisations, social interactions modelling approaches, the effectiveness of creative arts therapy, and educational theory.

2.1 Autism and Social Communication Challenges in Classrooms

Autism spectrum disorder (hereafter autism), as described by the National Autistic Society, is a "lifelong developmental disability that affects the way a person communicates and relates to others" (National Autistic Society, 2020). There are around 700,000 autistic people in the UK (1 in 100 presentations in the population), with the condition consistently being diagnosed more in boys (4) than girls (1) before the age of three years old. If families are also included, then autism is a part of the daily life of approximately 2.8 million people in the UK (National Autistic Society, 2019).
Autism tends to be characterised by differences in social communication, and the presence of restricted or repetitive behaviours (APA, 2013). Autistic people can also appear to have problems with sensory-motor functions, and differences in relations, and communication (McPartland and Volkmar, 2012).

Autism is associated with repetitive behaviours, social skills differences, language difficulties, sensory issues, differences in attention, and emotion dysregulation as well as executive functioning difficulties, which affect how information is processed (Fabri et al., 2016; American Psychiatric Association, 2013). Despite these difficulties, children with autism have a satisfactory level of ability to think logically, identify errors, and implement some alternative problem-solving approaches (Grant and Davis, 2009; Lorenz and Heinitz, 2014). In addition, some research has shown that they also have perceptual and intellectual strengths, inspired by special reasoning skills (Meilleur et al., 2015; Simard et al., 2015).

The theory of the double empathy problem (Milton et al. 2022) suggests that the struggles autistic people face regarding social interaction and communication are due to a mutual lack of understanding between autistic and non-autistic people. This theory shifts the long-standing view that the social impairments of autistic people are solely responsible for communication issues with non-autistic people. This theory proposes that the ability of people to empathise with each other is inhibited when their experiences and perspectives of the world are significantly different. It can be

difficult for non-autistic people to interpret autistic people's emotions (Sheppard et al. 2016) and comprehend the separate ways autistic people understand and experience the world due to cognitive sensory differences. The tendency of non-autistic people to form negative first impressions of autistic people (Sasson et al. 2017) is another contributing factor to the lack of understanding. Though the theory of the double empathy problem was originally developed through a mixture of personal experience and partial qualitative data, it has since been investigated in several research projects within different fields for example, Design (Gaudion et al., 2014), Philosophy (Chapman, 2019), and Psychology (Chen et al., 2021; Crompton et al., 2020; Sheppard et al., 2016).

There is a growing need to meet the requirements of children with autism in schools. The current school environment is challenging for children with autism who have differences and difficulties with communication skills and social interaction (Saggers et al., 2015). For instance, children with autism often have difficulties with typically expected social interaction (such as eye contact, facial expression, and emotional signals), communication skills (such as verbal and non-verbal), and repetitive behaviours (such as an excessive focus on parts or pieces, rocking, and need for routines) as well as often displaying restricted and repetitive patterns of activities or interests since early childhood, which limit and impair everyday functioning, and are often referred to art therapy (National Autistic Society, 2020; Schweizer et al., 2019; Elkins and Deaver, 2015). Additionally, children with autism can be distracted easily by light, sound, and even changes in seating arrangements. They can also be easily confused and stressed if there are disruptions in their daily routines or the environment that they are accustomed to. On the other hand, teachers also face this challenging environment, as they, in most cases, support the learning needs of children with and without autism with varied learning needs (Macdonald et al., 2017), without being provided with sufficient training or the necessary resources.

Murray et al. (2005) developed the theory of monotropism and considered it to be the basis of autistic cognition. Monotropism describes the tendency of autistic people to develop fewer interests than most but with greater intensity, channelling most of their attention into such interests and thus excluding other cognitive processes and tasks, including social interaction (Murray et al. 2005). However, monotropism does not view the distribution of attention demonstrated by autistic people as a deficit, rather it implies that this can be viewed as a positive feature of autism (Wood, 2021). If autism and monotropism are linked (Milton 2017), there are hypothetically significant implications for children with autism in schools (Wood, 2021).

The involvement of children with autism in creating methods and tools for their learning is vital. The co-designer is significant for evolving credible approaches and offering a means to address the double empathy problem (Hummerstone and Parsons, 2023). The engagement of children with autism remains largely disregarded and overlooked due to the general assumption that they are hard to engage with because of communication difficulties (Cascio et al., 2021). Hence, researchers need to prove proper methods and tools as well as participatory design approaches for facilitating participation and respecting various communication preferences (Parsons et al. 2020). It is also important to note that parents and teachers who interact with and understand children with autism are invaluable sources of information and can facilitate participation with important roles in development (Ellis 2017). The resulting complex problems can then be addressed using the creative design process (e.g. visual toolkit) with a wide range of materials, techniques, and ideas to support children with autism and their teachers in enhancing poor social skills, language difficulties, sensory issues, attention problems, executive functioning difficulties, and emotion dysregulation.

2.2 Design Thinking and Participatory Design

Design thinking and participatory design play a significant role in facing challenges in complex situations (such as classroom settings) (Fabri et al., 2016) and consider the multitude of factors that make up the complex classroom environment rather than tackling one single issue. The input of teachers, students, and parents will be considered throughout the design process, helping to ensure that the proposed learning and teaching methods are useful and realistic. By involving the active participation of end users and focusing less on assumptions, the outcome is more likely to work long-term and less likely to meet resistance from any of the involved parties. Participatory design is especially important as change can be overwhelming for children with autism, so involving them in decisions guiding the change in their routines and learning environment is important (Sanders et al. 2010).

The design supports current autism research activities by concentrating on not only people (children with autism and teachers) but also the surrounding environment in which they live and learn (Dargue et al., 2022; Karimi et al., 2017; Gaudion et al., 2015). The participatory design literature focuses on sufficiently fulfilling the requirements of people who have learning difficulties and communication problems and have difficulties in using products and/ or learning tools (Coon and Watson, 2013). There has been greater acceptance of the participatory design process and design thinking approach in several fields (such as education, health, business) (Withell and Heigh, 2013).

On the one hand, the design thinking approach requires further work to bridge the gap between research and practice in complex classroom settings, incorporating the participation of stakeholders (e.g. children with autism, teachers and teaching assistants) in the design process (Dykstra et al., 2015; Kasari and Smith 2013; Dingfelder and Mandell 2011; Nastasi et al. 2000). On the other hand, participatory design involves stakeholders in the design process and focuses on the design process to create responsive environments, which are proper to the end user's needs (Macdonald et al., 2017).

In addition, design thinking methods involve end-users in the design process (e.g. interviews, prototype, testing and evaluation) to gain a deep understanding of user problems and needs (Maguire, 2001). Participatory design not only considers the user as a resource of information and assessor of the final product but also as a main contributor to the design process (Sanders and Stappers, 2008). Several studies of participatory design have focused on the needs and requirements of children (Börjesson et al., 2015) and young people (Fabri and Andrews, 2016). Children can be the main source of information or act as design partners (Druin, 2002), with teachers and parents appearing as experts (Börjesson et al., 2015).

2.2.1 Design Thinking

Design thinking is based on a comprehensive - iteration process that focuses on the user's "human" needs and problems to identify and produce a practical solution. According to Brown, "a successful design outcome exists at the intersection of three concerns: what is desirable from the users' perspective, what is technically feasible, and what is commercially viable for the organisation" (Brown, 2009).

Design thinking is devoted to clearly understanding the major problems and challenges that face the users, redefining such problems and assumptions, creating novel and innovative solutions, prototyping such solutions, and then testing and confirming them. It is an iterative process, and it goes through several cycles of building, confirming, and optimising towards a final and sustainable solution which fulfils the users' major needs. Using design thinking approaches usually leads to a new tool and method that can help develop radical and sustainable solutions for associated problems (e.g. social and communication behaviours, lack of engagement, sensory issues, and attention problems).

The design thinking approach is used in collaborative and professional education and practice to involve knowledgeable users in tackling complex problems (Pope et al., 2020). The design thinking innovation method is well established in the product development practice processes and services focusing on the users' requirements and needs (Brown et al., 2008). It is important to get the end-users involved in the development and design process early to help them gain a full understanding of the problems and needs (Brenner et al., 2016).

Design thinking also focuses on developing users' creativity and self-confidence (Carroll et al., 2010). It includes various stages of building empathy and a full understanding of the users' needs and links it to a product that is developed (Lunch and Koningstein, 2017). Users are usually involved in projects which create empathy and promote ideation to actively solve complex problems. Design thinking has gained recognition and is seen as an exciting problem-solving method in several fields, including health, design, education, and business (Santos et al., 2017; Lunch and Koningstein, 2017; Stephens and Boland, 2014; Withell and Heigh, 2013). It supports the engagement of designers in the project from the beginning (Behrendorff et al., 2011) and supports the persisting debate that by merging creativity and analytical processes with compassion, real innovation can be implemented in the problem-solving process (Fabri et al., 2016). Design thinking generates new ways to facilitate the collaborations between the end-users and the designers from the beginning of the project (Brown, 2008). Designers can add value to potential end-user experiences, by considering the main requirements of the potential design solution and its benefits to the end-users (Verganti 2008; Behrendorff et al., 2011).

In other words, design thinking is a solution-centred approach to tackling impossible problems (Lawson, 2006). It combines an advanced human-centred method (Brown and Wyatt, 2010) that combines empathy with logic and creativity as well as experimentation to solve complex problems (Melles et al., 2012). Design thinking has progressively evolved from varying design approaches across a range of unique design fields to be used as a tool to improve creativity across various sectors (Dorst, 2011) (e.g. project management (Dijksterhuis and Silvius, 2017), planning and development (Mintrom and Luetjens, 2016)). Design thinking also links cross-disciplinary systems, promoting end-users and policymakers to collaboratively work in an interactive way, which has the potential to improve problem definition and fill the gap between communities and policymakers (Mintrom and Luetjens, 2016).

Furthermore, the term design thinking has become important over the past ten years and emphasises the processes of learning, teaching, and employing innovative ways to solve challenging problems (Badke-Schaub et al., 2010; Cross, 2010; Dorst, 2010; Tonkinwise, 2010). Design thinking is about how designers think and act to create the problem-solving process which itself shapes the solution, which will stimulate and involve users and stakeholders in design-based practice. Also, the designer brings a creative way of looking at the problems and finding innovative solutions (Blyth, S. and Kimbell, L., 2011). On the other hand, designers are working based on what end-users "need", such as they are expected to do this by using ethnographically inspired techniques that help them understand the user's perspectives and situated actions.

It is important to clarify which type of "design" we are referring to. It is referred to as "co-design" when considering problem-based or solution-oriented design practices and their multidisciplinary nature, whilst it is "diffuse design" when debating the importance of distribution design abilities among diverse stakeholders (as occurs in discussion on design thinking). In addition, it is referred to as "expert design" when considering certain design skills (Manzinin, 2016).

Notwithstanding the obvious omnipresence of design thinking it lacks an acceptable definition. This has led to confusion, reduction of design thinking, and restriction of the possibility of designing and the purpose it pursues to carry out creative results. Tuckwell (2017) focused on outlining design thinking models to help establish the role of design thinking in expanding multidisciplinary practices. Design thinking offered a chance for designers to broaden their capabilities, aiding the definition of evolving design practices when adopted with greater critical analysis. However, design thinking continued to be utilised with insufficient critique or appraisal. A conceptual interpretation of design practice modes will add to our knowledge of emergent design practices, enhance our appraisal of design thinking, and provide a clearer and more sustainable purpose of the design thinking term and meaning for design's future.

Pedagogical strategies have been the core of researchers' discussion to encourage design thinking as a valuable skill that allows users to solve their complex problems (e.g. de Figueiredo, 2020; Linton and Klinton, 2019; Razzouk and Shute, 2012; Scheer et al., 2012). However, design thinking has also been presented as a robust research method for design-based work (Dolak et al., 2013; Devitt and Robbins, 2012). Design thinking is proper for problems (e.g., teaching and learning with emerging technologies) which need stakeholder empathy, understanding, and creativity to bring radical innovations (Fromm et al., 2021).

Recently, physical environment design has been considered by several researchers, as a key point of interference for children with autism, to enhance the design of outdoor spaces (Gaudion and McGinley, 2012), living accommodations (Kanakri, 2013), and schools (Beaver, 2011). Notwithstanding this evolving field, some of these studies focused only on the design outputs and final products. There was little emphasis on the development of learning environment tools to encourage both children and teachers to participate in the design process of how the final products evolved. Therefore, this research will pay particular attention to the evolution of the outcome and the understanding of variations in different classroom settings, as well as notice patterns, themes, recurring problems, and preferences. For example, children with autism often face challenges regarding typical social interaction (e.g. keeping eye contact, interpreting facial expressions and emotional signals) and communication skills (verbal and non-verbal). Engagement in repetitive behaviours (e.g. hyper-fixation and a strong need for routine) and restricted and repetitive patterns of activities or interests since early childhood are also commonly observed traits. Such problems, and subsequent feelings of frustration, discomfort, and inadequacy, can significantly hinder the learning process and require careful attention. A novel solution is necessary to support the educational experience of children with autism. As such, this study provides 2D/3D visual toolkits which aim to break down lesson plans into more readily understandable components and translate tasks and worksheets into an immersive learning experience, employing a variety of visual aids. Vibrant and interesting imagery, puzzles, textures, etc. are used to bring the lesson to life in a way which allows children with autism to actively engage with the material at hand, whilst also ensuring that the visual and tactile experience is not overwhelming to the pupils.

2.2.2 Participatory Design Research

Participatory design was initiated in Scandinavia in the 70s and 80s, evolving from trade union activities which involved labour into system development in the workplace. Participatory design has been universally used, since then, within the design field and has been applied in settings spanning from the communities' redesign (e.g. Condon, 2008) to IT systems (Bødker et al., 2004). Spinuzzi (2005) defined participatory design as a method to comprehend knowledge by performing everyday activities and contended that participatory design is always research, though it was not clearly outlined as such. Sanders and Stappers (2008) referred to participatory design as co-design and co-creation and widened the idea of co-design, defining it as a collective approach in the design development process (e.g. close partnership between designers and participants, seeking robust ways of involving different stakeholders in the design process). Sanders et al. (2010) established a framework that delivered an outline of techniques and tools to support designers in involving non-

designers within the educational context. The techniques and tools were created based on the principle that people's experiences were accessed through what they can make and say and how they can act.

In other words, participatory design is a conventional way to involve children in the design process. For instance, children's participatory positions as design partners from brainstorming to prototyping to final assessment stages have been intensively studied (Gennari et al., 2017; Hall et al., 2015; Khaled and Vasalou, 2014; Read et al., 2013 and 2015; Druin, 2002). Participatory design techniques are usually entertaining for children, nevertheless, ahead of partaking in a fun event, the participatory design offers partial benefits to the child (Paracha et al., 2019). Although participatory design is regularly carried out in complex classroom situations, the effects of participation on children's learning development have not received great consideration, apart from gaining design skills via prototyping activities. It is important to focus on the value the children will gain rather than considering them as a mechanism to only inform designers (Paracha et al., 2019). Also, according to (Read et al., 2014), the participatory design was identified as "the involvement of end-users as informants in the design of technology" while (Dearden and Rizvi, 2008) underlined the importance of involvement "going beyond simply engaging people as informants in design".

Implementing participatory design approaches with children in both ideation and pre-build stages is of benefit to them despite the concerns about their abilities to engage (Sim et al., 2016; Khaled and Vasalou, 2014). As a collaborative approach, participatory design enables users to influence design decisions (Sim et al., 2016). The participatory design also allows end-users and designers to work together to deliver design ideas for a specific problem. It is a well-established user-centred design method often used with children with autism. Nevertheless, carelessness towards stakeholders and user experience of the real design approach is the main disadvantage of the participatory design method (Paracha et al., 2019), compared to design thinking, which encourages the user to think, using suitable techniques to solve problems and involves thinking about the users themselves. It is not only providing the solution to one problem but also a tool to tackle other challenges (Paracha et al., 2019).

With the design for developmentally diverse children, participatory design has made important practical impacts by examining what forms children's participation in the design process may take (Vasalou et al., 2021). With developmentally diverse children, research has suggested that technologies have been developed to support children's functional skills (Benton and Johnson, 2015).

Most of the work approached technology to teach specific skills that the children needed the most (e.g. motion games for social initiation skills of children with autism, (Malinverni et al., 2014)).

Participatory approaches to technology design have also appeared as participatory design allows end-users to be energetically involved in the decision-making and design process (Benton and Johnson, 2015). The involvement of children with autism in the technology design process can be complex due to the need for more support during the design process and hence, they have had limited opportunities to influence technology design (Benton and Johnson, 2015). Participatory design is a collaborative process by nature, and both end-users and designers are working together and contributing their ability. Hence, the final product design will bring together the ability of the end-users on the technology requirements and the ability of the designers on achieving those requirements within decisions made with the contribution of participants (Hussain, 2010).

Several research works have considered the involvement of children with autism in the technology design process in educational technology (e.g., creative play and expression (Durrant et al., 2013; Hourcade et al., 2012), literacy and language (Benton et al., 2014; van Rijn, 2012), emotions and social skills (Frauenberger et al., 2015; Malinverni et al., 2014), and educational software tools (Culén et al., 2013; López-Mencía et al., 2010). Participatory design has a clear impact on child participants and offers benefits through the mutual learning process, which is known as 'user gains' (Bossen et al., 2012). Researchers have also emphasised the significance of studying the impact on child participants in the technology design process (Guha et al., 2010). When considering the advantages of participation, the role performed by the child in the technology design process will have some effects, however measuring these advantages and evidence of impacts gathered to date is limited (Benton and Johnson, 2015).

Permitting children with autism greater participation in the design process through the use of participatory design presents huge benefits to the participant (e.g. providing the participants with a sense of ownership and empowerment over the system; enhancing their incentive to use the final product at the end of the design process; delivering instant feedback to enhance their engagement; developing new skills and enhancing their perceptions of the final design) (Bossen et al., 2012). These benefits may show the participant's achievements from both the enhanced production of the design process and the real participation in the design process (Vines et al., 2012). Guha et al. (2010) underlined the importance of studying the impact on children with autism who participate in the design process using qualitative approaches and linked to the level of their participation in the design

process (e.g. less involvement led to a slight impact on the final output and fewer feelings of ownership and empowerment over the system).

Hussain (2010) identified participatory design development with children with autism as a partnership with them surrounded by their natural environment to create design ideas and offer real opportunities to affect design choices. Guha et al. (2010) also suggested several techniques to investigate benefits to children with autism (e.g. questionnaires, interviews, case studies) to measure their creativity skills and identify if partaking in the participatory design sessions has positive impacts on the children. These methods can be strengthened by involving different stakeholders (e.g. children with autism, teachers, teaching assistants and researchers).

The benefits of using design thinking and participatory design together to support children with autism and their teachers in the classroom setting. For example, the use of design thinking will enhance children with autism problem-solving skills, memory skills, concentration, visual attention, and decision-making. On the other hand, the use of participatory design will enhance stakeholder's engagement, values opinions, and perspectives. In addition, exchange of knowlend information between teachers, researchers, and work co-designers.

2.3 Design Thinking and Innovation in Organisations

Addressing the complex classroom situation in schools requires consideration of how children with autism interact with their environment, process information, communicate with peers and teachers, and how the curriculum can be delivered in an accommodating manner. Knowledge of the specific barriers faced by teachers in terms of understanding and accommodating their students' needs is also imperative. Design thinking will allow for such knowledge to be gained and thus help ensure the successful implementation of new creative learning methods in classrooms.

The present trend for design in organisations (e.g. schools) addresses results in concepts of the design process that suppress the role of artistic judgments. It was debated that the promotion of design thinking replicated a trend in design thinking research to soften the importance of aesthetic design. Designing is a present economic influence when it is explicitly designed via practical patterns, as evidenced by persona-based design (Tonkinwise, 2011). In addition, Tonkinwise (2014) highlighted design thinking as a prompt to identify the nature of design studies. Considering brainstorming, strategic planning, and decision-making and utilising a SWOT (strengths, weaknesses, opportunities, and threats) analysis, it was debated that current changes in cultural theory about material practices

provide opportunities for design studies to grow beyond a broad moderate arts enhancement to the education of designers. However, design studies faced challenges from shifts in the field of digital interaction design and hence design studies must change beyond its current diversity (Tonkinwise, 2014).

Bailey (2013) studied an effective way spanning from design thinking to design practice and looked at understanding the behaviours in children of service design, leading to considering links between design thinking, psychology, sociology, and innovation. Visions into the designers' skills that helped much of the research studies and observations originated within discussions around design thinking and practice (Kimbell, 2011, 2012; Tonkinwise, 2010) and between the treatises on design-led and innovation (Brown, 2008; Verganti, 2009). In this regard, Verganti (2009) and Tonkinwise (2011) discovered how designers manage the interaction between aesthetics, style and meaning, establishing a way for interactions with practices of services and products. While Kimbell (2009) considered that design thinking is design minus the material practice, design thinking was described as the kind of action research that came from iterative prototyping in perspectives of immersive social research (Tonkinwise, 2011).

Kimbell (2011) emphasised that the term design thinking has earned huge interest in wide-ranging perspectives beyond the traditional cares of designers. The approaches designers adopt to solve problems are of excellent value to societies, helping to make change and create innovation. Kimbell (2011) studied the links between design thinking in research and how designers adopted it within education management and consultancies. In this regard, design thinking as a common theory of design, as the main resource for corporations as well as a cognitive style were considered. Kimbell (2011) also argued the several issues which undermined the statements made for design thinking, including the ignorance of design thinking to the variety of designers' practices and organisations that were previously established, dependence on a differentiation between knowing, thinking, and acting, and how design thinking relied on design theories that honour the designer as the key agent in designing. Hence, it was proposed that paying attention to the located, personified practices of designers presented a useful way to rethink design thinking.

Furthermore, Kimbell (2012) also studied design thinking and practice theory, which produced a new idea of design-as practice to analyse and explain the design activities recognizing the work done by several actors in representing designs-related practice (Kimbell, 2012). Tonkinwise (2012) considered design thinking as "design by non-designers", and made a clear distinction between the

definition of 'designer' to refers to the professionally trained designer and design schools, and 'service designer' which refers to practitioners from different fields involved in service design. Design thinking is a paradigm defined by practitioners acting as designers, engaging with end users (e.g. children with autism as co-designers) to create an innovative product that meets the needs of the consumer, based on research and practical experience. Tonkinwise (2010) and Kimbell (2010) identified how designers created significance to user research, revealing the visions of what was observed and the capability to change them into visualised opportunities for applicable future developments. Verganti (2009) claimed that by understanding meaning, designers were capable of proposing innovative products that reflect their cultural model to clearly understand the final product and associated interaction.

It is important to emphasise that implementing design approaches and tools as well as internet-based sources that enable design thinking have attracted interest in education sectors. The need to implement a design approach, and thus also design tools, has been increasing in recent years. Design thinking has been growing with success, affecting social organisations and society at large. In addition, service design is an additional quickly expanding area that is contributing to the redesign of various activities in both the private and public sectors. Manzini (2015) stated that there is a wave of social innovations as an extensive co-design procedure in which new solutions are recommended and new meanings are produced. Manzini (2015) also introduced a distinction between diffuse design (produced by people who are not trained to be designers, acting rather on their innate design ability) and expert design (produced by professional designers) and illustrated their interactive action in social change. Manzini detailed how expert designers can engage in collaborative practices to generate social value. From the perspective of practitioners acting as designers, as well as children with autism acting as co-designers, Manzini (2015) emphasised design as the consequence of a combination of the aptitude to explore the state of things and distinguish what would be satisfactory (critical sense), to envisage something that does not exist yet (creativity), and to distinguish feasible ways of getting things to happen (practical sense). Hummerstone and Parsons (2023) also reported both pedagogical and methodological observations through reflections on a co-design process regarding sensory preferences with children with autism and educational practitioners, which supported sharing information, building self-awareness, and full engagement of children with autism. Such engagement is critical for recognizing children with autism as having agency within their own lives (LeFrançois and Coppock 2014) and supporting meaningful authentic insights into their lived experiences (Lewis 2002). Such developments have centred around visual, creative design and arts-based methods (Hoy et al. 2018; Nind et al. 2012).

In addition, over the past decade, design thinking has been earning interest in higher education and design practice, considered in the development of diverse internet-based sources that enable design thinking. However, there was no complete evidence or analysis of this progress, particularly about the statements that emphasise the rise of design thinking. Kimbell and Sloane (2020) reviewed a wide range of internet-based design thinking sources and their statements and evaluated the connections between them. They studied the growth of design thinking sources online and their broader socio-economic perspectives and highlighted the similarity of internet-based design thinking sources, despite the variety of sites and conditions they appealed to be appropriate to. They claimed that the consequence of this growth for professional design practice is a necessary move to cruciality, through firmer connections to research and higher education (Kimbell and Solane, 2020).

2.4 Educational Theory

Concerning the educational point of view, this study will provide high-quality creative design activities (e.g. using a toolkit) in education. Creative activities in education provide opportunities for everyone to share knowledge, experiences, and responsibility, including children with autism, who often lack the opportunity for agency in an educational setting. Empowering children with autism capability and enthusiasm, they will learn to discuss different topics between themselves and with professionals, become independent in judgement and thinking, become more risk-taking, develop their decision-making skills, and develop a sense of themselves as creative young children and creative educators (Bovill et al., 2011; Katsenou et al., 2013). In this regard, this research will use learning theories in education following Vygotsky's (1896 - 1934) sociocultural theory of cognitive development. For instance, as defined by Modesto and Tau, (2017) Vygotsky's theory is "the idea that the potential for cognitive development is limited to a "zone of proximal development (ZPD)", and children need social interaction with other people who are more skilled than them to further their knowledge". In addition, Vygotsky talks about elementary mental functions (EMF), which means the basic cognitive processes (e.g., attention, sensation, perception, and memory). When children use those basic tools in interactions with their sociocultural environment, their cognitive/linguistic skills will improve as well as their understanding of the world around them.

It is critically important to mention that during the pandemic periods, efficient "out-of-school education" has turned into a major challenge for many schools (Ferri et al., 2020), impacting children with disabilities the most (Narvekar, 2020). Teaching children with autism is often difficult even for experienced teachers, who had to change their attitude toward teaching in many ways, as they should build stronger collaboration with parents to support home learning (Asbury et al., 2021).

In this regard, online educational platforms can accelerate the presence of children with autism in education, enabling them to maintain learning during a pandemic (Bjekić et al., 2014), however, this needs teachers to be more patient and attentive with children (Tu et al., 2021). The learning progress of children with autism can be improved using current digital innovations and tools allowing them to build social skills, and realise emotional and creative development (Collins et al., 2015; Gushchina et al., 2020). However, to support children with autism in online learning environments, a user-centred method is needed for curriculum planning with strategies that distinguish learning opportunities and predictable learning outcomes (Deschaine, 2018). Such support in online learning programmes deserves the efforts, as it provides support to children with autism through aimed educational opportunities (Rice and Ortiz, 2016).

Teachers play an essential role in the educational programme as they need to tackle a broad range of problems related to methodology, materials, process and entire curriculum (Rice and Carter, 2015). They also need to blend their knowledge of online education and methodology to build a plan explicitly designed to meet the learning needs of children with autism (Kamenopoulou et al., 2016). Also, parents play an essential role in the social, emotional, educational, and overall behavioural development of their children, as they also need to discuss their children's aspirations related to learning programmes with their school teachers (Rice and Ortiz, 2016).

Many teachers make use of books to start a dialogue regarding difficult matters, selecting stories that explain culturally and socially appropriate responses to situations children may face (Le Moine and Schneider, 2021). Examining these books, led to a contribution to research into children's representations and the societal problems linked with these representations (Sigmon et al., 2016) as well as showed society's attitudes toward children with autism, their parents, and support organisations (Le Moine and Schneider, 2021). These books can help children understand differences and enable them to develop more positive feelings towards others (Sigmon et al., 2016).

Despite the efforts to study the interactions and emotional behaviours of children with autism and overcome challenges faced, there is a lack of focus on how interactive experiences such as the creative design process can aid in how much children process information and stimuli. Hence, this study will focus on the enhancement of the learning outcomes of children with autism and their teachers through a range of creative design processes and will emphasise the impact of using a toolkit on their social perception, communication skills, and sensory sensitives which have not been profoundly considered using robust learning environment tool. It will also provide further insight

into the way children with autism interact and respond to the developed learning environment, as well as generate a full understanding of how the design process works to reduce anxiety and make them more comfortable, whilst enhancing their learning style and social communication skills and learning development. In addition, it will support overcoming some of the classroom challenges faced by teachers and teaching assistants for instance, "a surprising 36% of teachers reported on this subject indicating that they did not acquire the level of knowledge necessary to meet the mental health needs of the children nor did they feel adequately prepared to identify or implement practices to do so" (Campbell and Townshend, 1997; Reinke et al., 2011; Coholic, 2012).

It is worth mentioning that in this research study, the Reggio Emalia Approach will also be followed, which was developed as a self-guided curriculum with a student-centred manner to use practical and self-directed learning in relationship-driven environments (Moss, 2019). It recommends thinking, doing, feeling, and learning activities to be done by children. The educators are also inspired by such an approach as it cements the interaction between them and children to help create the opportunity to develop unique curriculums for the schools (Alisinanoglu et al., 2011). In addition, it promotes art education such as "developing critical thinking through artistic work, stimulating values and encouraging children to express their feelings, promoting the development of communication and social skills, and motivating cooperative work and discussion as key elements and a free and democratic society" (New, 2007, and Gonzalez, 2011).

According to the Reggio Emalia Approach (Arseven, 2014), children will get appropriate opportunities to prompt themselves in several distinct representative manners such as playing spectacular games, sculpturing, and painting pictures. This position is referred to as "the hundred languages of a child" by Reggio educators, who contend that children convert their existing experiences into symbolic experiences (Arseven, 2014). Children work with their peers to solve their problems, whilst the educators assist them. In this regard, the educators' main tasks are to support children's imagination in this approach, to arrange the classroom by creating different ways of expression ensuring that all work to be done is appropriate with the designed learning environment (Inan, 2012).

There are certain conditions are required to achieve the objectives of the Reggio Emilia Approach, including: Causes of particular problems (e.g. negative impacts of cultural and social philosophy) during children's development must be avoided; Freedom to express, and assess tasks and opportunities to develop creativity should be given to children; Children should be permitted to use

capabilities and utilise own social and physical environment using observation, imagination, conceptualisation and other mental activities; and Children to remain active and participate in activities to find appropriate solutions of problems instead of receiving such solutions by the educators (Unsal, 2005; Arseven, 2014). It is important to note that the planned activities using the Reggio Emilia Approach in schools are based on learning and projects, which are developed in subjects that are related to each other (Arseven, 2014). In such projects, subjects are selected based on children's experience and interests; children identify the project content, while the documents of the projects are to be provided by the educators; and projects to include sciences, math, music, social works and writing tasks (Alisinanoglu et al., 2011; Arseven, 2014).

2.5 Social Interactions Modelling Approaches

There are several social interaction modelling approaches (such as the integration of artificial intelligence and robot technology (Ma et al., 2019; Ai et al., 2019) and communication technology (Jian et al., 2018)), which have been developed and studied to solve social communication skills challenges (e.g. including children with autism and their teachers in the classroom setting). In addition, (Xiao et al., 2020) studied the emotional interaction of children with autism, focusing on the lack of emotional cognitive ability. In their work, they addressed the problem using audio-visual emotional interaction (a wearable robot) as a system carrier to aid in the emotional expression of children with autism. In the study, the lack of spontaneous seeking of shared enjoyment, interests, and/or achievements was the focus of investigating the difficulty in understanding humour in television programs, movies, cartoons (animated and static), and everyday social interactions.

In addition, Kathy and Howard (2001) studied social stories, written text cues and video feedback. They focused on collaboration between children without disabilities and children with autism. For instance, two peers without disabilities participated as social partners with each autistic child to support them in social interactions and self-evaluation using video feedback. In addition, their results showed that there are improvements in social communication skills, which will impact academic progress and friendship development in the classroom.

Gray (1991) developed a new technique for social stories to provide genuine social understanding in children with autism. Since then, social stories have developed a universal approach for teachers and parents. The social stories support children's understanding of social information in a certain school setting (Gray, 1998) and provide clear information on social situations (Lorimer et al., 2002). In Gray's technique, the social stories sentences are comprised of three types:

i) Descriptive sentences relate to what children do in certain situations to help children concentrate on pertinent cues (e.g. you will need to wait for your teacher to arrive). Descriptive stories including several descriptive sentences;

ii) Directive sentences, as personalised statements of preferred answers, to help children identify what to do to be successful in a certain situation (e.g. I will wait for my teacher to arrive). Similarly, directive stories include several directive sentences;

iii) Prescriptive statements to clarify others' responses in certain situations (e.g. my teacher will be happy to see all children in the class).

Most social stories include both descriptive and directive statements and may also contain some prescriptive statements depending on the needs of individual children (Gray, 2010; Gray and Garand, 1993). Social stories can be recognised as a good strategy for realizing possibly challenging situations for children with autism, preceding them being involved in the activity and planning for them to identify and cope with the situation (Ozdemir, 2010).

It is important to mention that there are several "teaching pedagogy" models, which have been used in primary schools in communication and interaction tools with children with autism. Despite being established a while ago, they are still relevant, however, there are some drawbacks to them (e.g. basic symbols skills such as eyes to see, and ears to listen). As strategies and resources for maintaining inclusion, the Symbols Inclusion Project (SIP) was established as a collaboration between Widgit Software and Warwickshire Integrated Disability Service (IDS) focusing on utilising different symbols to provide inclusion for learning environments and curriculum access (Harnew, 2011). Despite the use of symbols in education with children with autism that can help improve their behaviour, inspiration, motivation, and commitment, however, there is a need to make them presented in more attractive ways to make children with autism more effective in participating in different arts and design activities.

A range of models and strategies have been used to assist children with autism in obtaining efficient communication skills. As one of the existing models used with children with autism, the social communication emotional regulation transactional support (SCERTS) model is aimed at tackling the major challenges faced by children with autism and their partners. This was achieved as a result of solid partnerships between family and professionals and by highlighting the skills and help that led to

positive long-term outcomes. It was designed to provide guidelines for helping children progress via learning stages to become self-confident and good social communicators.

The SCERTS model was also designed to provide teachers, teaching staff and families with the help they may need to support children with autism in school and at home. In addition, the SCERTS model promoted emotional expression by using images such as happy face images "when I feel happy" or angry faces "when I feel sad", as well as visual supports to enhance understanding of the symbol use of support communication (SC), such as the raised hand means stop, thumb up for like and thumb down for dislike (Rubin, 2016).

In addition, the "treatment and education of autistic and related communication-handicapped children TEACCH" model, was developed by Schopler and Reichler (1971). The implementation of the TEACCH methodology has grown since then. Jones et al. (1993) and Jordan et al. (1998) acknowledged that there was unsatisfactory usage of the TEACCH methodology in the UK to incorporate it in their research of interventions. Mesibov et al. (2004) defined TEACCH as the UK's most popular intervention applied to children with autism. TEACCH advances the visual inclination of children with autism by utilizing visual systems (e.g. employing words, symbols, pictures, etc.) based on the children's requirements. The TEACCH model was designed to tackle the problems faced by children with autism (e.g. communication, cognition, perception, imitation, and motor skills, and to be flexible to different styles and levels of support needed (Mesibov et al., 2004). TEACCH was conventionally used in classroom settings but nowadays it is being applied in all settings, which can benefit both children with autism and children without special education needs (SEN) (Benton and Johnson, 2014).

TEACCH seeks to enable independence by providing reliable structure and assistance to reduce reliance on adults (Mesibov et al., 2004; Mesibov and Howley, 2003). There is immense evidence summarizing the efficacy of the TEACCH approach (Mesibov et al., 2004) and the common use of visual systems (Rao and Gagie, 2006) for children with autism. Panerai et al. (2002) described the TEACCH approach as one of the most effective treatment programmes for enhancing learning and minimising behavioural problems in children with autism. It highlights the importance of practical communication and recommends creating alternative communication methods (e.g. picture exchange communication technique) to enable profound communication and social engagement with children with autism (Mesibov et al., 2004).

The main features characteristics in the TEACCH model include a) the physical organisation of the environment (e.g., putting visual barriers and minimizing distractions); b) visual schedules (e.g., allowing students to know and expect the occurrence of events); c) work systems (e.g., that enables working independently and following a sequence of activities); and d) visual structure (e.g., within activities, showing students steps and using visual instruction and organisation to complete a task). In addition, this approach is not only considering the child's challenges but also their strengths, working through visual perception abilities, which many of them process visual information better than auditory (Mesibov and Shea, 2010).

One methodology to explain the usefulness of the TEACCH is empirical assistance for its elements and mechanisms (Iovannone et al. 2003). A series of results from researchers on diverse and personalised applications of the TEACCH principle delivered a stronger foundation for recognition of the fundamental principle (e.g. the efficacy of visual schedules for making future events coherent) (Mesibov and Shea, 2010). Its elements and mechanisms include arranging the activities and learning environment in understandable ways, considering related strengths in visual skills to supplement weaker skills, considering special interests to get involved in learning, and supporting self-initiated usage of expressive communication (Mesibov and Shea, 2010).

Moreover, the picture exchange communication system (PECS) is another model defined as a communication training programme (Bondy and Frost, 1994). This PECS model is a communication program that has become widely used, especially with children with autism. The PECS model aimed at teaching communicative skills within a social context through the use of pictures and started with the identification of what the children pursued in the real world. PECS encouraged communication in a social exchange through which the children originated the interaction. In this regard, children with autism can indicate what they want, by exchanging physical symbols such as pictures (Bondy and Frost, 2002), providing them with a functional way of communication. Many skills could be obtained using this model such as "eye contact; motor and verbal imitation skills, ability to sit tranquilly in a chair, match-to-model skills, and picture Discrimination" (Sulzer-Azaroff et al., 2009; Bondy and Frost, 1994-2002). The Impact of the application of the PECS on Understanding Guidelines in children with autism. It was concluded that it has a positive impact on both oral and visual instructions. It was also shown that PECS not only offered a robust alternative communication way for children with autism to articulate themselves but also provided substantial enhancement in contextual information understanding (Santos et al. 2021).

Most recently, Wright et al. (2023) investigated the influence of LEGO-based therapy on the social skills of children with autism. This form of therapy utilises LEGO play to facilitate social interaction between peers as they collaborate to construct models, providing an engaging way for children with autism to learn to work together with others. Questionnaires completed by the partners (or guardians), class teachers and children with autism were used to gauge the efficacy and outcome of the therapy. LEGO-based therapy proved beneficial to children with autism, enhancing their social skills beyond the levels displayed when limited to the usual activities offered by the school, without demanding high costs or difficult implementation.

This is the learning strategies intervention applied through this study (using visual communication) to support children with autism for example:
1) Complex learning environment and how to process the information for children with autism to enhance their visual attention. Moving away from traditional methods (e.g. oral instructions and use of whiteboarding in the classroom setting) to a new teaching strategy method (e.g. visual instructions such as the type and level of instruction and support is specifically tailored to children with autism use visual toolkits based on their particular skills, interests, and needs).

2) Keep a routine, which helps children with autism to feel safe and relaxed. It also enhances social communication and interaction between children with autism and their teachers in the complex classroom setting. Provide opportunities for social communication and interaction strategies through creative design activities are developed to enable children to interact and communicate in positive ways with peers and teachers as well as to engage in self-advocacy.

3) Encourage engagement through creative design activities and memory, problem-solving, decision-making, concentration, sensory, and creative and thinking skills. They are using visual toolkits based on creative design activities to develop learning skills through the three key elements such as design thinking, participatory design, and art therapy with multiple opportunities to use new techniques, materials, and ideas. This will help to find a creative solution for a complex problem in the classroom setting and provide children with autism and their teachers with visual tools to act as co-designers.

Hanley et al. (2020) started working on their Triple-A project, focusing on difficulties associated with children with autism regarding attention, arousal and anxiety in classrooms aiming to interpret their research into practice and supporting teachers who face these difficulties in classrooms. They described in a multi-sensory environment like a classroom, children tend to disregard a lot of sensory information just to concentrate and learn. However, this will be difficult with children with

autism as they have attention problems, stimulation differences, or increased anxiety. In their work, they developed a free online training tool to assist teachers in encouraging children who suffer Triple-A difficulties. This included experiments to measure the attention of children with autism during the settings, questionaries with class teachers and families, interviews with educators and workshops with teachers to identify and agree on the content to be used for the training tool (Hanley, M. et al., 2020*).* The online training tool was launched in March 2022 with more than 4000 people (typically educators) utilising the training tool and providing outstanding positive feedback (Hanley and Riby, 2023).

The above interventions have demonstrated notable improvements in social interaction, however, the theory of the double empathy problem as well as children with autism inputs into their design was not addressed in sufficient depth. Therefore, the main aim of the developed methods and toolkits in this PhD research is to encourage the engagement of children with autism as co-designers, understanding and supporting their needs with regards to social interaction and acknowledging their inputs in design activities at school, thus helping them to fulfil their potential.

2.6 Effectiveness of Creative Arts Therapy

Art therapy is an emotional therapeutic procedure that underlines children with autism exploration self-direction, and engagement in the process of artmaking-related tasks with qualified practitioners. Several research initiatives on art therapy have focused on its benefits and effects on a range of socio-emotional outcomes (Freilich and Shechtman, 2010). Art therapy could tackle some of the main symptoms of children with autism by enabling communication and fostering sensory regulation. In addition, making a piece of artwork expresses feelings and memories on both conscious and unconscious levels. On the other hand, "Trauma narratives are mastered which re-contextualises fragmented memories and allow them to be processed into the past tense" (Gannt et al., 2009). In this case, art therapy could help to process feelings and memories through artwork and allow non-verbal images to gain verbal descriptions.

Art therapy also contributes to overcoming as a result of poorly matched environment challenges faced by children with autism while improving their well-being, thanks to the multisensory nature of art materials (Pfeiffer et al., 2011). Also, the creative nature of art therapy, however, has been found to benefit such cognitive functioning, as well as social development, and emotional development through its creative art process (Flaherty, 2011). Art therapy's primary goal, however, is to encourage self-expression and provide opportunities for children to understand and express their

emotions while enhancing their thinking process and development (Flaherty, 2011; Mirabella, 2015). In addition, art therapy was used with children with autism to increase cooperation, peer interaction, and body awareness in the classroom setting.

In general, creative arts methods highlight children's intrinsic talents and abilities in early development stages (e.g. creative experiences of sensing, touching, and mirroring) (Park, 2021). These abilities connect to the core areas of social interaction and communication skills (Hildebrandt et al., 2016). In addition, art therapy presents opportunities for empathic interactions, via art making, which provides critical sensory experiences (Schweizer et al., 2014). However, the effectiveness of using the creative art process in educational interventions for children with autism is not well studied. (Park, 2021).

Several research activities have investigated the effects of art therapy on self-motivation (Lee and Liu, 2016). For instance, the use of art therapy has positive outcomes in helping with the challenges children with autism face such as social perception, communication skills, and sensory sensitives (Hass- Cohen and Findlay, 2015). In addition, Smith (2013) also suggested that creative activities consistently enhance and improve learning outcomes if we look to measures of improved communication skills, socialisation, self-esteem, civic awareness, and aspiration from the most challenged to the most talented. Moreover, there is evidence, provided by Fredrickson, (2000), that creative activities impact emotions. In his study, the implications of the role of positive emotions in regulating negative emotions were tested to clear the hypothesis. Furthermore, Coiner and Kim, (2011) suggested that participation in creative activities including art therapy can prove particularly useful for children in certain situations such as sexual abuse, neglect, low self-esteem, special education needs difficulties and depression.

As autistic people can demonstrate complexities with communication, interaction, and sensory-motor functions, (Volkmar et al., 2005), art therapy has the potential to tackle these complexities thanks to its multisensory nature and relational approach (Hass-Cohen and Findlay, 2015). However, art therapy lacks qualitative research, which is deemed to be the standard for evidence-based practice (Van Lith et al., 2017). Hence, more work to emphasise the cruciality of early intervention for skill development and modifying behaviours is sought (Pfeiffer et al., 2011). In art therapy, one of the key principles is that art-making is self-sustaining, self-motivated, and impulsive (Dalley, 2008). Children involved in art therapy, are offered freedom on what they want to create and choices to

accept or reject any suggestions made during the sessions. These experiences will improve the sense of independence of children by enabling them to practice self-desired behaviours (Lee and Liu, 2016).

In general, children with autism are regularly referred to art therapy (Schweizer et al., 2017; Elkins and Deaver, 2015). Though it works in practice, there is not enough real realistic empirical evidence about this treatment and its outcomes. As sensory challenges, as well as restricted and repetitive behaviours, might be affected by the creative processes and usage of art materials (Van Lith et al., 2017; Richardson, 2016), more empirical studies are needed to explore the influences of art therapy and its specific effects (Haeyen et al. 2019). Observational methods, including both observation in art therapy with children with autism and actions evaluation of the art therapist, may enhance knowledge of the impacts of art therapy on children with autism. Children with autism are projected to build more creativity, skills, managing strategies and expressions (Schweizer et al., 2019).

When working with children with autism, it is crucial to consider the art materials' sensory aspects (e.g. consideration of art supplies- number of materials available at the same, access, management, etc.) (Alter-Muri, 2017). Sensory challenges as well as restricted and repetitive behaviours might be affected by using art materials and creative processes (Richardson, 2016; Van Lith et al., 2017). Methods used in art therapy are mainly designed to explore the art product, using a wide range of shapes and colours, and were advised to develop such methods linking the art-making process with the behaviours rating of the users (Betts, 2016). The rating of the users is a way to observe behavioural changes in children with autism in art therapy and to drive the treatment process (Stemler, 2004).

2.7 Addressing the research-practice gap through research design:

The researcher studied other researchers' strategies and approaches (e.g. social interaction modelling (e.g., Gray, 1998 approach, SCERTS model, TEACCH model, etc.) and how their work positively affected children with autism in their learning environment. The researcher found that there is a gap in their research-practice. For example, Gray's approach (1998) uses social stories to support the emotional development of children with autism; the SCERTS model (Rubin, 2016) provides guidelines to help children with autism in their learning development and encourages children to convey their emotions using images presenting various facial expressions; and the TEACCH model (Mesibov et al., 2004) is designed to support children with autism through visual learning tools(e.g. symbols, pictures, calendars). However, the three models do not sufficiently address various other needs of children with autism, including overall well-being, communication

skills, and social interaction (Saggers et al., 2015). Additionally, the literature review provided a full understanding of three key research elements, including design thinking (Brown, 2009), participatory design (Sanders and Stappers, 2008) and art therapy (Schweizer et al., 2019) as supportive approaches to enhancing children with autism learning process. However, despite the documented efforts to study the interactions and emotional behaviours of children with autism and overcome challenges faced, there is a lack of focus on how interactive experiences such as creative design processes can aid how such children process information and stimuli. This research aimed to fill this gap, focusing on enhancing the learning outcomes of children with autism through a range of art and creative practices and considering the impact of design thinking and participatory design on their well-being, communication skills, social interaction, and sensory integration (e.g. sensitivities feelings to the light, sound, and textures) (Fabri et al., 2016, American Psychiatric Association, 2013), which have not been profoundly considered using robust learning environment tools. The researcher utilised design thinking to support problem-solving skills and decision-making, participatory design to support social communication skills, and art therapy to support well-being, covering a broader range of needs of children with autism and their teachers in the classroom setting.

According to Parsons et al. 2020, "researchers need to prove proper methods and tools as well as participatory design approaches for facilitating participation and respecting various communication preferences". This study used visual toolkits to support children with autism in the classroom setting with their 1) problem-solving skills (see Ch.4, Figs 4.14- 4.15, p. 103- 104); 2) memory skills (e.g. using puzzles and numbers to create various landscapes. See Ch.4, Fig 4.20, p. 114); 3) well-being (e.g. art therapy. See Ch.4, Fig 4.19, p. 109); 4) emotional regulation and awareness (e.g. social stories. See Ch.4, Figs 4.8- 4.9, p. 100); 5) sensory processing (see Ch.4, Figs 4.10- 4.11, p. 101); and 6) social communication skills (see Ch.4, Figs 4.25- 4.26, p.153). The toolkits helped the children to understand and work through English and Maths lessons, breaking down the subject matters using visual tools and activities. The researcher considered the needs and interests of the children when developing the toolkits and was flexible in changing planned activities according to the children's experience and feedback.

According to Ainscow et al. (2006), "there are three important conditions for inclusive education: being together, participation and achievements. Only being together is not sufficient, it is important to ensure the meaningful and active participation of the child in the educational process, involvement in joint activities with peers, acceptance by others, to feel being a part of a class, school community, as well as to achieve educational goals and results corresponding his opportunities and his full potential". This study aimed to

improve communication between children with autism and their teachers and peers in the classroom setting. This issue frequently arises due to the lack of mutual understanding as well as the fact that the additional support needs of children with autism often go unmet in the traditional classroom setting (Macdonald et al., 2017). Such unmet needs can result in a gap in communication between teachers and students and feelings of frustration for children with autism, which can significantly hinder the learning process (National Autistic Society, 2020: Schweizer et al., 2019; Elkins and Deaver, 2015). The researcher provided alternative visual communication (2D/3D visual toolkits) to enhance the learning environment for children with autism, helping them to improve their social communication skills (interacting with other children and expressing themselves) and encouraging them to engage and enjoy schoolwork instead of being isolated.

The literature review also presented a clear understanding of the body of knowledge and current thinking. It paved the way to develop a new integrated model of design practice to enhance children with autism's social perception and communication skills and address the sensory sensitives and other challenges faced by such children, as well as to support the classroom teachers working with them, as shown in Fig. 2.1.

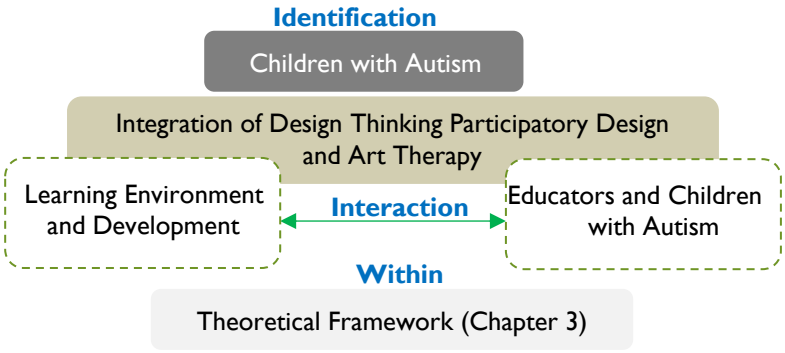


Figure. 2.1. *Literature review integration as a basis of the theoretical framework*

The model used throughout this thesis will be conceptualised as design-led practical sessions and toolkits (e.g. tools for data collection, analysis and interpretation, and engagement materials and practices) within a learning environment to assist teachers in making informed choices about the planning and implementation of learning experiences for this student group. This formed the basis of the theoretical framework development, adapting a coherent design-led approach in the complex learning environment within classroom settings. The planned theoretical framework will identify the main challenges facing children with autism, including communication and interaction problems, in

complex classroom settings and consider the role of design thinking and participatory design in tackling such issues.

The theoretical framework will also provide further insight into the way children with autism interact and respond to the developed learning environment, as well as generate a full understanding of how the design process works to reduce anxiety and make them more comfortable whilst enhancing their learning style and social communication skills.

Chapter 3: Methodology

This chapter defines the theoretical underpinnings of the research and explains the research design process and how it will be performed. This chapter contains important discussions of the research and epistemological positioning. The theoretical framework is also presented, as well as a description of the research model. This chapter also emphasises the importance of design in a complex context, as the design-led approach is a unique contribution to knowledge. The case study design, recruitment and selection of participants, and methods for data gathering, analysis, and reporting are also presented. In addition, the standards and principles of reliability and validity, as well as ethical considerations, are provided. (Fig. 3.1) shows how the research activities will be carried out and how the data are to be collected and analysed in this chapter (Elmarakbi, 2022).

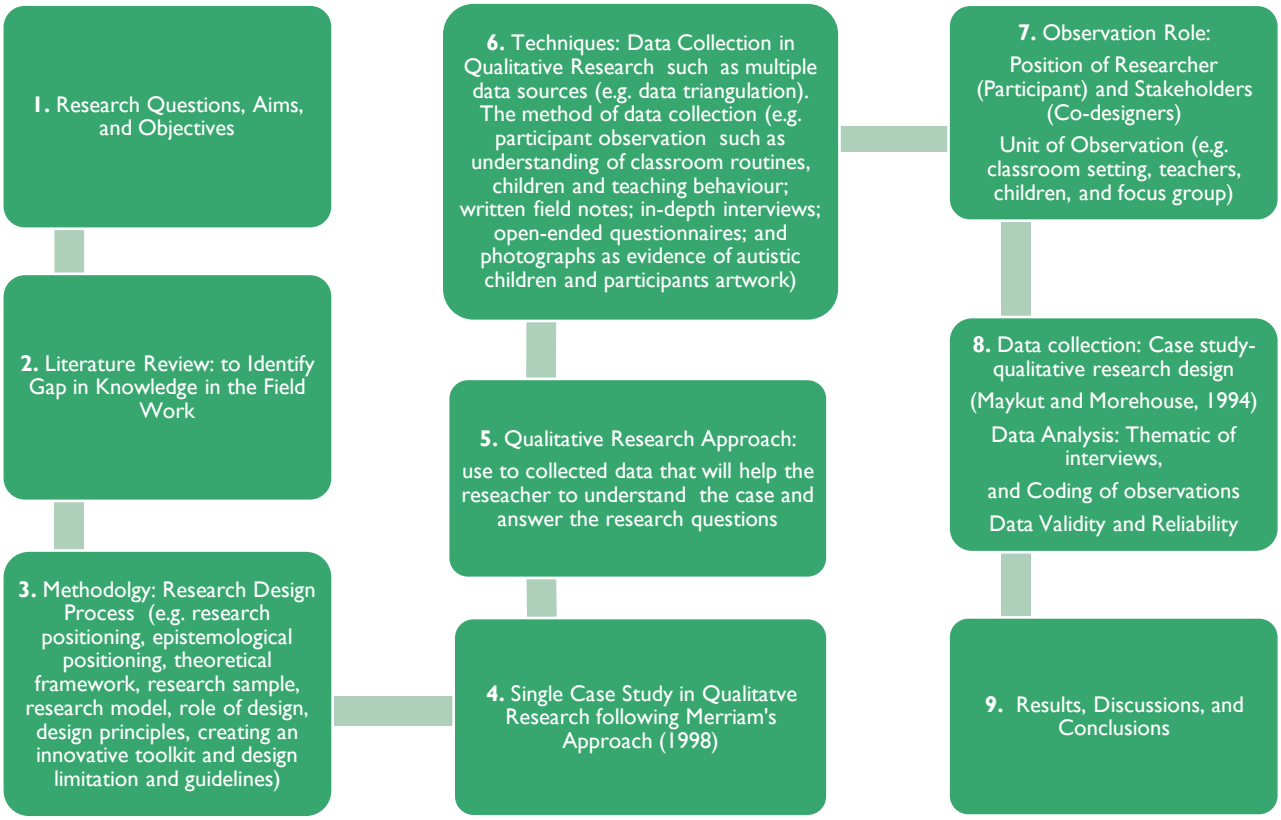


Figure. 3.1. *Steps of how the research is to be conducted*

3.1 Research Design Process

3.1.1 Research Positioning

This multi-disciplinary research brings several fields together (e.g., design, art therapy, and education), creating a unified theoretical framework to help adopt a design-led approach in the complex learning environment. Hence, this study will:

- Use design thinking and participatory design knowledge and theory to inform this research study's design (Fabri et al., 2016; Tonkinwise, 2014 and 2011; Kimbell, 2011 and 2012 Brown, 2009; Sanders and Stappers, 2008).

- Leading art therapy theory and practices to simulate the case study setting to support the co-creative process (Schweizer et al., 2019; Lee and Liu, 2016; Pfeiffer et al., 2011).

- Adapt learning theories in education to establish an analytical tool to apply to the case study (Tu et al., 2021; Asbury et al., 2021; Arseven, 2014).

3.1.2 Epistemological Positioning

The theory and production of new knowledge, linked to methodology, validity, and scope, were crucial to conceptualising and operating this research study. As Merriam notes, "Research is, after all, producing knowledge about the world in our case, the world of educational practice" (Merriam, 1998, p. 3). Following Merriam's epistemological view, constructivist epistemology will orient this qualitative research study as she argues that "the key philosophical assumption upon which all types of qualitative research are based on the view that reality is constructed by individuals interacting with their social worlds" (Merriam, 1998, p. 6). Hence, it is important to understand the meaning and knowledge constructed by people to build a coherent qualitative case study.

The practical implications of the double empathy problem are substantial, as more research is required to create and implement methods that take into consideration the views and perspectives informed by autistic people. Given the complexity of communication preferences, autistic people need to be more engaged in the development and evaluation of questions and methods that are utilised in research to make sure they are adequate for the purpose instead of asking them to explain their thoughts (Parsons et al. 2020).

At the start of this research, the researcher was aware that her interpretation and knowledge of creative design activities are collectively and socially positioned within the framework of her previous experiences and studies. By examining the personal experiences of children with autism, the researcher is competent to assess and critically analyse her previous knowledge (Elmarakbi, 2017 and 2016). Applying innovative design tools and processes will allow the researcher to contribute a critical opinion towards targeted knowledge, as the behaviours and cultural context of children with autism will be considered when understanding this knowledge.

By investigating how children with autism build their understanding, contributing, and engaging in the design process, knowledge about their experiences will be developed and improved. Hence, the epistemological perspective will affect the design process, oversight, and interpretation of the research study (Willig, 2002). Therefore, it is important to consider an epistemological way to get a sense of how we know the related knowledge and nature of reality before beginning the research work. In such a way, an essential appraisal of the statements and assumptions presented during the design process will be conducted to indicate how decisions about the design activities were made and how they might shape this study and its outcomes.

3.1.3 Theoretical Framework

In this research, the researcher seeks to develop a robust theoretical framework which simultaneously communicates the researcher's perspectives and offers a connected approach to how this work will contribute to new knowledge. The developed theoretical framework, as shown in Fig. 3.2, combines the following points:

1) The researcher's epistemological position;
2) Evaluation of existing knowledge and formerly established ideas and theories; and
3) Clarification of methodological selection and of how this research will contribute to the development and integration of theoretical approaches in a novel manner.

The researcher is mindful that her interpretation and knowledge of creative design activities are built based on the literature review and collectively and socially positioned within the framework of her previous experiences and studies (Elmarakbi, 2016 and 2017; Elmarakbi, 2022, see Chapter 1; see Section 1.2). The researcher focuses on the exploration, description, and sometimes generation and construction of theories using qualitative data within a constructivist epistemological view (guided by Merriam's view, arguing that "reality is constructed by individuals interacting with their

social worlds") (Merriam,1998, p. 6). The researcher's education (MA in design studies with dyslexic children) and work experience (20+ years as a designer and artist working in the educational sector) inform her standpoint based on the integration and application of multi-disciplinary fields (design, art therapy, and education) within a qualitative research framework with children with autism. This background and standpoint will be fully described and acknowledged with this study's constructivist framework. Additionally, it will aid the researcher in creating a theoretical framework, adapting a coherent design-led approach in the complex learning environment within classroom settings.

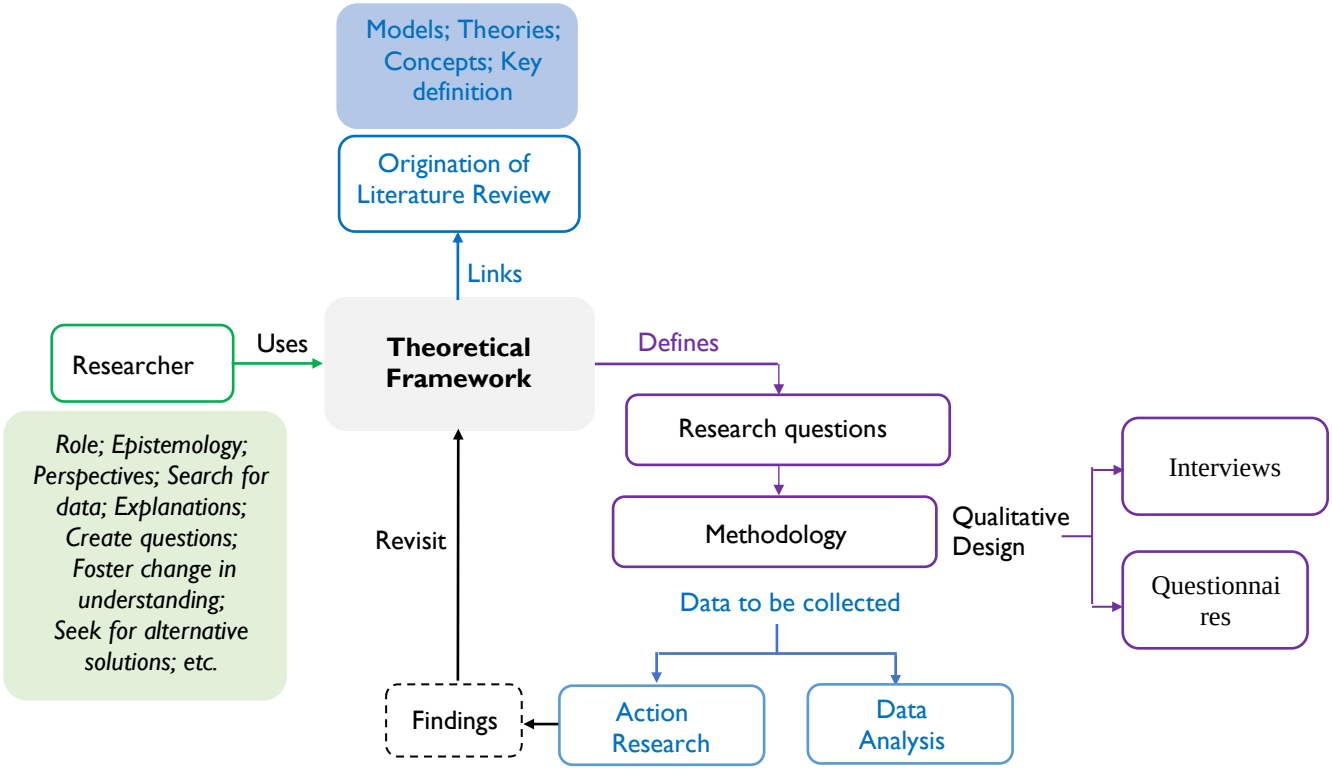


Figure. 3.2. *Theoretical framework in the qualitative research case study*

The theoretical framework is realised through the origination of the literature review (see Chapter 2) and identifies the main challenges and communication and interaction problems facing children with autism in complex classroom settings, and the role of design thinking and participatory design as main concepts in tackling such problems (National Autistic Society, 2020 and 2019; Fabri et al., 2016; Tonkinwise, 2014 and 2011; Kimbell, 2011 and 2012 Brown, 2009; Sanders and Stappers, 2008). It also identifies social interaction modelling approaches, innovation in organisations (e.g. primary schools), and the effectiveness of creative art therapy and its role in enhancing children with autism's learning environment. In addition, the theoretical framework is designed as a way of thinking and understanding autism as a different, rather than deficient, cognitive style, and as an effective way

to address the double empathy problem and provide a unique solution to the challenges of autistic learners. Hence, the theoretical framework considers monotropism as a powerful theory of autism.

As clearly shown in Fig. 3.2, the theoretical framework links the researcher's epistemological perspective and her role as an experienced researcher in this field (see Section 1.2 and 3.1.2) with full understanding and evaluation of the existing knowledge and established concepts to identify the main problems to be investigated and develop research questions to be answered, supported by a robust methodological approach (see Section 3.1.4 and 3.1.5).

Hence, the researcher identifies key concepts and themes to centre the workaround, including design thinking, participatory design, social interactions, and the effectiveness of creative art therapy in education, which are key concepts and themes that were explored in the literature review. The work begins with the identification of the key concepts (problem statement and research questions), followed by the development of the literature review foundation. Consequently, the literature review is logically organised into a conceptual framework that bridges art therapy with design thinking and participatory design (as shown in Fig. 3.3). The researcher believes that developing a multi-integrated approach using design thinking, participatory design, art therapy, and educational theory will enhance children with autism learning and development. Hence, the theoretical framework is a design thinking-based technique used with children with autism in complex classroom situations. It is distinguished by the researcher's emphasis on children with autism creating knowledge and establishing meaningful connections.

The literature review presented an overview of the autistic experience as well as an understanding of different practices and theories that seek to describe and deal with it (e.g. design thinking and participatory design (Fabri et al., 2016); participatory design research (Sanders and Stappers, 2008); design thinking and innovation in schools (Tonkinwise, 2011), social interactions modelling theories (Xiao et al., 2020; Kathy and Howard (2001), and art therapy approaches (Freilich and Shechtman, 2010). This knowledge offered the researcher a robust starting point to build this research. The literature review provided a theoretical prospect and knowledge of children with autism experiences which could be improved through their involvement in their curriculum using innovative and attractive design-led approaches (e.g. creative design sessions and a toolkit within full engagement materials and practices, see Appendix A) to assist teachers in making informed choices about the planning and implementation of learning experiences for this student group (Elmarakbi, 2016, 2017; Elmarakbi, 2022, see Chapter 2). In this manner, the researcher's skills and personal observations will be combined with the community's knowledge and literature review findings to create new

artefacts for the learning environment and support teachers to adapt and create resources for continual design and re-design of their classroom setting in response to the complex needs of their pupils.

The literature review begins by evaluating existing theories that describe a rationale for working with design thinking, participatory design, and art therapy themes within an educational environment. An interactive and creative research model and design activities are developed to link the three themes as design thinking enhances problem-solving skills; art therapy enhances feelings, emotions, and well-being; and participatory design encourages engagement of stakeholders (e.g. children with autism, class teachers, and teaching assistants) (see Sections 3.1.4, 3.1.5 and 3.3.3, Table 3). It has been noticed that though the utilisation of these themes with children with autism is a comprehensive research area, there is insufficient qualitative evidence and robust results regarding the application of such approaches in the complex classroom setting (Elmarakbi, 2016; Woolner, 2010). It was also observed that there is no alternative to working directly with the stakeholders (Elmarakbi, 2016; Woolner, 2010). By working directly with children with autism and their stakeholder community, the researcher established relationships which are defined and cemented by mutual experiences. Having frequent and numerous meetings with children with autism assisted the researcher in extending her understanding of autism and provided her experience of the problems generally faced by children with autism and their educators.

The core element of the theoretical framework is design thinking, which is a user-centred approach that utilises involvement, co-design, and problem-solving practices to match users' requirements with what is practically viable (Brown and Wyatt, 2010). It is usually employed to deal with difficult problems (e.g. challenges of supporting children with autism in their education) (Lawson, 2006)). The literature review analysed existing theories of design thinking, described their concepts and discovered core elements and characteristics of the existing models. Design thinking is commonly described as a creative analytical process that involves users creating, prototyping, experimenting, evaluating and redesigning (Plattner et al., 2009). Design thinking is applicable across various demographics, including school children (Noel and Liu, 2016; Curedale, 2013).

There are various approaches for design thinking within the literature review (IDEO, 2015; Liedtka and Ogilvie, 2011; Stanford d.school, 2010; Plattner et al., 2009; Brown, 2008) that focus on design thinking in a well-structured way. Brown (2008) presented IDEO's design thinking approach summarised examples and outlined the design thinking process. The IDEO's approach (3 steps -

Inspiration, Ideation, and Implementation) was further studied, particularly in the context of education, and the insights provided by this research were integrated into his methodology (IDEO, 2015). Plattner et al.'s (2009) approach defined crucial innovations in the design thinking field and was used at Stanford University (Stanford d.school's approach; 5 steps - Emphasis, Define, Ideate, Prototype and Test). Liedtka and Ogilvie's (2011) approach comprised a procedure of four phases (What is? What if? What wows? and What works?). Their approach was established based on the authors' practical consulting, teaching and experiences. Moreover, the Design Council (2015) in the UK established a "4 step double diamond" design model, including "Discover, Define, Develop and Deliver", in which problems will be detected in the first 2 steps, while the solutions will be proposed in steps 3 and 4. It is worth noting that the terms and number of phases may vary but the fundamental ethos of all approaches are similar. All these approaches indicate that the design thinking process begins with identifying a problem using an empathic attitude. It requires adaptation, knowledge and discussion of new solutions.

The combination of theoretical and practical knowledge is essential to enhance the children with autism understanding and engagement as it supports the way the design sessions are to be developed (theoretically based on previous knowledge) and executed in the classroom settings (practically based on previous experience) (Elmarakbi, 2016, 2017) (see Appendix A). Hence, within design thinking, and designing prototypes for children with autism, it is essential to have both theoretical (gathered via the literature) and working (developed via contact and networks with stakeholders) knowledge of the autism condition. This will provide a good level of understanding that allows needs to be addressed and beneficial interactions with children with autism to take place.

This research is driven by the well-recognised design thinking model for education developed by Plattner et al. (2009) as it is aimed at both children with autism and teachers working together on design challenges, enabling the students to develop their skills through various stages (see Table 1).

Table 1. *Design thinking steps and how they are applied in this research.*

Phases/steps	**How steps to be applied**
Emphasis: *Understand what children with autism do, their needs and what influences their learning.*	Questionnaires and Structured interviews for each of these stakeholder groups: teachers and teaching assistants
Define: *Observations and responses are examined and grouped, then patterns and themes are identified. The focus is on understanding children with autism and their needs and circumstances.*	Through collaborative and observation sessions that involve researchers, teachers and teaching assistants, the data are segmented, requirements are identified and findings are summarised. Common challenges encountered by children with autism will be identified.
Ideate: *Considering the data from the earlier step as a starting point, a number of ideas to meet children with autism needs are created. Stakeholders have an opportunity to contribute and the best ideas are chosen for prototyping.*	Stakeholders are invited to suggest topics linked to the identified challenges to meeting children with autism specific needs. Simple forms are provided as a template for topic suggestions. The most important ideas will be considered for prototyping.
Prototype: *Develop various prototypes in an attempt to produce the simplest design that will help understand the needs of children with autism. Prototyping is an iterative process to be fine-tuned or disregared once tested and evaluated.*	Several prototype versions of 2D/3D toolkits will be produced, covering a wide range of topics. There are variations in how the concepts and content are to be explored. The toolkit prototypes are designed with consideration to attractive colour palettes and simple assembly guidance.
Test: *Testing the designed prototypes with children with autism to identify enhancements. Based on engagement, performance, and feedback, the prototypes will be modified and an enhanced version will be provided.*	To assess the prototype toolkit and to gather ideas related to the design-led activities, a series of participatory design practical sessions are carried out. A social story linked to the selected toolkit topic is prepared to enhance imagination and photos are taken to capture participation.

To identify the position design thinking has in the scholarly society, it is important to map its connections to practices with similar aims, methods, and applications (e.g. participatory design, bricolage (tinkering), LEGO play, and making, Panke, 2019). Participatory design is a technique that involves the users early on in the design and development process. Linked to the theoretical

framework, participatory design techniques reveal the mix of activities users participate in, indicating the social nature, flexibility, and intricacy of each activity (Kaptelinin and Nardi, 2012). Children with autism are granted control and room for ideating and conceptualising in the early stages of the design process (Sanders and Stappers, 2008).

As design thinking usually emphasises empathy and user-centred design, participatory design plays an important role in understanding design thinking (Fabri and Andrews, 2016). Sanders et al. (2010) established a participatory design framework that delivered an outline of techniques and tools (based on the principle that people's experiences are accessed through what they can make and say and how they can act) to support designers to involve non-designers within the educational context. The research that focuses on the connections between design thinking and participatory design is promising and will help to achieve improved creativity and open up further educational opportunities. Hence, this research will incorporate participatory design (guided by Sanders et al. 2010) within prototyping and testing steps in the design thinking framework, in which children with autism will play an essential role in the design process.

Examining previous studies and teaching "pedagogy models" (e.g. TEACCH, SCERTS, PECS, Triple A), the researcher believes that children with autism difficulty and communication problems in a complex classroom comprise two measures: understanding the challenges and constructing knowledge. Thus, in this research, the researcher establishes a new theoretical framework to implement a multi-integrated approach consisting of design thinking, participatory design and art therapy, as mentioned above, and utilises the main principles of social interactions within educational principles of enhancing relationships among children, teachers and parents (Arseven, 2014) in the hope of delivering a means of enabling their educational achievement and modify behaviours that can be linked to communication and social problems. Social stories are commonly applied to teach communication as well as social skills and concepts to children with autism. This research contends that Gray's (2010) social learning theory can be used to link designs with stories, identify possibly challenging situations, and describe the methods behind social stories and how they influence changes in response and engagement.

Consequently, in this research, the developed theoretical framework (as shown in Fig. 3.2) identifies the conditions by which the phenomenon of interest (design-led approach and its impact on children with autism within a real-life setting) was expected to occur and argued to be observed (literal replication logic) and in opposition, the conditions when it was not expected to be observed

(theoretical replication logic). The theoretical framework presents literal replication logic and shows that applying a design-led approach with children with autism in complex classroom settings will produce positive outcomes. The theoretical framework links research questions and methodology, with special consideration to the logical process, credibility, epistemology, and the researcher's role.

It is important to clarify that unexpected outcomes may emerge, or positive research outcomes may be brought about by unexpected explanations. Such findings will be investigated, and the theoretical framework will be revisited and optimised to outline whether there is a literal or theoretical replication of the study outcome. Hartley (2004) suggested that theoretical frameworks are continually reiterated to ensure that the collected data remains relevant, therefore the theoretical framework developed in this thesis will be enhanced by the end of the study.

Theoretical plans are developed from the theoretical framework to guide the researcher to the required data to be collected and analysed to determine if literal or theoretical replication will be observed. The theoretical framework is supported by the understanding of i) The social challenges, learning ability and behaviours before and after attending the tailored participatory design-led sessions; ii) The integration of the planned sessions within the school's curriculum and the willingness of teachers to adopt them.

3.1.4 Description of the Research Model

A comprehensive research model is established that integrates the design thinking approach as a mindset, underlying the design philosophy, and participatory design process with art therapy within educational settings as shown in Fig. 3.3.

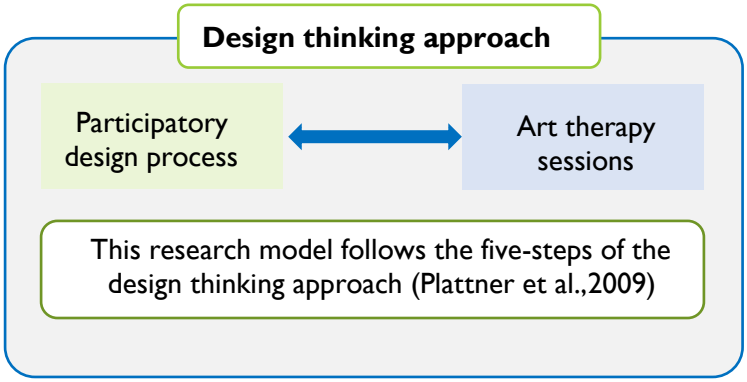


Figure. 3.3. *The research model approach and main principles*

This research follows the five steps of the design thinking approach (Plattner et al., 2009), including:

1) Emphasis (to watch, listen, observe and engage);

2) Define (statements of problem, views);

3) Ideate (to identify problems and to seek solutions);

4) Prototype (building, problem-solving, testing, monitoring and developing solutions);

5) Test (enhancing prototypes, optimising solutions, and liaising with end-users).

Participatory design is also adapted to carry out the design research process; investigate the problems facing children with autism and their teachers in the classroom setting and provide meaningful solutions to help them in their learning and development and to support teachers and teaching assistants while interacting with them. The relationship between the design process and the process of research has been highlighted by Press and Cooper (2003) and Hall (2000), showing that the commonalities are apparent, with both processes determining a problem, commencing a sequence of steps to examine it and offering a practical solution. In all steps, there is a process of knowledge exploration to identify the design process. They are mainly focused on the process of searching for understanding, creating ideas, and providing solutions (Press and Cooper, 2003).

A new approach to enhance the learning outcomes of children with autism through a range of design thinking processes is developed, emphasising the impact of participatory design on their social, communication, and sensory processing, which has yet to be profoundly considered using a robust learning environment tool (as shown in Fig. 3.4). Via several practical sessions, a new toolkit-based design is developed and used by the children with autism as well as their teachers. The toolkit will be a main source of practice once the practical sessions are completed. The main purpose of the toolkit is to serve as an easy tool to deal with problems and challenges that children with autism may face within the classroom setting and to create an environment that is more conducive to effective learning. The stimulating challenge of this research is to engage children with autism in participatory design as co-designers, allow them to contribute and participate in the designed practical sessions, and help them to use the developed toolkit easily.

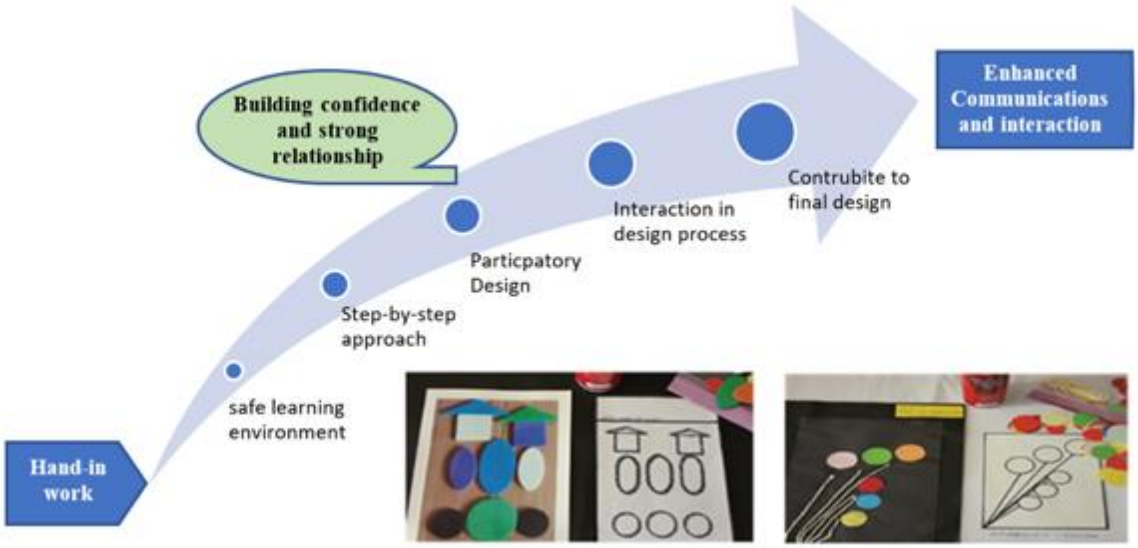


Figure. 3.4. *Enhanced learning environment- hand-in work and interaction in the design thinking process*

3.1.5 Case Study Methodology: Single Case Study

Case study methodology, one of the most frequently utilised qualitative research methodologies in educational research (Yazan, 2015), is chosen for this research as the literature review revealed that though design thinking, participatory design and art therapy with children with autism are comprehensive research areas, there is insufficient qualitative evidence and robust results regarding the application of such approaches in the complex classroom setting (Elmarakbi, 2022 and 2017). Consequently, it is crucial to gather detailed information to create initial ideas and develop theoretical understanding. In this research, the case study methodology allows for in-depth information collection at an exploratory phase of theoretical development as well as examination of the phenomenon of interest, (design-led approach and its impact on children with autism) within a real-life setting (a school environment).

Yin (2009), Merriam (1998) and Stake (1995) developed varying approaches to case study research. Merriam and Stake adopted a qualitative direction to the case study (favouring an inductive or reproductive approach), whilst Yin had a more quantitative direction (favouring a deductive or testing approach). Stake (1995) provided a flexible design, allowing researchers to make significant changes after advancing from design to research, whilst Yin recommended a tightly structured design for the case study (Yazan, 2015). On the other hand, Merriam's approach complemented both qualitative research design (Stake's version) and well-organized design (Yin's approach). Merriam (1998) provided step-by-step guidance on designing a qualitative research process in a fairly detailed manner, which included carrying out a literature review, building a theoretical framework, recognising a research problem, identifying research questions, and choosing the sample. Merriam

emphasised the creation of the theoretical framework as a critical step in developing and understanding the research investigation. It is worth noting that neither Stake's (1995) nor Yin's (2009) approaches contained such advice and guidelines, however, Merriam's approach was a combination of both approaches.

Merriam sees "the case as a thing, a single entity, a unit around which there are boundaries" (Merriam, 1998) (see the single case study design below). She also considers a qualitative case study as "an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" (Merriam, 1998). To further distinguish case study methodology, two individual characteristics will be used to focus on a particular situation and programme (Particularistic) and to clarify the description of the problem under investigation (Descriptive).

Hence, in this research, a comprehensive explanatory case study is used, employing qualitative research methods (interviews, observation, documents, and workshops to collect and analyse data*)* as a main methodology, and integrating the participatory design, art therapy and educational theory approaches during complex classroom situations. The design and methods of the qualitative research and case study focus on understanding, step-by-step, the process of designing qualitative research, including:

1) Beginning with a detailed literature review to conceptualise the inquiry, to steer the development of a new theoretical framework;

2) Identifying the research problems and motivation;

3) Constructing and sharpening clear research questions;

4) Selecting purposive and theoretical sampling. It is suggested that "Purposive sampling usually occurs before the data are gathered, whereas theoretical sampling is done in conjunction with data collection" (Merriam,1998).

Single Case Study Design (see Section 3.3 for participants and educational context): For this research, the researcher identifies a single case study design (with two units of analysis: KS1 and reception children with autism; two different settings/groups), according to Merriam (1998). It is

believed that this will generate a practicable quantity of data and will allow for the literal experiment that expects to find similar (literal) or contrasting (theoretical) outcomes. In addition, the researcher will work with two units of analysis to facilitate the flexibility of design and to allow adaptations to support a literal replication of the theoretical framework. On the other hand, if a unit of analysis offers contrasting data, then it will enable a theoretical replication. The case study developed in this research is supported by the understanding of:

i) The social challenges, learning ability, and behaviours of children with autism before and after attending the tailored participatory design-led sessions (to be measured by naturalistic observations and assessment of engagement in design, understanding the sessions, learning improvement, and the enhancement of the children with autism social interaction); and

ii) The integration of the planned sessions within the school's curriculum and the willingness of teachers to adapt them (to be measured by feedback, via questionaries, interviews and workshops, from the class and head teacher and their stance on the implementation of the new approach in the current school plan).

The case study places emphasis on dealing with the complexity of the classrooms involving children with autism and their teachers and will also draw attention to the aspects of data collection and analysis concerning the situation under study. Accordingly, the case study method will answer the research questions and clarify the best design practices for teachers to establish in the classroom. Thus, the following foreseen tasks are developed in collaboration with the stakeholders:

i) Data gathering through interviews, using field notes equipment and transcripts of the interview, as well as observation, documents, and workshops (e.g. day-to-day diary and photographs);

ii) Data analysing (case study is described in detail) through ethnographic analysis, narrative analysis, and content analysis;

iii) Data reporting (focuses on describing the case study with description, analysis, and explanation addressed differently or equally);

iv) Data validating through long-term observation, participatory research, and disclosure of research bias;

v) Data reliability through explanation of the investigator's position with regards to the study as well as the case studies protocols and databases.

3.1.6 Role of Design in this Complex Context/Design-Led Approach is A unique Contribution to Knowledge

A design-led approach will offer a holistic way to investigate the complex learning environment in the classrooms of children with autism. This study will focus on how the design-led approach can be used in such a complex situation, and identify, through a comprehensive explanatory case study, the multi-disciplinary nature of the work.

Various studies have investigated the applications of design thinking (Novak and Mulvey, 2020; Henriksen et al., 2020; Dai, 2012; Brown and Wyatt, 2010) and participatory design (Panke, 2019; Bødker and Kyng, 2018; Temple, 2010; Maguire, 2001) in an educational setting. There are examples when the design has been applied to address the specific needs of autistic individuals (Silva and Teixeira, 2019; Mazon et al., 2019; Gaudion et al., 2015; Bovill et al., 2011; Katsenou et al., 2013; Brown, 2009; Cross, 2001). However, these examples take an industrial design approach to technical problem-solving. Also, to date, there are no studies that consider the application of participatory design and design thinking practices in the context of a classroom setting responding to the complex needs of autistic pupils.

This study will address this knowledge gap and has the potential to make a unique and significant contribution. Specifically, this study has the potential to develop a new understanding of how participatory design can lead to the establishment of meta-design that accounts for and responds to a complex classroom setting.

3.1.7 Design Principles

Design principles are used to inform the toolkit design and highlight what should be included or avoided within the design context. The specific sensitivities, requirements, and preferences of children with autism will be considered to simplify the aptitudes, needs and interests of children with autism. The main design principles are summarised in (see Table 2), reflecting the knowledge and needs described in the literature review (see Chapter 2) and considering the main challenges children with autism face within the context of social and communication interaction.

Table 2. *Main design principles while working with children with autism.*

Visual Attention	• Colour arrangements need to be simple with the ability to allow colour variation (e.g. background colour to maximise contrast with main core of pictures) • Graphical representations need to be clear, realistic, and simple to avoid problems in understanding the concepts of the work and a mix of drawings and photographs can be produced. • As children with autism are facing issues with understanding work concepts, hence, symbols should be utilised as a substitute to text. • Consider an approach which merges animation, symbols, sounds, and colours while designing the tasks to accommodate their sensory issues and to help them to pay attention to specific tasks. • Ensure that the work is not over complicated, simplifying the lesson plan generated by the teacher into easily understandable visual presentations. • Sounds, if used, should be used with caution, with options to switch off as it might initiate nervousness and anxiety in some children with autism who have auditory problems.
Guidance and Feedback	• Design the structure of the tasks in a focused way (e.g. clear start and finish points) to avoid unnecessary repetition and open tasks. • Ensure a variety of options for the children, providing a clear mechanism for them to easily switch between activities as children with autism like to choose and discover in a non-systematic way (e.g. trial and error). • Support children with autism in exploring different interaction approaches with their peers and teachers. • Feedback should be provided promptly to allow actions to be integrated into the design process, as children with autism might become impatient and worried as there is no immediate reaction to their hard work. • Support children with autism to be in control of their tasks by giving direct and positive feedback and avoiding critical feedback on their incomplete or wrong work, and instead providing different alternatives and work strategies to build their confidence.
Participation and Motivation	• Encourage participation and engagement of children with autism by introducing rewards schemes (e.g. bonus activities, small gifts, scoring systems, sensory rewards)

	• Providing such rewards should not make children with autism distracted from main tasks, rather it will motivate them to do the tasks actively and eagerly. • Personalisation-tailor the activities to the specific needs for individuals to meet their personal needs, which will help them to work actively (e.g. chosen colours, abstract schemes, layout, animation).

These principles will help to highlight the key points to be considered when designing the toolkits to guarantee that they are suitable and attractive to children with autism. It is important to underline the necessity to integrate the strengths and support the needs when designing the toolkits for children with autism. As a result of the extensive range of specific needs, interests, and aptitudes across children with autism, it is important to develop a set of design principles for children with autism that are appropriate in the long term. As it is difficult to predict what children with autism-specific needs and interests are at any developmental stage, it is important to emphasise getting them involved in the design process as they are the experts concerning their specific needs and interests.

3.1.8 Description of the research process and research model:

This study is composed of two integrated and complemented phases: the first phase includes the participatory design approach, working directly with children with autism through design creative activities sessions alongside their class teachers and teaching staff (see Section 3.3.3, developed sessions in Table 3). The second phase is designed exclusively with the class teachers and teaching assistants to introduce 2D/3D toolkits for them to use with children with autism in future classroom settings. In this phase, full guidance and a detailed "step-by-step" design process will be provided (see Section 3.2); including preparation, planned activities based on the school curriculum, building, and testing prototypes, observing, and monitoring the outcomes, and evaluating, reflecting, and providing recommendations.

3.2 Creating an Innovative Toolkit as an Integrated Part of the Research Method

3.2.1 3D Design and Visual Attention

Paying attention is a crucial skill for learning. Children with autism need to not only pay attention to a teacher's guidelines but also to the tasks at hand. They also need to be capable of keeping their attention on allocated tasks to learn effectively (Fitzgerald et al., 2015). However, some children with autism can find it difficult to pay attention, particularly if they are tired or not interested in the task (e.g. reading a book with a career or doing a puzzle). It can also be difficult if they believe they

cannot perform the task or if they find their surroundings too distracting. On the other hand, they can keep their attention on things that they enjoy for a long time (Najdowski, 2017).

There are several strategies and skills which can help them to focus on paying attention, for instance: choosing interesting activities (e.g. Lego, 3D designs, and painting), providing efficient guidelines (e.g. limiting the word numbers to be used, repeating keywords, and break up instructions), creating model tasks, talking and playing while preparing the tasks as well as preparing them for transitions (Wilson et al., 2019). Following both Reggio Email's approach (Arseven, 2014) as well as Carol Gray's writing social stories technique (Gray, 2019 and 1993) mentioned in previous sections, creating creative design process and tools will be developed to support children with autism and their teachers in the complex learning environment of the classroom setting.

In this regard, this section focuses on creating an efficient and innovative toolkit for 3D models to design a variety of visual materials of different daily life scenes which are essential for the learning and development of children with autism. The aim is to provide a friendly learning environment to guarantee that teachers can clearly and effectively convey their expertise and requirements to children with autism. The focal points are to use social stories to enhance awareness, art therapy to help express feelings and enhance self-acceptance, and creative design activities to move from traditional teaching styles to a new enhanced style such as design-based practice.

The plan is to investigate and identify critical design components for several daily events (e.g. start and finish the task; reward and behaviour charts; keep calm and carry on; emotion and well-being; encourage and support routine; design sequences; week planners; meaningful engagement in the learning environment; warm, welcoming and mindful music; and visual communication map) using a case study of design and practice and interviews with teachers. It is anticipated that there will be certain benefits of several design activities (e.g. a variety of visual structures and assemblies, symbols, thinking, understanding, and knowledge) in the therapy of children with autism. In addition, there are particular and obvious components that are important and shared between these designs. As a result, detailed guidelines and toolkits can be simply put together and enhance the effectiveness of outcomes of potential 2D/3D designs.

In this work, toolkits incorporating several design elements are developed which allow for the transformation of lessons into visual stories. The toolkits provide everything required for construction that is crucial to the successful implementation of full virtual construction with visual

stories, including clear instructions regarding how to design and complete the activities using the different elements of the toolkit to create secure and effective shapes and designs for children with autism. The toolkit also allows for separate steps and spaces to withdraw if sensory inputs become overwhelming, without the need to reinitiate the previous steps (e.g. provide opportunities for children with autism to do what they can to feel relaxed and happy). This provides an alternative strategy to the usual method of interaction and facilitates between children with autism and their teachers by using tailored 3D models instead as a starting point for more familiar communication. The design toolkit is developed to be used by children with autism and their teachers and teaching assistants at primary schools as a case study to test its efficacy.

The toolkit aims to break down lesson plans into more readily understandable components and translate tasks and worksheets into an immersive 3D learning experience. Inspired by theatre production, the toolkit will employ appropriate imagery, textures, music, etc. to bring the lesson to life in a way in which children with autism can actively engage with the material at hand whilst also ensuring that the visual, auditory and tactile experience is not overwhelming to the students.

The goal is to assist teachers in modifying their traditional teaching style to incorporate new design-based practice through the adoption of the methodology, design process and tools to be developed in this work, and thus help children with autism to understand and take part in classroom activities more easily. Additionally, the applications of the toolkit that will be developed have the potential to extend beyond the classroom environment. It will highlight the need for an improved interchange between teachers and children with autism and encourage consider using 3D models to communicate their ideas and expertise when designing. It is vital to understand that the toolkits have various potentials, which are all equally important. Visual interaction is a good way of helping them, allowing easy communication and interactions with teachers and teaching assistants.

3.2.2 The Design limitation

Understanding the children's background information is crucially important before starting design work. This is particularly valid when the information is dedicated, as in the case of designing for special educational needs. This applies to the framework of designing a friendly learning environment toolkit. This is intended to get teachers to communicate and convey their thoughts on the designed learning environment completely and openly.

The limitation and guidelines are as follows depicted in Fig. 3.5:

Safety and Security

Children with autism are often reluctant to follow instructions. Hence, it is crucial to have easy-to-follow and safe instructions to keep them focused and to allow the class teachers and teaching assistants to monitor them.

Sensory Integration Activities

Children with autism are often less receptive to sensory stimuli, thus solid multi-sensory 3D designs and activities that will draw their attention will significantly benefit them. Multisensory stimuli promote the visual, physical, and auditory of children.

Clear Physical Structure

They are also can feel emotional security when they are supported and well guided through a surrounding environment. The 2D/3D design of the proposed activities should be clear, disciplined, and well-structured. Preparing toolkits with clear visual boundaries (clear images to let them know what to do easily) and avoiding vagueness and components that might confuse them will create a distinct context for each design activity in association with a given guidelines.

Flexibility in Structure Design

Flexible designs to adapt a wide range of practical skills and various teaching concepts.
The design should allow for modifications easily.

Visual Cues for Direction and Instructions

Children with autism face communication challenges in social settings, repetitive behaviours and limited interests. The toolkit and visual hints and guidelines help them to communicate efficiently. It is important to specify the structure to be followed when presenting specific activities using not only written guidance but also pictures, images, and visual timetables, etc.

Opportunity for Activities to Stimulate Children's Skills and Relieve Stress

Children with autism encounter sadness, stress, and some negative feelings during the day, therefore it is crucial to generate an outlet for these feelings in the designated working area.

Space to Withdraw

Regulating sensory response and preventing sensory overload are crucial objectives of the toolkit for children with autism. A private space to withdraw where they can take a "sensory break" to leave and change themselves over the 3D assembly is essential.

Figure. 3.5. *Design Limitations and Guidelines*

Considering these limitations and guidelines, toolkits with many design components will be created. These components will be showcased in images, depicting how each component can be used and combined. These toolkits will be designed and produced to support primary schools to help develop their awareness of strategies for children with autism to address issues faced with interaction and communication.

As children with autism have particular interests and can struggle with ordinary classroom activities, it is extremely challenging to think of the most appropriate teaching strategy for them. In this regard, it is believed that adapting 2D/3D modelling design in the classroom will lead to numerous benefits (e.g. improved visual, social, and problem-solving skills). The 2D/3D modelling design typically entails fun activities such as forming a 2D/3D character, making interesting images or designing a virtual structure. It is worth noting that this 2D/3D toolkit will complement the ongoing Triple-A project led by Hanley et al. (2020), which will create an online training tool aimed at teachers, whilst in this research the toolkits will be used physically in schools.

3.3 Participants (see section 3.1.5 for a detailed case study design)

3.3.1Educational Context

This activity was undertaken at a Primary School, which included specialist autistic classrooms. The school is in South Shields, Northeast of England, UK, and provides special classes to children with autism aged 3-11 years in different key stages. The school's related data is as follows: A large proportion of children with autism from minority ethnic groups (70%); Gender of entry: mixed; School capacity: 238; Number of pupils: 198; Pupils with SEN support: 23.2%; English is not the first language: 59.1%; Ofsted rating: good. The head teacher was provided with relevant documents and letters describing the overall research.

3.3.2 Research Samples

The number and size of the potential groups were typical class sizes of the designated classrooms in the selected school. Participants were children with autism in primary school, aged between 4 and 6 years old; boys and girls. There were around 6 children in the classroom setting, in addition to their class teachers, and teaching assistants who were also involved.

Critical peer review was carried out by a set of experienced teaching practitioners who have worked with children with autism for several years and have guided learning through classroom interactions. They have also adopted problem-solving techniques to their teaching and learning activities,

monitored problems, and assessed the levels of understanding and progress of their students. This research will allow teaching practitioners to further enhance their interaction with children with autism and improve the outcomes of such students.

A set of around 4 experienced teachers and academic experts in the school were to review the data generated in the case study, passing critical commentary, and mapping it against their own experiences and challenges. This generated the core features and properties of an enhanced participatory design approach to support teachers in continual design processes made to adapt their classrooms to the dynamic needs of their pupils.

3.3.3 Research Activities and Procedure

The research activities were designed with two integrated phases, including: i) Phase One: to prepare and plan for school settings with design practice activities; and ii) Phase Two: to create innovative 3D toolkit designs for school implementation.

Within the planned phases, the following procedure (action research approach) has been followed (details in Table 3 below): Observing (identify a concern); Reflecting (on some possible ways forward and being able to plan a solution); Planning for solutions (take action to try out the solution); and Acting (evaluate and reflect on what has happened, modify practice, and move in a new direction or return to observe, reflect, and act cycle) (Herr and Anderson, 2014; Crouch and Pearce, 2012).

3.3.3.1 Phase One: School Settings and Planned Design Cycles

This study was a collaborative work between the researcher, teachers, teaching assistants (stakeholders), and children with autism in creative design activities, in a series of 22 creative design process sessions. The sessions took place weekly at the children's school (in the classroom setting) and focused on designing visual communication and the use of art therapy. The school was consulted to review the data generated in the case study.

In addition, this research adhered to appropriate ethical considerations, including consent and moral values. Also, all sessions were audio recorded to ensure all discussions were captured (as detailed in the ethics form). This practical study began in January 2022 and followed a series of 28 sessions in two cycles, as described in Table 3, to carry out a detailed design approach (using an action research approach such as planning, acting, observing, and reflecting) with children with autism and their stakeholders (Herr and Anderson, 2014; Crouch and Pearce, 2012).

The planned two cycles are classified as: i) first cycle (22 weeks): to implement the design process approach in the case study. ii) second cycle (6 weeks): to implement the revised processes after optimisation. The structure of the sessions (time, number of sessions per week, activities, individual/group) were determined before the start of the project to accommodate the needs of the children and primary school. The participatory sessions used photographic as well as field notes equipment to document the content of the workshop. The data collected were related to what was discussed verbally during the workshop, as well as any relevant written and/or drawn material such as interviews, feedback, and photos of the children's artwork.

Table 3. *The planned sessions and their description for each cycle.*

	Sessions/ time frame	**Description**
Cycle 1 (Design process) - 22 weeks	***2 Sessions:*** *Initial Observation and Planning (Preparation stage)* ***2 weeks*** *(one day per week). This was updated regularly based on the school's availability. This included two units of analysis: KS1 and reception children with autism - two different settings/groups.*	Observation: was used to get an idea of the current situations and to evaluate the learning styles, inspiration, and emotional and behavioural change of the participants. The planned activities and rationale of the design of the sessions were discussed with the teachers and teaching assistants and their comments and concerns were taken into consideration. Interview preparation: design questions (such as closed-ended questions) for teachers and teaching assistants to obtain the number of children with autism and their specific needs before and after the planned activities. Written field notes to document the verbal content of the interview, when conducted face-to-face. When face-to-face interviews were not achievable, internet-based video conferencing was used (e.g., Team, Skype) to digitally record the audio component only. This stage was intended to: 1. Provide a safe, warm and welcoming learning environment, and a work plan to complete the creative design activities. 2. Build a strong relationship with children with autism and their teachers.

		3. Respect children with autism perspectives and promote opportunities for decision-making. 4. Take notes and collect all the relevant data.
	20 Sessions: Including 1),2) and 3) ***20 weeks*** *(one day per week). This was updated regularly based on the school's availability. This included two units of analysis: KS1 and reception children with autism - two different settings/group.* ***1)*** *Acting (Preparation Stage)*	A criticism-free and safe environment was prepared and assessed through the engagement of the participants, who learned how to use a wide range of art and design materials to build their imagination. In addition, children with autism learned through the creative design approach to follow eight steps such as looking, learning, asking, making, testing, evaluating, selecting, and communicating to enhance thinking skills. Although the creative tasks were already determined for planned sessions, the opportunity for participants to provide their self-initiated work was also be given with full guidance (e.g., visual communication) and professional support. This stage was intended to: 1. Provide visual instructions (supplementing oral instructions) for each session. 2. Provide free materials, preparation approach, and procedure to carry out activities. 3. Integrate instructions into discussions about student work. 4. Divide the planned activities into small steps and keep activities short. 5. Praise and encourage the children to participate with good motivation.
	2) *Planned Activities* (Working Stage)	The issues identified in the preparation stage (such as working in groups, making friends, and improving social perception, communication skills, and sensory sensitives) were considered while planning the session activities by encouraging the participants to overcome them during sessions.

		The sessions were organised to give the participants time in the beginning to gain some confidence by doing free activities prior to full engagement with the planned tasks for the given session. Appropriate time to complete creative design activities and full instructions for each session using visual communication were given. Children were involved in determining the criteria for success of each project, and actively engaged in formative evaluations of their work throughout the design process. The typical working sessions included: 1.Warm-up: providing opportunities for decision making, which allowed the children with autism to engage in a more meaningful manner with their work. 2. Providing sensory activity using a range of different materials, including hard textures (e.g. pink salt for sand) and soft textures (e.g. fleece or fur). Gradual and controlled exposure to a variety of textured art mediums, working with clay, play dough, cardboard, etc., can help children with autism get used to interacting with different textures which they often find overwhelming and overstimulating. 3. Providing creative design instructions step-by-step (visual instruction) to enhance thinking, communication, and imagination skills for children with autism, such as using numbers to complete design work, teaching them how to start and finish work, and how to ask for help and/or extra materials to complete the task. 4. Ending each session with praise, encouragement, and rewards to encourage good behaviour in children with autism as well as self-esteem and self-acceptance.

		5. Enhancing visual communications tools (e.g. 2D/3D toolkit and models) to help children with autism to understand and communicate complex ideas, information, and realities will be adopted.
	3) *Observation and Monitoring* *(Evaluation stage)*	After the sessions, interviews were carried out, with the support of the teachers and teaching assistants, to recognise the alterations made in the participants' learning style, inspiration, and behaviour and emotional state. The participants were monitored, observed, and evaluated to quantify improved competence and engagement in the creative design sessions. Analysis and evaluation: while participants engaged in practice activities, the performance and engagement of the participants were carefully observed and analysed using Merriam's analysis process, considering the balance of developed sessions, autonomy, competence, and understanding of the participants. The effectiveness of the developed sessions and design work were assessed to identify appropriate outcome measures and address the effectiveness of creative design process interventions. Full observations were carried out to understand the children's behaviour and evaluate the new learning inspiration and emotional wellbeing of the participants. The outcome of the planned activities and the design of the sessions were discussed with the stakeholders and their perspectives and concerns were taken into consideration.
Cycle 2 (Optimisation) -	***1 Session*** *Refection and working with professionals (Reflection stage)* ***1 week*** *(one day per week). This was updated*	Workshop with experienced teachers: a workshop session with a range of experienced teachers (and academic experts) was held. The participants reviewed the data generated and analysed, passing critical commentary, and mapping it against their own experiences and challenges.

	regularly based on the school's availability. This included two units of analysis: KS1 and reception children with autism - two different settings/group	This generated the core features of design activities to support teachers in continual design processes made to adapt their classroom to the dynamic needs of their pupils.
	5 Sessions: Including 1), 2) and 3) ***5 weeks*** *(one day per week). This was updated regularly based on the school's availability. This included two units of analysis: KS1 and reception children with autism - two different settings/group.* ***1)*** *Planning and Acting* *(Preparation stage)*	Preparing for the optimised planned activities based on the analysis of the Cycle 1 outcomes. Observations, reflections and working with professionals in the first Cycle provided comprehensive inputs to re-plan the sessions and activities to accommodate any specific needs that appeared during the first iteration of the work. The new planned activities and rationale of the design of the sessions were discussed with the teachers and teaching assistants and their comments and concerns were taken into consideration. A full review of the learning environment was carried out to assess the performance of the children with autism in terms of engagement in all designed activities based on all data, which have been collected and analysed in Cycle 1. In addition, new creative tasks were identified for the planned optimised sessions.
	2) *Planned Activities* *(Working Stage)*	The issues identified in Cycle 1 were considered while planning the new enhanced session activities. The new sessions were organised to give the participants time to reflect on what they have done in previous sessions and provide a new way to approach the planned activities. The typical working sessions included similar activities as per Cycle 1. However, new activities or approaches to participate were used based on the outcomes of the previous sessions.
	3) *Evaluation, Reflection, and Recommendations*	The outcome of the sessions and reflection on the participatory design process sessions were carried out by receiving feedback from children with autism using face images rating scale (such as awful, not very good, good, very good, and brilliant), and from

		the stakeholders using questionnaires. Clear thoughts on how the design process and participatory qualitative research will impact children with autism learning ability in a positive way was provided. The overall review of the project and associated learning environment was summarised.

3.3.3.2 Phase Two: 2D/3D Toolkit Design and Implementation

This phase included collaboration between the researcher, class teachers, teaching assistants, and children with autism in the creative design activities process (using the 2D/3D toolkit). This toolkit will enhance visual attention by guiding tasks step-by-step to explain the whole story for children with autism. The toolkit will provide a wide range of materials with varying textures, colours, etc. and enhance problem-solving skills in appropriate ways to work with children with autism effectively.

The 2D/3D design creative activities approach involved six steps, as presented below. Each step was allocated 1-2 hours each week (within the planned activities and sessions), for a total of 22 weeks, in a primary school. Participants are described in Section 3.3. Photography and field notes were used to document the content of the workshop. The data collected were related to what was discussed verbally during the workshop, as well as any relevant written and/or drawn material (if applicable). As stated in Section 3.3.3.1, this research adhered to ethical considerations, including consent and moral values.

The 2D/3D toolkit design creative activities approach steps are as follows:

1. Introducing the toolkit to the class teachers and teaching assistants in the classroom setting;

2. Preparation stage (e.g., observe, engage, watch, and listen);

3. Planned activities based on the school curriculum to support teachers in the classroom setting;

4. Test to fine-tune prototypes and solutions and to learn about the needs of the user (i.e. children with autism);

5. Observation and monitoring of the outcomes; and

6. Evaluation, reflection, feedback, and recommendations.

In both phases, the study focused on the principles of social communication skills with children with autism, making sure to:

- Explain ideas and information clearly throughout the day to eliminate anxiety about what will be happening later, keeping children informed through visual communication (e.g. symbols, toolkit).

- Practice new skills in various situations once the information is presented.

- Pay attention and listen to them carefully using both verbal and non-verbal approaches.

- Support them and find out what they like, enjoy doing, and what is an important task to them.

- Provide gentle support and adequate space to withdraw if needed as they may be anxious about physical proximity with an adult.

- Keep a reliable daily routine to enhance emotional regulation.

3.4 Data Collection Methods and Analysis

Qualitative research (Maykut and Morehouse, 1994) emphasises data collection, which is explanatory, and comprised of observations, images, symbols, and words. A variety of data collection methods were selected to help the researcher directly answer the research questions and to assess the effectiveness of the developed theoretical framework throughout this research at various stages within the design process. Data collection and analysis methods within dedicated research activities were employed to allow the researcher, teachers, and teaching assistants to build a stimulating classroom learning environment which encourages children with autism engagement. The questionnaires were utilised to determine the thoughts of the participants regarding their involvement in the study as well as their experiences in similar complex classroom settings. The work was detailed through written observational reports supported and documented by photos and field notes.

The researcher's methodological experiences in engaging children with autism in qualitative research (see Chapter 1) were adopted and she carried out questionnaires and interviews, which were transcribed and coded into main themes and sub-themes. Throughout conversations with teachers and interactions with children with autism, the researcher maintained an appropriate balance of being close enough to the children to obtain their confidence and facilitate good interaction with them, but not too close (e.g. to avoid social desirability prejudice). The researcher also followed her own friendly and open-minded approach in the interviews (e.g. being respectful and not intrusive).

In this research, the methodological start point was based on generally accepted guidelines for research involving children which describe how the researcher adapted an exploratory case study (Merriam, 1998) and considered the design thinking/participatory design settings and toolkits, including the language used and questions asked as children with autism are sensitive towards biased or leading questions (Kirk, 2007). The methodological approach was based on the understanding that autism might cause problems in communication and social interactions (Einarsdottir and Egilson, 2016). Thus, children with autism were engaged according to their individual preferences regarding communication styles (e.g. playing while speaking, sitting) and work topics to stimulate their decision-making ability.

3.4.1 Data collection

The researcher relied on the literature review and her experiences to produce the evidence in different ways, using various explanations. Hence, the data were gathered in a coherent and integrated manner through different design thinking/participatory design creative sessions with children with autism and their teachers and teaching assistants, including participant observation (e.g. field notes), structured interviews (e.g. closed-ended-questions), and semi-structured interviews (e.g. open-ended questions; a set of topics to act as a guide to enable interview conversation) (see Table 4). It is important to mention that it was useful to start with limited and precise questions, particularly focusing on the child's current state and well-being, and then explaining the researcher's objectives regarding communication. The collected data were integrated through the structure of the design thinking/participatory design sessions and process, pre-session stage, preparation stage and working stage.

Table 4. *Activities and tools utilised by the researcher related to the data gathering.*

Data collection methods/purpose	Approach	Interaction/Sample
Observations: Gathered comprehensive information about the children with autism and their culture and behaviours, and decided on any potential alterations to the learning environment.	Written field notes.	All children, specific group of children with autism, and their teachers in the classroom setting.
Photos: Supported the written observations through visual proof such as the artwork of children with autism. Evidence of children's learning development through design processes.	Photographs: modifications implementation to support written observation.	Children with autism and their teachers in the classroom setting.
Interviews: Acquired class teachers' and teaching assistants' perceptions of the complex learning environment and communication and interactions with children with autism. Follow up interviews to keep updated on progress.	Semi-structured and structured interviews as well as unstructured interviews (conversation with stakeholders).	Teachers and teaching assistants in the classroom setting.
Questionnaires/Feedback: Obtained and understood the class teachers' and teaching assistants' opinions and experiences related to the design-led sessions and toolkits. Follow up questions and feedback to keep updated on progress.	A series of written closed-end questions marked by informants.	Teachers and teaching assistants in the classroom setting.
Sensory description: Acknowledged sensory obstacles facing children with autism and adapted the session accordingly.	Sensory profiles cards and different textures.	Children with autism in the classroom setting.
Personal meetings with decision-making staff: Received continuous feedback from the head teacher, class teachers and teaching assistants regarding the design sessions.	One-to-one meetings (physical and/or virtual meetings).	Teachers and teaching assistants in the classroom setting as well as the head teacher.

The participants were asked to engage in creative design workshops which were implemented in 2 cycles: 1) in the designed process approach in the case study; and 2) to implement the revised processes after optimisation. Data gathering was achieved through the design sessions and process, pre-session stage, preparation stage and working stage (see Table 3). An example of an observation session and practical examples are presented in Appendix A.

It is worth noting that children with autism are regularly represented by their teachers. It is crucial to establish trust with children with autism as it can be difficult for them to understand what a conversation with a stranger will require, and they will need guidance in advance. It was also important to prepare for more unusual communication styles (e.g. having dialogue while they are turning around, talking without eye contact or imitation).

Furthermore, the research emphasises both theoretical propositions and data triangulation (e.g. multiple sources of data gathering) and investigator triangulation (e.g. different respondents: teachers and teaching assistants). The theoretical propositions derived from the developed theoretical framework were presented before data collection to define how and what data will be gathered in the case study (see Table 5). They are effective in such an exploratory case study to provide a focal point to the data gathering and avoid the gathering of inappropriate data. The theoretical proposition connects the required data-gathering techniques to each unit of analysis, therefore offering a clear guide to what needs to be investigated, the evidence required to answer the research questions (two units of analysis in the case study), and how the data and information should be collected. Cohen et al. (2007) defined "Triangulation" as a technique to explain the complexity and richness of human behaviours by investigating it from several perspectives which can take several forms (e.g. data triangulation (multiple sources); investigator triangulation (different investigators perspectives); theoretical methods and perspectives) (Patton, 2002).

Table 5. *Example of a theoretical proposition and associated data methods (a session with a unit of analysis: KSI/Reception).*

Proposition	**Focus of Data to be gathered**	**Data gathering methods**
The social challenges, learning ability and behaviours of children with autism before and after attending the tailored	Children's performance and presentation before and after the sessions; Observations of the children with autism within the design session - e.g. any signs of engagement problems;	Semi-structured interviews with teachers and teaching assistants; Photographs of children with autism explaining the work and

participatory design-led sessions.	Own note making and reflective diaries; Comments from teachers regarding modifications to better accommodate their needs; Perception of the impact on children's behaviours	toolkit; Sensory observations.

To achieve data triangulation, multiple sources of data gathering (e.g. different respondents: teachers and teaching assistants) were used to obtain evidence in support of the theoretical propositions as a useful way of improving the legality of the research outcomes. The researcher considered that assessment and comparison of different participants' views highlight exciting differences within the data.

3.4.1.1 Classroom Observations

Observation is a useful methodology to advise and understand the development of an ideal learning environment for children with autism, as it provides the opportunity for their participation and engagement within their learning environment. Hence, it is vital to understand the nature of the children with autism involved in the study and integrate such observations to build up an evidence-based structure to advise appropriate practices. Cohen et al. (2000) underlined that observation analyses are superior to surveys and tests. Denscombe (2007) also underlined that it is important to observe what happens rather than relying on what individuals usually say they do or think to do.

3.4.1.2 Types of Observations

Two main aspects of observation we considered (Cohen et al., 2000): i) unstructured observation, which includes the researcher's interaction with children with autism to fully build a comprehensive understanding of their behaviours and mannerisms (qualitative data collection); ii) structured observation, which focuses on the study of classroom-based interactions and collection of quantitative data to enable comparisons, understanding trends and patterns of the children's behaviours. Both practices mainly allow data collection directly and in real-life natural classroom settings situations.

The unstructured observations allowed the researcher to make field notes (e.g. helping to notice details and identify what happens) of the behaviours of the children with autism, teachers and teaching assistants and make comments with potential importance to the research. Hence, it was important for the researcher to spend an appropriate period integrating with children with autism

in the classroom to allow them to become comfortable and familiar with the researcher's presence in the classroom. This period also allowed the researcher to build a full understanding of individuals' behaviours and common attitudes.

Engagement in the learning environment is known to be a critical facilitating factor for the effective learning of children with autism. It is important to measure the engagement of children with autism in a range of different activities using the two observation approaches.

3.4.1.3 Interviews

The interviews consisted of guided discussions with the main goal of obtaining and analysing related data linked to the research activities. In this research, the teachers involved in the interviews were aware of the main purpose of this research, and the importance of the investigation, collection of data, and analysis of the outcomes.

There are three different types of interviews, structured (face-to-face meetings where closed inquiries are questioned), semi-structured (a set of topics to act as a guide to enable interview conversation) and unstructured (the researcher leads the occurring discussions) interviews (Cousin, 2009; Denscombe, 2007).

The three types of interviews were considered to understand the participants' behaviour, beliefs, and opinions, understand social interactions between children with autism, teachers, and teaching assistants, give voice to issues of certain populations that may be overlooked and examine sensitive and complex issues in detail (e.g. sensory sensitive, social communication, emotions), and provide detail and context to research issues.

3.4.1.4 Sensory Description

Sensory descriptions can help understand children with autism's sensory patterns and managing processes. Children with autism show a range of regulatory difficulties and sensory treatments have been developed which can have a significant impact on the suitability of the educational environment tailored for them (Bogdashina, 2003). Sensory descriptions are vital in the data-gathering process to facilitate recognizing the complexities of children with autism sensory processing and to build strategies for managing their daily practices (Dunn, 2006; Shabha, 2006).

3.4.1.5 Data Collection from Classroom Settings

The uses and evaluation of the developed 2D/3D toolkit models were considered using participatory design such as planning, acting, observing, and reflecting (Herr and Anderson, 2014; Crouch and Pearce, 2012) to run creative design activities in the classroom setting.

In this stage, the researcher (cycle 1) started with sessions 1-2: Initial observation (direct observation of KS1 and reception class using field notes) and planning (preparation stage), including all children within the classroom setting, both with and without special educational needs, as well as the class teacher and teaching assistants. This was followed by 20 other sessions, including three key stages: 1) acting (preparation stage), 2) planning activities (working stage), and 3) observation and monitoring (evaluation stage). The researcher worked with stakeholders (e.g. children with autism, the class teacher, and teaching assistants) as co-designers to develop prototypes, collaborating in the creative design process session-by-session to enhance the learning environment. During the creative design process, knowledge and information were exchanged between the researcher, class teacher, and teaching assistants to help and support children with autism in their learning and development.

This study used three key research elements) design thinking to enhance problem-solving skills, memory skills, concentration, sensory sensitivity, decision-making, visual attention, and thinking creatively and imaginatively; 2) participatory design to encourage engagement, work with stakeholders as co-designers, and measurement level of the participant; and 3) art therapy to improved self-esteem, self-acceptance, self-expression, and self-express. Also, during the creative design process, the researcher used observation (field notes- method), interviews (semi-structured, unstructured, and structured), and photos of the children with autism artwork to collect and analyse data based on social communication skills between children with autism and their teachers and the teacher's opinions and perceptive to meet children with autism needs, and to measure the level of participation and active engagement of the children with autism in the creative design process. The creative design process covered 22 sessions to explain how data was collected and will be analysed, as depicted in (see Table 6).

Table 6. *Designed 2D/3D toolkit within creative design process sessions.*

Session of Creative Design Process	**Aims**	**Session Title and Date (using designed toolkit)**	**Benefit**	**Participants**
(1) to develop prototype, (start of creative design sessions).	Work and preparation stage. Using visual instructions step-by-step.	Warm, welcoming and mindful music for children with autism, (18/01/2022).	Improved engagement.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(2) to develop prototype.	Children with autism using shapes and art therapy (AT).	Keep calm and carry-on, (01/02/2022).	Improved memory, self-esteem, and problem-solving skills.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(3) to develop prototype.	Children with autism practice using social stories and art therapy (AT).	Don't talk with strangers, (08/02/2022).	Improved awareness feelings by using social stories, and self-expression.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(4) to develop prototype.	Children with autism practice using different textures, such as soft and hard textures.	Using different textures (e.g., soft and hard textures), (15/02/2022).	Improved sensory, concentration, and problem-solving skills.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(5) to develop prototype.	Children with autism practice using art therapy (AT) and working with shapes.	Using art therapy, (01/03/2022).	Improved emotions (self-acceptance), concentration, and memory skills.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(6) to develop prototype, (mid of creative design sessions).	Children with autism practice using shapes as well as drawing faces (e.g., happy, and/or sad face).	Using shapes (e.g. squares, circles, semi-circles, and drawing faces (e.g. happy and/or sad face), (08/03/2022).	Improved emotions (self-expression), problem-solving, and memory skills.	Children with autism **(KS1)**, class teacher, and teaching assistants.

(7) to develop prototype.	Children with autism practice using collage art (e.g., black, white, and working inside the frame).	Using collage art (e.g., black, white, and working inside the frame), (22/03/2022).	Improved memory, problem-solving, concentration skills, and creative and imaginative thinking.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(8) to develop prototype.	Children with autism practice decision-making, such as selecting which project they want to do (based on children's interests).	Based on children's interests (e.g., clock, characters, and textures), (29/03/2022).	Improved decision-making, problem-solving skills, self-confidence, and creative and imaginative thinking.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(9) to develop prototype.	Children with autism practice using different textures and art therapy (AT).	Based on warm/cold colours (e.g., animals in warm landscapes (e.g. desert)/cold landscapes (e.g. snow), and textures), (05/04/2022).	Improved self-expression, sensory, problem-solving skills, and creative and imaginative thinking.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(10) to develop prototype.	Children with autism practice using collage art, art therapy (AT), and problem-solving skills.	Africa landscape, collage art (such as tree, sun, and animals), and use of art therapy, (03/05/2022).	Improved self-confidence, problem-solving, memory skills, and creative and imaginative thinking.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(11) to develop prototype.	Children with autism practice using problem-solving skills (e.g. engaging with interactive	Save the cat (e.g., build your own story using a cat, tree, ladder, and walking steps), (10/05/2022).	Improved creative and imaginative thinking, self-expression,	Children with autism **(KS1)**, class teacher, and teaching assistants.

	arts and crafts with movable parts to create a specific scenario or story, such as saving a cat from a tree).		decision-making, problem-solving sensory, concentration, and memory skills.	
(12) to develop prototype.	Children with autism practice using problem-solving concentration, and memory skills.	Japanese landscape- collage art (e.g., draw sky using numbers in order from 1-3, draw tree using sizes such as big and small, draw flowers using numbers in order from 1-7, and create a 3D monkey to run between the mountain, trees, and flowers, (17/05/2022).	Improved creative and imaginative thinking, problem-solving concentration, and memory skills.	Children with autism **(KS1)**, class teacher, and teaching assistants.
(13) (teamwork project), (final of creative design sessions).	Encourage children (including children with autism) in the classroom setting to work with professionals and teachers as co-designers. Enhance children's engagement skills and teach them how to create a meaningful landscape using	Sandcastle, (using collage art, painting, glue, glitter, hessian fabric, foam board, pink salt, and seashells), (07/06/2022).	Improved creative and imaginative thinking, self-expression, decision-making, problem-solving sensory, concentration, and memory skills.	All children in the classroom setting **(KS1)**, children with autism, class teacher, and teaching assistants.

	a variety of materials.			
(14) to develop prototype, (start of creative design sessions).	Work and preparation stage. Using visual instructions step-by-step.	Blue chicken, (22/03/2022).	Improved engagement.	Children with autism **(reception class)**, class teacher, and teaching assistants.
(15) to develop prototype.	Children with autism practice using shapes, glue, and glitter to be familiar with circle shapes, numbers, and colours.	Count donuts, (29/03/2022).	Improved emotions (self-esteem), concentration, and memory skills.	Children with autism **(reception class)**, class teacher, and teaching assistants.
(16) to develop prototype, (mid of creative design sessions).	Children with autism practice using colours to create a meaningful landscape painting.	Using art therapy (AT), (05/04/2022).	Improved emotions (self-expression), and sensory skills.	Children with autism **(reception class)**, class teacher, and teaching assistants.
(17) to develop prototype.	Children with autism practice using textures, glue, and glitter.	The squirrel twins, (03/05/2022).	Improved creative and imaginative thinking, sensory, concentration, and memory skills.	Children with autism **(reception class)**, class teacher, and teaching assistants.
(18) to develop prototype.	Children with autism practice using collage art (e.g., buttons for eyes, stake for wires, and trees, painting, glue, and glitter).	The crows, (10/05/2022).	Improved emotions (self-confidence), problem-solving, concentration, and memory skills.	Children with autism **(reception class)**, class teacher, and teaching assistants.
(19) to develop prototype.	Children with autism practice	The light house, painting, use	Improved creative and	Children with autism

	using art therapy (AT), collage art such as square shapes.	square shapes (e.g., boats in different sizes), and build a 3D fish to swim in the sea, (17/05/2022).	imaginative thinking, emotion (self-esteem), problem-solving concentration, and memory skills.	**(reception class)**, class teacher, and teaching assistants.
(20) (teamwork project), (final of creative design sessions).	Encourage children (including children with autism) in the classroom setting to work with professionals and teachers as co-designers. Enhance children's engagement skills and teach them how to create a meaningful landscape using a variety of materials.	Friendship, (07/06/2022).	Improved creative and imaginative thinking, self-expression, decision-making, problem-solving sensory, concentration, and memory skills.	All children in the classroom setting **(reception class)**, children with autism, class teacher, and teaching assistants.

Implications of the creative design process on children with autism and their teachers

The researcher designed 22 creative design process sessions (cycle 1) for participants of children with autism in KS1, reception class, and their teachers. Each session had different ideas, techniques, and visual materials to meet children with autism and their teachers' needs. The researcher gathered three key elements in this workshop, design thinking, participatory design, and art therapy, to encourage children with autism to improve their skills such as memory, sensory, problem-solving, concentration, decision-making, and creative thinking as well as enhance their well-being. Also, this workshop was collaborative with the class teachers and teaching assistants involved with children with autism in the classroom setting. The workshop was intended to introduce a new teaching style based on using visual communication (2D/3D toolkits), instead of the old teaching style based on

oral instructions and the use of the whiteboard, as children with autism need different methods of learning to support their learning and development. The researcher built her hypothesis based on the literature review and collected data from different sources (observations, interviews, and photos of children with autism artwork). After investigating the work of other researchers in the same field, the researcher decided that using only one or two elements (e.g. design thinking and participatory design) is not enough to encourage children with autism to fully engage in the workshop and enhance their skills, as each child with autism with has different problems, needs, and interests. To create solutions for these problems, needs, and interests, more than one or two elements (e.g. design thinking and participatory design) are required. The researcher thus used the three key elements of design thinking participatory design, and art therapy, with each element improving children with autism skills differently. For Instance, design thinking was used to enhance children with autism's problem-solving, memory, and concentration skills. Participatory design was used to enhance the children with autism engagement and communication with others. Finally, art therapy was used to enhance children with autism's senses, emotions, and well-being. Children with autism, and children with special educational needs in general, need a new model to improve their learning and development such as 2D/3D toolkits (visual communication). The creative design process sessions used 2D/3D toolkits as a method to encourage children with autism and their teachers in the classroom setting to work as co-designers, changing the teaching style from oral instructions to visual instructions, and collecting data. This study created a new creative solution (2D/3D toolkits-visual communication) for existing problems such as social communication skills between children with autism and their teachers in the classroom setting, offering an alternative communicative medium that focuses on visual rather than oral learning.

3.4.2 Data Analysis

Data analysis emphasises examination, categorisation, tabulation, and merging of evidence to deliver the plans of the case study. The thematic analysis technique (Braun and Clarke, 2006) is selected within an "inductive approach" to allow the data to be coded (inductive coding is a bottom-up approach starting without codes and then developing codes as the data set is analysed). It allows the substantial qualitative data sets to be characterised in a reduced yet significant form and enables a unified method of analysis across the data collected in the case study. Thematic analysis (as shown in Fig. 3.7) is viewed as a manageable logical approach and fits with the proposed method of data collection.

The researcher handled the data with particular research questions in mind. It is established that the method can be used to achieve various analyses within several frameworks and be performed

in different ways (Fereday and Muir-Cochrane, 2006). Though this flexibility may be considered advantageous, it may lead to a lack of clarity within the literature when it comes to how and when thematic analysis should be performed (Braun and Clarke; 2006). Hence, the researcher was also mindful that it is important to be informed about how the theoretical framework will be constructed and the processes to follow when reporting the thematic analysis outcomes (as shown in Fig. 3.6).

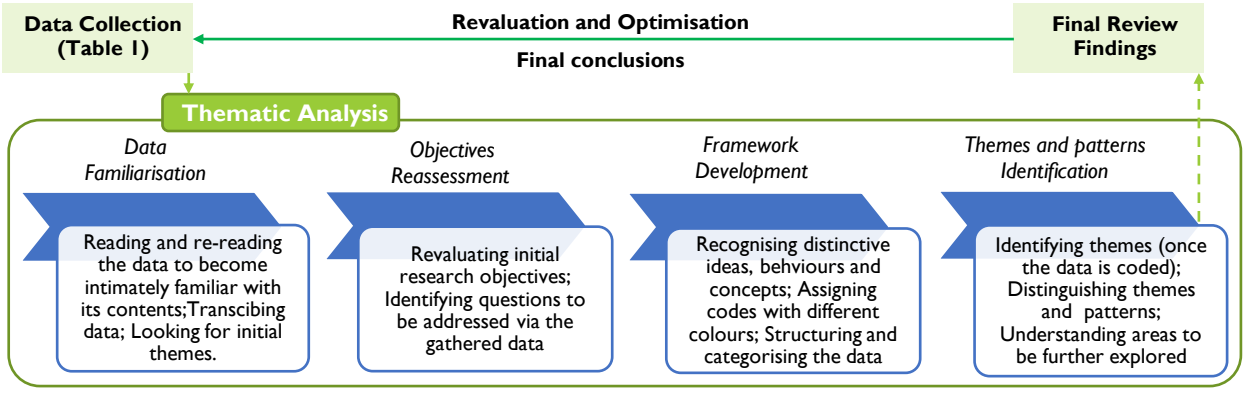


Figure. 3.6. *Data collection and analysis approaches (session with units of analysis: KSI/Reception)*

It is acknowledged that two different states are being represented in the case study (see Section 3.1.5) (e.g. KS1 and reception groups with their teachers and teaching assistants) and thus it was essential to regard the different participants' viewpoints with equal consideration. To allow a process of data triangulation through the thematic analysis, whilst maintaining each participant's viewpoints, the following was considered: i) Ensuring participant viewpoints are recorded into different coloured notes while searching themes from coded sections of original text/observations; ii) Identifying generated/basic themes while creating the thematic map; iii) Combining coded notes from different participants to see if they will create a common theme and recording using different colours, ensuring that individual views are identifiable as distinct contributions, etc. This enabled the researcher to follow all collected data from all participants and create an image of the different views and their interactions within the case study.

3.4.3 Data Reporting, Validating and Reliability

While reporting a case study's outcomes, several strategies (such as thematic analysis, categorical analysis, and narrative analysis) need to be developed to complete the task and find the right answers to the research questions. Once required data were collected from all the sources (all information gathered in the study that is relevant to the research questions) and analysed, a report was prepared

to identify the findings, to articulate the event, situations, and activities under investigation, to reflect on the existing related literature and to highlight how that literature informs the research questions.

It is important to guarantee the validity and reliability of the developed case study to increase the credibility of the research findings. This was considered by comparing different research methods used to investigate the complex learning environment of the classroom with children with autism and how the developed case study correlates with them. In addition, the process described by Merriam (1998) using long-term observation, participatory research, and disclosure of research bias was considered. Moreover, the case study protocols and databases as well as the researcher's position with regards to this study were considered to ensure reliability. In addition, this study followed key steps to ensure reliability and validity, such as researcher reflectivity and reflexivity, internal validity (considering if the devised coding system/rating scale we have devised is appropriate to the aims and objectives), and external validity and reliability (do the findings 'fit' with other studies in the field?).

The researcher was mindful that the reliability and validity of the collected data as well as the methodological approach and ethical principles are important tasks to be considered. The steps taken in the data collection and analysis phases to make sure the research showed both reliability and validity are presented (see Table 7).

Table 7. *Steps were taken to assure reliability and validity.*

Validity	**Reliability**
i) Data collection (Use of data triangulation using multiple sources of evidence; Make sure data is a true description of the experiences of participants by checking comments via interviews).	i) Data collection (Methods are operationally described in detail to make sure they are reproduced; Clarity of data collection and analysis: precise questions for interviews).
ii) Data analysis (Retain an observable sequence of data analysis and evidence from the original text through to the thematic analysis).	ii) Data analysis (Thematic maps present the sequence of evidence from the original collected data to the conclusion).

3.5 Ethical Consideration

This study ensured respect, dignity, and safety for children with autism and their teachers and teaching staff when gathering information through observations, interviews, and questionnaires. For instance, when processing the research design, the researcher followed certain steps to ensure respect, dignity, and safety for all participants, including:

- Taking every precaution to maintain confidentiality and to ensure privacy.
- Asking permission and gaining consent to take and/or use any footage of the child and their work.
- Understanding that the child has the right not to take part in research activities.
- Being respectful and keeping a reasonable amount of space between the researcher and the child.
- Seeing each child as a unique individual who has their perspectives, feelings, interests, and way of socializing, along with their cultural context, belief systems, and values.
- Informing the child about the purpose of the observation.
- Sharing information with the child and family about what has been observed when appropriate.
- Being aware that photos and observation data should be collected in a friendly way.
- Ensuring that observation evidence is used only for the purposes intended.
- Handling photos and data with care and sensitivity, and always storing information securely.
- Realising that a child's reactions, behaviours, and conversations may not be what we expect, and therefore we should refrain from being judgmental or tainted by our cultural biases.

This study received ethical approval from Northumbria University and the University of Sunderland (application reference 26630).

Chapter 4: Results, Discussion, and Interpretation of the Data

This chapter presents the outcomes of the case study within the school setting, evaluating the children with autism engagement with the learning materials, communication with teachers, and overall performance in the complex classroom environment. This chapter also discusses the added value of the developed design process and toolkits on the children's engagement, from the underlying theory to the final investigation using the developed methodology. In addition, this chapter presents formative discussions of the crucial findings and contributions to the knowledge and proposes solutions to fill the gap and address problems identified by the literature review using these findings.

The research activities and procedures described in Section 3.3.3 were developed and designed in two phases: i) Phase one: design practice activities in the school setting; and ii) Phase two: innovative 2D/3D toolkit designs for school implementation. Two cycles, namely Cycle 1 (Design process) - 22 weeks, and Cycle 2 (Optimisation) - 6 weeks, were considered (see Table 3; Section 3.3.3; See Table 8; Section 4.4). The full descriptions and results of both cycles are presented below:

4.1 Cycle 1 (Design Process)

4.1.1 Participant Observations and Interviews: A first set of designed questions of the interviews with the class teacher on barriers and needs of the stakeholders as well as a first set of questionaries on the influences of the creative designs and engagements of children with autism are prepared and provided to the teaching assistants to understand the specific needs before and after the planned activities. The interview questions are discussed, face-to-face, with the class teachers. It is important to note that these will be ongoing activities to create more interviews and gain more information via the questionnaires, as a result, the researcher will update the planned sessions and design activities as well as monitor processes to optimise the development and engagements of the sessions.

Examples of Participants Observations: A narrative observation used dates and time of observation (e.g., started and ended); a description of the context in which the observation was being made, and descriptions of what happened. This was an observation from (KS1) in a classroom setting at a School in South Shields, NE, England (this was the main school for the case study).

Observation 1:

Date: 13/01/2022

Start time: 9.00 am.

End Time: 12.00 pm.

Place: A Primary School

Key Stage: KS1

Children aged: 5-6 years old

No. of pupils/ staff: 25

Class Teacher: -

Description of observation:

The classroom setting included furniture, whiteboards, reading books, pencils, and papers, birthday calendars, educational materials regarding numbers, letters, shapes, and the four-yearly seasons, art, play areas, lights, and colourful decoration. This participant observation focused on the behaviour, social interaction, and social communication skills between children with autism, class teachers, and teaching assistants (as shown in Fig. 4.1).

Figure. 4.1. *Classroom setting (KS-1)*

At 9.00. The class teacher began her lesson with the children with English phonics and spelling (oral instructions). The teaching assistants helped the children follow the teacher's instructions inside and outside of the classroom setting, paying particular attention to the children with autism. The teaching assistants used visual materials (basic materials as shown in Fig. 4.2) to help the children with autism cope with the lesson.

Figure. 4.2. *Basic visual materials used in a classroom setting (KS-1)*

At 10.00. The class teacher and teaching assistants took the children to practice the English language in different ways, using PowerPoint and musical methods such as songs and piano activities with the music teacher. All children had the opportunity to engage in these different teaching practices, however, the children with autism struggled to understand the given information and were not able to follow the instructions (orally and/or using PowerPoint). Rather, the children with autism demonstrated a tendency to dance to the music without necessarily comprehending the educational purpose of the activity.

At 11.00. The children returned to the classroom to start the maths lesson. Each child was given a whiteboard to practice the maths lesson following the class teacher's instructions. Whereas most of the children could easily follow the instructions (orally and/or using the whiteboard), the children with autism once again struggled to do so. In this case, the children needed to work with the teaching assistants in the classroom using basic visual materials to cope with the maths lesson and help them finish the work with the teaching assistants' support (one-to-one support). Later, before lunchtime, the class teacher read a story using a whiteboard for all the children in the classroom setting. The title of the story was *The Emperor's New Clothes*. Similarly to the English, music, and maths lessons, most of the children in the classroom setting were able to understand the information and follow the class teacher's instructions, except for the children with autism.

Observation 2: This was an observation of the Reception class at the School in South Shields, NE, England.

Date: 16/03/2022

Start time: 1.00 am.

End Time: 2.00 pm.

Place: A Primary School

Key Stage: Reception

Children aged: 4-5 years old

No. of pupils/ staff: 16

Class Teacher: -

Description of observation:

The classroom setting included furniture, whiteboards, reading books, pencils, paper, birthday calendars, educational materials regarding numbers, letters, shapes, and the four yearly seasons, art, play areas, lights, and colourful decorations. This participant observation focused on the behaviour, social interaction, and social communication skills between children, class teachers, and teaching assistants.

At 1.00. The class teacher began by introducing me to all the children in the classroom setting. Then, we discussed my research project, why I was there, and how I would support children with special educational needs in general, and with autism in particular. The class teacher gave me background on the children with autism needs. For example, the teacher highlighted that they express delays in speaking, poor memory and communication skills, and attention problems. I observed that teaching assistants were not enough to support the children one-on-one. The children were friendly and open to communicating with me and we shared paintings, talked, and played together. The class teacher worked with all children inside the classroom and outside the classroom to support children one-on-one and/or in small groups.

A Sample Interview (1) Questions in the Classroom Settings

(Barriers and needs of stakeholders)

Key Stakeholders	**What barrier and challenges does the Stakeholder's face?**	**What does Stakeholder's need and want?**	**Design meets the problem and create solution?**	**Children with autism**
Teachers, and Teaching assistants	1. Poor social communication skills 2. Lake of understanding the knowledge, information, and feelings (e.g. verbal and non-verbal) 3. Language difficulties (e.g. reading, writing, and spelling) 4. Sensory issues (e.g. light and noise) 5. Attention problems 6. Emotion dysregulation (e.g. anger, frustration, and anxiety) 7. Narrow range of interests and activities 8. Difficulty to change and transition behaviour and/or activity 9. Poor memory skills			**Key stage**

Interview Questions in the Classroom Settings

Key Stakeholders	What barrier and challenges does the Stakeholder's face?	What does Stakeholder's need and want?	Design meets the problem and create solution?	Children with ASD
Teachers, Teaching staff, and Parents/Carer	1. Poor social communication skills. 2.Lake of understanding the knowledge, information, and feelings (e.g., verbal, and non-verbal). 3.Language difficulties (e.g., reading, writing, and spelling). 4.Sensory issues (e.g., light and noise). 5.Attention problems. 6.Emotion dysregulation (e.g., anger, frustrated, and anxiety). 7.Narrow range of interests and activities. 8.Difficulty to change and transition behaviour and/or activity. 9.Poor memory skills.	Support to participate appropriately in a two way interaction with adults and peers	The activities allowed for this exposure.	Reception Class
		Support listening and attention	Small group/ quiet space with resources pre prepared allowed this	
		Support/ preparation around transitions back to the classroom	The Reception children were able to return calmly because they had something to take away	

(1) **Interview Questions in the Classroom Settings**

Key Stakeholders	What barrier and challenges does the Stakeholder's face?	What does Stakeholder's need and want?	Design meets the problem and create solution?	Children with ASD
Teachers, Teaching staff, and Parents/Carer	1. Poor social communication skills. 2.Lake of understanding the knowledge, information, and feelings (e.g., verbal and non-verbal). 3.Language difficulties (e.g., reading, writing, and spelling). 4.Sensory issues (e.g., light and noise). 5.Attention problems. 6.Emotion dysregulation (e.g., anger, frustrated, and anxiety). 7.Narrow range of interests and activities. 8.Difficulty to change and transition behaviour and/or activity. 9.Poor memory skills.	To express needs emotions "Ask for help" (2) Self Regulation of emotions (3) To read and write with increasing independence (4) Develop resilience to cope with changing (5) Focus for increasing periods of time (6) See 1/2 (7) To assess a wider range of activities (8) To Manage transitions	• Involving autistic children in the design process (workshops) to enhance social Communication, self-Confidence, self-expression, self-acceptance, and visual attention. • Also, encourage memory skills through following sequences design using numbers from (1-9) to building shapes as well as the example introduced for autistic children by the researcher/designer.	Key stage (1)

4.1.2 Examples of Planning Creative Design Process Sessions

4.1.2.1 Acting Preparation Stage:

A criticism-free and safe environment was prepared and evaluated through the engagement of children with autism, who learned how to use a wide range of art and design materials to encourage their imagination. It was designed to allow children with autism to learn through a creative design approach, following several steps such as looking, learning, asking, making, testing, evaluating, selecting, and communicating to enhance thinking skills. Within the next planned sessions, opportunities would be given to the children with autism to self-initiate work and to be part of the design processes with full guidance (e.g. visual communication) and professional support from the researcher.

To initiate this stage, the researcher liaised with the teachers and teaching assistants to build the forthcoming planned activities. The researcher provided visual instructions in each session along with free materials; she explained the preparation approach and procedure to carry out the planned activities; integrated a set of principles and instructions into active discussions with the children with autism on their work and activities; divided the planned activity into small steps; kept the activities short; and always praised and encouraged them to participate with good motivation.

4.1.2.2 Sessions Design:

The issues identified in the observation stage were considered while planning the session activities by encouraging the participants to overcome them during the sessions. The planned sessions were organised to provide the participants with enough time, in the beginning, to be involved with free activities before full engagement of the session to increase their confidence. An appropriate time to complete the creative design activities and full instructions for each session using visual communication (e.g. cognitive models) were provided.

4.1.2.3 Sessions Activities:

The sessions started with a 5-10 minute warm-up to give the children with autism the opportunity to make various choices within the scope of the project they were working on (e.g. colour choices) and allow them to gain confidence to engage in the session. Materials were provided for sensory activities (e.g. bubble wrap) and carefully introduced to the children with autism whilst supporting them, helping the students to become accustomed to various textures and sensations and preventing them from being overwhelmed. Visual instructions and step-by-step guidance were provided to

stimulate creative thinking and imagination skills. The children with autism were allowed to engage in the activity design process and to play an active role throughout the entire session to give them a sense of empowerment in their learning process and enhance their confidence and communication. Praise, encouragement, and rewards were used with children with autism to encourage participation and improve motivation.

4.1.2.4 Settings Resources:

The classroom was equipped with appropriate furniture and equipment (e.g. whiteboards, reading books, pencils, papers, and art tools). The researcher provided all other needed materials to work on the project and achieve the planned design.

4.2 Examples of KS1 Sessions:

Date: Weekly
Start time: 13:30
End Time: 14.30
Place: A Primary School
Key Stage: KS1
Children aged: 5-6 years old
No. of pupils/staff: 25
Class Teacher: -

In all sessions, at 13.30: The researcher started with a mindful teaching style (10 minutes with the children with autism, class teacher and teaching assistants using stress relief tools (e.g. stretchy silicone toys of various shapes and colours, stress relief squeezing balls, and push pop to fidget toys) to encourage their visual attention and help them to feel relaxed and happy to engage in the design sessions. The researcher also provided art materials (free and safe for the children to use) such as gouache paint, PVA glue, glitters, ink stamps, colourful stamps as rewards, coloured pencils, 2B pencils, erasers, paper, and watercolour brush pens (as shown in Fig. 4.3).

Figure. 4.3. *Materials to be used during the session*

Session 1:

Date: 18/01/2022

Session Title: Warm Welcome and Mindful Music to Enhance Visual Attention.

This session was planned to encourage children with autism to work with simple shapes such as circles, ovals, and lines. Simple visual examples were used to help children with autism follow instructions and feel welcome and confident.

At 13.40. The project was based on creating simple shapes such as circles, ovals, and lines to draw a cat and using painting as a therapeutic tool. Moreover, the researcher provided opportunities for children (A) and (B) to play with various materials and art mediums such as paint, pen brushes, glue, and glitter to do what they want. Children (A) and (B) were able to engage in the design process in different ways. For instance, child (A) followed and copied shapes (e.g. circles, ovals, and lines to draw a cat by the provided design example). On the other hand, child (B) drew what they wanted based on their imagination, such as animated characters (as shown in Figs. 4.4- 4.5).

Figure. 4.4. *Using an example of the toolkit in the session*

Figure. 4.5. *A participatory session [1] in the classroom setting*

Session 2:

Date: 01/02/2022

Session Title: Keep Calm and Carry-on Enhance Concertation and Memory Skills.

This session was planned to encourage children with autism to use painting and numbers to build a whole picture to enhance concentration and memory skills.

At 13.40. This project used painting as a therapy tool. Toolkits were provided for the children to build shapes and pictures based on the examples provided for them, using numbers from 1 to 5. The researcher also provided opportunities for the child (A) to experiment with various materials such as ink stamps, glue, pen brushes, and paints. Child (A) engaged in the design process of the paint-by-numbers activity to build meaningful shapes and scenes. The class teacher and teaching assistants said that child (A) was happy to engage in the participation session, and if he was not happy he would have left the session immediately (as shown in Figs. 4.6- 4.7). In addition, they mentioned that the

design session impacted them positively and altered their behaviour smoothly during the classroom setting (e.g., children with autism were happy to engage in the design process and share their work with others in the school and at home).

Figure. 4.6. *Using an example of the toolkit in the session*

Figure. 4.7. *A participatory session [2] in the classroom setting*

Session 3:

Date: 08/02/2022

Session Title: Don't Talk with Strangers to Enhance Awareness and Memory Skills.

This session was planned to encourage children with autism to use painting and numbers to build a whole picture to enhance awareness and memory skills.

At 13.40. This project used painting as a therapy tool. Toolkits were provided for the children to build shapes and pictures based on the examples provided for them, using numbers from 1-7. The researcher also provided opportunities for child (A) to experiment with various materials such as

ink stamps, glue, pen brushes, and paints. Child (A) engaged in the design process of the activity to build meaningful shapes and scenes (as shown in Figs. 4.8- 4.9).

Figure. 4.8. *Using an example of the toolkit in the session*

Figure. 4.9. *A participatory session [3] in the classroom setting*

Session 4:

Date: 15/02/2022

Session Title: Used Different Textures to Enhance Decision-making and Sensory Skills.

This session was planned to encourage children with autism to work with soft and hard textures to enhance decision-making and sensory skills.

At 13.40. This project involved teamwork, including the researcher, child (A), child (B), and two teaching assistants (every autistic child in the classroom had a teaching assistant to support them on a one-to-one basis). During the session, the children autism were ready to start the work immediately. Once the toolkits were placed on the table, they followed the visual examples and used the soft texture materials to start the first project, creating a scene with a panda bear (mimicking fur through the use of fleece) and bamboo. Upon completion of the first project, the children immediately moved on to the next project, using the hard texture materials to create a scene with pyramids, sand (pink salt), and a camel. Their self-confidence, self-esteem, self-expression, and self-acceptance were at high levels (as shown in Figs. 4.10- 4.11).

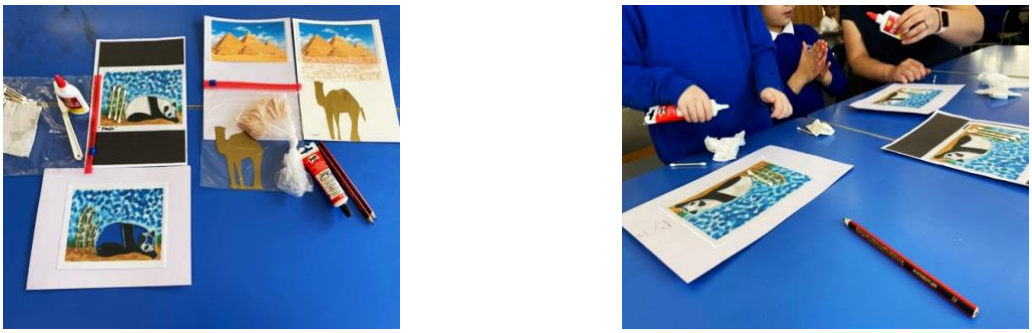


Figure. 4.10. *Using an example of the toolkit in the session*

Figure. 4.11. *A participatory session [4] in the classroom setting*

The toolkits offered an alternative (as shown in Fig. 4.12) learning method for children with autism to enhance their problem-solving, visual attention, memory skills, engagement, concentration, and creative skills. The class teacher and teaching assistants confirmed that the toolkit worked positively with children with autism in the classroom setting. Well done!

Figure. 4.12. *An alternative toolkit used in the classroom setting with children with autism*

Session 7:

Date: 22/03/2022

Class: KS1

Session Title: Using Collage Art to Enhance Problem-solving Skills and Decision-making.

This session was planned to encourage children with autism to practice using collage art and working inside the frame to enhance problem-solving skills, decision-making, and creative and imaginative thinking.

At 13.40. This project was based on collage art. Toolkits were provided to the children with autism containing black and white images. During the session, the class teacher and teaching assistants mentioned that Tuesday afternoon (art day) would be the optimal day for the children with autism in particular, and for all the children in general. During the session, the children with autism were ready to start the work immediately. Once the toolkits were placed on the table, they followed the visual examples and used the materials provided to start the project. The children had the opportunity to complete more than one piece of collage artwork, a relatively easy and small task to finish without overwhelming them, or they could relax. (as shown in Fig. 4.13).

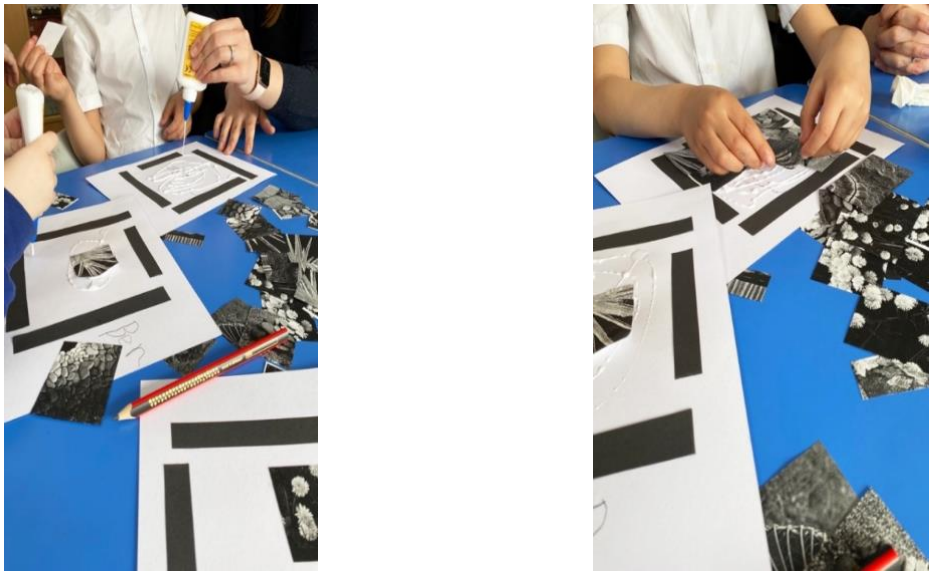


Figure. 4.13. *A participatory session [7] in the classroom setting*

Session 11:

Date: 10/05/2022

Class: KS1

Session Title: Save the Cat: Enhancing Problem-solving Skills, Decision-making, and Creative and Imaginative Thinking.

This session was planned to encourage the children with autism to practice using collage art and working inside the frame to enhance problem-solving skills, decision-making, and creative and imaginative thinking.

At 13.40. This project involved using problem-solving skills to navigate a constructed scene. The children were provided with toolkits containing a picture of a cat on a stick and various craft components to construct a scenario in which the cat is stuck in a tree and must be returned safely home. For the given scenario, the children needed to build a tree, ladder, and house before 'rescuing' the cat from the tree and walking it back home. This activity was more challenging for the children with autism, but they were able to complete it through additional support such as visual instruction, simple steps, and learning a new way of thinking (creative thinking). This session helped the children with autism enhance their problem-solving skills and decision-making. Both child (A) and child (B) followed the given instructions for the project and completed the project successfully, demonstrating enjoyment and comfort throughout the activity (as shown in Figs. 4.14- 4.15).

Figure. 4.14. *Using an example of the toolkit in the session*

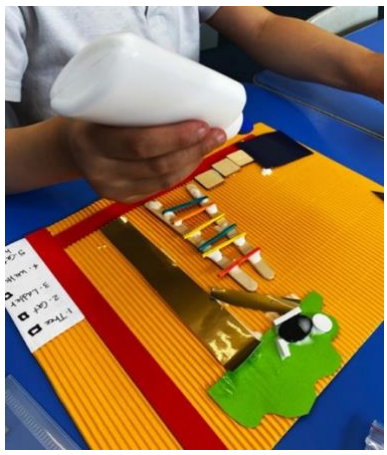


Figure. 4.15. *A participatory session [11] in the classroom setting*

The Impact of Creative Design Activities Sessions on the Learning Environment in the Classroom Setting (KS1).

<u>Cycle 1(Design process 14 weeks- KS1):</u>

This session process began with an observation, and then from weeks [2-4 in KS1], the researcher started with basic learning skills to build a strong relationship with the children with autism and their teachers. She used simple designs, ideas, and techniques to understand the needs of the children with autism and their teachers to support them in interacting and communicating in an easier way. From weeks 4-10 in KS1, the researcher conducted data through observations in the classroom setting (based on the behaviour of the children with autism, their communication with their teachers, and the learning environment), interviews (based on the teachers' and teaching assistants' knowledge, experience, and information), questionnaires and feedback (based on the teachers' and teaching assistants' opinions and perspectives). Such information supported the researcher in developing her designs, ideas, and techniques in the next stage to meet the needs of children with autism and their teachers in the classroom setting through the use of the 2D/3D toolkits (visual materials). In addition, from weeks 10-14 in KS1, the researcher began the challenging stage to enhance the children with autism problem-solving, decision-making, concentration, visual attention, memory, sensory skills, and creative thinking skills.

Reflection on the creative design activities sessions with children with autism and their teachers:

There was evidence of an improved learning environment for the children with autism and their teachers in the classroom setting. The sessions initially began with a simple level of design and ideas (as shown in Figs. 4.16- 4.17) to encourage the children with autism and their teachers to engage. The researcher then developed the sessions to the next level of design and ideas (as shown in Fig. 4.18) to enhance the children with autism learning skills such as concentration, visual attention, memory, sensory skills, and creative thinking skills. Finally, the researcher developed the sessions to the challenging level of design and ideas to enhance the children with autism learning skills such as problem-solving skills and decision-making (as shown in Fig. 4.19).

4.3 Examples of Reception Class Sessions:

Date: Weekly
Start time: 14.30 pm.
End Time: 15.30 pm.
Place: A Primary School
Key Stage: Reception
Children aged: 4-5 years old
No. of pupils/staff: 16
Class Teacher: -

In all sessions, at 14.30: The researcher started with a mindful teaching style (10 minutes with the children with autism, class teacher and teaching assistants using stress relief tools (e.g. stretchy silicone toys of various shapes and colours, stress relief squeezing balls, and push pop to fidget toys) to encourage their visual attention and help them to feel relaxed and happy to engage in the design sessions. The researcher also provided art materials (free and safe for the children to use) such as gouache paint, PVA glue, glitters, ink stamps, colourful stamps as rewards, coloured pencils, 2B pencils, erasers, paper, and watercolour brush pens.

Session 14:

Date: 22/03/2022

Class: Reception

Session Title: The Blue Chicken to Enhance Visual Attention.

This session was planned to encourage children with autism to practice using splash painting, glue, and feathers to enhance concentration.

At 14.40. The researcher began with an introduction to the design project with four children, the class teacher, and teaching assistants so that they were able to work together effectively on the planned project (e.g., use splash painting, glue, and feathers).

The project involved teamwork between the researcher, four children, and the class teacher. There were not enough teaching assistants to support the children with autism one-to-one in the reception class. The researcher discussed a visual example of the project with the class teacher before starting the session with the children with autism in a quiet area of the classroom. The researcher planned and managed the session with four children with autism without support (e.g. teaching assistants). The class teacher observed the session from beginning to end and offered feedback, describing the first session as "excellent artwork" and recognising the researcher's ability to manage the children's behaviour and attitude (as shown in Figs. 4.16- 4.17).

Figure. 4.16. *Using an example of the toolkit in the classroom setting*

Figure. 4.17. *A participatory session [14] in the classroom setting*

Session 16:

Date: 05/04/2022

Class: Reception

Session Title: Art Therapy with Pen Brushes to Enhance Self-expression, Concentration, and Sensory Skills.

This session was planned to encourage children with autism to practice using pen brushes, various shapes, glue, and glitter to enhance self-expression, concentration, and memory skills.

At 14.40. This project involved children with autism practising painting to create meaningful landscapes. During the session, the children with autism were ready to start the work immediately. Once the toolkits were placed on the table, they followed the visual examples and used the materials provided to start the project. The children had the opportunity to complete more than one piece of collage artwork, a relatively easy and small task to finish without overwhelming them, or they could relax. (as shown in Fig. 4.18).

Figure. 4.18. *A participatory session [16] in the classroom setting*

Session 19:

Date: 17/05/2022

Class: Reception

Session Title: The Lighthouse: Enhancing Problem-solving Skills, Decision-making, and Creative and Imaginative Thinking.

This session was planned to encourage children with autism to practice using collage art to enhance problem-solving skills, decision-making, and creative and imaginative thinking.

At 14.40. This project involved children with autism practising using collage art and 3D to create a meaningful landscape painting. The children were provided with toolkits containing a picture of a fish on a stick and various craft components to construct a scenario in which the fish is 'swimming' in the sea. This activity was more challenging for the children with autism, but they were able to complete it through additional support such as visual instruction, simple steps, and learning a new way of thinking (creative thinking). In addition, this session helped the children with autism to enhance their problem-solving skills and decision-making. The children followed the given instructions for the project and completed the project successfully, demonstrating enjoyment and comfort throughout the activity (as shown in Fig. 4.19).

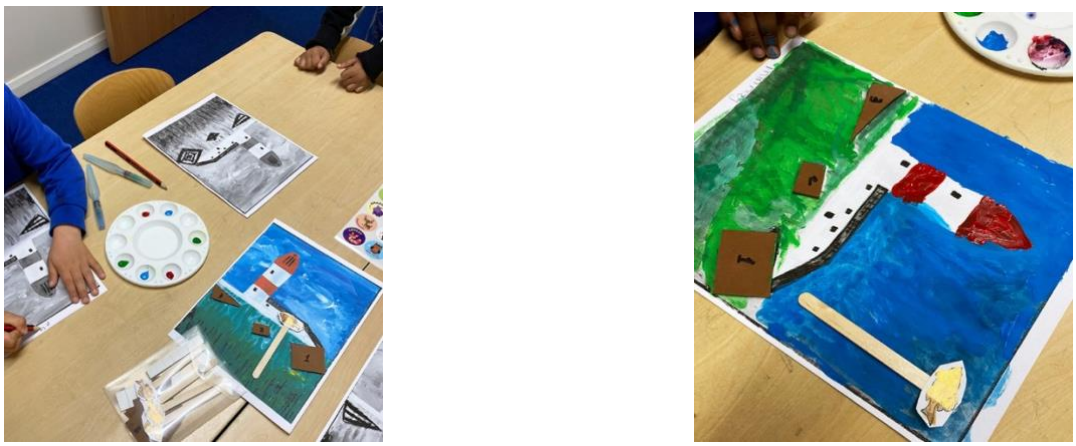


Figure. 4.19. *A participatory session [19] in the classroom setting*

The Impact of Creative Design Activities Sessions on the Learning Environment in the Classroom Setting (Reception Class).

Cycle 1(Design process 8 weeks- Reception class):

The session process began with an observation, and then from weeks 2-4 in the Reception class, the researcher started with basic learning skills to build a strong relationship with children with autism and their teachers. She used simple designs, ideas, and techniques to understand the needs of the children with autism and their teachers to support them to interact and communicate more easily. From weeks 4-6 in the Reception class, the researcher collected data through observations in the classroom setting (based on the behaviour of the children with autism, their communication with their teachers, and the learning environment), interviews (based on the teachers' and teaching assistants' knowledge, experience, and information), questionnaires and feedback (based on the teachers' and teaching assistants' opinions and perspectives). Such information supported the researcher in developing her designs, ideas, and techniques in the next stage to meet the needs of children with autism and their teachers in the classroom setting through the use of the 2D/3D toolkits (visual materials). In addition, from weeks 6-8 in the Reception class, the researcher began the challenging stage to enhance the children with autism problem-solving, decision-making, concentration, visual attention, memory, sensory skills, and creative thinking skills.

Reflection on the creative design activities sessions with children with autism and their teachers:

There was evidence of an improved learning environment for the children with autism and their teachers in the classroom setting. The sessions initially began with a simple level of design and ideas (as shown in Figs. 4.16- 4.17) to encourage children with autism and their teachers to engage. The researcher then developed the sessions to the next level of design and ideas (as shown in Fig. 4.18) to enhance the children with autism learning skills such as concentration, visual attention, memory, sensory skills, and creative thinking skills. Finally, the researcher developed the sessions to the challenging level of design and ideas to enhance the children with autism learning skills such as problem-solving skills and decision-making (as shown in Fig. 4.19).

4.4 Cycle 2 (Optimisation)

Cycle 2 of the researcher's work, carried out over approximately 6 weeks (starting from Oct. 2022-Nov. 2022) in a Primary School KSI and reception classes. The researcher attended the school one day per week, one hour per day. Cycle 2 involved the development of prototype 2D/3D toolkits to encourage teachers, teaching assistants, and children with autism to act as co-designers. Prototype testing was based on the needs of children with autism and their teachers. For example, in the first week, the researcher met with the head teacher to discuss a climate change project planned for the KSI and reception classes. The researcher prepared a visual example for the head teacher to discuss how to effectively break down and explain the topic of climate change for children with autism in the KS1 and reception classes, tailoring the material to the learning style of the children with autism by employing visually immersive tools to demonstrate the impact of climate change on our lives (e.g. foods, animals, and temperature). An important and complex topic could thus be delivered to the students in a simplified, clear manner. The researcher also worked with the head teacher to arrange a workshop for KSI and reception classes, teachers, and teaching assistants to exchange knowledge and information, practice decision-making, and gather information from interviews and feedback.

Cycle 2 began with session 1: planning and acting (preparation stage) including the head teacher, class teacher, and teaching assistants; session 2: planning activities (working stage) including children with autism, class teachers, and teaching assistants; and session 3: evaluation, reflection, and recommendations (workshop) including KSI and reception classes, teachers, and teaching assistants. The researcher worked with stakeholders (e.g. children with autism, their class teacher, and teaching assistants) as co-designers to develop the prototype, collaborating in the creative design process session-by-session to enhance the learning environment. During the creative design process,

knowledge and information were exchanged between the researcher, class teacher, and teaching assistants to help and support children with autism in their learning and development.

In this study, the researcher used three key research elements: 1) design thinking to enhance problem-solving skills, memory skills, concentration, sensory sensitivity, decision-making, visual attention, and creative and imaginative thinking; 2) participatory design to encourage engagement and work with stakeholders as co-designers (level of participation was measured); and 3) art therapy to improve self-esteem, self-acceptance, and self-expression.

During the creative design process, the researcher used observation (field notes), interviews (semi-structured, unstructured, and structured), and photos of the children with autism artwork to collect and analyse data regarding the children with autism communication skills as well as the opinions and perspectives of the teachers and teaching assistants. Participation levels of the stakeholders were also measured, assessing the extent of engagement in the creative design process. This stage included 6 creative design process sessions, as described in Table 8.

Table 8. *Designed 2D/3D toolkits within creative design process sessions.*

Session of Creative Design Process	**Aims**	**Session Title and Date (Using designed toolkit 3D)**	**Benefit**	**Participant**
(1) to work with stakeholder as co-designers	Children with autism complete colour-coded puzzles to construct different images, scenes, and concepts (e.g. green imagery to represent the	Climate change 06/10/2022	Enhanced problem-solving and sensory skills.	Children with autism (KS1 class), class teacher, and teaching assistants.

	environment in a healthy state, favourable temperatures and weather conditions etc. and yellow to represent a frail environmental state) and use the traffic light system (visual scheduling).			
(2) to work with stakeholder as co-designers	Children with autism use art therapy (e.g. hand- painting to become accustomed to various sensations and textures and improved sensory skills) and visual scheduling to help them to understand how the project will be carried out (such as the traffic light system: red, stop and take	Climate change 12/10/2022	Enhanced problem-solving and sensory skills.	Children with autism (Reception class), class teacher, and teaching assistants.

	your time; yellow, begin the project if ready; green, complete work to receive reward).			
(3) to work with stakeholders as co-designers	Children with autism use puzzles to build various landscapes as 3D images.	Landscape puzzles 20/10/2022	Improved problem-solving skills, and enhanced concentration.	Children with autism (Reception class), class teacher, and teaching assistants.
(4) to work with stakeholder as co-designers	Children with autism use college art (e.g. black and white college and worked inside the frame).	College art 03/11/2022	Improved thinking creatively, and decision-making.	Children with autism (Reception class), class teacher, and teaching assistants.
(5) to work with stakeholder as co-designers	Children with autism use art therapy (e.g. pen brushes) and problem-solving skills.	Art therapy 10/11/2022	Improved emotions (self-esteem), sensory skills, and problem-solving skills.	Children with autism (Reception class), class teacher, and teaching assistants.

4.4.1 Cycle 2 - Session (1) with Children with Autism (KS1)

Session title: Climate Change: Enhancing Problem-solving and Sensory Skills.

At 13.40. The project involved the children with autism completing colour-coded puzzles to construct different images, scenes, and concepts (e.g., green imagery to represent the environment in a healthy state, with favourable temperatures, and weather conditions, etc., and yellow to represent a frail environmental state) and use visual scheduling to help them to understand how the project will be carried out (such as the traffic light system: red, stop and take your time; yellow, begin the project if ready; green, complete work to receive a reward), (as shown in Fig. 4.20).

Figure. 4.20. *A participatory session [1] in the classroom setting*

4.4.2 Cycle 2 - Session (2) with Children with Autism Reception

Session title: Climate Change: Enhancing Problem-solving and Sensory Skills.

At 13.40. This project involved children with autism using art therapy, in this case, hand-painting, to become accustomed to various sensations and textures and improve their sensory skills. Visual scheduling was employed to help the children understand how the project will be carried out (such as the traffic light system: red, stop and take your time; yellow, begin the project if ready; green, complete work to receive a reward), (as shown in Fig. 4.21).

Figure. 4.21. *A participatory session [2] in the classroom setting*

Reflection: The researcher tested a toolkit prototype with the children with autism and their teachers and gathered data which demonstrated that the 2D/3D toolkit could improve learning skills in the classroom setting with children with autism (KS1and Reception class). For instance, the creative design activities sessions helped the children with autism enhance their problem-solving skills, decision-making, memory, and sensory skills.

4.4.3 Cycle 2 - Session (6) with Teachers and Teaching Assistants

This workshop was carried out in a Primary School and included 2 class teachers (KS1 and reception classes), 2 teaching assistants, and the researcher. This workshop consisted of reviewing various creative design sessions carried out by the researcher with children with autism and obtaining feedback from the class teachers and teaching assistants. The researcher randomly selected some of the 2D/3D toolkits which were used with the children with autism in KS1 and reception (Jan. 2022- Nov. 2022) and provided sticky notes and pencils to collect the opinions, perspectives, and comments from the teachers and teaching assistants. Both positive and negative feedback was offered. For example, positive feedback from the teachers and teaching assistants included the view that the visual communication offered by the toolkits could impact children with autism and themselves in the classroom setting in a positive way, allowing for enhanced engagement, exploration and experimentation with new techniques and textures, creative thinking, and enhanced well-being of the children with autism. On the other hand, negative feedback from teachers and teaching assistants included comments regarding the difficulty of some of the activities for children with autism and the amount of time taken to complete them. The researcher respected all the feedback, opinions, and comments that came from teachers and teaching assistants and acknowledged how both positive and negative feedback could improve the study results. These results will help to enhance the 2D/3D toolkit prototype based on the needs and interests of children with autism and

their teachers, furthering the goal of creating an innovative solution to tackle complex problems in the classroom (as shown in Figs. 4.22- 4.24).

4.4.4 Examples of Workshop with Teachers and Teaching Assistants

Figure. 4.22. *Teachers and teaching assistants workshop session [6]*

Figure. 4.23. *Teachers and teaching assistants workshop session [6]*

Figure. 4.24. *Teachers and teaching assistants workshop session [6]*

Reflection: This workshop supported researchers, class teachers, and teaching assistants to exchange knowledge, information, and experiences. During the workshop, we discussed how the visual materials (2D/3D toolkits) could be used as an alternative method to support children with autism and their teachers to easily communicate in the classroom setting, and enhance the children's problem-solving skills, visual attention, concentration, memory, sensory skills, well-being, and creative thinking. In addition, we agreed that visual materials play a vital role for children with special educational needs in general, and for children with autism in particular. During the workshop, the teachers and teaching assistants confirmed that the children with autism were able to use the toolkits by themselves. However, they mentioned that to see definitive improvement in children with autism behaviour they need to continue the creative design activities for a long period. Finally, they confirmed that the researcher was friendly, proactive, and respectful; had a positive relationship with the children with autism and all the staff; and could manage the children with autism behaviour during the sessions.

4.4.5 Example of Worksheet for Teachers and Teaching Assistants

Workshop with the Teachers and Teaching Assistants (60 minutes)

1. Name and Role.

2. The purpose of this workshop is to provide the opportunity to give your opinions, perspectives, and recommendations regarding the research project.

3. Your opinions, perspectives, and recommendations regarding the research project including cycle 1 (planning and developing the creative design activities, January to June 2022), and cycle 2 (follow up the creative design activities, October to November 2022) to finalise the prototype.

4. During the creative design process (28) sessions, the researcher used 2D/3D toolkits (visual materials) with autistic children. I will propose various techniques, ideas, and creative solutions to address existing problems in the classroom setting, such as social communication between you and the autistic children. I would like your feedback on the 2D/3D toolkits and to know if you think that the toolkits could improve social communication between you and the autistic children.

5. The researcher published her work in the 24th International conference on Engineering and Product Design Education, September 2022, in London. She has also received the European student award for innovation social inclusion.

6. Finally, could you please complete the interview questions, which will help the researcher to gather information from your opinions, perspectives, recommendations and enhance the prototype accordingly.

   Your help and support are highly appreciated.

   Thank you,

   Nesrin Elmarakbi
   PhD researcher at faculty of Health Science and Wellbeing
   University of Sunderland

4.5 Implications of the Creative Design Process on Children with Autism and Their Teachers

The researcher carried out this study in a Primary School to investigate the research questions and find creative solutions:

1. Does an approach that integrates design thinking, art therapy, and educational theory deliver new forms of pedagogy when applied to the challenges of complex classroom situations?

2. What form of design practice aids do teachers establish that is suitable for continual design and re-design of their classroom setting as a response to the complex needs of their pupils?

To investigate the research questions, the researcher conducted 28 creative design process sessions (cycles 1 and 2) with the stakeholders (e.g. children with autism, class teachers, and teaching assistants). The researcher used design thinking to develop prototype 2D/3D toolkits with the stakeholders (co-designers) through participatory design. Qualitative research was used to gather data (triangulation data such as observations, interviews, and children with autism artwork). Art therapy was used to enhance children with autism's well-being.

The researcher paid particular attention to finding a creative solution for the issue of poor social communication skills between children with autism and their teachers. For instance, children with autism often 1) struggle to understand oral instructions provided by teachers in the classroom setting. In this case, the researcher used visual as opposed to oral learning materials with the children with autism to help them understand the topic at hand; 2) struggle to understand facial expressions and the feelings of others, disrupting communication with their peers and teachers. In this case, the researcher used art therapy to help children with autism express their feelings, enhance their self-esteem, and help them to comprehend the feelings and expressions of others more easily; 3) have a lack of attention, concentration, and memory skills as their teachers described. In this case, the researcher focused on enhancing such skills by using different colours, collage art, puzzles, etc. to engage the students in interesting ways; 4) struggle with knowing how to move through various stages of the project they are working on: starting, continuing, and finishing the work. In this case, the researcher used visual scheduling, using the traffic light system in a table divided into three sections: a) the red traffic sign (stop), take your time and start when you feel ready; b) the yellow traffic sign (steady), you can start to work now, and c) the green traffic sign (go), finish your work and receive your reward. Well done! And finally; 5) have anxiety and feel uncomfortable with communicating with new people and change of routine. In this case, the researcher prepared various

tools and coping mechanisms (e.g. stress balls) to help the children with autism relax, worked with their teachers and teaching assistants in the classroom setting, and kept their routine as consistent as possible.

The researcher designed 6 creative design process sessions (cycle 2) for KSI and reception classes for children with autism and their teachers. Each session includes different ideas, techniques, and visual materials to meet the needs of children with autism and their teachers. The researcher incorporated three key research elements in this workshop, design thinking, participatory design, and art therapy, to help children with autism improve their skills such as memory, sensory processing, problem-solving, concentration, decision-making, and creative thinking as well as enhance their well-being. The creative design sessions involved working in collaboration with the children with autism, their teachers, and teaching assistants, who acted as co-designers.

The workshop introduced a new teaching style based on the use of visual materials (2D/3D toolkits) instead of the old teaching style based on oral instructions and a whiteboard, as children with autism need different methods of learning to support their development and educational success. The 2D/3D toolkits offer a new creative solution to address existing problems in the classroom setting, such as social communication skills between children with autism and their teachers, facilitating easier, clearer communication and mutual understanding by using images rather than relying on oral instructions. Using the three key research elements, the researcher built her hypothesis based on the literature review and collected data from different sources (observations, interviews, and photos of the children with autism artwork). After investigating other researchers in the same field of work, the researcher decided that using only one or two of the research elements (e.g. design thinking and participatory design) was not enough to encourage children with autism to fully engage in the workshop and enhance their skill, as each autistic child has different problems, needs, and interests. Thus, to create solutions for the problems faced by children with autism in the classroom setting whilst considering their needs and interests, the additional element of participatory design is required. The researcher thus strategically combined design thinking, participatory design, and art therapy, with each element improving children with autism skills differently. For instance, design thinking enhanced children with autism's problem-solving, memory, and concentration skills. On the other hand, the participatory design enhanced children with autism engagement and communication with others. Finally, art therapy enhances children with autism's sensory processing, emotions, and well-being.

4.6. How Children with autism and their Teachers are Involved in the Creative Design Process

The researcher considered the needs of children with autism and their teachers in the classroom setting. The research carried out observational work (direct and participatory observations) and used field notes to understand the behaviours and emotions of children with autism and their communication with their teachers. She also conducted interviews (structured, semi-structured, and unstructured) with class teachers and teaching assistants to understand their opinions, perspectives, and needs. Later, she provided feedback and questionnaires for the class teachers, teaching assistants, and children with autism (providing them with the option of a happy and/or sad face to easily express their feelings about the workshop). The researcher used the data, knowledge, and information collected to understand the social communication skills problems between children with autism and their teachers, other obstacles teachers faced when attempting to meet their needs, and what the children with autism felt they needed to effectively communicate with their teachers in the classroom setting.

4.7 The Benefits of and Differences between Cycles 1 and 2 of the Creative Design Process

The creative design process sessions (workshop) were intended to create an enhanced learning environment by providing a new solution for an existing problem, such as social communication skills between children with autism and their teachers in the classroom setting. The 2D/3D toolkits (visual communication) offered such a solution, helping to support communication between children with autism and their teachers, and thus improving the delivery of lesson content. In the first cycle of the workshop (Jan.2022- June 2022), the researcher designed 22 sessions to encourage the stakeholders (children with autism, teachers, and teaching assistants) to work with her by stimulating them to work as co-designers to develop the 2D/3D toolkit prototypes. The researcher carefully designed each session to build the problem-solving, memory, concentration, sensory processing, and creative thinking skills of children with autism as well as enhance well-being and encourage engagement. In this stage, the researcher provided the opportunity for children with autism and their teachers to experiment with a variety of textures, try out the 'learning by doing approach, and explore new visual learning strategies. The researcher thus provided teachers with new tools to support children with autism in their learning and development and mediate successful communication. The researcher used the three key research elements (design thinking, participatory design, and art therapy) to create toolkits to meet the needs of children with autism and their teachers in the classroom setting.

Following the end of the first cycle, the researcher confirmed that the 2D/3D toolkits could support children with autism and their teachers in the classroom setting based on the data collected from observations, interviews, and photos of the children with autism artwork. Based on these results, the researcher designed her second cycle (Oct.2022- Nov. 2022) and created 6 sessions to encourage the stakeholders (children with autism, teachers, and teaching assistants) to finalise the prototype to be ready for use by teachers in the classroom setting with children with autism.

The first and second cycles covered different stages of prototype development. In the first cycle, the 2D/3D toolkit prototype underwent experimentation, testing, and evaluation. In the second cycle, the prototype was tested and finalised to be ready for use by teachers in the classroom setting with children with autism. In addition, the researcher planned workshops for KSI and reception classes, teachers, and teaching assistants in November 2022 to discuss this study and receive their opinions, perspectives, and recommendations.

4.8 Using Visual Scheduling in the Classroom Setting

Visual scheduling was used to support children with autism to understand how the task would be started, what they should do before starting the task, and when they should stop. As children with autism are often frustrated by changes in routine, visual scheduling helped them to see and learn how the task would start and be ready to end the task easily without overwhelming them, thus moving through different stages of the task more seamlessly.

Visual scheduling

Start of project	Middle of project	End of project
1. Take your time to be relax and ready to start your project	2. Understand your project using visual examples	3. Try to complete your project, which is simple and easy to complete
		
		

4.9 Interviews, Questionnaires, and Feedback

Interviews, questionnaires, and feedback were used to gain insight into the barriers and needs of the stakeholders. The planned creative design activities for children with autism were prepared and provided to the class teacher and teaching assistants to understand the specific needs before and after the sessions. The interview questions were discussed, face-to-face, with the class teachers. Further interviews and questionnaires were conducted throughout the project to gain more information. In accordance, the researcher updated the planned sessions and design activities and monitored progress to optimise session development and engagement. Examples of interviews, questionnaires, and feedback obtained from the stakeholders (e.g., children with autism, head teacher, class teachers, and teaching assistants):

A Sample Interview (2) Questions in the Classroom Settings

*(*Children with Autism Behaviour)

1. Do you think children with autism are easily overwhelmed by sensory sensitivities such as sight, touch, taste, smell, and sound? How?

2. Do you think children with autism can be easily confused and stressed if there are disruptions in their daily routines? How?

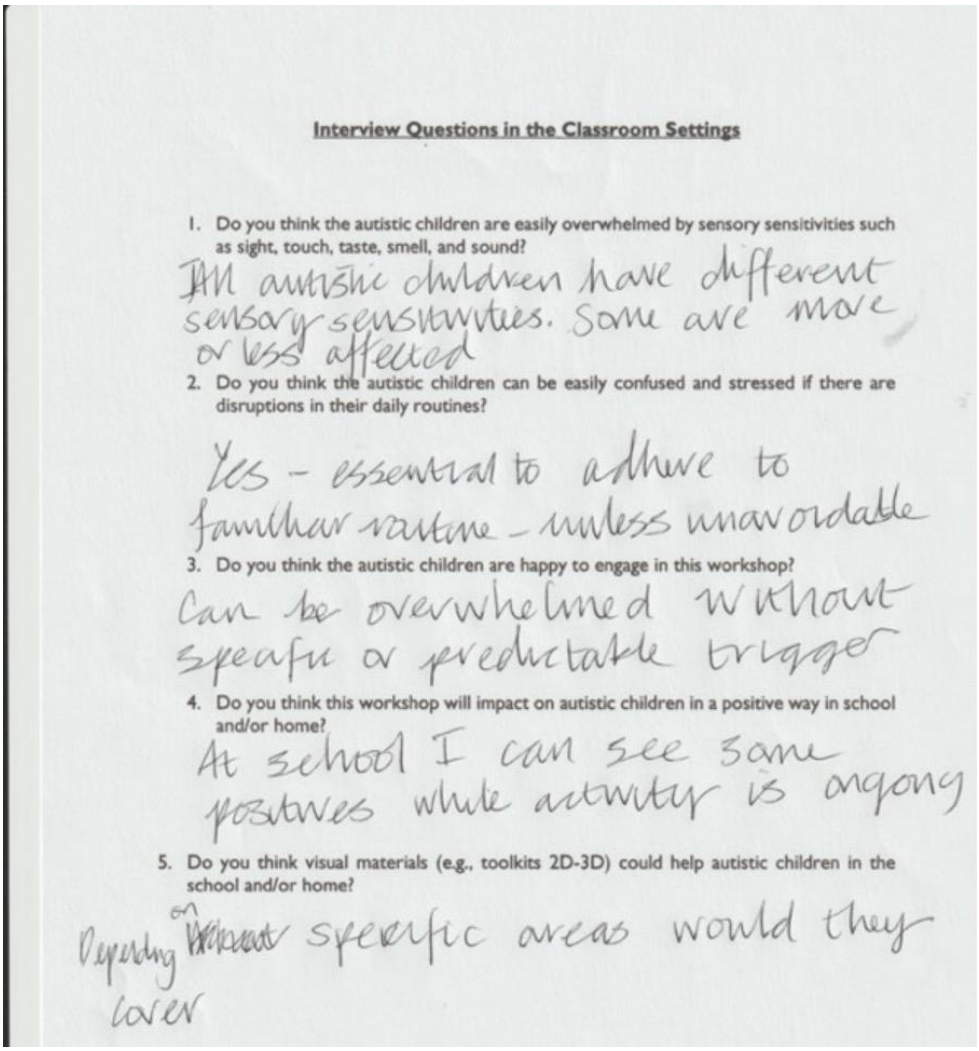
3. Do you think the children with autism are happy to engage in this workshop? Why?

4. Do you think this workshop will positively impact children with autism in school and/or at home? How?

5. Do you think visual materials (e.g., toolkit 2D-3D) could help children with autism in school and/or at home? How?

Sign by:

Date:



Interview Questions in the Classroom Settings

1. Do you think the autistic children are easily overwhelmed by sensory sensitivities such as sight, touch, taste, smell, and sound?

All autistic children have different sensory sensitivities. Some are more or less affected

2. Do you think the autistic children can be easily confused and stressed if there are disruptions in their daily routines?

Yes - essential to adhere to familiar routine - unless unavoidable

3. Do you think the autistic children are happy to engage in this workshop?

Can be overwhelmed without specific or predictable trigger

4. Do you think this workshop will impact on autistic children in a positive way in school and/or home?

At school I can see some positives while activity is ongoing

5. Do you think visual materials (e.g., toolkits 2D-3D) could help autistic children in the school and/or home?

Depending on ~~what~~ specific areas would they cover

Interview Questions in the Classroom Settings

1. Do you think the autistic children are easily overwhelmed by sensory sensitivities such as sight, touch, taste, smell, and sound?

Every child presents with a different sensory profile. Some children are overwhelmed by sound while others struggle with tou

2. Do you think the autistic children can be easily confused and stressed if there are disruptions in their daily routines?

Very much so! We use visual timetable and try to stick to a consistent routine throughout the year.

3. Do you think the autistic children are happy to engage in this workshop?

The children have really enjoyed participating in the craft workshops as working within a very small group away from the busy classroom helped with focu

4. Do you think this workshop will impact on autistic children in a positive way in school and/or home?

Hopefully, the children will have been able to talk to their parents at home about their creations. It is always lovely for children to have something physical to take home and share

5. Do you think visual materials (e.g., toolkits 2D-3D) could help autistic children in the school and/or home?

Children with ASD appear to have greater success with highly practical and visual activities that link in with their own interests

A Sample Interviews (3) Face-to-Face (Jan-June 2022)

(Class Teachers and Teaching Assistants (KS1- Reception class)

Researcher (R): Do you know why I am here?

Class Teacher (CT): Yes, the head teacher has given me an idea about your PhD research project, and I am happy to work with you.

Teaching Assistant (TA): Yes, the class teacher has talked to me about your project, and I would like to participate.

R: Are you happy to support my PhD research and allow me to carry out a case study with the children with autism in your classroom?

CT-TA: Yes, it is great to work with you and together we could change our learning environment to support children with autism.

R: The creative design activities will be divided into different sessions (e.g., observations, and planned activities for several weeks). Each session will focus on a specific topic to enhance children with autism skills (e.g., social communication skills). Would you be able to collaborate with me during the sessions and support my research plan?

CT-TA: Yes, it is great to work with you to support children with autism to enhance their skills such as social communication skills.

R: Before each session, I will provide you with a full explanation and identification of the main objectives and processes to be considered for each session (e.g., rationale, step-by-step guidelines, and visual instructions). Would this be acceptable?

CT-TA: Yes, sharing session details and step-by-step instructions would help us to work together to support children with autism.

R: I will use 2D/3D toolkits to support children with autism in their learning development. Do you agree for such toolkits to be used during the session as a part of the research methodology?

CT-TA: Yes, it is great to try a new tool in our classroom setting. Children with autism need new learning techniques to support them in their learning and development.

R: I will provide all materials, which are free and safe to use, for children with autism. The session will include a preparation stage around 10-15 minutes before the start of the session's main activities, would this be acceptable?

CT-TA: Yes, take your time and thank you for providing the free materials.

R: I will lead and manage the design activities with the children with autism during the session in the classroom with your support. Do you agree to this arrangement?

CT-TA: Yes, I am happy to give my opinion, let you know my thoughts about your sessions, and share my experience.

R: During and after the session, I will share information with you, ask for feedback ask you to complete questionnaires, and take photos and notes. Do you agree to patriciate and provide the required information and feedback?

CT-TA: Yes, I am happy to give you my opinion, and feelings about your topic, and share my experience with you.

R: How many children with autism are in your Key Stage 1 classroom?

CT-TA: Two boys with autism.

R: How many children with autism are in your Reception classroom?

CT-TA: Four boys and girls with autism

R: Are you working with children with autism in a small group and/or on a one-to-one basis to support their learning development?

CT-TA: We are working with children with autism on a one-to-one basis in and outside the classroom setting.

R: Are there any subjects which you feel could benefit from an alternative approach to supporting children with autism, such as a visual toolkit produced by the participatory design process?

CT-TA: Yes, sometimes we need an alternative method to support children with autism to complete their work in different subjects such as Maths, Sciences, and English.

R: Could you please explain why you think the design process using toolkits will benefit the children with autism in your classroom?

CT: The design process using the toolkit will encourage children with autism to enhance problem-solving and memory skills in maths and sciences as well as different topics. This will enhance their confidence as they will feel part of the team and feel ownership.

TA: The design process using the toolkit will also encourage them to work actively and build on their confidence to share designs and ideas, which will enhance their social and visual communication.

R: Do you think children with autism feel comfortable engaging in creative design activities?

CT-TA: Yes, in fact, children with autism love to engage in the artwork and design activities you plan each week.

R: Do you think there are benefits to their engagement in creative design? If yes, could you please explain how?

CT: Yes, their active engagement will lead to a great enhancement of their self-acceptance and self-expression.

TA: Yes, it will also improve their self-esteem and self-confidence and make them more active and productive.

R: Could you please explain why children with autism like and/or dislike creative design activities?

CT: I am confident that they would like to engage in the design activities. Painting, working with numbers to build pictures, and working with puzzles will enhance their memory and problem-solving skills and help them to engage more actively in the learning process.

TA: Painting, watercolours brush pens, and anxiety stress relief squeezing balls, will enhance their behaviours and emotional skills. They will like it and will be keen to participate.

R: Do you think that sessions focused on social communication skills to meet the children with autism needs are interests in your classroom?

CT-TA: Yes, I can observe that children with autism have a positive change in their behaviours and social communication skills.

R: Do you think the process and toolkits are easy to use, without the researcher, in the school and at home?

CT-TA: Yes, the toolkits are easy to use with and without the researcher in school and at home.

R: Do you think the researcher needs to add more details for the sessions to fit your classroom? If yes, could you please explain how?

CT: Yes, (e.g., if the researcher delivers more sessions to support Maths, English, and Science lessons).

TA: Yes, (e.g., if the researcher expands the use of painting and brush pens as they have been enjoying using them).

R: Do you think that there have been any positive impacts regarding the learning and development of children with autism in the classroom? If yes, could you please explain how?
CT: Yes, their self-esteem, self-confidence, and problem-solving skills have been improved and there has been a positive impact on their behaviours in the classroom.

TA: Yes, their self-acceptance, self-expression, and memory skills are changed in a positive way in the classroom.

R: Do you think that there have been any positive impacts regarding the children with autism social communication skills in the classroom? If yes, could you please explain how?

CT: Yes, there have been noticeable improvements in their social communication skills in the classroom and I think at home, too.

TA: Yes, I noticed good progress and improvement in their social communication,in the classroom.

R: Do you think the use of a mindful teaching style (e.g., 10 minutes of preparation before beginning tasks to destress using tools such as stretchy silicon toys stress relief squeezing balls, and push pop to fidget toys) to maintain the children with autism attention and help to engage in the design sessions is useful?

CT-TA: Yes, it is a great idea and helps children with autism to be happy and relaxed in the classroom.

R: Do you think the researcher provided suitable materials to use with children with autism and introduced proper visual instructions (e.g., step-by-step guidance)?

CT-TA: Yes, the work plan, materials, and visual instructions have been useful and easy to use and implement.

R: Do you think the researcher is working collaboratively, is well-organised, and provides appropriate preparation and finishing stages before and after the sessions?
CT-TA: Yes, the researcher is friendly, respectful, and proactive. The researcher interacts well with children with autism and has good leadership skills.

A Sample Feedback (1) from Class Teachers (Jan- June 2022)

Staff role:

Date:

How the researcher carried out the design sessions with children with autism and stakeholders?
Do you think the researcher can meet children with autism and stakeholders needs and interests?
Do you think these design sessions would have a positive impact on children with autism behaviour in the school and/or home?
Do you think the researcher had a good relationship with children with autism and stakeholders in the classroom setting?
Do you have any comments to the researcher to enhance the future design sessions in the next stage to support the learning environment?

Feedback (Jan. -March 2022)

Staff role: Class Teacher / Art & Design co-ordinator

Date: 28/3/22

How the researcher carried out the design sessions with autistic children and stakeholders? Researcher was full supported by 1-1 teaching assistants
Do you think the researcher can meet autistic children and stakeholders' needs and interests? Activities reflected children's interests and were appropriate to their needs
Do you think these design sessions would have positive impact on autistic children's behaviour in the school and/or home? Needs to be sustained over a longer period to measure specific impact.
Do you think the researcher had a good relationship with autistic children and stakeholders in the classroom setting? Lovely; gentle & friendly relationship
Do you have any comments to the researcher to enhance the future design sessions in the next stage to support the learning environment? More multi-sensory activities.

Feedback (March-June 2022)

Staff role: EYFS Lead

Date: 10 May 2022

How the researcher carried out the design sessions with autistic children and stakeholders? Children were withdrawn in pairs to work in quiet area.
Do you think the researcher can meet autistic children and stakeholders' needs and interests? It is difficult to answer this from the work carried out. The activities certainly engaged the children and they were very keen to take part the flowing weak the activities did capture their interes
Do you think these design sessions would have positive impact on autistic children's behaviour in the school and/or home? The children appeared calm during the session. They were able to maintain focus while working within a small group and enjoyed having someth to take home.
Do you think the researcher had a good relationship with autistic children and stakeholders in the classroom setting? The children responded very well to Nesrin and there was a very positive relationship between them.
Do you have any comments to the researcher to enhance the future design sessions in the next stage to support the learning environment? Ask class teachers about what the children have previously enjoyed doing in school. - Could activities be linked to ongoing work within the setting?

A Sample Feedback (2) from Teaching Assistants (May 2022)

1. Do you think the children with autism are happy to engage in this workshop? How?

2. Do you think this workshop will positively impact children with autism in school and/or at home? How?

3. Do you think visual materials (e.g., toolkits 2D/3D) could help children with autism enhance their behaviour, attitude, and learning environment in the school? How?

Feedback from the Classroom Settings

1. Do you think the autistic children are happy to engage in this workshop? How?

It is unclear if C is happy and enjoys the workshop as he is unable to verbalise so. However he will sit for 5-10mins to complete the task in order to get his reward.

2. Do you think this workshop will impact on autistic children in a positive way in school and/or home? How?

For C, the workshop would have a positive impact in both School and home if it was tailored to his interests. For example drawing, monsters and aliens. However his interests can change from week to week.

3. Do you think visual materials (e.g., toolkits 2D/3D) could help autistic children to enhance their behaviour, attituded, and learning environment in the school? How?

Yes by the use of fidget and then boards, visual pictures to show how and what needs to be done in the session.
C uses fidget and then boards throughout this day. So he knows whats expected and reduces anxiety.

staff role: TA

Date : 10/05/22

Feedback from the Classroom Settings

1. Do you think the autistic children are happy to engage in this workshop? How?

When regulated B enjoys messy play and enjoys the tasks set by Nessa, however this is mood dependant. His attention lasts approx 10-15 mins, this is maintained with fidget toys.

2. Do you think this workshop will impact on autistic children in a positive way in school and/or home? How?

for B, if this workshop was part of his daily routine it would have a positive impact at school + home by improving his fine motor skills. [redacted] (which are currently quite weak)

3. Do you think visual materials (e.g., toolkits 2D/3D) could help autistic children to enhance their behaviour, attituded, and learning environment in the school? How?

yes, B responds well to visual picture cards. ~~and~~ this helps him know what's coming next reduce ~~anxiety~~ anxiety. If B was prepped before the activity, with ~~visuals~~ step by step visuals, this may increase understandings and improve behaviour.

Staff role: TA

Date : 6/05/22

A Sample Interview (4) with Teachers and Teaching Assistants (Nov. 2022)

(Evaluation, Reflection, and Recommendations)

1. Do you think children with autism behaviour (e.g., social communication skills) has changed since the workshops began in (January – Nov. 2022)?

2. How do you think the workshops using the 2D/3D toolkits have impacted children with autism in their learning in the classroom setting?

3. Do you think that the 2D/3D toolkits are easy to use in your school? If so, could you please explain why?

4. What do you think about the use of visual materials with children with autism in your school as a new teaching style?

5. What impact do you think these workshops have had on you as class teachers and teaching assistants?

Interview with Class Teachers and Teaching Assistants
Nov. 2022

1. Do you think the autistic children's behaviour (e.g. social communication, sensory sensitives, and well-being) has changed since the workshops began in (January - Nov. 2022)?

N/A.

2. How do you think the workshops using the 2D/3D toolkits have impacted the autistic children in their learning in the classroom setting?

A very positive experience for children. Working in a very small group with adult focus.

3. Do you think that the 2D/3D toolkits are easy to use in your classroom? If so, could you please explain why?

The toolkits are self explanatory and ~~need~~ a however I feel they would need a lot of preparation of resources.

1

4. What do you think about the use of visual materials with autistic children in your classroom as a new teaching style?

It would like a style that would be appropriate for all children. Visual materials instantly capture children's focus.

5. What impact do you think these workshops have had on you as class teachers and teaching assistants?

Has given me opportunities to consider teaching styles. and consider alternative approaches.

2

Interview with Class Teachers and Teaching Assistants
Nov. 2022

1. Do you think the autistic children's behaviour (e.g. social communication, sensory sensitives, and well-being) has changed since the workshops began in (January - Nov. 2022)?

I don't think their behaviours have changed but then the children selected, have complex needs that are enduring. The children did engage well and clearly enjoyed the activities.

2. How do you think the workshops using the 2D/3D toolkits have impacted the autistic children in their learning in the classroom setting?

The children were given opportunities to explore different media / materials within a quiet environment with an adult supporting them directly. They were able to focus better during the sessions.

3. Do you think that the 2D/3D toolkits are easy to use in your classroom? If so, could you please explain why?

I think some of the activities would be difficult to deliver whole class with very young children. The activities required lots of adult direction and were generally very prescribed rather than them having opportunities to explore / demonstrate independent creativity

1

4. What do you think about the use of visual materials with autistic children in your classroom as a new teaching style?

Visual resources are a normal part of good early years practice. I don't see visual materials as being a 'new teaching style'.

5. What impact do you think these workshops have had on you as class teachers and teaching assistants?

It was lovely to see the selected children having success and being able to focus within the sessions. The children were all very enthusiastic about working with Nesrin

Interview with Class Teachers and Teaching Assistants
Nov. 2022

1. Do you think the autistic children's behaviour (e.g. social communication, sensory sensitives, and well-being) has changed since the workshops began in (January - Nov. 2022)?

I think work around sensory and well-being all tie into emotions. I think we do alot of work on emotions and since the workshops there has been some communication around the activities.

2. How do you think the workshops using the 2D/3D toolkits have impacted the autistic children in their learning in the classroom setting?

This will certainly have an impact when accessing 'small group'. Using the materials (having already used some they will have an understanding of how to use)

3. Do you think that the 2D/3D toolkits are easy to use in your classroom? If so, could you please explain why?

I think they could be good to use in the class as an intervention or some of the tools could be well used.

1

4. What do you think about the use of visual materials with autistic children in your classroom as a new teaching style?

I think visuals work extremely well with autistic children. It helps them to know what is coming next or what they are doing. Visuals help keep them calm.

5. What impact do you think these workshops have had on you as class teachers and teaching assistants?

I dont think they have had an impact but you can see ~~it has~~ the children have enjoyed it

Interview with Class Teachers and Teaching Assistants
Nov. 2022

1. Do you think the autistic children's behaviour (e.g. social communication, sensory sensitives, and well-being) has changed since the workshops began in (January - Nov. 2022)?

N/A

2. How do you think the workshops using the 2D/3D toolkits have impacted the autistic children in their learning in the classroom setting?

benefit from small groups.
tactile + sensory activities,
develop language skills.

3. Do you think that the 2D/3D toolkits are easy to use in your classroom? If so, could you please explain why?

All materials + provided
Easy to see what can be
produced.

1

4. What do you think about the use of visual materials with autistic children in your classroom as a new teaching style?

benifical for autistic learners – visual aids : but not too bright or too overwhelming.

5. What impact do you think these workshops have had on you as class teachers and teaching assistants?

Frees up other resources to use elsewhere.
Specialist teacher to teach Specialist subject.

2

A Sample Feedback (3) from Children with Autism Feedback

Sessions Feedback from Children with Autism	Happy 	Not Happy 
Session-1		
Session-2		
Session-3		
Session-4		
Session-5		
Session-6		
Session-7		
Session-8		
Session-9		

(2022)

	Sessions Feedback from Children	Happy	Not Happy
13/01	Session-1 Observation	N/A	N/A
18/01	Session-2	★	
01/02	Session-3	★	
08/02	Session-4	★	
15/02	Session-5	★	
01/03	Session-6	★	
08/03	Session-7	★	
22/03	Session-8	★	
29/03	Session-9	★	

(KS1) (Child-A)

	Sessions Feedback from Children	Happy	Not Happy
13/01	Session-1 observation	N/A	N/A
12/01	Session-2	★	
01/02	Session-3	N/A	N/A
08/02	Session-4	N/A	N/A
15/02	Session-5	★	
01/03	Session-6	★	
08/03	Session-7	★	
22/03	Session-8	★	
29/03	Session-9	★	

(KS1) (Child-B)

4.10 Researcher, Children with Autism, Class Teachers, Teaching Assistants, and Other Children- Teamwork Summer Project

Title: Friendship (Reception)

Preparation:

- We will need to work in small groups (4 groups).
- Each group will prepare one painting following the instructions below.
- At the end of this project, we will have four paintings which we will combine to build our friendship artwork.

Materials:

1. Painting (blue, brown, yellow, purple, red, green, and orange)
2. Brushes
3. Water (cups)
4. Glue
5. Scissors (adults)
6. Pasta (gold and silver)
7. 5 circles as flowers+3 leaves
8. 5 threads
9. Stakes

Procedure:

1. Start to paint background
2. Paint the children in your classroom setting
3. Finally, start to decorate your painting using flowers, leaves, threads, pasta, and stakes, etc.

Figure. 4.25. *The creative design visual example- teamwork summer project*

Figure. 4.26. *The creative design session- teamwork summer project*

Figure. 4.27. *The creative design session- teamwork summer project*

Reflection: This activity encouraged children in the classroom setting to work with professionals and teachers as co-designers. It enhanced the children's engagement and they learned how to create a meaningful landscape using a variety of materials. In addition, this activity enhanced sensory, memory, problem-solving, decision-making, and concentration skills as well as creative and imaginative thinking. The children were also provided opportunities to explore and experiment with new techniques and ideas, enhancing their self-esteem, self-confidence, self-acceptance, and self-expression.

4.11 How the Researcher Used Design Thinking, Participatory Design, and Art Therapy to Involved Children with Autism in the Sessions

Key Words		Key Words	
PD	Participant Design	SC	Self-Confidence
DT	Design Thinking	SE	Self-Esteem
CO	Co-Design	SE	Self-Expression
TM	Teamwork	SA	Self-Acceptance
IB	Improved Behaviour	VA	Visual-Attention
PS	Problem-Solving	SS	Social Skills
DM	Decision-Making	ENG	Engagement
MS	Memory-Skills	CS	Creative Skills
CO	Concentration	ES	Emotions Skills
ENJ	Enjoyment	SS	Sensory Skills
AT	Art Therapy	AF	Awareness Feelings

2

4.11.1 Examples of Sessions for Children with Atusim (KS1)

Sessions Jan-June (2022) KS1	Design Approach	Cognitive Development	Social Communication Skills	Behavioural and Emotional Development	Role in Design Process for Children and Stakeholder	Outcomes of Participation for Children and Stakeholder
18/01/22	PD AT	Co	VA: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
01/02/22	PD DT AT	Co: PS MS	VA: SC: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
08/02/22	PD AT	Co: PS MS: AF	VA: SA: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
15/02/22	PD DT AT	Co: PS MS: DM	VA: SE: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
01/03/22	PD DT	PS: MS DM	VA: SA: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
08/03/22	PD DT AT	PS: DM: MS: Co	VA: SE: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
22/03/22	PD DT	PS: DM: MS	VA: SA: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
29/03/22	PD DT AT	PS: DM: MS: Co	VA: SC: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
05/04/22	PD DT	PS: DM: MS	VA: SA: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
03/05/22	PD DT AT	PS: DM MS: Co	VA: SC: SE SA	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
10/05/22	PD DT	PS: DM: MS	VA: SA: SC SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
17/05/22	PD DT	PS: DM: MS	VA: SA: SC SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
07/06/22	PD DT AT	Co: PS: DM: MS	VA: SE: SA: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
				ES: SS: IB	Co: TM	ENJ: ENG: CS: SS

1

4.11.2. Examples of Sessions for Children with Autism (Reception Class)

Sessions March-June (2022) Reception	Design Approach	Cognitive Development	Social Communication Skills	Behavioural and Emotional Development	Role in Design Process for Children and Stakeholder	Outcomes of Participation for Children and Stakeholder
22/3/22	PD AT	Co	VA: SE	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
29/3/22	PD DT AT	PS: DM: MS	VA: SE: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
05/04/22	PD AT	Co : PS	VA: SA: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
03/05/22	PD DT	PS: MS	VA: SC: SE: SA	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
10/05/22	PD DT	PS: MS	VA: SC: SA	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
17/05/22	PD DT AT	PS: DM: MS	VA: SA SE: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
07/06/22	PD DT AT	Co: PS: DM: MS	VA: SE: SA: SC	ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
				ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
				ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
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				ES: SS: IB	Co: TM	ENJ: ENG: CS: SS
				ES: SS: IB	Co: TM	ENJ: ENG: CS: SS

1

4.12. How the Researcher Measures Levels of Participation in the Workshops

Levels of Participation in the Creative Design Process

1. Children with autism interests and needs are considered.	Yes, the interests and needs of children with autism have been considered. For instance, sessions (1-25)
2. Children with autism share responsibilities for decision-making.	Yes, children with autism share responsibility for decision- making. For instance, sessions (1-25)
3. Children with autism can work independently and with adults supporting.	Yes, children with autism can work independently and with adult's support. For instance, sessions (1-25)
4. Children with autism are engaged in the creative design process.	Yes, children with autism are engaged in and enjoy in the creative design process. For instance, sessions (1-25)

Chapter 5: Thematic Analysis and Discussion

This chapter contains important discussions of the research findings, using evidence from data collected from observations, interviews, questionnaires, and feedback. Additionally, this chapter presents formative discussions of the crucial findings and contributions to the knowledge and will propose solutions to fill the gap and address problems identified by the literature review using these findings.

5.1 Summary of Thesis Findings

This thesis aimed to explore a new teaching approach in the classroom setting, shifting away from the traditional oral teaching style towards a visual style more suited to the needs of children with autism to help them more easily understand information and move through the curriculum. The new teaching style was based on the three key research elements of design thinking, art therapy, and participatory design. After studying the literature of the field, the researcher discovered that using one or two of the elements in isolation was not sufficient to encourage children with autism to engage in classroom activities. Hence, the researcher combined design thinking (e.g. to enhance problem-solving skills), art therapy (e.g. to enhance well-being), and participatory design (e.g. to encourage engagement and exchange of knowledge and information between stakeholders) to address existing problems facing children with autism such as social communication skills. To establish a tailored visual teaching style, the researcher developed visual toolkits, offering the opportunity for children with autism and their teachers to engage in creative design activities which facilitate more effective learning. The research answers the following questions regarding the benefits of visual communication for children with autism and their teachers in the classroom setting:

5.2 How Do the Results of Using Visual Toolkits Could Support Children with Autism in their Learning?

5.2.1 The Classroom Setting without the Visual Toolkits

The teacher and teaching assistants use oral instructions, whiteboards, and one-to-one support with children with autism. There are some visual materials to aid children with autism in their learning, but they are not enough to support them in completing their schoolwork and regulating their emotions. Children with autism require extra help regarding their learning and well-being.

5.2.2 The Classroom Setting with the Visual Toolkits

Using visual toolkits provides opportunities for children with autism to experiment with different creative tasks and learning techniques and enhance their well-being in general. They learn new skills such as problem-solving and decision-making, explore new textures and materials, and engage in activities based on their needs and interests. The toolkits provide children with autism with visual instructions, which are easier to understand than oral instructions. The designer plans creative design activities incorporating numerical tasks, puzzles, and art. The activities include safe and free materials that the children can easily work with and assemble in various ways to navigate lessons. Before the children are seated at the table to work through the visual toolkits, they are given ten minutes to destress and engage in emotional regulation activities using fidget tools and stress balls to support their well-being in general. The visual toolkits enhance children with autism's learning environment (learning new skills in different ways), development (more easily understanding information and knowledge), and well-being (being happier and more relaxed). Overall, the toolkits play an important role in the children with autism learning process in the classroom, offering a new solution for the challenges they face.

5.3 Analytic Approach

The researcher used participatory observations to understand the children's behaviour and evaluate their new learning inspiration and emotional well-being. The researcher used structured participatory observations, focusing on the study of classroom-based interactions and collecting qualitative data to enable comparison and understanding of trends and patterns regarding children with autism behaviour. She also used unstructured participatory observations, taking field notes regarding children with autism behaviour and the conduct of the teachers and teaching assistants. The field notes helped the researcher to keep accurate records and retain important details. Hence, it was important for the researcher to spend an appropriate period integrating with the children with autism in the classroom to allow them to become comfortable and familiar with the researcher's presence. This period they were also allowed the researcher to fully understand individual behaviours and common attitudes.

The researcher used photographic and field note equipment during the participatory observations to document the workshop's content. The data collected were related to what was discussed verbally during the workshop, as well as any relevant written and/or drawn material such as interview transcripts, feedback, and photos of the children's artwork.

After each session, interviews were carried out, with the support of the teachers and teaching assistants, to recognise the alterations made in the participants' learning styles, inspiration, behaviours, and emotional states. The participants were monitored, observed, and evaluated to quantify improved competence and engagement in creative design activities. Throughout the participatory observations, the researcher encouraged the participants to engage in creative design activities. The performance and engagement of the participants were carefully observed and analysed using Merriam's analysis process (Merriam, 1998), considering the balance of developed sessions, autonomy, competence, and understanding of the participants. The effectiveness of the developed sessions and design work was assessed to identify appropriate outcome measures and assess the benefit of creative design process interventions.

The researcher used three different types of interviews: structured (face-to-face meetings with closed inquiries), semi-structured (a set of topics used as a guide to facilitate interview conversation) and unstructured (the researcher leads the occurring discussions) (Cousin, 2009; Denscombe, 2007).

The three types of interviews were used to understand the participants' behaviours, beliefs, and opinions; understand social interactions between children with autism, teachers, and teaching assistants; recognise issues faced by children with autism that may be overlooked; examine sensitive and complex issues in detail (e.g. social communication skills); and provide detail and context to research issues.

The researcher carried out questionnaires and interviews, which were transcribed and coded into main themes and sub-themes. Throughout conversations with teachers and interactions with children with autism, the researcher maintained an appropriate balance of being close enough to the children to obtain their confidence and facilitate good interaction with them, but not too close (e.g. to avoid social desirability prejudice). The researcher also followed her own friendly and open-minded approach in the interviews (e.g. being respectful and not intrusive).

The researcher used data triangulation (using multiple sources of data) and investigator triangulation (using different respondents, teachers and teaching assistants). According to Cohen et al. (2007), 'triangulation' is a technique used to explain the complexity and richness of human behaviour by investigating it from several perspectives, which can take several forms (e.g. data triangulation (multiple sources); investigator triangulation (different investigators' perspectives); theoretical methods and perspectives) (Patton, 2002).

To carry out data triangulation whilst maintaining each participant's viewpoints, the following was considered: i) Ensuring participant viewpoints are recorded into different coloured notes while searching for themes from coded sections of original text/observations; ii) Identifying generated/basic themes while creating the thematic map; iii) Combining coded notes from different participants to see if they create a common theme and recording using different colours, ensuring that individual views are identifiable as distinct contributions. This enabled the researcher to follow all collected data from all participants and create an image of the different views and their interactions within the case study.

In addition, the researcher collected data by observing children with autism and their levels of participation (engagement) in the design process activities they can accomplish (See section 4.12, p. 159).

5.3.1 Thematic Analysis Method

"Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail. However, frequently, it goes further than this and interprets various aspects of the research topic (Boyatzis, 1998)".

Thematic analysis is described by Braun and Clark (2006) as "a flexible and useful research tool, which can potentially provide a rich and detailed, yet complex account of data" (p. 5).

"Thematic analysis is an appropriate and powerful method to use when seeking to understand a set of experiences, thoughts, or behaviours across a data set (Braun and Clarke 2012)".

The work began with a problem statement and the research questions to be explored, followed by the development of the literature review. The literature review explored existing theories that describe a rationale for working with design thinking, participatory design, and art therapy themes within an educational environment. The literature review is logically organised into a conceptual framework that bridges design thinking with participatory design and art therapy. The researcher believed that developing a multi-integrated approach using design thinking, participatory design, and art therapy would enhance children with autism learning skills and optimise the learning environment.

The researcher carried out a thematic analysis (see Chapter 3, Section 3.7) based on the developed theoretical framework incorporating the researcher's epistemological perspective and her role as

an experienced researcher in this field (see Chapter 1, Section 1.2 and Chapter 3, 3.1.2) alongside full understanding and evaluation of existing knowledge and established concepts. The framework was used to identify the main problems to be investigated and develop the research questions to be answered, with the support of a robust methodological approach (see Chapter 3, Sections 3.1.4 and 3.1.5).

The researcher followed the principles of Braun and Clarke's approach (2006), as described in Section 3.4.2 (Data Analysis) to conduct a thematic analysis for qualitative research. One type of thematic analysis uses an inductive approach (e.g., participatory observation, pattern, and conclusion) for data coding and analysis. Inductive thematic analysis uses a bottom-up method and is driven by what is in the data. This means that codes and themes are derived from the content of the data. Another type of thematic analysis uses a deductive approach (e.g., theory, hypothesis, data collection, data analysis, acceptance or rejection of hypothesis) for data coding and analysis. Deductive thematic analysis uses a top-down method driven by concepts and ideas that researchers bring to the data. The researcher used a combination of both inductive and deductive thematic analysis in this study.

This study adopted the six-phase approach to thematic analysis proposed by Braun & Clarke (2006):

1) Familiarising yourself with the data: In this phase, the researcher reads and reread the textual data (transcripts of interviews, written notes regarding classroom observations, questionnaires, and feedback). She also reviewed the photos of the children with autism artwork as part of the data collection. This process helped the researcher to thoroughly understand and become familiar with the data to create codes.

2) Generating initial codes: In this phase, the researcher created codes, providing labels to data items related to the research questions. Codes can describe the content of the data such as descriptive or semantic codes typically related to data and the participant's meaning. The codes generated by the researcher are shown in sections.

3) Searching for the theme: Following the completion of the coding process, the researcher reviewed the codes to determine which codes share sufficient similarity to be merged into a theme. The candidate themes identified by the researcher are shown in sections.

4) Reviewing potential themes: In this phase, the researcher reviewed the potential themes, evaluating them with consideration to the collected data and the generated codes. The researcher

considered the relevance of the themes to the research questions and their ability to provide relevant interpretations of the data. Candidate themes which did not offer a meaningful contribution to the broader narrative of the data were excluded.

5) Defining and naming themes: The researcher refined the selected themes in this phase. The themes were considered about each other, ensuring that each theme is distinct but connects with the others to build a logical overall narrative of the data. The researcher also ensured that each theme had a singular focus and directly addressed the research questions.

6) Producing the report: The report was written and introduced in this chapter to describe the themes, codes, and findings. Once required data were collected from all sources (all information gathered in the study that is relevant to the research questions) and analysed, a report was prepared to identify the findings; articulate the event, situations, and activities under investigation; reflect on the existing related literature and; highlight how that literature informs the research questions.

In addition, the researcher followed the principles of Merriam's approach to the analysis of a qualitative case study as "an intensive, holistic description and analysis of a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" (Merriam, 1998).

5.3.2 Thematic Analysis using NVivo

The researcher used NVivo: NVivo is a software package developed for qualitative and mixed-methods research and thematic analysis. It was used especially for the analysis of image data and texts, including interviews, observations, and surveys. NVivo has a broad range of visualization abilities that are useful for thematic analysis, allowing for the discovery of a new perspective, data coding, and the identification of connected themes, as well as facilitating a proper way of finding commutations.

Within NVivo, the following tasks were carried out: interview transcription; question responses; making sense of the data, categorising themes, and coding emerging themes; connecting themes; studying comparisons among participants; maintaining a clear focus on the main research design and questions (e.g. organising themes in a sensible hierarchy); visualising a conceptual framework within a mind map, for example (as shown in Fig. 5.1). Thematic analysis identified four themes: 1) Enjoyment and Engagement (emotional, needs and interests, and well-being); 2) Learning Environment (teachers, teaching assistants, and researcher); 3) New Approach (2D/3D toolkits,

participatory design, art therapy, and design thinking); and 4) Skills (problem-solving, memory, sensory processing, concentration, decision-making, visual attention, and creative and imaginative thinking). An interactive and creative research model and design activities were developed to link the four themes.

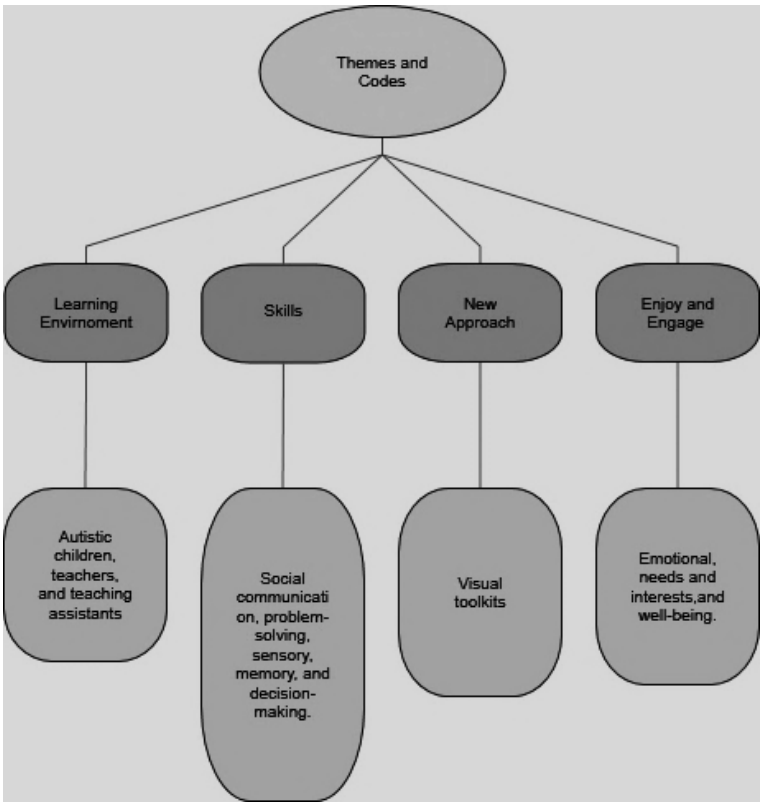

Figure 5.1. *Mind Map for the Themes and Codes*

Themes and Codes: This figure shows how the codes were generated from themes. For instance, 1. Learning environment themes created codes, which came from the needs of children with autism and their teachers to enhance the learning environment in the classroom setting; 2. Skills themes created codes, which came from the needs of children with autism and their teachers and teaching assistants to improve learning skills; 3. New Approach themes created codes, which came from the needs of children with autism and their teachers to enhance the learning environment in general; and 4. Enjoyment and engagement themes created codes, which came from the needs of children with autism to improve their well-being.

The data from the conducted observations and interviews were analysed qualitatively using the principles of thematic analysis. The findings from the thematic analyses were presented as thematic

networks (mind maps), with an explanation of the theme in each network. The organising themes produced and outlined connections between them.

5.4 Themes and Codes

5.4.1 Theme [1] Enjoyment and Engagement

Researcher: *"Do you think the use of a mindful teaching style (e.g., 10 minutes of preparation before beginning tasks to destress using tools such as stretchy silicon toys and stress relief squeezing balls, and push pop to fidget toys) to maintain children with autism attention and help them to engage in the design sessions is useful?"*

Teachers: *"Yes, it is a great idea and helps children with autism to be happy and relaxed in the classroom".*

The new teaching approach proposed by the researcher emphasises mindfulness during the creative design activities sessions, incorporating tools such as stress balls and fidget toys can help children with autism reduce stress and anxiety and feel more relaxed before starting their schoolwork. The teachers and teaching assistants confirmed that the mindful teaching style used by the researcher was useful, addressing the emotional needs of children with autism in the classroom setting, helping them to settle down, and feel happy and relaxed.

Researcher: *"Do you think that there have been any positive impacts regarding the learning and development of children with autism in the classroom?"*

Teachers: *"Yes, their self-acceptance, self-expression, and memory skills are changed in a positive way in the classroom".*

The researcher provided art therapy through creative design activities to improve the well-being of children with autism as well as their self-esteem and self-expression. The teachers confirmed that they observed positive changes in children with autism behaviours and improvements in their general well-being.

Research: *"The class teacher began by introducing me to all the children in the classroom setting. Then, we discussed my research project, why I was there, and how I would support children with special educational needs in general, and with autism in particular. The class teacher gave me background on children with autism needs. For example, the teacher highlighted that they express delays in speaking, poor memory and communication skills, and attention problems. I observed that teaching assistants were not enough to support the children one-on-one. The children were friendly and open to communicating with me and we shared*

paintings, talked, and played together. The class teacher worked with all children inside and outside the classroom to support children one-on-one and/or in a small group".

Teacher (KS1): *"The creative design activities reflected children with autism interests and were appropriate for their needs".*

Teacher (Reception Class): *"The creative design activities certainly engaged children with autism, who were keen to take part in these activities. In addition, the activities were aligned with children with autism needs and interests".*

Children with autism need extra support in their learning environment due to issues such as speech delays, poor memory, and poor communication skills. The new teaching approach proposed by the researcher aimed to provide such support through the use of 2D/3D visual toolkits, enhancing the learning and understanding of the children by using a more effective medium of teaching. The teachers confirmed that they observed positive changes in children with autism learning levels and that the activities met their needs and interests.

Researcher: *"Do you think children with autism are happy to engage in creative design activities?"*

Teacher (Reception class): *"Children with autism enjoyed and engaged in creative design activities. Because these activities enhanced their well-being".*

Teacher (KS1): *"The children have enjoyed participating in the creative design activities".*

Researcher: *"Do you think children with autism feel comfortable engaging in creative design activities?"*

Teachers: *"Yes, in fact, children with autism love to engage in the artwork and design activities you plan each week".*

The researcher provided creative design activities tailored to the needs and interests of children with autism, encouraging them to engage in the activities. The teachers confirmed that they observed positive changes in children with autism engagement with their schoolwork and that the activities met their needs and interests and enhanced their well-being.

In summary: Theme [1] Enjoyment and Engagement highlighted the concerns brought up by the teachers and teaching assistants regarding the well-being of children with autism. The creative design activities helped to improve their well-being through the use of the alternative toolkit (visual materials), helping them to be more comfortable in the classroom setting.

5.4.2 Theme [2] Learning Environment

Teacher (KS1): *"The researcher had a lovely, gentle, and friendly relationship.*

Teacher (Reception Class): *The children with autism responded very well to the researcher and there was a very positive relationship between them.*

Teacher (KS1): *To support the learning environment in our classroom we need more multi-sensory activities.*

Teacher (Reception Class): *To support the learning environment in our classroom we need activities suited to our curriculum".*

Teachers: *The visual materials are an important teaching method in the classroom with all children in general, and in particular with children with autism. This method could improve the learning environment because it makes it easier for them to understand information and obtain knowledge.*

Children with autism need extra support in their learning environment to more easily comprehend the information provided. The new teaching approach proposed by the researcher aimed to provide such support through the use of 2D/3D visual toolkits, enhancing the learning and understanding of the children by using a more effective medium of teaching. The teachers confirmed that they observed positive changes in children with autism learning levels and that the researcher had a friendly relationship with children with autism and teachers in the classroom setting.

Teaching Assistant (1): *"Children with autism were happy and enjoyed engaging in the activities. They focused on completing their tasks to get their rewards.*

Teaching Assistant (2): *Children with autism responded very well to the researcher and there was a very positive relationship between them".*

The 2D/3D toolkits developed by the researcher helped to improve the well-being of children with autism, helping them to engage more easily and enthusiastically with their schoolwork whilst taking into consideration their personal learning strengths and emotional needs. The teaching assistants confirmed that they observed positive changes in the children with autism well-being.

Researcher: *"Do you think the researcher is working collaboratively, is well-organised, and provides appropriate preparation and finishing stages before and after the sessions?*

Teachers: *Yes, the researcher is friendly, respectful, and proactive. The researcher interacts well with the children with autism and has good leadership skills.*

Researcher: *Do you think the researcher provided suitable materials to use with children with autism and introduced proper visual instructions (e.g., step-by-step guidance)?*

Teachers: *Yes, the work plan, materials, and visual instructions have been useful and easy to use and implement".*

The researcher provided free and safe toolkits in the creative design activities which supported the children with autism in their learning environment. The teachers confirmed that they observed that the researcher had a friendly relationship with children with autism and teachers in the classroom setting. In addition, the teachers confirmed that the visual instructions and materials were useful and easy to use and implement.

In summary: Theme [2] Learning Environment highlighted the concerns brought up by the teachers and teaching assistants that the learning environment was not sufficiently accommodating for children with autism. The creative design activities helped to improve the children with autism learning environment through the use of the alternative toolkit (visual materials), helping them to more easily understand lessons and complete tasks

5.4.3 Theme [3] New Approach

Researcher: *"I will use 2D/3D toolkits to support children with autism in their learning development. Do you agree for such toolkits to be used during the session as a part of the research methodology?*

Teachers: *Yes, it is great to try a new tool in our classroom setting. Children with autism need new learning techniques to support them in their learning and development.*

Researcher: *Are there any subjects which you feel could benefit from an alternative approach to supporting children with autism, such as a visual toolkit produced by the participatory design process?*

Teachers: *Yes, sometimes we need an alternative method to support children with autism to complete their work in different subjects such as Maths, Sciences, and English.*

Teachers: *The toolkit was easy to use in the classroom setting. Also, all the materials were free and safe for children with autism to use.*

Teaching Assistant (1): *The 2D/3D toolkits could improve children with autism behaviour, by reducing anxiety, for example.*

Teaching Assistant (2): *The 2D/3D toolkits could improve children with autism behaviour by enhancing their well-being, for example".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels, behaviour, and well-being.

Researcher: *"Before each session, I will provide you with a full explanation and identification of the main objectives and processes to be considered for each session (e.g., rationale, step-by-step guidelines, and visual instructions). Would this be acceptable?*

Teachers: *Yes, sharing session details and step-by-step instructions would help us to work together to support children with autism.*

Researcher: *I will provide all materials, which are free and safe to use, for children with autism. The session will include a preparation stage around 10-15 minutes before the start of the session's main activities, would this be acceptable?*

Teachers: *Yes, take your time and thank you for providing the free materials.*

Researcher: *I will lead and manage the design activities with children with autism during the session in the classroom with your support. Do you agree to this arrangement?*

Teachers: *Yes, I am happy to give my opinion, let you know my thoughts about your sessions, and share my experience.*

Researcher: *During and after the session, I will share information with you, ask for feedback, ask you to complete questionnaires, and take photos and notes. Do you agree to patriciate and provide the required information and feedback?*

Teachers: *Yes, I am happy to give you my opinions and share my experience with you.".*

The researcher worked in close collaboration with the teachers and teaching assistants to carry out the research project to enhance the learning environment. Discussions before and after each creative design activities session were carried out to plan the sessions together to support the children with autism and address their needs and interests. The researcher asked the teachers and teaching assistants for their opinions, feedback, and recommendations to understand the problems faced in the classroom setting, such as poor social communication skills between children with autism and their teachers, and help the researcher to enhance the visual toolkits (prototype).

Researcher: *"Do you think art therapy could improve children with autism self-perceptions and self-expression?*

Teacher (KS1): *Yes, their active engagement will lead to a great enhancement of their self-expression and self-acceptance.*
Teacher (Reception Class): *Yes, it will improve their self-esteem and self-confidence and make them more active and productive".*

The researcher provided art therapy through creative design activities to improve the well-being of children with autism as well as their self-esteem and self-expression. The teachers confirmed that

they observed positive changes in children with autism behaviours and improvements in their general well-being.

Researcher: *"Do you think design thinking could improve children with autism learning skills, such as problem-solving skills?*

Teacher (KS1): *I am confident that they would like to engage in the design activities. Painting, working with numbers to build pictures, and working with puzzles will enhance their memory and problem-solving skills and help them to engage more actively in the learning process.*

Teacher (Reception Class): *Painting and anxiety stress relief by squeezing balls will enhance their behaviours and emotional skills. They will like it and will be keen to participate.*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels, creative thinking skills, and well-being.

In summary: Theme [3] New Approach highlighted the need mentioned by the teachers and teaching assistants to support children with autism with a new teaching approach such as visual toolkits to enhance their learning and development. The creative design activities could help to improve children with autism behaviour, learning environment, and well-being through the use of the alternative toolkit (visual materials).

5.4.4 Theme [4] Skills

Researcher: *"Could you please explain why you think the design process using toolkits will benefit the children with autism in your classroom?*

Teaching Assistant (1): *The design process using the toolkit will enhance children with autism problem-solving and memory skills in Maths and Sciences as well as other topics. This will enhance their confidence as they will feel more included in the classroom and like part of a team.*

Teaching Assistant (2): *The design process using the toolkit will also encourage them to work actively and build their confidence to share designs and ideas, which will enhance their social and visual communication skills".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism in their social communication skills.

Teachers: *"The toolkits could support children with autism to improve their learning skills in the classroom such as enhanced memory skills."*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels and memory skills.

Researcher: *"Do you think children with autism are easily overwhelmed by sensory stimuli such as sight, touch, taste, smell, and sound?"*

Teachers: *Children with autism have different sensory sensitivities. Some of them are easily overwhelmed by sensory stimuli such as sight, light, and touch and others are not.*

Researcher: *Do you think that there have been any positive impacts on children with autism's social communication skills in the classroom?*

Teachers: *Yes, there have been noticeable improvements in their skills in the classroom and I think at home, too".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers

confirmed that they observed positive changes in children with autism learning levels, behaviour, and sensory processing skills.

Teachers: *"I can see positive changes in children with autism in the classroom, such as enhanced concentration and problem-solving."*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels and concentration skills.

Teacher (KS1): *"The design process using the toolkit will enhance children with autism problem-solving and memory skills in Maths and Sciences as well as other topics. This will enhance their confidence as they will feel more included in the classroom and like part of a team.*

Teacher (Reception Class): "*The design process using the toolkit will also encourage them to work actively and build their confidence to share designs and ideas, which will enhance their social communication skills and decision-making".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels, decision-making skills, and social communication skills.

Teachers: *"I can see positive changes in children with autism in the classroom, such as enhanced concentration and visual attention".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels and visual attention skills.

Teachers: *"The creative design activities certainly engaged children with autism, who were keen to take part in these activities. In addition, the activities aligned with children with autism needs and interests.*

Teachers: *The creative design activities had a positive impact on our classroom. For instance, they helped children with autism to focus and engage, and enhanced their well-being".*

Children with autism need an alternative method to support them in completing their schoolwork. The 2D/3D toolkits developed by the researcher supported children with autism in their learning and development, helping them to more easily work through the curriculum. The teachers confirmed that they observed positive changes in children with autism learning levels and creative and imaginative thinking skills.

In summary, Theme [4] Skills highlighted the need mentioned by the teachers and teaching assistants to enhance the problem-solving, memory, sensory processing, and decision-making skills of children with autism, as well as their concentration, visual attention, and creative and imaginative thinking. The creative design activities helped to improve children with autism learning skills, sensory processing, and well-being through the use of the alternative toolkit (visual materials).

5.5 Researcher Position

The researcher used her knowledge and work experience in the education, art, and design fields over 20 years around the world to encourage children with autism to be involved in creative design activities. While the researcher is not an autistic person, she has learned how to effectively work with and support children with autism in their learning environment. These experiences provided opportunities for her to gain more insight into the requirements and struggles of children with special educational needs and access their day-to-day lives in school to investigate their problems in the classroom setting (such as social communication skills). This helped the researcher to carry out this study to create an alternative approach (visual toolkits) to support children with autism and their teachers to easily communicate in the classroom setting. Three key research elements were used in this study:

1) Design thinking to enhance problem-solving skills, memory skills, concentration, sensory sensitivity, decision-making, visual attention, and creative and imaginative thinking;

2) Participatory design to encourage engagement, work with stakeholders as co-designers, and measure the engagement level of the participant; and

3) Art therapy to improve self-esteem, self-acceptance, and self-expression to enhance children with autism skills in their learning environment.

5.6 Discussion of Findings and Contributions

Benefits of the new innovative design model- 2D/3D toolkits (visual communication)

The implementation of the 2D/3D toolkits in the classroom setting has been identified were found to yield benefits in the following areas:

Learning Environment: Visual communication positively impacted children with autism's learning and development skills, improving their creative thinking, problem-solving, decision-making skills, memory, and concentration through creative design activities. The children with autism were taught new skills within each session and improved from low to medium to higher learning skills. During the sessions, they were taught to communicate with others, engage with different ways of thinking and problem-solving, and explore and experiment with new ideas based on visual communication.

Well-being (in general): Visual communication positively impacted children with autism's self-esteem, self-confidence, self-acceptance, and self-expression. The well-being of children with special educational needs in general, and autism in specific, significantly benefits from art therapy. Art therapy can reduce anxiety, improve low self-esteem, facilitate self-acceptance, and encourage self-expression by using drawing, painting, crafting, etc., as an alternative medium of expression instead of oral communication.

Social Skills: Visual communication positively impacted the standard of communication between children with autism and their teachers. The main problem this study aimed to address was poor social communication skills between children with autism and their teachers in the classroom setting. The traditional oral teaching style used in the classroom with all of the children, including children with autism, fails to address the specific needs of children with autism sufficiently. In place of this teaching strategy, the researcher used a visual strategy with children with autism to teach them how to communicate with others, understand lessons more easily by using different materials such as 2D/3D visual toolkits, and help them to transition between different stages in the learning process more easily.

Sensory processing: Visual communication positively impacted children with autism tolerance of various sensory stimuli by using a variety of textures (e.g. hard textures like pink salt, soft textures like fleece, and fluid textures such as paint and glue) and providing opportunities for children with autism to try new techniques, ideas, and materials to enhance their sensory skills.

Engagement: The children with autism and their teachers were able to engage well in the creative design activities and work as co-designers, helping to create toolkit prototypes step-by-step based on their needs and interests.

Benefits of Stakeholder Participation: The stakeholders were provided with opportunities to exchange knowledge and information with each other and the researcher. By attending the creative design sessions, the teachers and teaching assistants were able to learn how to use the new visual communication, with or without the presence of the researcher, and can thus use these toolkits in the classroom to support children with autism in their learning. The teachers and teaching assistants confirmed that the children with autism did not exhibit behavioural issues during the creative design activities, and the researcher focused on praising them with small toys and stickers to encourage their confidence. The researcher's time experiencing and engaging in the classroom setting allowed her to learn how the teachers and teaching assistants work with children with autism one-on-one, what visual materials the school uses to support children with autism, and how they teach children with autism different topics (e.g. English, Maths, and Science).

The case study findings and contribution, according to Merriam's approach (1998), answered the research questions and clarified the best design practices (visual communication) for children with autism and their teachers to establish in the classroom. For instance, 1) Data gathering through interviews, using field notes equipment and transcripts of the interview, as well as observation, documents, and workshops (e.g. day-to-day diary and photographs); 2) Data analysis (case study is described in detail) through ethnographic analysis, narrative analysis, and content analysis; 3) Data reporting (focuses on describing the case study with description, analysis, and explanation addressed differently or equally); 4) Data validating through long-term observation, participatory research, and disclosure of research bias; and 5) Data reliability through explanation of the investigator's position with regards to the study as well as the case studies protocols and databases. Based on the information gathered from the data, this study created innovative visual communication (2D/3D visual toolkits) to support children with autism and their teachers in the classroom setting. This visual communication is used by children with autism to support them in understanding and

completing their schoolwork in the classroom and at home to be engaged in the learning activities as well as their peers of the same age. This visual communication enhanced the learning environment for both children with autism and their teachers to easily communicate. Finally, there is evidence that this visual communication is used by children with autism and their teachers in the classroom setting (children aged 4-6 years old, boys and girls; approximately 12 children in total; 8 teachers in total; and length of 7 months in primary school, in the UK) could enhance the learning environment and social communication skills between both.

In summary: The findings provided evidence that the developed 2D/3D toolkits could improve the learning environment, as shown in Fig. 5.2. The three key research elements of participatory design, design thinking, and art therapy were used together to deliver the new innovative design model (visual communication), which was applied during the creative design activities sessions to address the challenges within a complex learning environment. During the creative design sessions, the researcher worked on building a good relationship with children with autism and their teachers and enhancing her understanding of the problems they face in the classroom setting (e.g. exploring the difficulties children with autism and their teachers face about communicating with each other) and their unique set of needs and interests, designing the prototype of the 2D/3D toolkits accordingly. The toolkits were intended to facilitate communication and develop the learning skills of children with autism.

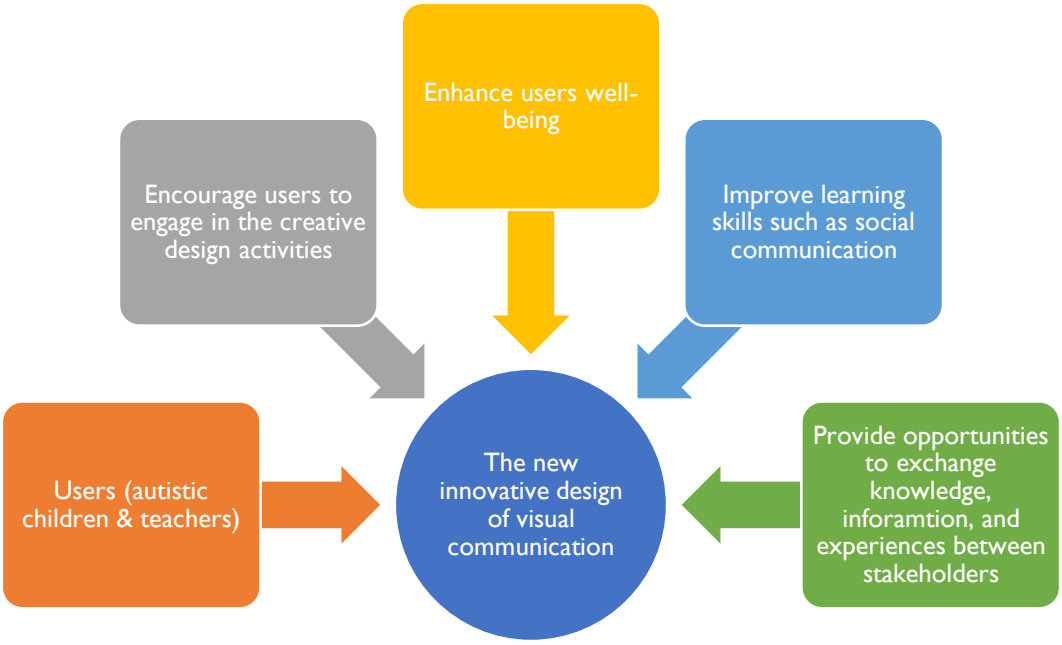

Figure 5.2. *The new Innovative Design Model of Visual Communication.*

Figure 5.2 shows how the new innovative model of visual communication, offering an alternative visual learning approach, positively impacted the learning environment. Visual communication encouraged children with autism and their teachers in the classroom setting to engage in creative design sessions through the use of art therapy, design thinking, and participatory design. The use of visual communication yielded positive impacts regarding the well-being (in general) of children with autism, helping them to feel safe and relaxed and reducing their anxiety by using mindfulness techniques. It also improved their learning skills, such as social communication. Finally, the creative design activities workshops provided opportunities for the stakeholders to exchange knowledge, information, and experiences with other professionals.

Chapter 6: Conclusions, Recommendations and Future Work

This chapter concludes the research, summarising the main contributions, key outcomes, advantages, and limitations. It also suggests further work regarding the complex learning environment and special educational needs provision that could be carried out in the future. It is anticipated that class teachers and educators can apply the outcomes and conclusions established in this work to enhance the social communication and learning skills of children with autism.

6.1 This Research aimed to find the Answers to the Research Questions:

1. Does an approach that integrates design thinking, art therapy, and educational theory deliver new forms of visual communication when applied to the challenges of complex classroom situations? (See section 6.2).

2. What kind of design-based practice aids do teachers establish that are suitable for the continual design and re-design of their classroom setting in response to the complex needs of their pupils? (See section 6.3).

6.2 Summarise and Reflect on the Research Conducted

This thesis aims to investigate a creative solution for the existing problems facing children with autism regarding social communication skills in the classroom setting. It also aimed to examine the impact of the new innovative design approach using the three key elements together (e.g. design thinking, participatory design and art therapy) to create the solution for exciting problems such as social communication skills between children with autism and their teachers.

As shown in the literature review, various solutions for these problems have been proposed by researchers in the fields of art and design, education, and social sciences. Some researchers have combined participatory design and design thinking to create their solution (Benton and Johnson, 2015), (Brown et al., 2008), whereas others have focused solely on the use of art therapy (Park,

2021). The researcher investigated the other researchers' work in the same field (education, art and design) to understand the gap between what happened and what we need to do to solve the problems of social communication skills. In the current study, the researcher combined the three methods of participatory design, design thinking, and art therapy in a new innovative design approach to create a new solution (visual communication). The researcher observed that the other researchers could use one or two methods, such as art therapy, participatory design, and design thinking, and two of them together to support children with autism in their learning environment. That could solve the problem but from one perspective (e.g. social communication skills), not all problems.

The researcher is an artist and designer with over 20 years of experience working in art and design and education and has worked in private and public schools around the world with children with and without special educational needs. Based on her own experiences and the experiences of other researchers working in the same field, the researcher built her hypothesis that using one or two of the key research elements of participatory design, design thinking, and art therapy is not sufficient to address social communication skills problem in the complex learning environment. It was apparent to the researcher that an innovative design approach combining the three key elements was necessary to create a solution capable of addressing the existing problems.

The researcher used art therapy to improve the well-being of children with autism, helping them to relax and reduce anxiety. Art therapy encourages children with autism to engage in and enjoy creative design activities. In addition, art therapy helps children with autism to express their feelings through drawing and painting instead of words. The researcher also used design thinking to improve children with autism learning skills such as problem-solving, concentration, memory, sensory processing, decision-making, and creative thinking using various puzzles, painting activities, and art exercises. Each creative design activities session utilised different ideas, materials, and techniques. The human-centric approach of design thinking ensured that the activities were tailored to the specific needs and interests of the children with autism in the classroom setting.

In addition, the researcher aimed to improve the learning environment by interacting with stakeholders (class teachers, teaching assistants, and children with autism) through participatory design. The stakeholders were encouraged to engage in the creative design process session-by-session as co-designers, providing their input and opinions and exchanging information, knowledge, and experiences with each other and the researcher. The researcher collected the stakeholders'

feedback and comments to improve her prototype to meet their needs and interests. Children with autism were allowed to explore and experiment with the use of visual toolkits in their schoolwork (visual instruction instead of oral instruction). They gained new experience working with other professionals and adults, helping them to improve their communication skills.

This study took place in a Primary School South Shields, UK. The stakeholders were two class teachers, two teaching assistants, and six children with autism - two units KS1 and reception class (four boys and girls aged between 4-5 years old and two boys aged between 5-6 years old). The first cycle of the case study was carried out between Jan. 2022 to June 2022, and the second cycle was carried out between Oct. 2022 to Nov. 2022. After completing both cycles, the researcher collected the data to be analysed and recorded the findings. The new innovative design approach process is shown in Fig. 6.1.

Figure 6.1. *The New Innovative Design Approach Process*

Figure 6.1 outlines the innovation design process: (1) the research questions; (2) investigating the problem to create a creative solution (visual communication); (3) collecting data using qualitative research (observation, interviews, questionnaires, and photos); (4) three key elements (design thinking, participatory design, and art therapy); (5) testing the prototype (2D/3D toolkits); (6) evaluation and end-user inputs (children with autism and stakeholders); and (7) analysis, results, and recommendations (stakeholders).

6.3 The Research Aims to Create a New Approach

This research aims to create a new approach (2D/3D toolkits- visual communication) to use by children with autism and their teachers in the classroom setting for instance they need to:

- Communicate visually not orally through using the visual toolkits to enhance their understanding and learning differently;
- Encourage their thinking and creative imagination by using design thinking to enhance their problem-solving skills;
- Relax, be happy, and express their feelings through using art therapy to enhance their well-being;
- Feel safe and avoid triggering their emotions to become overreacted such as sensory processing (e.g. noise, light, smell, and touch), which the researcher worked on by using stress balls, and fidget toys, and tried different textures to encourage children with autism to use the different feelings touched;
- Challenge their skills to feel they can do it instead of being isolated from the activities, which the researcher provided opportunities for them during activities to explore and experiment with a new way of knowledge and information through the use of the 2D/3D toolkits (e.g. visual materials); and
- Learn how to understand other emotions (sad, happy, and angry), and the researcher uses social stories during the creative design activities to support children with autism in understanding other's feelings.

The teacher also needs to change their teaching style with children with autism from oral to visual teaching style, which the researcher provides opportunities for them to exchange knowledge and information during the participatory design workshops. Also, they used the new innovative design model (visual communication) with children with autism in the classroom setting, which improved the learning environment based on their feedback and opinions conducted in the interviews and surveys.

The findings of this study show that children with autism are talented, smart, and unique students. They need a different teaching style, which the researcher offers in this study (the new innovative design model includes design thinking, participatory design, and art therapy). This model using visual communication will support both children with autism and their teachers in the classroom setting to enhance the learning environment. It could be used with the school curriculum, art activities, and an alternative subject to support children with autism in learning information and knowledge with a new teaching strategy, which uses visual instead of oral instruction. Also, the findings from this study suggest that extra support with visual communication, working one-to-one, and supporting emotions and feelings for children with autism will enhance their ability to communicate, interact, and engage. In addition, the main core of these findings is that the visual toolkits could

improve social communication skills (including memory, visual attention, problem-solving skills, and sensory issues) for children with autism.

6.4 Suggestion

The researcher observed that the teachers relied on oral instructions and the use of whiteboards as teaching tools in the classroom setting with all children, including children with autism. The researcher observed that children with autism in the classroom could not follow the teacher's instructions as the oral teaching approach was not tailored to their specific needs. Children with autism also require extra time to complete their tasks; opportunities to work one-on-one with a teacher or teaching assistant; and techniques to sufficiently reduce stress and promote relaxation to help them communicate with their teachers and peers in the classroom setting and cope with the daily schoolwork.

6.5 Contribution

The researcher thus offered: (1) An alternative teaching style favouring a visual teaching approach using visual communication toolkits (as shown in Chapter. 4, Session. 4, Figure. 12) tailored to the needs and interests of children with autism; (2) Mindfulness techniques to help children with autism to reduce stress and better acclimate to the classroom setting; (3) Art therapy which can be implemented as part of the curriculum to enhance the well-being of children with autism, helping them to express themselves and improve their self-esteem, self-confidence, and self-acceptance (as shown in Chapter. 4, Session. 16, Figure. 18); (4) Various activities to improve the problem-solving skills and creative thinking skills of children with autism (as shown in Chapter. 4, Session. 11, Figures. 14-15); and (5) Opportunities for the teachers and teaching assistants to work with other professionals (participatory design) to exchange knowledge and information and enhance their skills (as shown in Chapter. 4, Cycle two - Session 6, Figures. 22-24).

The previous interventions positively worked with children with autism For example, Gray's approach (1998) uses social stories to support the emotional development of children with autism; the SCERTS model (Rubin, 2016) provides guidelines to help children with autism in their learning development and encourages children to convey their emotions using images presenting various facial expressions; and the TEACCH model (Mesibov et al., 2004) is designed to support children with autism through visual learning tools(e.g. symbols, pictures, calendars). However, the three models do not sufficiently address various other needs of children with autism, including overall well-being, communication skills, and social interaction (Saggers et al., 2015). Additionally, this research study's literature review provided a full understanding of three key research elements,

including design thinking (Brown, 2009), participatory design (Sanders and Stappers, 2008), and art therapy (Schweizer et al., 2019) to create a new alternative visual communication model to supporting children with autism in their learning environment. Also, this study took place in a primary school in the UK. This study is tailored to the needs and interests of children with autism (such as social communication problem skills) to meet the schoolwork day-to-day. The researcher collected multiple data from observations, interviews, surveys, and children with autism's artwork. Then, the researcher analysed data by using the NVivo software to figure out the findings to support understanding why there is a specific problem (such as social communication) faced by children with autism and their teachers to communicate together in the classroom. The findings showed that children face some obstacles with autism to communicate with their teachers and peers in the classroom setting. For instance, children with autism often have difficulties with typically expected social interaction (such as eye contact, facial expression, and emotional signals), communication skills (such as verbal and non-verbal), and repetitive behaviours (such as an excessive focus on parts or pieces, rocking, and need for routines) as well as often displaying restricted and repetitive patterns of activities or interests since early childhood, which limit and impair everyday functioning, and are often referred to art therapy (National Autistic Society, 2020; Schweizer et al., 2019; Elkins and Deaver, 2015). This study provides a new visual communication toolkit which will support children with autism in their learning environment. For instance, a) Teachers in the classroom setting used oral instructions, a whiteboard, and an international curriculum (in the mainstream school) for all children with or without autism. This study used participatory design to exchange knowledge and information with teachers and provide opportunities for them to talk about the problems faced by children with autism; b) All children could follow the class teacher's notes on the whiteboard and copy after her/him on their workbooks. However, children with autism cannot follow the class teacher and copy after her/him in their workbooks because they cannot understand oral instruction. Also, it is not easy for them to copy after their teacher writes on the whiteboard because they need extra time and different tools to support them in following their teacher as well as other children in the classroom. This study used design thinking to support children with autism in following her/his class teacher's instructions instead of using oral instructions, using visual instructions (e.g. instead of the teacher using a whiteboard with all children, she/he can use a visual toolkit 2D/3D such as visual map, story, and schedule to support children with autism in the classroom); c) Children with autism suffer from sensory issues such as sensory sensitivities to noise, light, and touch. These sensory issues in the classroom could be normal issues for other children but could be a big problem for children with autism. This study used a visual toolkit to support children with autism to cope with sensory sensitivities (e.g. provide opportunities to explore and experiment with a variety of textures,

such as soft and hard materials, to be familiar with the touch skills); d) Children with autism are easily overwhelmed, frustrated, and anxious in the classroom setting, which causes their angry behaviour. This study used art therapy to support children with autism to be relaxed and happy (e.g. using art therapy could improve children with autism's well-being); and e) Children with autism need extra time and extra attention in the classroom (e.g. work one-to-one), and divided schoolwork to be small work to be easy to complete. This study used a visual toolkit to support children with autism to complete their schoolwork (e.g. make the projects small and easy to complete, which will positively affect them, using the visual toolkit to support them to complete their schoolwork such as Math, English, and Science In different ways, and finally, using art therapy any time to support them to be relaxed and happy).

Also, there are positive results of using visual toolkits in the learning environment. For example, all of the teachers agreed that visual toolkits supported children with autism in their learning environment (e.g. social communication skills). They also encouraged children with autism to use visual toolkits as an alternative method in the classroom setting to support them in coping with their schoolwork (e.g. Math, English, and Art). They agreed that the use of visual instead of oral instruction would be more useful to be part of children with autism school plans. Also, they observed there are improvements in children with autism behaviour, learning skills, and well-being during creative design activities using 2D/3D toolkits (visual toolkits), (See Table 9).

Table 9. *Children with Autism Problems and Creative Design Solutions (with 2D/3D Toolkits)*

Children with Autism's Problem	**Creative Design's Solutions**
Lack of understand emotions such as awareness feelings.	See Ch.4 - Session.3 "Don't talk with strangers to enhance awareness and memory skills using social stories".
Lack of sensory processing	See Ch.4 - Session.4 "Used different textures to enhance sensory processing such as soft and hard textures".
Lack of problem- solving skills	See Ch.4 - Session.11 "Enhancing problem-solving skills, decision-making, and creative and imaginative thinking".
Lack of Memory skills	See Ch.4 - Session.
Lack of decision-making	See Ch.4 - Session 7 "Using collage art to enhance problem-solving skills and decision-making".
Lack of self-esteem, self-confidence, self-acceptance, and self-expression	See Ch.4 - Session.16 "Art therapy with pen brushes to enhance self-expression, self-confidence, self-esteem, and self-acceptance.

6.6 Limitations

This thesis aimed to support children with special educational needs and children with autism specifically to communicate with their teachers in the complex learning environment easily. However, the opportunities made available to the researcher to work in schools were vastly limited due to the COVID-19 pandemic. The researcher spent six months contacting schools to secure a placement before being accepted into a special educational school in Newcastle. Upon the first visit to the KSI classroom, it was clear that children with autism were not ready to work with the researcher as the class teacher had stated, due to issues of isolation and limited social interaction arising from the pandemic. The researcher thus resumed her search for a placement for another three months before being accepted at a primary school in South Shields, where she carried out her research for eight months (with the first cycle spanning from January-June 2022 and the second cycle spanning from October-November 2022). The headteacher, class teacher, teaching assistants, and children were all highly busy. Although happy to engage in the art and design workshops offered by the researcher, the tight schedules of the staff limited the exploration and development of the 2D/3D toolkits.

Additionally, observing the students and staff can result in altered behaviour and stress, making it difficult to assess the natural state of the classroom. Furthermore, privacy concerns limited data gathering as it was not always possible to record interviews or take video records. Feedback was also dependent on the inclination of participants to share their honest opinions and recommendations and the varying extents to which they were willing to critique and discuss.

6.7 Recommendations and Future Work

The findings of this study suggest that the three key research elements of design thinking, art therapy, and participatory design (the new approach method) should be used in combination to provide the most optimum support for children with autism and their teachers in the classroom setting, improving social communication skills of the children.

This work developed a new teaching strategy in the classroom setting for children with autism and their teachers, producing a new innovative design model- 2D/3D toolkits (visual communication). If implemented in more schools in the future, the visual teaching approach offered by the toolkits could help children with autism to better engage with and understand the learning material, delivering the national curriculum in a manner that is more easily digestible as opposed to the traditional teaching approach, relying on oral instructions and the use of whiteboards. The toolkits

could support children with autism and their teachers to cope with the challenge of social communication skills (by using visual toolkits) in the classroom, whilst facilitating the children's learning skills and enhancing their sensory processing (by using ball stress and fidget toys) skills and general well-being (by using art therapy). In addition, children with autism may demonstrate enhanced performance in subjects such as Maths, English, Science, and Art and greater enjoyment of the learning experience.

Finally, this study recommends using 2D/3D toolkits (visual communication) with children with autism in schools and at home. Also, it offers an innovative solution to tackle the existing problem of social communication skills between children with autism and their teachers in the classroom setting. If implemented in more schools in the future, the visual teaching style offered by the visual toolkit could help children with autism to better engage with and understand the learning material, delivering the national curriculum in a manner that is more easily comprehended as opposed to traditional teaching approaches which do not take into account the specific needs, strengths, and weaknesses of children with autism.

6.8 Publications

1. Elmarakbi, N., Dr Pearson, A., Pro Macintyre, J. (2023), "Creative Design Thinking Approach to Support the Complex Learning Environment of the Classroom for Autistic Children and their Teachers", 25th International Conference on Engineering and Product Design Education, ELISAVA, Barcelona School of Design and Engineering, Barcelona, Spain, 6-8 September 2023

2. Elmarakbi, N. (2022), "Determination with Respect, Trust and Sharing" Teaching and Learning Together in Higher Education (TLTHE), https://repository.brynmawr.edu/tlthe

3. Elmarakbi, N., Dr Robson, H., Dr Currie, L. (2022), "Creative Design Activities to Support the Complex Learning Environment of the Classroom with Children with Autism Spectrum Disorder", 24th International Conference on Engineering and Product Design Education, South Bank University, London, UK, 8-9 September 2022

4. Elmarakbi, N. (2017) "Design in Art Therapy for Dyslexic Children, Create Space" Amazon, May 2017, ISBN-13: 978-1546638773

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Appendix A: Design of a Toolkit for Children with Autism and Teachers in a Primary School Including Visual Communication (2D/3D)

The toolkit aims to break down lesson plans into more readily comprehensible components and translate tasks and worksheets into an immersive 2D/3D learning experience. Inspired by theatre production, the toolkit will employ appropriate imagery, textures, music, etc. to bring the lesson to life in a way in which children with autism can actively engage with the material at hand whilst also ensuring that the visual, auditory, and tactile experience is not overwhelming to the students. The goal is to assist teachers in modifying their traditional teaching style to incorporate new design-based practice through the adoption of the methodology, design process and tools to be developed in this work, and thus help children with autism to understand and take part in classroom activities more easily. Additionally, the applications of the toolkit that will be developed have the potential to extend beyond the classroom environment.

Contribution: The toolkit will be used to teach children with autism how to approach various key social interactions, communicate more effectively, and filter their environment in a way which is more understandable and manageable to them. Such skills can be transferred to their home environment and can greatly assist them in daily life and boost their learning potential. The education and development of children with autism can thus continue to flourish outside the classroom, and parents and teachers can easily cooperate to ensure the best outcomes for children with autism, as well as to increase their overall confidence and self-esteem.

What we have at the moment: For instance, there is a 2D toolkit from Widgit (www.widget.com) for schools to communicate with children with SEN, in general, and with autism, in particular, such as basic symbols (e.g. eyes to see, mouth to talk, and ears to listen), and a worksheet based on the school activities (e.g. school day, maths mat, and science experiment). The toolkit is good but not enough to cover all children's needs and interests in the classroom during the day, events, and at home.

Also, there are a variety of websites, software, and online applications that offer different materials for schools to communicate with children with autism. All the materials are good but the impact on the schools (mainstream and special educational needs) is not optimum based on OFSTED schools reports. Many schools need to transform their responses to the learners, in general, and to children with autism, in particular, to move from a standardised to a personalised learning approach (Carroll

et al., 2017). In addition, there are cognitive behaviour therapy (CBT) books, for instance, CBT Toolbox for Children and Adolescents (Phifer et al., 2017) and Social Skills Activities for Kids (Daniels. 2019). Both books are good and focus on supporting the emotional and behavioural disorders of children, but the activities were based on explaining the feelings by writing, which is not suitable for children with autism.

What is new, why, and how: Design of a toolkit for children with SEN, in general, for children with autism, in particular, and their teachers in primary schools. Including visual communication books and 2D/3D models to ensure the best outcomes for children with autism as well as to increase their overall confidence and self-esteem.

Using innovative toolkits in the learning environment to enhance awareness, curiosity, experiment, and self-directed is a need. Without the toolkit in the learning environment, there will be no deep learning experiences, effective teaching styles, and meaningful outcomes. Also, the meaningful toolkit involves a robust connection between children with autism and their environment. The toolkit will be divided into three stages, for instance, stage one (e.g. visual communication book- 2D such as activity for each event and/or daily work), stage two (e.g. theatre production- 3D such as transfer of a curriculum lesson from a normal plain lesson to a 3D technique to enhance children with autism visual attention), and stage three (e.g. use and evaluation of developed 2D/3D toolkit models such as design thinking to enhance problem-solving skills; art therapy to enhance feelings, emotions and well-being; and participatory design to encourage engagement of stakeholders (e.g. children with autism, class teachers and teaching assistants).

Stage (1): The visual communication book (2D) will include approximately 14 activities such as events and/or daily work (e.g. rewards and behaviour charts; encourage and support routine; start and finish tasks; keep calm and carry on; emotional and well-being; design of creative activities sequences; art therapy helps to express feelings and enhance self-acceptance; using social stories to enhance awareness; integrated creative design activities approach with; moving from the traditional teaching style to a new style; meaningful engagements in the learning environment; warm welcome and mindful music; visual communications map; and week planners). Each activity will be explained in detail, including title, plan, duration, aim, objectives, materials and tools, preparation steps, procedure, and anticipated outcomes.

Toolkit stage (1): *a framework for creative design activities.*

Toolkit Project 2D	**Activity Process**	**Problem-Solving**
1. Reward and behaviour charts	1. Using this activity with children with autism to build their reward chart from bottom, middle, and top using stickers.	1. Encourage children self-esteem and self-confidence.
2. Encourage and support routine, behaviour, and independence	2. Using this activity with children with autism to build their reward chart for routine, behaviour, and independence during the week using happy faces, stickers, and check marks.	2. Encourage children to keep their routine, have positive behaviour, and enhance self-directed.
3. Start and finish tasks	Using this activity with children with autism because it is important to mentioned when activity will be starting and finished.	No anger, frustrated, and anxiety.
4. Keep calm and carry on	Using this activity with children with autism when teachers need to manage children's behaviour.	By drawing and painting activities.
5. Emotional and well-being	Using this activity with children with autism to teach them how to explain their feelings such as sad "don't be alone" and happy "working with other children".	Support children with autism to express their feeling by drawing, painting, and working with other children and adults.
6. Design of creative activities sequences	Using this activity with children with autism to teach children to create artwork step-by-step.	Support children with autism to create artwork by numbers.
7. Art therapy helps to express feelings and enhance self-acceptance	Using this activity with children with autism to teach them to express their feelings and enhance their self-acceptance.	Support children with autism to express their feeling by drawing and painting instead of words.
8. Using social stories to enhance awareness	Using this activity with children with autism to teach them don't talking to strangers.	Enhance awareness through social stories, drawing, and painting.

9. Integrated creative design activities approach	Using this activity with teachers and all children.	By providing opportunities for children to do what they want, which will get them engaged well in the learning environment.
10. Moving from the traditional teaching style to a new style	Using this activity with teachers and all children.	By changing teaching style strategies.
11. Meaningful engagement in the learning environment	Using this activity with children with autism to teach them to making friends.	By drawing, painting, and learning to share.
12. Warm welcome and mindful music	Using this activity with children with autism when teachers start a daily routine to manage children's behaviours and attitudes.	By drawing, painting, play with dough and listening to music activities.
13. Visual communication map	Using this activity with children with autism to understand what to say and do to communicate with others.	Support children with autism to understand information and the meaning of communication.
14. Week planners	Using this activity with children with autism to plan their work at the school and home during the week.	Support children with autism to understand what they need to do in the morning, afternoon, and at home during the week.

Stage (2): Theatre production (3D) will include the school curriculum such as Art, English language, and Science. It aims to develop the knowledge and information for children with autism in an easy way, enhance their visual attention, and provide opportunities for children with autism to do what they can to feel relaxed and happy.

Toolkit stage (2): *a framework for creative design activities.*

Theatre Production Project-3D	Lesson	Traditional Teaching Style	A new Teaching Style-Outcomes
1. The Little Scared Bird.	English Language	1. Oral instruction. 2. Drawing on a white board. 3. Teachers expect all children can follow their instructions, copy information, writing, reading, and drawing.	1. Visual instruction 2. Using 3D toolkit materials instead of drawing on a white board. 3. Teachers will work with children one-to-one to make sure each child understands the visual instructions, can follow and copy information, writing, reading, and drawing by using the 3D toolkit materials (e.g. images, textures, and puzzles).
2.Chacolate Factory	Art		
3.Bean Plant Diary	Science		

Practical Example of 3D model:

A) Intervention's strategies

In addition, the intervention's strategies developed through this research are categorised and focus on:

i) Complex learning environment and how to process the information for children with autism to enhance their visual attention. For instance, moving away from traditional methods (e.g. oral instructions and use of whiteboarding in the classroom setting) to a new teaching strategy method (e.g. visual instructions such as the type and level of instruction and support is specifically tailored to children with autism use 2D/3D toolkits based on their particular skills, interests, and needs);

ii) Keep a routine, which helps children with autism to feel safe and relaxed. Also, enhance social communication skills and interaction between children with autism and their teachers in the complex classroom setting. For example, several social communication skills and interaction strategies through creative design activities are developed to enable children with autism to interact and communicate in positive ways with peers and teachers as well as to engage in self-advocacy;

iii) Encourage engagement through creative design activities as well as memory, problem-solving, decision-making, concentration, sensory, and creative and thinking skills. For example, use 2D/3D toolkits based on design practice to develop learning skills through the three keys such as design thinking, participatory design, and art therapy using a variety of techniques, materials, and ideas. This will help to find a creative solution for a complex problem in the classroom setting and provide children with autism and their teachers with appropriate tools to act as co-designers.

B) 3D Model Example

Teaching styles with KS1 children with autism and non-children with autism in a classroom setting. Two different teaching styles are presented, as examples using a short story from the KSI curriculum, in Figs. A.1- A.2, respectively. In Fig. A.1, a traditional teaching style was presented by the class teacher with non-children with autism as they can easily understand, copy work, and write their story based on their imagination. On the other hand, a new teaching style was presented by the researcher, which was designed for children with autism, who cannot comprehend the traditional teaching style as they need tailored strategies encouraging visual attention using (e.g. 3D toolkit).

The KSI short story involves The Little Scared Bird: "Once upon a time, there was a happy couple woman and a man living together. One day, they were walking slowly through the big forest and when they found three golden eggs! They carefully carried them back to their cosy home and gently put them in a brown basket. Suddenly, a tiny chick cracked out of the egg and ran away from home. The scared little bird was afraid to fly and tried to find a friend who didn't fly like himself but found he didn't fit in with any of the other animals he stumbled upon. He found a mouse who cannot fly but also cannot get out of a hole. Then, he found a cat who could not fly but also could not get out of a box. Finally, as the little bird tried to help his new friends, he got over his fear and learned to fly!". The End!

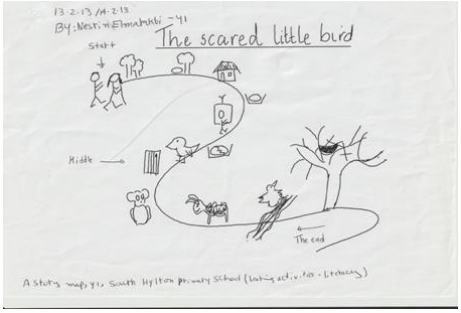

Figure A.1. *Traditional teaching style in a classroom child with autism*

Figure A.2. *Creative design activities (e.g. using a 3D toolkit) with children with autism to enhance the learning environment in the classroom*

The aim of the 3D toolkit (Fig. A.2) is to break down the lesson plans into more readily comprehensible components and translate tasks and worksheets into an immersive 3D learning experience. Inspired by theatre production, the toolkit will employ appropriate imagery, textures, music, etc. to bring the lesson to life in a way in which children with autism can actively engage with the material at hand, whilst also ensuring that the visual, auditory, and tactile experience are not overwhelmed to the students. The goal is to assist teachers in modifying their traditional teaching style to incorporate new design-based practice through the adoption of such toolkits (to be developed for different cases and scenarios to accommodate a wide range of lessons and teaching styles), and thus help children with autism to understand and take part in the classroom activities more easily.

Stage (3): In this stage, the use and evaluation of the developed 2D/3D toolkit models are considered and follow participatory design such as planning, acting, observing, and reflecting (Herr and Anderson, 2014; Crouch and Pearce, 2012) to run creative design activities in the classroom setting. In addition, it includes 22 sessions (e.g. such as initial observation for KS1 and reception class, use of participatory design to enhance problem-solving skills and to encourage engagement of stakeholders (e.g. children with autism, class teacher, and teaching assistants); and art therapy to enhance feelings, emotions, and well-being (See Table 6, Section 3.4.1.5).

B Appendix: Opinions, Perspectives, and Comments on the 2D/3D Toolkits from Teachers and Teaching Assistants

Appendix C: A Sign from the Head Teacher of the Marina Park Primary School

[1] This activity used visual communication to enhance the memory and problem-solving skills of the children with autism in reception using shapes such as circles, craft supplies including glue and glitter, and counting-based challenges (e.g. counting doughnuts). The teachers and teaching assistants were asked if they thought this activity was a good or bad idea (as shown in Fig.1).

Figure. 1. *Enhanced children with autism problem-solving and memory skills*

Fig. 1 shows that there was agreement among the teachers and teaching assistants that this activity was a good idea

[2] This activity used visual communication to enhance the problem-solving skills of the KS1 children with autism using shapes such as circles, ladders, small toys, and buttons. The teachers and teaching assistants were asked if they thought this activity was a good or bad idea (as shown in Fig. 2).

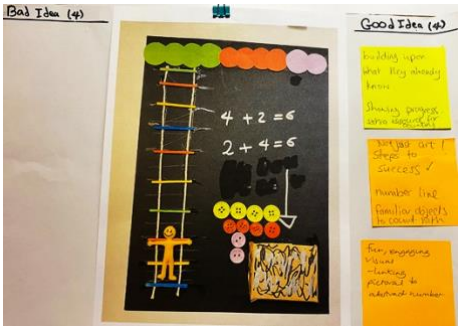

Figure. 2. *Enhanced children with autism problem-solving skills*

Fig. 2 shows that there was agreement among the teachers and teaching assistants that this activity was a good idea.

[3] This activity used visual communication to enhance the memory, creative and imaginative thinking, and problem-solving skills of the KS1 children with autism, helping the children build and work through a given scenario (e.g. saving a cat from a tree and walking it home). The teachers and teaching assistants were asked if they thought this activity was a good or bad idea(as shown in Fig. 3).

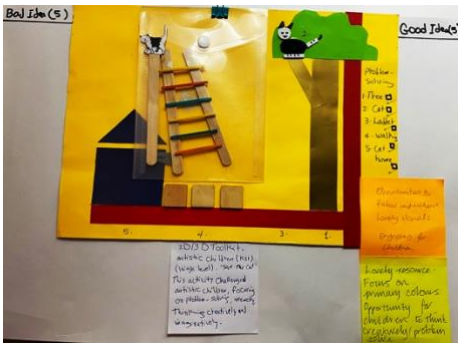

Figure. 3. *Enhanced children with autism problem-solving, memory skills, and thinking creatively and imaginatively*

Fig. 3 shows that there was agreement among the teachers and teaching assistants that this activity was a good idea.

[4] This activity used visual communication to enhance the problem-solving skills of the KS1 children with autism, using shapes such as circles, squares, and boxes. The teachers and teaching assistants were asked if they thought this activity was a good or bad idea (as shown in Fig. 4).

Figure. 4. *Enhanced children with autism problem-solving skills*

Fig. 4 shows that there was agreement among the teachers and teaching assistants that this activity was a good idea.

[5] This activity used visual communication to enhance the memory and creative and imaginative thinking of the KS1 children with autism, helping the children use numbers to build a scene (creating a 3D monkey to run between mountains, trees, and flowers). The teachers and teaching assistants were asked if they thought this activity was a good or bad idea (as shown in Fig. 5).

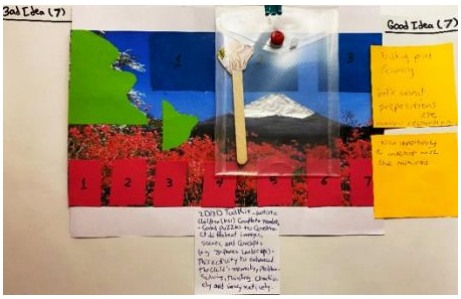

Figure. 5. *Enhanced children with autism memory skills and thinking creatively and imaginatively*

Fig. 5 shows that there was agreement among the teachers and teaching assistants that this activity was a good idea.

[6] This activity used visual communication to encourage the engagement, decision-making, enjoyment, and co-design of the children with autism in reception. The teachers and teaching assistants were asked if they thought this activity was a good or bad idea (as shown in Fig. 6).

Figure. 6. *Encouraged engagement, decision-making, enjoyment, and co-design*

Fig. 6 shows both positive and negative feedback from the teachers and teaching assistants regarding this activity. Criticism of the idea included the opinion that it could be too difficult for children with autism to engage with other children. Though, through my personal work experience with children with special educational needs in general, and children with autism in specific, I have seen that children with or without autism can enjoy working with other children or adults, so long as the right opportunities are provided with sufficient encouragement.

Northumbria University
NEWCASTLE

FOR USE WITH ORGANISATIONS

Project Title: Creative Design Activities to Support the Complex Learning Environment of the Classroom with Children with Autism Spectrum Disorder (ASD)

Principal Investigator: Nesrin Elmarakbi

Student ID No. (If applicable): W19027418

A consent to carry out research activities related to my PhD study at your organisation. In this study, new creative design activities will be developed to enhance visual communications and support the complex learning environment of the classroom with children with autism spectrum disorder (ASD).

As a main part of this study, a comprehensive explanatory case study will be developed to be implemented at your school, employing qualitative research methods (such as interviews, observation, questionnaires, audio recording, and photography) as a main methodology. It is important to widen my knowledge and seek new practice development, hence, I am getting in touch with you to seek a collaboration opportunity to establish the case study.

The case study will place emphasis on dealing with the complexity of the classrooms involving children with ASD and their teachers. Children with ASD, aged between 5-12 years (both boys and girls), their classroom teachers and teaching staff are expected to be part of this case study.

It is anticipated that the case study will generate the core features and properties of an enhanced participatory design approach to support teachers in continual design processes made to adapt their classroom to the dynamic needs of their pupils. Accordingly, this will enhance the visual communications of the children with ASD and learning environment at your school.

Anonymity and Confidentiality:

[ ] No confidentiality required

[✓] Masking of organisation name in research report YES .

[✓] No publication of the research results without specific organisational consent YES

[✓] Other by agreement as specified by addendum YES .

1

A senior organisation manager, director or representative must give consent:

Name: ALISON BURDEN

Position/Title: HT

Organisation Name: MARINE PARK PRIMARY

Location/s where the research is permitted: AS ABOVE

Signature: [signature] Date: 7/2/22

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