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## Using a systems thinking approach to understand teachers perceptions and use of assistive technology in the republic of Ireland

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### ABSTRACT

**Purpose:** Assistive technology (AT) enables and promotes inclusion and participation, especially for persons with a disability, ageing populations, and those with non-communicable diseases. AT is essential for generating collaborative learning environments, inclusive of students with a range of specific needs and required supports. However, many teachers lack the training, resources, and skills to use AT in the class. This study uses a systems thinking approach to consider teachers AT needs in the Irish classroom.

**Methods:** Three hundred and five teachers completed an online survey, and 10 took part in semi-structured focus groups. The survey examined teachers experiences with AT, their training needs, and the context within which they need support.

**Results:** Teachers reported low levels of AT knowledge, skills, and confidence. Many described limited access to training and support for AT use. Results also reveal non-systems thinking, whereby there is no meaningful linking across the main strategic drivers of AT - policy, products, provision, and personnel, to support the people at the centre of the AT system - between these and the contextual factors that influence their effectiveness.

**Conclusion:** An AT system which is easy to navigate, which has policies and provision that supports educators, and has expert personnel on hand to support teachers, is crucial if AT is to become embedded in Irish classrooms. This research shows that a comprehensive AT system in education should include policies, practices, personnel, and products that interact to support people to engage easily and successfully with AT in the classroom.

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Assistive technology; teacher training needs; inclusion; classroom systems thinking



### ► IMPLICATIONS FOR REHABILITATION

- Describes current trends in how teachers are engaging with Assistive Technology.
- Describes the current trends in disabilities in Irish classroom and teachers requirements for support.
- Understand the system challenges facing teachers attempting to use Assistive Technology.
- Support the development of Assistive Technology training for teachers which are informed by teachers needs.
- Inform the development and improving policies and processes for common situations.

## Introduction

Assistive technology promotes the inclusion and participation of persons with a disability, ageing populations, and those with non-communicable diseases. It is recognised as being a crucial mediator and moderator of achieving the Sustainable Development Goals in an equitable and fair way [1]. In education Assistive Technology (AT) is often used as a generic term to describe the products and practices which enhance the learning potential of mainstream students, as well as students with specific disabilities and/or special education needs (SEN) [2]. Its goal is to generate independence for students with specific needs and mediate the effect of potential educational barriers that interfere with learning

and functional outcomes [3]. While the categorisation of AT differs across the literature, Blackhurst [4] argues that AT includes electronic, mechanical, microprocessor-based equipment, non-mechanical and non-electronic aids as well as specialised services, instructional materials and strategies that aid people with disabilities to (a) make their environment more accessible, (b) assist their learning, (c) enable them to perform in their workplace, (d) improve quality of life or, (e) enhance their independence. This definition refers specifically to assistive products designed, produced or available, whose purpose is to support or improve an individual's functioning. Maclachlan and Sherer describe the "assistive technology system" as the space where assistive

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products, their uses, the AT infrastructure and technologies, co-exist to facilitate and support wellbeing [5]. Hence, any work which examines AT must consider the assistive technology system within which such use occurs. A systems approach to AT should include understanding the relationship between the main strategic drivers; products, personnel, policies, and provision; and how they operate in relation to the contextual factors of procurement, partnerships, the places AT is actually used, the pace or ability of the systems to adapt to change and the promotion of positive images around AT and AT users [5]. This paper uses a system approach to better understand the factors that influence teachers' perceptions and use of AT in the Irish classroom.

The interest and recognition of AT as a method of enhancing the learning potential for students with a disability has expanded rapidly in the past three decades [2]. Moreover, the sophistication of technology in the classroom has marked a new era of mediating performance and academic achievement between those who have disabilities and those who do not [6–9]. Technology integration in the classroom for students with disabilities has been divided into two categories, (a) tools used by the demonstrator to enhance learning skills and (b) tools that help students to engage with the activity [2]. The teacher or demonstrator plays a critical role in supporting students to use technological assistive tools that enhance their learning potential and bypass academic weaknesses [10].

Despite the potential of AT in the classroom, its use and applications are still in its novelty and subject to various barriers [10]. These include a lack of resources to get relevant AT, and the lack of training to enable teachers to identify and obtain AT for their students [11–13]. Teachers are not prepared to incorporate advanced assistive technology in the classroom [10–13]. This is an international issue, and globally there is a lack of training and professional development in AT courses for teachers [13,14]. In addition, despite the vast availability of AT in educational settings, 30% of AT is disposed of after one year, which is due to the product not performing as expected or being unsuccessful at saving time and energy for the student [12–15]. Al-Dabebneh and Al-Zboon examined teacher beliefs and professionalism regarding AT use among children with specific learning disabilities in Jordan [14]. Their results indicated that teacher attitudes impact on the professionalism and application of AT practices in the classroom. The authors concluded that teachers who work directly with children with specific needs appreciate the importance of integrating AT into teaching practices; however, they need training and professional support. In line with the systems approach proposed by Maclachlan & Scherer's research highlights difficulties in the provision, processes and policies which support the successful integration of AT in the classroom [5]. Teachers lack support through the provision of AT training, and the provision of AT use is negatively impacted upon by teachers lack the knowledge and reduced confidence (11, 12).

### **An Irish context**

The Irish education system provides an ideal context for studying the system in which AT use occurs in classrooms. Service providers and civil society have highlighted the value of an integrated AT system [16]. At the same time, a recent study by the National Council for Special Needs Education in Ireland in 2018 [17] found that Irish teachers would like to see formal policy around AT training and continuous professional support. Irish teachers feel they lack the essential training needed to enhance the applications of AT in the classroom, including the need for

training at an individual level. They also lack the support and confidence to source equipment, and they do not understand criteria for AT, lack resources to keep up to date and struggle with the inconsistencies within the broader AT system. In addition, research highlights the lack of follow up of pupils receiving AT, as well as maintenance and monitoring of progress. The study illustrates that in Ireland, the broader system which supports AT lacks links between its core elements [17].

Research thus far suggests that within an Irish education context, AT policy and practice is inconsistent, disorganised, inconclusive, and lacks clear guidance [17]. Two-thirds of primary schools have no clear policy for AT usage, application, or monitoring; whilst 60% of schools assign no designated staff responsible for overseeing AT in the school, and 60% of schools provide no formal AT training to staff. Moreover, there is a lack of knowledge and guidance regarding the most effective AT equipment to support children with special needs to engage in the general curriculum [17]. While there is a wide body of literature supporting the need for AT in the classroom, there is a lack of guidance and direction for teachers to implement and support students using AT. This study looks to better understand the experience of teachers in the Irish education system regarding AT use, support, and provision. It asks teachers to identify their training needs and explores their experience within the modern classroom.

Using a system thinking approach, this research also considers the interaction between key factors in the education system, which influence teachers use of AT. Systems thinking addresses the relationship which occurs between the core elements of the system. These relationships are dynamic and often bi-directional; changes to one aspect of a system can have identifiable effects on other aspects of the system [5]. This study, therefore, also aims to extend the existing body of knowledge by using a systems thinking approach to consider teachers experiences. The study will consider how the four main strategic drivers – Policy, Products, Provision and Personnel – and the five contextual elements – Procurement, Promotion, Place, Pace and Partnership – impact upon teachers use of AT within the Irish education system.

## **Method**

### **Research design**

This study featured a quantitative and qualitative mixed-methods research design. Participants included primary and secondary school teachers as well as Special Need's Assistants (SNA's). The survey questioned participants about their experience and needs regarding their ability to incorporate and support the use of AT in the classroom. The qualitative study featured an Interpretative Phenomenological Analysis (IPA) approach and was conducted and reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ). The design featured focus groups with teachers asking open-ended questions through a semi-structured interview format. The goal of the mixed-methods design was to gain insight into the specific training needs of teachers as well as to understand teacher challenges, perceptions and experiences associated with AT use in the classroom.

### **Data collection method**

Quantitative data was collected through a survey, and qualitative data was yielded through semi-structured focus groups. Quantitative data illustrated demographic information of participants as well as categorised their current experience and perceived needs regarding AT training. Participants were invited to

attend focus group interviews to further investigate their experiences, perceptions and attitudes towards AT usage in the classroom. Focus groups were the chosen method of qualitative data collection as they facilitate social learning and encourage scaffolding of ideas and concepts [16]. Participants were randomly assigned to one of two focus groups, which were facilitated through Microsoft Teams and led by the researchers. The topics of each focus group included an open-ended discussion regarding either “what would the perfect classroom look like in relation to inclusivity of all children, without any barriers or challenges or systemic issues” or “what supports are available to you, that you know of in terms of using and supporting the use of assistive technology in the classroom.” The goal of these discussions was to get insight into the perceptions, experiences and needs regarding teacher’s ability to incorporate AT into the classroom. Focus groups were recorded with participant permission and transcribed verbatim.

### Survey questions

Participants were initially asked what form of teacher they are (Primary School/Secondary School/Special Needs Assistant (SNA) or Guidance Counsellor). Participants then ranked their teacher experience from either 1–5 years, 6–10 years, or 10+ years. Participants were also asked whether they have worked with a student(s) who used assistive technology (yes/no). The survey addressed participant perceptions of how knowledgeable they are about assistive technology and how they rated their school in technology use. Complete survey questions and responses can be found in Table 1.

**Focus group schedule.** The focus group was semi-structured around five core themes. These related specifically to AT provision, use and the system of education. The interviewer used a funnelling technique where each theme was introduced broadly, and then questions became more specific as conversation emerged. The themes were explored through the following question schedule;

1. Discuss/describe your experiences with AT in school in general
  - a. Explore challenges and values

2. Imagine no barriers exist – now discuss what the ideal school/classroom would look like for assistive technology to become an easy part of the day to day classroom
  - a. Explore challenges to this
  - b. Explore facilitators
  - c. Ask for examples
3. Discuss the type of supports in place in education they you know about for AT
4. Describe any experiences they have had to-date with these supports
5. Describe the supports you or other teachers would require using AT successfully.
  - a. Explore structural supports (education system and school-wide),
  - b. Explore digital supports
  - c. Explore personal supports (for the teachers)

### Data analysis method

Statistical analyses were carried out on the quantitative surveys to understand demographic and categorical information. Thematic analysis was implemented to analyse the semi-structured focus groups. This method of analysis was chosen due to the potential it has in yielding high- quality data [17]. Open coding techniques were used to allow exploration of common topics associated with lived experiences. A systematic process of thematic analysis was carried out, as the researcher identified and categorised codes before reconstructing codes into a coherent narrative. Themes were then developed and compared with a second researcher to achieve consensus and to complete the final set of themes.

### Participants

Three hundred and five participants completed the quantitative survey. 57% of participants were primary school teachers, 21% were secondary school teacher’s, 22% were an SNA, and 1% were guidance counsellors. 66% of participants had over ten years of teaching experience, while 14% had 6–10 and 21% had 1–5 years of teaching experience. The semi-structured focus groups included ten individuals who agreed to attend after completing

**Table 1.** Questions in the quantitative survey, assessing AT teacher training needs.

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What type of teacher are you? (Primary, Secondary, Special Needs Assistant  
 How many years have you been teaching? (1–5 years, 6–10 years, 10 years +)  
 How knowledgeable are you about assistive technology? (No knowledge at all, Small amount of knowledge, Quite knowledgeable, Knowledgeable, Extremely knowledgeable)  
 Have you ever worked with a student(s) who used assistive technology? (Yes, No)  
 If yes to question 4, please list the types of assistive technology used and what they were used for?  
 If yes, please select the disability(i.e.s) that the student(s) had. (Select all that apply): (Immersive Reader/ Autism Spectrum Disorders (ASD)/ Other Health Impaired (OHI)/ Intellectual Disabilities/ Emotional Disturbance/ Deafness/ Hearing Impairment/ Visual Impairment/ Deaf-Blindness/ Specific Learning Disability (LD)/ Multiple Disabilities/ Orthopaedic Impairment/ Speech or Language Impairment/ Traumatic Brain Injury/ Physical disability/ Other.)  
 How comfortable do you feel assisting a student using assistive technology? (Very comfortable, Somewhat comfortable, Neither comfortable nor uncomfortable, Somewhat uncomfortable, Very uncomfortable)  
 Would you like support/training in assistive technology? (Yes, No, Maybe)  
 Are there specific areas that you would like support with assistive technology?  
 Please select the disability(i.e.s) that you would particularly like to learn about the assistive technologies available for them (Select all that apply): (Immersive Reader/ Autism Spectrum Disorders (ASD)/ Other Health Impaired (OHI)/ Intellectual Disabilities/ Emotional Disturbance/ Deafness/ Hearing Impairment/ Visual Impairment/ Deaf-Blindness/ Specific Learning Disability (LD)/ Multiple Disabilities/ Orthopaedic Impairment/ Speech or Language Impairment/ Traumatic Brain Injury/ Physical Disability/ Other.)  
 If we were to offer a teacher professional development or postgraduate certificate on assistive technology, would you participate in this? (Yes, No, Maybe)  
 If we created a certificate for teaching in assistive technology, when would you like it to run? (Evenings and weekends/ During school time (CPD), Online (with community element)/ Other)  
 Would you like an assistive technology course to be accredited through the university? (Yes, No, Maybe)  
 How can we support you to better use assistive technology in your classroom?  
 Please rate your school in terms of their use of assistive technology (1 = Poor- 5 = Excellent).  
 Please rate your school in terms of their ability to use assistive technology (1 = Poor- 5 = Excellent).

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the initial survey. Participants were recruited through various online platforms and through snowball sampling.

### Procedure

Ethical approval for this study was granted by the Maynooth University ethics committee (approval number ID: 2413343). Participants were recruited from online social media platforms and from snowballing methods. Participants were sent an online survey to complete, which invited participants to attend a focus group to further discuss their experiences with AT in the classroom. Consent was achieved through the survey, and again verbally through the focus group. At the start of the focus group, participants were briefed about the nature of the study and randomly divided into two groups to discuss the semi-structured topics. These topics were included their views and experiences with AT and the AT system. At the end of the focus group, participants were de-briefed and reminded that they had the right to remove their data from the study at any point up until publication.

### Results

The purpose of the teacher survey was to collect information reflecting the reported use of AT by teachers, their perception of their AT needs and their training requirements. The survey items elicited answers on knowledge and comfort in using AT, the purpose of AT, training needs of AT and teacher's perceptions of AT needs. Demographic information was analysed and reported in Table 2. This shows that 55% of the teachers were primary school teachers and that 65% had been working as a teacher for over ten years. 85% of the teachers surveyed stated that they needed training or support to use AT effectively. When asked about their knowledge of AT use, a large majority of teachers reported small

**Table 2.** Descriptive information of teacher characteristics and responses to survey questions.

Question	Percentage
Teacher type	
Primary	55%
Secondary	24%
SNA	21%
Have you ever used AT with a student?	
Primary	61%
Secondary	64%
SNA	60%
Years Teaching	
1–5 Years	21%
6–10 Years	65%
10+ Years	13%
Do you require support with AT?	
Yes	85%
No	1%
Maybe	14%
How comfortable do you feel assisting a student using assistive technology?	Average = 3.2
Very uncomfortable	4%
Somewhat uncomfortable	18%
Neither comfortable nor uncomfortable	27%
Somewhat comfortable	51%
Extremely comfortable	0%
How knowledgeable are you about assistive technology?	Average = 2.6
No knowledge at all	12%
Small amount of knowledge	44%
Quite knowledgeable	13%
Knowledgeable	30%
Extremely knowledgeable	0%

or no knowledge (56%) and 51% of teachers said they were somewhat comfortable to use AT with students.

### Factors which impact teacher at use

To understand the factors which influence teachers use of AT one-way ANOVAs were undertaken with the teacher type and years teacher as independent variable and questions on knowledge of and comfort using AT as the dependent variable.

#### Teacher type

Results revealed a significant result for knowledge of AT and teacher type;  $F(304) = 6.27, p < .001$ . Post Hoc analysis revealed that primary school teachers reported higher levels of knowledge of AT ( $M = 3.03$ ) than secondary school teachers ( $M = 2.55$ ) and SEN teachers ( $M = 2.32$ ). The one-way ANOVA which examined teacher type and comfort to use AT was not significant.

#### Years of teaching

The one-way ANOVAs which examined teacher type and knowledge of AT and comfort to use AT was not significant.

#### School factors

To further understand the factors which influence teachers use of AT Pearson correlation analysis was conducted between the knowledge of AT question, Comfortable to use AT question and the ratings that teachers gave for their schools AT capability and their school technology capability overall (Table 3). The analysis revealed a moderate (+3) significant correlation between knowledge of AT and feeling comfortable using AT with students, and there was also a moderate (+3) and significant relationship between teacher's level of comfort in using AT and how they rate their school in terms of using AT.

### Training and support needs

To understand the training needs of teachers and their views on where they need to be supported, we asked if they would engage in a professional development programme or a postgraduate training course on AT and 91% said they would like to receive such training. We explored this more, and 42% of teachers said they would prefer to engage in a university accredited qualification, and 50% responded that they would consider this. We asked teachers their preferred mode of training delivery and found that the largest percentage of teachers would prefer the training to happen during school time (53%) and a large minority (43%) would engage with online training (see Figure 1).

With developments in educational psychology, diagnostic tools and AT, the types of disabilities which teachers are supporting in the mainstream classroom are expanding. To ensure that training needs are being met, we asked the teachers to identify the types of disabilities they had experience using AT with and the type of disability that they need training for in AT support and provision. Figure 2 shows that 33% of teachers have some experience using

**Table 3.** Correlation coefficients for school AT and technology ratings and teacher's knowledge and comfort level using AT.

Variables	Knowledge AT	Comfort using AT	School AT	School tech
Knowledge AT	1.00			
Comfort using AT	.386**	1.00		
School AT	.268	.315**	1.00	
School tech	.121*	.192*	.535**	1.00

\*\*Correlation is significant at .001.

\*Correlation is significant at .05.

AT with students with ASD- this was the highest percentage reported. It also showed that 20–25% of the teachers surveyed had experience using AT with students with a physical disability, hearing impairments, speech and language disorders and specific learning disabilities. It is clear that teachers need support and training in AT provision for several different types of impairments/ disabilities. 79% of teachers said they wanted training in the AT available for students with ASD, while 54% of teachers required AT training for students with speech and language impairments, and 47–49% of teachers required AT knowledge for students with specific learning disabilities and intellectual disabilities. An

interesting observation was made in terms of emotional disturbances, while only a small percentage of teachers had the experience of working with AT with a student with such problems (6%), over 34% said they would like support to use AT with this group of students; suggesting that these students may need added support in the classroom that the teacher does not feel qualified to provide.

**Qualitative results**

Focus groups were carried out with ten teachers and SNA’s to gain insight into their experiences and perceived training needs.

**Teachers lack AT confidence and the at system**

A predominant theme yielded from the focus groups is the lack of confidence among teachers and SNA’s to use AT in the classroom. Teacher’s complete formal teacher training without any specific training or tools needed to facilitate and support AT use: *“a lot of teachers, even in 2020, are coming out of college with little if any exposure to assistive technology. Even though AT is being used more widely across the student cohort now then it would have been in the past”*. Therefore, teachers are entering the classroom with little to no training, which affects their confidence and ability to support children who rely on AT. The effect of the lack of training on student outcomes was a concern to many teachers: *“Just it’s so important for children like you know, it’s fundamental to their, to their education. Yeah, you know, there’s no point giving the child something if the staff can’t use it.”* Teachers and students are at the centre of the AT system, the observation

Teacher training preferences by %

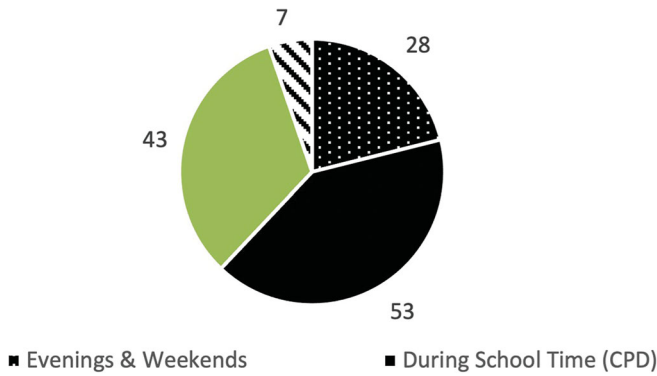


Figure 1. Preferred mode of training teachers on AT.

**AT and Specific Disabilities**

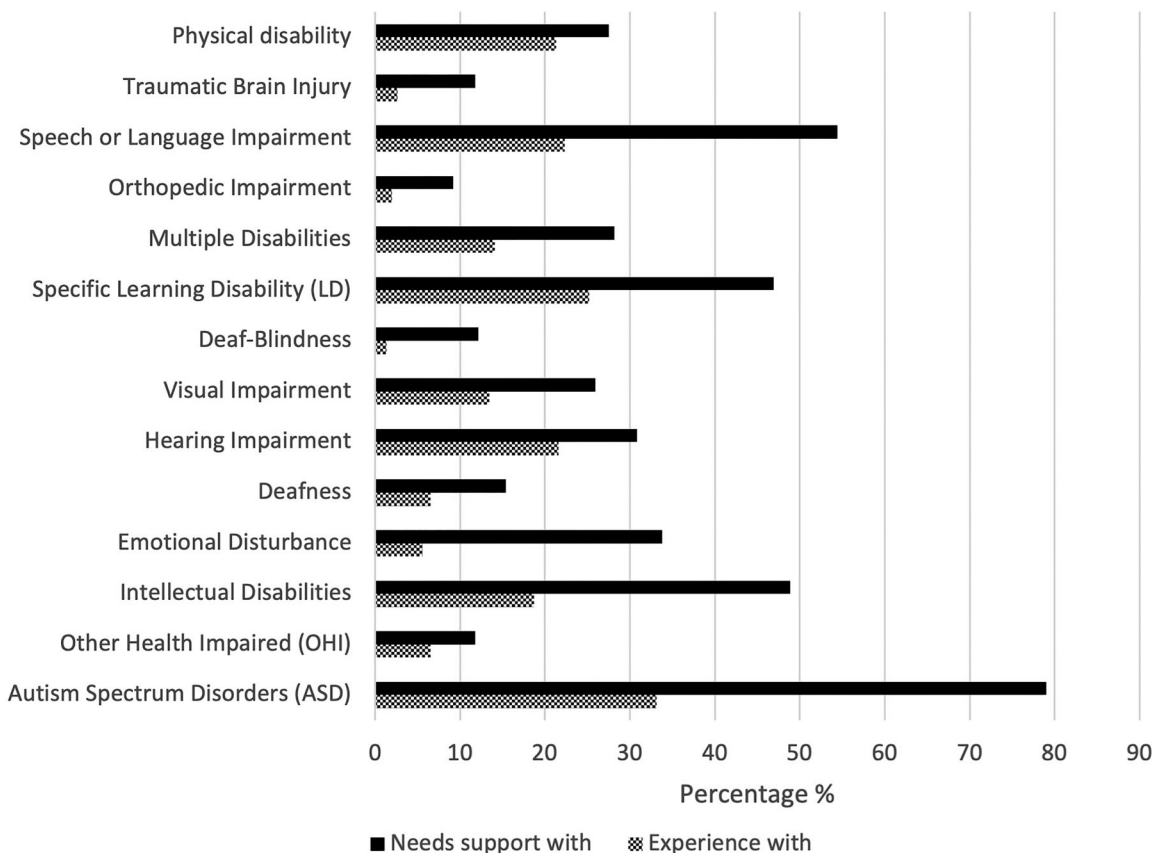


Figure 2. Types of disability teachers experience in the classroom and types they need support with.

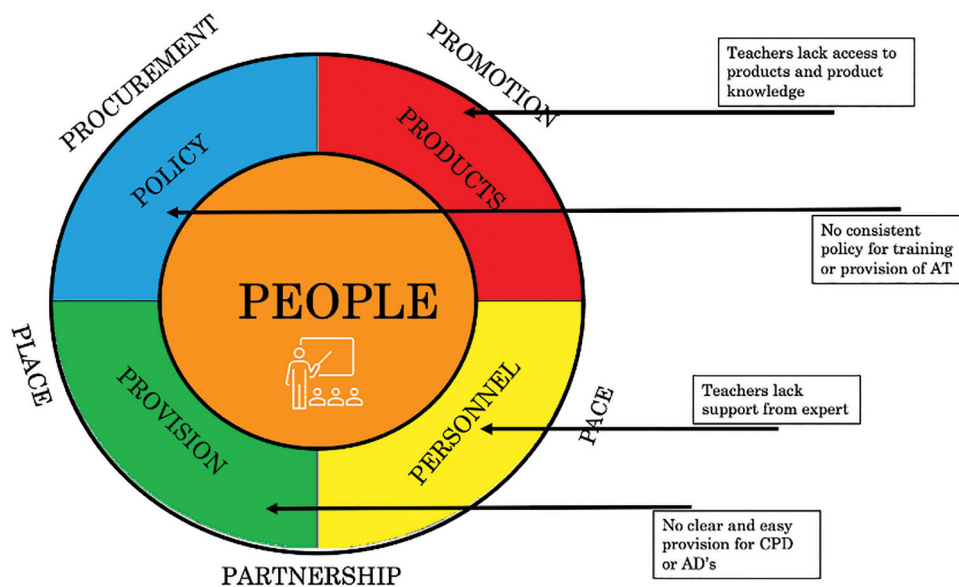


Figure 3. Adapted from Maclachlan and Sherer (2018), demonstrates the systems thinking framework in relation to teachers experience of AT in the Irish classroom.

that there is no structured training in AT use in Initial Teacher Education shows the impact a lack of necessary policy and practices in the AT system (see Figure 3). The four main strategic drivers of a successful AT system include Policy, Products, Provision and Personnel – in this study we see that teachers lack access to training due a lack of national strategy and policy regarding AT training provision.

#### *At products, provision, and personnel*

There were mixed beliefs among teachers regarding their specific AT training needs and access to products. The survey results highlight the specific disabilities that teachers sought AT training for; however, the focus groups yielded mixed results regarding which areas of training are most needed. All participants discussed their need for continuous training and support and knowledge of how to access and use AT products. Some teachers and SNA's discussed the idea of being a blank canvas regarding their AT knowledge and practice: "I said I think we're pretty much a blank canvas. I think any help- Yes, any support at all." Whereas other teachers expressed their need to learn simple AT solutions: "You know it could be something as simple as the settings or something you know that could make different, but it's just you're on the spot you're trying to get on through the day, you're trying to get the work done. And it's often the devices or the setup of the devices that you've purchased, and you know you're not trained to set them up... I think that's kind of where we often spend hours going around in circles." Other teachers expressed the desire to learn more about specific AT functions, such as enhancing social skills: "Social skills that area how you could use an AT with that area" or how to facilitate maths tasks: "It's very hard to find that kind of thing. Sometimes in a keyboard that you can put it put into um. You know, just, if there were more kind of Mathsey apps." Knowledge about the products and provision of AT products were a significant barrier for teachers, whilst there were products in classrooms, teachers knew little about their capabilities and felt unsure about where and whom to go to for support. The lack of school policy was highlighted by many around AT provision and supports.

The most prominent theme regarding teacher needs was continuous support from an expert on AT. The teachers and SNA's discussed how staff members would share knowledge and

attempt to support each other: "And somebody who has a bit of experience in the school might say, Oh, have you tried this or the different organisations?." The participants expressed tangible benefits from receiving support from experienced personnel: "I found that really empowering because I literally had two hours and I brought every possible problem I had and she watched and she gave me that, because that's her area she could look at it and just small tweaks like so. We didn't have very big problems." The consensus from the group was a need to get continuous support and validation from an expert – ideally at the peer-to-peer level: "it was having that person to talk to about it. Whose area of expertise was assistive technology. But who is looking at it not as a technical person in the sense of at an IT person but was looking at it with a view to how it was going to improve learning, or how it's going to improve speech. Because the class teacher is very busy, so they need the equipment to enhance the learning situation. But they don't need it to take over." Figure three shows the impact that personnel can have in a system thinking approach to AT. In this study, teachers need personnel who are relatable and understand the complexities of teaching- rather than an AT specialist.

The participants agreed that having an expert that they could link with would empower them and facilitate the use of AT in the classroom: "You know it would be great if there were a couple of staff who were dedicated to this or they had time to dedicate them. Or they could, phone somebody or email somebody like that and just say these are. This is the kind of situation I have in my class. I have a child who has such particular needs. Could you recommend some apps that would be very practical?." This theme was clear throughout the focus groups. Teacher's and SNA's felt empowered by the limited support they received from experts in the field of AT, however, expressed the need to receive support on a continuous peer level.

#### *Systemic barriers interfere with at facilitation*

A common theme which arose from the focus group was the size of systemic barriers that interfere with AT use in the classroom. It was clear that these barriers must be overcome to enhance AT outcomes and optimise the ability to support children who rely on AT. A common theme was the issues regarding acquiring AT, which was described as a complex process, which often prolonged the acquisition and use of AT: "It's like by the time the

*funding comes through, if a clinician has recommended some software or piece of equipment, by the time it goes through to the proper channels. They might get it in the second last week in June. So yeah, we're losing precious time."* This relates again to the policies and provision within the system and highlights the impact that the broader procurement processes have on the system. Teachers recognised that delayed access to AT has a significant effect on the education outcomes of the children who need it and can interfere with their progress: *"I think sometimes we're nearly disabling the kids because we're not providing what they're entitled to. Yeah, I personally find (that) very, very difficult ... and I just find that, just gets me, gets me where it hurts."*

## Discussion

This study sought to extend the existing evidence base by understanding the needs of teachers in terms of AT use and provision within the Irish classroom. The research found that teachers felt unprepared for the changing AT needs within the classroom, and they need help in supporting students. The study sought to use a system thinking framework to understand the factors influencing AT use in the Irish classroom. Results reveal non-systems thinking, whereby there is no meaningful links between the policy, products, provision, personnel and the people in the AT system, or the contextual factors that influence the effectiveness of AT.

The research revealed a lack of knowledge and understanding of AT across the teacher groups, 85% of respondents said that they needed added support and only a third of participants felt that they had any knowledgeable with AT. AT promotes social interaction and curriculum access for students with SEN and has the potential for heightened inclusion in the classroom [18]. If teachers lack knowledge and support for successful implementation, this will negatively affect inclusion and may act as a significant barrier to students' ability to engage. The qualitative findings showed that teachers are concerned over their lack of confidence to use AT, which stems from a lack of training. Teachers recognise that a lack of AT knowledge interferes with their student's scholastic progress, which has been seen in other research [18] and shows the importance of providing teachers with the confidence to use AT, and access to suitable tools to use AT in the classroom. This finding is consistent with various research which also highlights the lack of perceived AT knowledge among teachers, all of which show that teacher's knowledge and confidence to use AT is related to the availability of training and resources [11–15,19]. The research shows that students are at risk of falling behind in the modern classroom if teachers are not supported to feel confident to use AT.

A unique feature of this research study was that it used a mixed-method design to gain insight into the AT training needs among teachers and SNA's. It asked teachers to consider the types of disabilities within the classroom and what the emerging trends were in terms of their AT training needs. Most teachers from this study said an interest in a professional development program or postgraduate training course for enhancing their AT knowledge and skills. Over half of respondents want this training to occur during school time, and just under half of the participants expressed interest in engaging with online training. This reflects the emerging trend in teacher Continuous Professional Development (CPD) [20]. With the rapid development of information technology, teachers are being asked to reconsider their views on how and where teaching and learning should occur, they are being asked to review their class and content to align with the growth in information communication and technology.

The results of this study reveal that many teachers want CPD for AT support to be taught face-to-face, in the classroom, preferably. This finding shows that teachers may be tied to pedagogical views of teaching, and learning, which value face-to-face interactions over those mediated through technology. This value system may be one of the barriers to the full integration of AT use in the classroom. If teachers prefer talk and chalk methods of learning themselves, then how are they going to move to teaching with or through AT. These findings can be used to inform teachers AT CPD; training may need to consider supporting a mindset shift about how and what quality education is. Teachers who value in class, person-to-person learning, may resist the idea that quality teaching can occur through alternate means and therefore may need support to move these views.

The findings of the research reveal that there are shifting trends in the type of disabilities teachers need support with; we also see that primary school teachers report more knowledge than a secondary school teacher. Many teachers need supports with AT provision for children with ASD, speech and language difficulties and specific/intellectual disabilities, while only a third of participants expressed AT training needs that would help children with emotional disturbances. These findings are in line with changing prevalence rates of developmental disorders. There have been an increased prevalence of attention-deficit/hyperactivity disorder, autism spectrum disorder and intellectual disability [21]. Results show that teachers are aware that they do not have the skills to support children who would potentially receive help from AT. What was stark in the qualitative analysis how little teachers know about AT, they lacked the vocabulary to express their AT training needs. It appears that teachers "don't know what they don't know" and potentially lack the knowledge to appreciate the potential of AT in enhancing access of better education for children.

## System thinking

This study aimed to extend the existing body of knowledge by using the system thinking approach to consider how the four main strategic drivers – Policy, Products, Provision and Personnel – and the five contextual elements – Procurement, Promotion, Place, Pace and Partnership- impact upon teachers use of AT within the Irish education system. The research findings point towards a non-systems thinking approach to AT in the Irish classroom. The people at the centre of the system in this study include teachers and the students who will receive help from AT. Teachers describe difficulty in accessing AT and using the devices correctly. Their confidence appears to be negatively affected by a lack of training. There is no specific policy relevant to AT use, provision and/or training in education in Ireland. The Health Act (1970) is the main piece of legislation of direct relevance for AT provision, and this does not refer to AT directly (24). As a consequent AT training and provision has developed in disparate ways, and there is little or no coherent overall national vision for assistive technology use in the classroom. This was seen in this study- teachers in this study had little or no awareness of how or where resource-allocation occurs. As it currently stands under the Assistive Technology scheme, funding is provided to schools towards the cost of computers and specialist equipment, which are needed for educational purposes. Children with more complex disabilities are prioritised in this scheme, and teachers are asked to supply supporting evidence for the application (see [www.DES.ie](http://www.DES.ie)). In this study teachers consistently referred to the difficulties in this process - this included having limited time to complete



applications and little awareness of where to go especially if an application is unsuccessful. The importance of appropriate training and support for AT use in education was a common theme throughout the study and can also be seen in the research literature [17]. The research shows a need for AT to be addressed in initial training and continuing professional development programmes for teachers. The ideal place for this to first occur is within Initial Teacher Education. In this study, we see that effective AT use was only seen in teachers who had access to both formal and informal supports.

Good systems thinking include the necessary knowledge and consideration of AT products that are needed and available [5]. We did not see this in this study. Teachers had little awareness of what products were available to them, and this was a barrier to integration and use of AT. Some teachers could describe the areas in which they need support while others did not know what they did not know. If systems thinking was applied in this context, and teachers and students' needs were considered in the development of product standards; they would more accurately reflect the needs of teachers and then be more "relative" to the reality of their context. Further to this, the results also show a non-system thinking approach to provision of products, teachers' report being limited by the supply of AT and an overall lack of understanding of how AT is obtained. The sense of frustration in the teachers was seen throughout, and they described the impact this had on AT users and their own ability to support students in the classroom.

According to Maclachlan and Sherer, a systems-thinking approach to personnel addresses some of the practical realities which can act as a barrier to successful AT use. For example, one challenge which emerges in terms of personnel is a lack of or limited numbers of professionals who can deliver AT supports. A good systems thinking approach to this would plan alternative models of service delivery that are not completely dependent on experts or professionals; these can include offering remote support for providers, increasing peer support networks and developing the users capability, so they do not have to rely on professionals [5]. Teachers in this study described the importance of having access to different types of personnel. They want access to support through expert peer personnel; they all spoke of the impact that other teachers have on this and how an expert peer is of more value than an AT expert. This is likely not only because of their greater availability but also their greater familiarity with the contextual factors that may either facilitate to hinder the access to and effective use of AT. As it stands, most teachers highlighted a lack of system thinking in terms of personnel, saying repeatedly that they felt there is nowhere for teachers to go to ask questions or garner support.

### Limitations

Though this study produced valuable data, there are some limitations. First, the researchers sought a sample set that would be equally represented across teachers demographics. However, the sample set was dependent on the willingness of teachers to participate. There may have been teachers with alternate views and experiences who did not participate. Secondly, while the data provides support for a system thinking approach to AT provision in education, it does not provide information on the weighted importance of each of the elements within the system. Understanding which factors which have more impact may provide firmer evidence for the development of future interventions and supports.

### Implications

This research highlights the need for comprehensive AT training for teachers. Efficient and targeted teacher training is the key to maximise the learning and inclusive potential of children with physical and/or intellectual needs [17]. It is clear that teacher engagement with AT and confidence with AT is essential for AT to become part of the day to day classroom activities, and so to meaningfully include all children in the day to day life of the classroom. However, the AT system is not working to support teachers to engage meaningfully with this process. There are no clear, consistent, and accessible national policies for training and product access and teachers lack the skills, resources, and knowledge to use the AT solutions. Despite the potential of technology to bridge academic gaps between children with and without various disabilities [6–9], we have seen a system which is not yet capable of supporting teachers AT practice - this is a finding also seen on a global scale [11–14]. While the findings of this study confirm the need for comprehensive teacher training, it also highlights the importance of having an AT system which is easy to navigate, which has policies and provision which support educators and has expert personnel and AT-competent colleagues on hand to support teachers. Teachers in the study are motivated to use AT and want to embed good practice in their classrooms. It should be a priority to identify how best the pace of responding to this challenge can be addressed through developing a connect-up systemic approach, which also champions the success of children using AT and profiles their abilities and technological competence. The next step is to develop an AT system where policies, practices, personnel and products interact to support the people (teachers and students) to engage easily and successfully within a broader context that valorises children using assistive technology so that they can experience the same quality of education as their peers.

### Disclosure statement

The authors report no conflict of interest.

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