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Published online: 12 May 2020.

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The DreamSpace STEM-21CLD model as an aid to inclusion of pupils with special education needs

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ABSTRACT

Fostering inclusion of students with Special Education Needs (SEN) within mainstream classroom supports positive education outcomes for all. Teachers' attitudes towards inclusion can also impact; those teachers who perceive themselves as well-trained are more likely to hold positive attitudes towards inclusion. Classroom practices which focus on 21st Century skill development, including collaboration, problem-solving and technology have the potential to positively impact on the education outcomes of students with SEN. The current research sought to explore these themes, and the role a STEM-21st Century Learning by Design (STEM-21CLD) education activity has on teachers' perceptions and attitudes towards, students with SEN. Nineteen teachers who participated in the STEM-21CLD education activity took part in this qualitative study. Thematic analyses revealed that teachers perceived students differently following participation in the STEM-21CLD activity. Teachers reported seeing students as more confident and capable of leadership. Teachers attitudes towards student with SEN were positively impacted, with a skill focused classroom seen as having a positive influence. Teachers described practical constraints; withdrawal of students for supplementary learning support can mean that these students 'miss out' on skill focused learning activities. We argue that the STEM-21CLD learning approach can facilitate teachers to consider inclusive classroom practices in new and innovative ways.

Introduction

Young people with disabilities have lower rates of completion in primary education, and face significant barriers in the transition to higher level education . The Convention on the Rights of Persons with Disabilities reiterates an international commitment to 'an inclusive, quality, and free primary education and secondary education on an equal basis with others in the communities in which they live' (United Nations 2007). Teachers attitudes towards inclusion often correlate with inclusive practices (Leonard and Smyth 2020) and are influenced by a myriad of factors – including available time (Chiner and Cardona 2013), resources (O'Toole and Burke 2013) and training (Sharma and Nuttal 2016; Leonard and Smyth 2020). While a shift in education focus has led to greater inclusion of children with SEN in Ireland (O'Toole and Burke 2013), questions about which models of learning best facilitate inclusive classroom practices are beginning to emerge.

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Preparing young people for the twenty-first Century workplace is another major focus of education reform. By 2022, it is estimated that there will be at least 6.2 million jobs unfilled and 60% will require a skillset not being actively taught in the modern classroom (World Economic Forum 2018). These skills include communication, collaboration, creativity, critical thinking and self-reflection (ATC21S 2014). Teacher training activities have developed as a result of this shift in focus. For example, Microsoft Ireland developed a Science Technology Engineering Maths-21st Century Learning by Design (STEM-21CLD) activity to support Irish classroom reform. Underpinned by the competency framework for educators (UNESCO ICT-CFT) it offers teachers support in delivering collaborative, real-world problem-solving activities which use information and communication technologies (ICT) for communication. The 21CLD idea grew out global research programme across eight countries (Shear et al. 2010) and it offers an alternative to traditional instructional practices (Shear, Gallagher, and Patel 2011; Butler 2016).

When considering inclusive classrooms, the STEM-21CLD is an interesting model to consider. We know that collaborative classroom approaches can facilitate greater participation of students with SEN (Bricker et al. 2020) and pedagogies which employ group work prevent teacher dependence, facilitating student-leadership (O'Toole and Burke 2013). Furthermore, technology-mediated learning environments support leadership skills in ALL students (Ghergulescu et al. 2018). Hence, the STEM-21CLD model of learning has the potential to support skill development, while encouraging inclusion of ALL students. In this paper, we seek to understand the role that a STEM-21CLD education activity can play in teachers' perceptions of students with SEN. We ask teachers who have participated in the Microsoft STEM-21CLD education activity to describe the impact that this experience has on their students; examining the role it can play in teacher's perception of, and attitudes towards, students with SEN capabilities.

Materials and methods

Design and data collection

A qualitative research design was employed, a counting method was used to support the qualitative design, to identify patterns in the occurrence of themes to help generate explanations for those patterns. The study consisted of semi-structured interviews with teachers who attended the STEM-21CLD (Interview schedule found here https://osullik77.wixsite.com/dreamspaceresearch/research-method-page). Interpretative Phenomenological Analysis was employed which included thematic content analysis techniques. First, transcripts were read by two of the authors. The authors then coded the excerpts. The codes and categories were then reviewed, and themes identified. The researchers then applied the counting analysis developed by Hjelte and Ineland (2020). This was used to understand the qualitative analyses and quantify the themes (see Table 1).

Respondents

Nineteen teachers took part in interviews relating to their experiences of attending the STEM-21CLD activity (n = 19). All of the teachers had volunteered to attend with their student group and they came from five different counties across Ireland. Eleven teachers

Table 1. Overview of themes and subthemes.

Themes (% of respondents)	Subthemes (number of quotes)
Positive Shifting Attitudes (65%)	Student capabilities (10)
	Value of Collaborative Teaching Methods for Students with SEN (8)
Perception of Students (100%)	Better in Non-Traditional Classrooms (12)
	Confidence and Self-Belief (10)
Barriers to 21CLD in school (100%)	Withdrawal of students from mainstream (8)
	Time and Resources (15)

were from primary schools (aged 9–11 years) and eight attended with a Transition Year class group from Secondary schools (aged 14–16 years). Teachers were included in this study who had at least one student with SEN attend the activity with the group. Average number of students with SEN in attendance was 3 (range 1–8). In this context, the authors defined SEN as children with learning difficulties or disabilities that make it harder for them to learn than most children the same age. The researchers chose this general SEN term to try to ensure all children were considered.

STEM-21CLD education activity

The STEM-21 Century Learning by Design (STEM-21CLD) education activity was designed and delivered by Microsoft Ireland. The activity is called 'DreamSpace'. It extends the 21CLD approach by adding STEM/Computer Science skills to Collaboration, Skilled Communication, Real-world Problem Solving, Knowledge Construction and Use of ICT for Learning. The DreamSpace format is a 3-stage learning process, in stage one students get to grips with what the world could be in 30 years by researching how technology will change our lives. Stage two involves visiting the 'DreamSpace' in Microsoft Ireland, attending a half-day workshop where in teams' participants (student and teachers) are bought through the DreamSpace STEM-21CLD education model (see Figure 1). This involves forming small groups and solving the problems of an imaginary country where transport is non-existent. Students and teachers are asked to develop solutions to this problem. They work together to find the solutions. They use a range of technologies to build these solutions. They then test their solutions and present them to the rest of the class at the end of the session.

Ethical considerations

Our research complied with the ethical principles of research in the humanities and social sciences according to the standards set out by the European Research Council. The research received ethical approval from the Maynooth University Ethics Committee.

Findings

Table one shows that there was a general perception that students with SEN gained considerably from attending DreamSpace. The interviews revealed a change in the perception of these students and surprise at the impact that the DreamSpace activities had on these students, or students who the teachers described as 'less academic'. Teachers noted that the collaborative learning activities, and the interactive learning
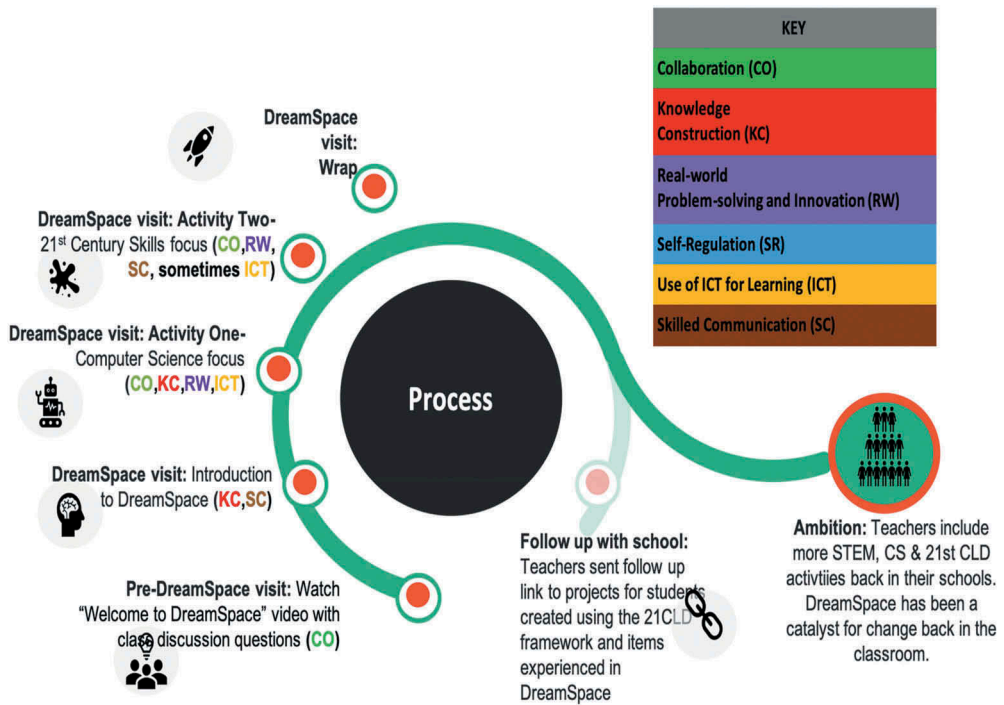
Figure 1. Description of the STEM-21CLD education activities and how they correspond to the 21CLD skills framework.

environment, provided an outlet and opportunity for these young people to excel, to showcase their abilities as leaders and to learn through a more accessible medium.

Positive shifting attitudes

Student capabilities

In terms of attitudes towards students with SEN, the teachers were surprised by the capacity of these students to engage in activities. This teacher had not expected these students with SEN to 'get it': '*There were two or three students that you would never think … and they were really catching on really quickly. And one of them who would never really shown interest in technology was saying she thought it was really good'.* Another teacher described the value of observing these students being able to achieve things with technology; '*one of the boys … his literacy scores would be catastrophic … it was brilliant for me to see'.* Teachers saw the STEM-21CLD activity as a space to explore skills that may not always be celebrated in the classroom. The teachers describe observing the students with SEN in different settings; the tone and type of answers suggest this was new and changed their view of these students; '*I see STEM as an invaluable resource for our SEN children. We have pupils who have found their "thing" in coding and the boost it has given them is incredible. It changes their attitude to school and they see it as a more positive place as they are achieving success in an area with sometimes little struggle'*; another teacher talked about how the activity impacted on those who were not usually able to participate;' … … *the 8 kids that really understood*

weren't the most academically gifted in fact some of them have SEN … they got to own something'. There was this tendency to bunch together students with SEN and refer to them as being 'less academic', with several teachers referring to this. While many were positive about the impact of the STEM-21CLD approach, it was hard to tease out whether teachers were being specific to the students with SEN in their answers. The tendency to refer to these students as one group may be an indicator of the underlying attitude towards students with SEN as being 'less academic' and may require further examination in this context.

Value of collaborative teaching methods for students with SEN

The collaborative and interactive nature of the tasks undertaken in the STEM-21CLD impacted teachers' attitudes. Teachers talked about these activities equalising relationships across student peer groups; 'this showed me how the students who are usually take out of class for SEN activities can engage with the rest of the class". In one instance a teacher saw a student in completely different light; 'a child who struggles in school. she was really good, and she kind of nearly led the group which is great to see as well cos she generally wouldn't.'. The value of collaborative, student-led, activities can be seen here in terms of changing teachers attitudes towards their students and their perceptions of what students with SEN can achieve in a less didactic learning environment. 'One pupil in particular with autism become "socially alive" when using the technology and mixed better with peers.'

Perception of students

Better in non-traditional classroom

When describing technology-mediated learning activities teachers perceived these as beneficial for students with SEN compared to traditional learning environments: ' … with children with special needs they find it easier to participate in these kinds of modern settings than in the traditional … '. One teacher described their view of coding and technology; 'Often a child (with SEN) who struggles in other aspects … who are weak at English … cos they don't have the literacy skill, but it doesn't necessarily transfer to the programming. They're not any weaker at that. They can be strong at it … ' Technology activities provided what was referred to as a 'level playing field' where students were not limited by the literacy and numeracy focus which dominates traditional classrooms. One teacher perceived the students as being the most likely to enjoy coding and motivated to follow up with the learning in their own time: ' … I would know one or two of mine are (SEN), they're the ones who really enjoyed the coding and they are really into it … they go home themselves and they YouTube everything … '. Unlike traditional forms of learning, success in the STEM-21CLD environment did not rely on skills normally associated with attainment such as literacy and numeracy. Teachers perceived the interactive learning environment as providing opportunities to show these skills which contributed to them being seen differently: 'as all children regardless of ability worked together to create something … different skills were being used pupils didn't have the same perceptions they may have in a regular classroom'

Confidence and self-belief

Many teachers talked about the growth in confidence they perceived in students: ' … from children that were going to Special Ed. to say children with severe dyslexia who really struggled but would be quite bright … right across the board a confidence (developed)

and I suppose just the belief that they took the belief in themselves.' The accessibility and interactive nature of the activities were key to growing confidence. 'One *of the boys with autism he was totally engaged in the day totally interested you know he was amazed by what he could do and eager to try it again*'. By perceiving these students as more confident and growing in self-belief through these activities the teachers themselves described a growth in their own motivation to use the activities to make their own classrooms more inclusive; ' … *I knew this stuff, but wasn't utilising it the best way in my classroom … and (the STEM-21CLD) just exposed me to what I could do in the classroom*'. Teachers had begun to plan how they would use the activities; '*but seeing them (students with SEN) in action and seeing them push themselves, for me, kind of when we go back, it defiantly steers me into okay more collaborative team-based stuff, I will be more likely to let them lead now … I will be like here's the issue or here's the problem go about it come back to me … '*.

Barriers to STEM-21CLD

Withdrawal of students from mainstream

Withdrawal and 'missing out' were described as posing a challenge to meaningfully including students with SEN in classroom activities. The teachers highlighted a concern that students often miss out on more engaging aspects of the curriculum to facilitate withdrawal for learning support; ' … *children are going out to special ed who are missing out and you don't want them missing out, you're trying to juggle everything.*'. Having seen these children in the STEM-21CLD the teachers reported wanting to change this; the activities encouraged collaboration and inclusion which is not always seen with students with SEN. In light of the fact that participants noted many highly positive impacts on students with SEN participation in an interactive and engaging learning environment, it is concerning that these students may be most likely to miss out on these types of activities in order to facilitate improvement in areas such as literacy and numeracy attainment.

Time and resources

Even when teachers were highly motivated to use the STEM-21CLD activities they faced barriers of time and adequate resources to properly include students with SEN. When asked about the barriers one teacher stated: '*Time and resources. Trying to cover what is demanded under the curriculum while also introducing activities like coding and video making, and supporting students with SEN, it's difficult, something has to give*'.

Discussion

This study examined the role that the STEM-21CLD model of learning could play in supporting inclusive practices in mainstream classrooms. The findings indicate that teachers see this activity as being positive for the students with SEN and that it has the potential to facilitate these students to play different roles in the classroom. Teachers described students as leaders and saw the students as confident collaborators. The findings indicate that the STEM-21CLD activity is positive; it encourages teachers to consider the potential of students with SEN differently, and therefore indicates that this model of learning has the potential to support an inclusive classroom.

Collaborative classroom approaches, technology-mediated and peer learning activities can play a role in the development of all students, especially those with SEN (Erdogan and Stuessy 2015; Means et al. 2016). The current study contributes to this discussion by establishing the role that the STEM-21CLD activity plays in teacher attitude and the inclusive classroom. The teachers were positive towards the STEM-21CLD, and saw it as a tool which creates a more inclusive classroom. The current findings suggest that the STEM-21CLD model of instruction may support inclusion by offering teachers training in skill-focused classroom activities. The STEM-21CLD activity supports teachers' positive attitudes, and in a time where there is a push for reform in education towards the development of core skills, there may be scope to rethink our classrooms to be skills focused AND inclusive.

Another contribution of this paper is it reveals the impact that taking students out of the classroom for special education can have on inclusive practices. Too often students with SEN 'miss out' on interactive learning activities, particularly technology-mediated learning, in order to facilitate withdrawal aimed at improving literacy and numeracy attainment. Since teachers highlighted the positive impacts that an interactive learning environment can have on students, it is concerning that these students may be most likely to miss out on these types of activities. Previous research has highlighted that teachers often have to make these trade-offs when attempting to balance creating interactive and inclusive environments by adopting pedagogical approaches such as group work due to time and other practical constraints. The current research suggests that these trade-offs are made in terms of more skills focused classroom activities and that students with SEN may be the biggest losers in this regard. Interestingly, the teachers made commitments to changing this practice, once they observed the positive effects that collaboration, leadership and technology had on students, thus supporting the observation that training can impact on the attitudes of teachers towards inclusion and inclusive practice (Chiner and Cardona 2013).

Limitations

When interpreting the results of this study, some limitations should be considered. First, the empirical data are limited to teachers who volunteered to participate in the research; the analysis, and different recruitment strategies limit the ability to generalise the findings to a larger population. Thus, the respondents cannot be viewed as being representative of all teachers of students with SEN. The teachers were not asked to make comparisons between the students with and without SEN in this activity, hence this research cannot speak to whether the findings are SEN specific, or whether they generalise more broadly. Our analysis is based exclusively on interviews with the teachers; future research should consider exploring students experience of these activities and how they support inclusion. Teachers were generally positive about the impact of the activity and while this may reflect their actual perception, more research should examine the possible negative effects this type of activity may have on inclusive practices. The teachers were willing participants, which may reflect a predisposition to see these activities as overly positive, future research should broaden the respondent group to gather a fuller picture of the potential of the STEM-21CLD in supporting an inclusive classroom. We did not observe changes in classroom practice and we use attitudinal change as an indicator of possible behaviour change. Future research should consider observing the impact of the STEM-21CLD in the inclusive classroom.

Disclosure statement

The authors acknowledge that there is no conflict of interest.

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