TEACHING STRATEGIES USED IN INCLUSION SCIENCE CLASSES TO DEVELOP SCIENCE LEARNING OF STUDENTS WITH LEARNING DIFFICULTIES IN PRIVATE SCHOOLS IN DUBAI

AlSadoon M[1]* and Forawi S[2]

Faculty of Education, The British University in Dubai, United Arab Emirates

Abstract: One of the most important things for students with LD to do to improve their science learning is for their science teacher to be ready to provide the right adaptations, accommodations, resources, and methods in a general classroom setting. As part of a PhD dissertation, this research paper is meant to look at the strategies' science teachers use to help students with learning difficulties learn science in the middle grades of private schools in Dubai. The goal is to answer the question, " What practices do science teachers have to develop science learning among students with LD in middle schools in Dubai?" A sequential mixed approach has been used to answer this research question, including a science teacher's questionnaire and a semi-structured interview of some science teachers. A 33-item questionnaire based on the study had been piloted to test the consistency of the items after they were revised by experts in the education field. 156 science teachers in different private schools in Dubai have responded to the questionnaire. The researcher then held a semi-structured interview with 14 science teachers individually to gain a deeper understanding of their point of view regarding the teaching strategies used in their classes. Except for a few highlighted points, the data collected and independent t-test results show that there are no significant differences in using one strategy over another in science classes. The research study confirmed that in the Dubai context, participants in this survey stressed the need for science teachers to learn about various learning difficulties so they may better understand how to instruct these students, which requires cooperation among all the stakeholders in the educational process to work together with clear goals and strategies to raise the science teachers' performance.

Keywords: Science learning, Teaching Strategies, Learning Difficulties, Inclusion

Introduction

The United Nations Educational, Scientific and Cultural Organization (UNESCO) Vision 2030 aims to provide a solid knowledge to all children and adult learners in science, technology, and innovation by professional, trained, and motivated teachers in an equitable and decent classroom setting(UNESCO, 2016), along with that, the United Arab Emirates (UAE) government has promoted Science, Technology, Engineering, and Math (STEM) through educational improvement and national planned processes, aiming to be among the top 20 highest achieving countries in Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS)(Ministry of Education, 2019). Further, according to industry leaders, a concentration on science and math in UAE schools will help to generate future innovators. Youth may be inspired to pursue careers in thriving disciplines such as health sciences, space exploration, and Web3(Nasir, 2022). This vision can be realized in a full learning opportunity that includes access to scientific

*Corresponding Authors' Email: *munaalsaaduon@gmail.com*

knowledge and discovery, questioning about the real world, exploring phenomena, creating tools to solve a problem, and recognizing means related to earth science, life science, and physical science(Spooner et al., 2011).

Sstudents with learning difficulties (LD) face a challenge when trying to improve their science learning(Villanueva et al., 2012). Studies have shown that general education instructors are not sufficiently set up to successfully reinforce this group of students in a comprehensive teaching setting (Mastropieri et al., 1999; Bencze et al., 2006; Kim, 2013; Park et al., 2015). The setting may be related to how the information is introduced, how learners are approached to react, the physical characteristics of the setting, and the timetabling and arranging of instruction(IRIS Center., 2018).

This research study aims to investigate science teachers' teaching strategies to develop science learning in students with LD in middle schools in Dubai and to answer the below research question:

What practices do science teachers have to develop science learning among students with LD in middle stage of private schools in Dubai?

Science learning is an important target for all students, including those with LD. However, there is concern about the effects of science learning at school, since science is a typical subject to respond to the students' curiosity and allow them to find out about the surrounding world that fills up with new thoughts and idea (Mittal, 2017) , further, as it limits applications for science degrees and decreases the supply of science graduates (Kaptan and Timurlenk, 2012), also, teachers' beliefs about learners' abilities have a significant impact, and there is a shortage of highly qualified teachers to teach students with LD(Darling-Hammond, 2000; Stronge et al., 2007). Additionally, these students do not get the opportunity to keep on with science or mathematics as a study stream or career(Sharma and Chunawala, 2013; Burgstahler and Chang, 2014). Additionally, effective strategies that can significantly improve learner achievement are rarely used by teachers (Cook and Odom, 2013). Azman and Teo (2019) cited in (Teo, 2021)conducted empirical studies on students with LD in North America, which provides a rationale for this study in this part of the world.

The significant of the study is related to the global trends are aiming to improve STEM education to produce a new generation that holds professional skills to gain work in STEM fields (Therrien et al., 2011; Satashal . Green, 2014). STEM education relies on problem-solving skills related to real-life experiences, which students with LD in particular struggle to develop these skills (Street et al., 2012; Chen, 2013). Additionally, understanding science syllabus enhances students' comprehension of how the world functions(Mastropieri et al., 2006). Educators must use instructional approaches that inspire and encourage learners to appreciate science and maybe follow it in their college and career choices(NRC, 2012). The UAE Vision 2021, which adopted innovation, research, science, and technology as an essential policy, needs an extensive strategic program besides education, wellbeing, business, international accessibility, and social insurance (Kippels & Ridge, 2019; UAE Ministry of Education, 2015). This study will highlight the unique obstacles that students with LD face in science classes, as well as the extent to which science teachers are willing and equipped to teach science in inclusive settings, as well as their aspiration to support students with LD.

This research is based on the Social Model of Disability, disability movement has endorsed the social model, which is based on Victor Berel Finkelstein and Paul Hunt's founding of the Union of the Physically Impaired Against Segregation in 1972. Oliver launched the term "social model" in 1983

and Goodley in 2001(Porter, 2015). The social model differentiates between impairment and disability, with impairment being the shortage or constraint of natural, intellectual or tangible ability on a long-term or permanent source, while disability is the loss of opportunity to participate in the normal life of the individual's society on an equal footing with others (Tugli et al., 2014), so, this study discusses the best practices followed by science teachers to reduce or remove barriers for students with LD, underlines the possibilities available to them to navigate institutional impediments and provides this group of students an adequate opportunity to be involved in the science class.

Recommended Strategies and Practices in Science Classes for Students with LD

The research studies recommended many teaching strategies to be used with students with LD to create a welcoming inclusive science class. Investigations have been conducted to establish the goals of Individual Education Programs (IEPs) and to use differentiated instructions within the scope of science learning for students with LD(Hall et al., 2004; Watt et al., 2013). Also, curriculum modification is the process of adjusting curriculum components such as content, teaching methods, and acquisitions to meet the needs of students(King-Sears, 2001), this leads to differentiated instruction which identifying students' learning characteristics, providing students with varying ability levels with suitable teaching techniques and instructional resources, and then organizing activities to maximize their learning(Tomlinson, 2000; Tomlinson et al., 2003; Edyburn, 2006; Knight, 2017). Olsen (2007) and Anderson and Rainie (2010) investigated the effects of a technology-supported differentiated teaching method used to teach an activity-based middle school science lesson on students' acquisitions in a unit. According to the findings, differentiated instruction implemented through curriculum modifications improved the achievement levels of students with LD in science and technology courses. Additionally, the quality of the responses provided by learners in the group receiving differentiated instruction has improved. Jimenez et al.,(2012) and Knight et al.,(2013) investigated the effectiveness of instructions with a fixed waiting time provided to five students (two females and three males) with moderate intellectual disabilities aged 11 to 14 years old through their peers using the KWHL diagram (K = what do you know?, W = what do you want to know?, H = how will you find out?, and L = what did you learn). In addition, Wood, (2014) used the multiple-probe across subjects' model to find out how well systematic teaching (fixed waiting time) helps students with moderate intellectual disabilities ask and answer questions in a science e-book. All of the individuals improved their mental ability to answer properly and their ability to answer correctly by replaying the target part. According to peers and teachers, science lessons necessitate a high level of interaction among students as well as between students and the teacher.

Research has shown that an inquiry-based method can help students with learning disabilities (LD) do better in science (Ma and Nickerson, 2006). This approach is supported by several national science associations and can help make the classroom a place where all students feel valued, respected, and able to fully participate in science class (Trundle, 2008). Additionally, note taking can help keep students alert, focused, and accountable while they listen, and serve as a record of what was said in a lecture or discussion (Boyle, 2010, 2012; Boyle et al., 2020). Furthermore, writing in class and reading notes prior to testing improve recollection, which is critical for exam success(Oregon State University, 2021).

Note-taking is an important skill in content areas such as science because it allows learners to retain and remember knowledge(IRIS Center., 2013). Recent studies have found that learners lack basic

study abilities such as note-taking and homework completion(Boyle, 2010, 2012; Boyle and Forchelli, 2014), and these challenges are exacerbated for students with reading difficulties, so, Haydon et al. (2011) proposed a technique to overcome this issue, which involves giving students a handout that includes a map or outline of the lecture as well as important facts, definitions, and concepts. Guided notes are usually 3–5 pages long, depending on how much academic content the teacher covers. Guided notes can help students prepare for quizzes, tests, and exams.

Another suggested teaching strategy through research studies is Project-based learning (PBL) can help teachers tailor projects, learning routes, and assessment criteria to meet the needs and interests of their students (Kortam et al., 2018). Also, The Universal Design for Learning (UDL) framework is a three-principle framework that includes visual representation options, engaging students in learning tasks, and varying how students express what they know(Boyle et al., 2020; CAST., 2018). The right science class setting can inspire students to be more responsible about their learning, such as a creative teacher, appropriate questioning technique, planning regarding learning needs and goals, and motivating students to attend science classes (Lee et al., 2008; Rogers, 2019).

Materials and Methods

This research paper follows a mixed methods approach to answer the research question below:

 what practices science teachers have to develop science learning among students with LD in middle stage of private schools in Dubai?

The researcher analysed the part of the science teachers' questionnaire related to the teaching strategies, which was answered by 156 science teachers in different private schools in Dubai.

 This "explanatory sequential mixed method", which means that the quantitative data was analyzed and the results were used to help understand the qualitative data. Interview questions were developed to address all of the questions that came out of the teachers' questionnaire.

The science teacher's questionnaire was piloted using the responses of 33 science teachers, and its reliability was tested using Cronbach's alpha. The second cluster of the science teachers' questionnaire, which includes (16) items related to science teachers' teaching strategies, teachers' perceptions of inclusive education, and learning barriers that reduce students with LD in science learning as perceived by teachers, was used to answer the research question. The researcher used several procedures to support the validity of the research findings and guarantee commitment to research ethics(Rimando et al., 2015). Challenges were identified and dealt with at every stage, and the ethical research forms were submitted for approval to the Education Faculty's Research Ethics Committee in the British University in Dubai (BUiD). The researcher set up the study instruments and had them reviewed by experts in the field of education. The researcher asked science teachers to take part in the research study, and all responses were revised before entering them into the Statistical Package for Social Sciences (SPSS) program.

Descriptive statistics were used to examine the quantitative data collected from the teachers' questionnaire in order to determine the frequencies, means, standard deviations, and percentages of the teachers' responses. Inferential statistics were used to determine if there was a statistical difference between the sample mean and the mean of the science teacher's questionnaire. The one sample t-test

was directed by applying SPSS, version 23 to determine if there was a significant statistical difference in mean.

The science teachers' interviews were conducted to gain a deeper understanding of how to involve students with LD in the general school stream. They were asked to answer fifteen open-ended questions either through a Zoom meeting or through email.

The most important ethical aspects of a research project are confidentiality and anonymity(Cohen et al., 2011). This was demonstrated by the researcher removing all of the names of the teachers who took part in the study, and not mentioning the location of the participating schools. Additionally, the researcher chose an adequate sample size to collect, analyze, and generalize the findings, with 156 science teachers responding to the questionnaire and 14 selected teachers being interviewed.

Results and Discussion

The research study aims to investigate the practices that science teachers use to develop the science learning of students with LD in private schools in Dubai. A mixed-method approach of quantitative and qualitative instrumentation has been followed to achieve this objective.156 responses from 156 science teachers in different private schools in Dubai have been analysed, removing invalid data and examining reliability and validity.

- **Quantitative Data Analysis of Teaching Strategies Used by Science Teachers**

The table below shows a descriptive analysis of science teachers' responses about the strategies used in science classes. The majority of responses agreed with the cluster items and have high frequencies (2042), while the disagree responses have low frequencies (165), indicating that science teachers have attitudes and are willing to use different strategies to help students with LD.

Table 1: The Frequencies and the Percentages of Science Teachers' Responses in Cluster Teachers' Strategies Used with Students with LD

Teacher' Strategies used with students with LD	# Disagree	%	# Neutral	%	# Agree	%
1. Coordination between science teachers and support teachers can enrich inclusive education policy application.	11	7.05	21	13.46	124	79.48
2. Reading scientific texts constrain students with LD to learn Science	10	6.41	19	12.17	127	81.41
3. Scientific terminology constrain students with LD to learn Science	10	6.41	19	12.17	127	81.41
4. I prefer to have a support teacher during science lessons.	17	10.89	23	14.74	116	74.35

5. I integrate technology to facilitate learning for students with LD.	9	5.76	6	3.84	141	90.38
6. The class size affects the quality of inclusive education provided.	11	7.05	19	12.17	126	80.76
7. I use Enquiry based learning strategy in most science lessons.	7	4.48	15	9.61	134	85.89
8. Use of higher order thinking skills	10	6.41	19	12.17	127	81.41
9. I use Guided Science Inquiry instruction with students with LD.	9	5.76	19	12.17	128	82.05
10. Inclusive education building better people for a better society	8	5.12	23	14.74	125	80.12
11. I use differentiated work to meet the needs of students with LD.	10	6.41	11	7.05	135	86.53
12. I am open to change my teaching strategies and the learning environment in order to address the needs of students with LD.	9	5.76	6	3.84	141	90.38
13. I use note-taking technique to improve student's science learning.	10	6.41	27	17.30	119	76.28
14. I follow small group strategy (4-5 students) in planning the lesson activities and running them in class.	10	6.41	21	13.46	125	80.12
15. Students with learning difficulties will be more successful in inclusive classes.	12	7.69	27	17.30	117	75
16. An experienced teacher has a positive attitude towards inclusive education.	11	7.05	15	9.61	130	83.33
Total	164	6.5	290	11.6	2042	81.9

The second part of the data analysis shows the score value of the responses, which includes the mean and standard deviation of the 156 science teachers' responses as shown on the table below. The highest mean score is shown in item # 5 (M = 4.429, SD =.9511), which indicates that science teachers depend on the integration of technology in the science classes to facilitate learning for students in general and students with LD specifically. On the other hand, the lowest mean score is shown in item # 16 (M = 3.865, SD =.9843), indicating that the years of experience of teachers may support the teachers in applying proper strategies and practices to help students with LD learn science.

Table 2: The Mean Score and SD of the Science Teachers' Responses regarding
the Teaching Strategies used in Science Classes

Science Teacher' Strategies used with students with LD	N	Mean	Std. Deviation
1. Coordination between science teachers and support teachers can enrich inclusive education policy application.	156	4.147	.9890
2. Reading scientific texts constrain students with LD to learn Science	156	4.231	.9076
3. Scientific terminology constrain students with LD to learn Science	156	4.096	.9557
4. I prefer to have a support teacher during science lessons.	156	4.103	1.0787
5. I integrate technology to facilitate learning for students with LD.	156	4.429	.9511
6. The class size affects the quality inclusive education provided.	156	4.282	1.0522
7. I use Enquiry based learning strategy in most science lessons.	156	4.237	.8733
8. Use of higher order thinking skills constrain students with LD to learn Science	156	4.122	.9252
9. I use Guided Science Inquiry instruction with students with LD.	156	4.083	.9295
10. Inclusive education building better people for a better society	156	4.218	.9456
11. I use differentiated work to meet the needs of students with LD.	156	4.224	.9268
12. I am open to change my teaching strategies the learning environment in order to address the needs of students with LD.	156	4.128	1.0014
13. I use note-taking technique to improve student's science learning.	156	4.256	.9630

	N	Mean	SD
14. I follow small group strategy (4-5 students) in planning the lesson activities and running them in class.	156	4.026	.9964
15. Students with learning difficulties will be more successful in inclusive classes.	156	4.333	1.0181
16. An experienced teacher has a positive attitude towards inclusive education.	156	3.865	.9843

The researcher compared the mean score of this cluster with the general mean score of the science teacher's questionnaire using one sample t-test, and the results showed there were no significant differences between the general mean score of the science teacher's questionnaire (M = 4.1038 SD = 0.65498) and the mean score of cluster B (M = 4.1738 SD = 0.68149) (p = 0.201 > 0.05).

Table 3: Comparison of the General Mean Score of the Science Teacher's Questionnaire and the Mean Score of Cluster B: Teaching Strategies Used by Science Teachers

Mean Score	N	Minimum	Maximum	Mean	Std. Deviation	Test results
General Mean Score of Science Teacher's Questionnaire	156	1.19	5.00	4.1038	.65498	t= 1.284 p= .201
Mean Score Cluster B	156	1.19	5.00	4.1739	.68149	

To gain more details from the data, the researcher ran one sample t-test to compare whether there is a significant difference or not between the general mean score of cluster B (4.1739) and the mean score of each item; the results are shown on the table below:

Except for item # 5 (I integrate technology to facilitate learning for students with LD.) in (t = 3.356, df = 155, p value 0.05 =.001), there were no significant differences between the general mean score (M = 4.1739, SD =.68149) and the mean score of each item in cluster B regarding the teaching strategies used by science teachers. The inferential analysis confirmed the results of the descriptive analysis that science teachers use and apply the practices and strategies that help them to improve and develop the science learning of students with LD in

general, but the significant differences in item # 5 indicate that some teachers have another point of view regarding the integration of technology.

Table 4.: Inferential Statistics of Science Teacher' Teaching Strategies used with Students with LD

Cluster B Items	Test Value = 4.1739					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
1. Coordination between science teachers and support teachers can enrich inclusive education policy application.	-.334	155	.739	-.0265	-.183	.130
2. Reading scientific texts constrain students with LD to learn Science	.783	155	.435	.0569	-.087	.200
3. Scientific terminology constrains students with LD to learn Science	-1.016	155	.311	-.0777	-.229	.073
4. I prefer to have a support teacher during science lessons.	-.826	155	.410	-.0713	-.242	.099
5. I integrate technology to facilitate learning for students with LD.	3.356	155	.001	.2556	.105	.406
6. The class size affects the quality of inclusive education provided.	1.284	155	.201	.1082	-.058	.275
7. I use Enquiry based learning strategy in most science lessons.	.905	155	.367	.0633	-.075	.201
8. Use of higher order thinking skills	-.703	155	.483	-.0521	-.198	.094
9. I use Guided Science Inquiry instruction with students with LD.	-1.217	155	.225	-.0906	-.238	.056

10. Inclusive education building better people for a better society	.582	155	.562	.0440	-.106	.194
11. I use differentiated work to meet the needs of students with LD.	.680	155	.498	.0505	-.096	.197
12. I am open to change my teaching strategies and the learning environment in order to address the needs of students with LD.	-.570	155	.570	-.0457	-.204	.113
13. I use note-taking technique to improve student's science learning.	1.070	155	.286	.0825	-.070	.235
14. I follow small group strategy (4-5 students) in planning the lesson activities and running them in class.	-1.858	155	.065	-.1483	-.306	.009
15. Students with learning difficulties will be more successful in inclusive classes.	1.956	155	.052	.1594	-.002	.320
16. An experienced teacher has a positive attitude towards inclusive education	-3.915	155	.000	-.3085	-.464	-.153

- **Qualitative Data Analysis of Teaching Strategies Used by Science Teachers**

This part of the data finds out the deep aspects of science teachers' efforts to develop the science learning of students with LD, and the researcher collected data qualitatively, including science teachers' interviews.

- **Analysing Data from Science Teachers' Interview Questions**

The researcher followed precise steps in order to analyse the findings from qualitative data. The first step involves lowering the volume of the collected data and eliminating the invalid responses. The researcher then arranged the collected responses from all science teachers in a way that would make the key points from the interview clear. The 15 questions of the semi-structured interview were divided into 5 sections; the table below shows the summary of the results.

Table 5: Interview Questions and Results Summary

Interview Question	Results of Teachers' Responses
Section 2: Point of view of science teachers and the education curriculum applied	
Do you think that experienced science teachers can help students with learning disabilities with science better than new teachers?	Teachers with a lot of experience can use different teaching methods in their classes to meet the needs and abilities of each student.
Question 2: Why? Explain.	Both groups of teachers are able to do this work since it depends on the teachers' readiness and attitudes to deal with students with LD.
	There are no differences in how the curriculum is taught to help students with LD. Including these students depends on the school's resources and how ready the science teacher is.
Question 3: To what extent does the British Curriculum, American Curriculum, or IB accommodate LD students?	
	The science teacher, the consular officer, the social worker, and the SEN department all need to work together on this project.
Section 3: Teacher Attitudes About Teaching Science to Students with LD in Regular Classes	
Question 4: How do you set learning expectations and objectives for LD students in science lessons?	Depending on the IEP, set goals for each student based on his or her learning needs.
	Besides the IEP goal, teachers' observation of students with LD in the science classes
	There are no specific goals for these students.
	Speeding up to cover the syllabus prevented these students from catching up.
	a scarcity of time
Question 5: What challenges do you believe LD learners face in a regular science setting?	Inside the classroom, there is a lack of learning support.
	Language barriers, not being able to focus on one task, and other barriers to learning make it hard for students to understand and move on in a science lesson.
	It is hard to understand the abstract concepts.
	Self-efficacy is low.
Section 4: Interesting in Science	
	using interactive activities.
Question 6: What are the key factors that affect students' individual interest in school science lessons?	Connecting science lessons to everyday life
	Avoiding lecturing.
	Giving constructive criticism

	The science teacher's readiness and attitudes
	giving the students an opportunity to model and design science concepts.
	In addition to the previous strategies and practices employed by science educators,
Question 7: How do you promote students' interest in science learning in your classroom?	Using technology and going on field trips
	encouraging students to use their observation skills scientifically.
	The nature of science is represented by the character of a science teacher as a positive role model.
	Hands-on activities are encouraged.
How do you get students with learning difficulties to be more interested in learning science?	inquiry-based education
	scientific concept that is applicable in their daily lives.
	technology integration in the science lesson.
	· Language barrier.
Question 9: Are there any other factors affecting your students' interest in school science?	· Home.
	bad experience with another science teacher.
	Students' self-efficacy and self-determination
Section 5: Based on the Data Collected	
Question 10: Regarding the use of effective strategies with students with LD, science teachers do not agree on one strategy over another, except using technology; 65% of the sample accepts that the integration of technology facilitates learning for students with LD Do you have an explanation for that? Why are teachers more convinced by this strategy than others?	Most of the answers were about how technology works and how it can help learning in general.
	Technology promotes students' independence.
	Some online platforms and resources give students work that is tailored to their needs and skills.

Science learning requires complex cognitive abilities like problem-solving, critical thinking, assessing, analysing, and interpreting data (Hartas and Donahue, 1997; Wong *et al.*, 2003; Steele, 2007). To meet the demands of students with different abilities, teachers must devise efficient and sensible teaching methods (Tomlinson *et al.*, 2003). Research has shown that one of the top issues for new teachers is identifying student differences and offering differentiated instruction to account for those differences (Tomlinson *et al.*, 2003). The science teachers' responses to this cluster of the questionnaire show a high percentage of agreement on the majority of items, including the strategies used, the barriers that prevent students from developing science learning, and the establishment of

inclusive science classes. The highest percentage of agreement of science teachers was with the integration of technology in the science classes that facilitates learning for students with LD (90%).

Technology can assist in completing the assignment and in avoiding a challenging area for the learner, and has the potential to enhance and support their learning and academic performance (Edyburn, 2006). For students with LD, assistive technology can be a helpful and supportive tool, aiding in the creation of distinctive educational experiences for both teachers and students(Ahmed, 2018).Additionally, science teachers must have a flexible and multifarious cognition, sufficient to impart numerous explanations of the same topics or principles. Additionally, science teachers are now expected to be knowledgeable about the topic of inclusion, as their strategies and practices cover a wide range of topics, such as learning a second language, diversity, underrepresented student populations, culturally significant pedagogy, and multicultural pedagogy(Miranda *et al.*, 2018).

Students with LD prefer direct instruction and hands-on activities when it comes to science learning, and that science teachers must be trained and have enough experience to be able to spot LD students in their classes (Murtaza, 2018). Additionally, there are a number of issues that need to be resolved in order to provide students with a suitable environment in which to learn science, such as teacher qualifications, teaching methods, improper use of technology, lack of integration between science and other subjects, class size in relation to the number of students present and access to laboratory activities, students' motivation and interest in learning science, the traditional (teacher-centred) method of instruction, and the overwhelmed science curriculum filled with information and less time to allocate (Kaptan and Timurlenk, 2012; ASTE, 2021). Additionally, science teachers and future science teachers think they lack the qualifications needed to teach science in an inclusive environment (McNamara, 2007; Kaskaloglu-Almulla, 2018).

The results of the sample t-test show no significant differences in using one strategy rather than others, except for item #5 (integrating technology to facilitate learning for students with LD), This result confirms the descriptive data, but at the same time, the technology has some disadvantages that affect the students' independence and creativity. As the studies show, the connections that technology makes possible through social networks are causing an increase in the number of people in society to feel alone and separated. Young children who spend more time using technology may not engage with their peers as much, which may hinder their social and emotional development. In order to reduce this risk, "technology time" must be moderated so that kids can socialize with their relatives and friends. Further, many technology-based games and activities are pre-made, enabling kids to finish tasks without having to use their imaginations and creative problem-solving skills (Gaille, 2018; Brown, 2019;Todd, 2020).

The strategies and practices used by science teachers to reduce difficulty barriers and assist students with LD in improving and developing science learning in the classroom are consistent with the social model of disability, which ensures that people with disabilities can participate in all aspects of life on an equal footing with others(Oliver, 2004; Loewen and Pollard, 2010). Science teachers use a variety of techniques and strategies to ensure that all students acquire the knowledge and skills linked to science learning and facilitate the learning environment to enable students with LD get the opportunity to learn science.

The analysis of interviews with science teachers confirmed that science teachers have positive views about helping students with LD to learn science, but need more effort and cooperation from different stakeholders to be useful. Although, the quantitative data does not support one teaching strategy than another, the interviewed science teachers support the use of hands-on activities and inquiry-based learning in their classes, which is in line with other research studies that support these strategies to reduce barriers in the science setting that keep students with LD from learning science (Tomlinson *et al.*, 2003; Hall *et al.*, 2004; Edyburn, 2006; Watt *et al.*, 2013; Olçay Gül, 2014; Knight, 2017; Rudiyati et al., 2017).

Further, the differentiated instructions with accommodations and modifications allow students with LD to be involved in science learning in an efficient way, and that using technology in science classes gives students with LD a chance to engage in and take part in science activities and tasks (Jeong and Hmelo-Silver, 2016). Additionally, the findings demonstrate that science teachers are solely responsible for developing this group of students' science learning on the basis of their knowledge, readiness, and skills without any help from other stakeholders like the administration or parents, that gives a significant of this study to provide guidance to help the schools set up an adequate environment for learning science for this group of students.

Conclusion

The results showed the positive perceptions of science teachers regarding improving and developing science learning, although there were highlighted points that showed significant differences. These were related to the teacher's readiness, the availability of resources, coordination among different departments to exchange data and experiences, and the involvement of other stakeholders, as discussed before.

Regarding the strategies and practices used by science teachers, the research study confirmed what has been found in other studies in different contexts: inquiry-based learning and hands on activities are the most effective strategies for reducing the impact of difficulties' barriers in science classes, besides using some accommodation and modification to these practices to fit the students' needs, such as graphic organizers, ready notes, and guided instructions.

Furthermore, other stakeholders in the educational field need to support science teacher to maximize the benefits for this group of students in general science stream which means the field needs a systematic process to help students with LD in a regular setting.

References

Ahmed, A. (2018). Perceptions of using assistive technology for students with disabilities in the classroom. International Journal of Special Education, 33(1), 129–139. https://files.eric.ed.gov/fulltext/EJ1184079.pdf

Anderson, J., & Rainie, L. (2010). Future of the Internet. Pew Research Center. https://www.pewresearch.org/internet/2010/06/11/the-future-of-cloud-computing/

ASTE. (2021). ASTE Position Statement on the Inclusion of Underserved Populations in Science Education. By The Association for Science Teacher Education. https://theaste.org/aste-position-statement-on-the-inclusion-of-underserved-populations-in-science-education/

Bencze, J. L., Bowen, G.M., & Alsop, S. (2006). Teachers' tendencies to promote student-led science projects: Associations with their views about science. Science Education, 90((3),), 400–419.

Boyle, J. R., & Forchelli, G. A. (2014). Differences in the note-taking skills of students with high achievement, average achievement, and learning disabilities. Learning and Individual Differences, 35, 9-14. https://doi.org/10.1016/J.LINDIF.2014.06.002

Boyle, Joseph R. (2010). Strategic not-taking for middle-school students with learning disabilities in science classes. Learning Disability Quarterly, 33, 93–109.

Boyle, Joseph R. (2012). Note-Taking Techniques for Students With Disabilities : A Systematic Review of the Research. Learning Disability Quarterly, 35(3), 131–143. https://doi.org/10.1177/0731948711435794

Boyle, S., Rizzo, K. L., & Taylor, J. C. (2020). Reducing Language Barriers in Science for Students with Special Educational Needs. Asia-Pacific Science Education, 6(2), 364–387. https://doi.org/10.1163/23641177-bja10006

Brown, C. (2019). 12 pros and cons of technology in the classroom. Classcraft. https://www.classcraft.com/blog/pros-and-cons-of-technology-in-the-classroom/

Burgstahler, S., & Chang, C. (2014). Promising Interventions for Promoting STEM Fields to Students Who Have Disabilities. Review of Disability Studies An International Journal, 5(2), abstract. https://www.rdsjournal.org/index.php/journal/article/view/218

CAST. (2018). Universal design for learning guidelines version 2.2. CAST.

Chen, X. (2013). . STEM Attrition: College Students' Paths Into and Out of STEM Fields. https://doi.org/(NCES 2014-001).

Cohen, L., Manion, L. &, & Morrison, K. (2011). Research Methods in Education. ((7th edn).). Routledge.Abingdon Oxon,. https://gtu.ge/Agro-Lib/RESEARCH METHOD COHEN ok.pdf

Cook, B. &, & Odom, S. (2013). Evidence-based practices and implementationscience in special education. Exceptional Children, 79 , 135–144.

Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. In "Educational Policy Analysis Archives, 8((1),), 1-44.

Edyburn, D. L. (2006). Assistive technology and students with mild disabilities. Focus on Exceptional Children, 32(9), 18–28. https://doi.org/10.17161/foec.v32i9.6776

Gaille, B. (2018). 23 Advantages and Disadvantages of Technology in Education. Brandon Gaille Small Business and Marketing Advice. https://brandongaille.com/23-advantages-disadvantages-technology-education/

Green, Satashal L. (2014). S.T.E.M. Education Strategies for Teaching Learners with Special Needs (Satasha L Green (ed.)). NOVA Scince publishers, Inc.

Hall, T., Vue, G., Koga, N., & Silva, S. (2004). Curriculum Modification. Wakefield, MA: National Center on Accessing the General Curriculum. (Links Updated 2014). http://www.cast.org/publications/ncac/ncac_curriculummod.html

Hartas, D., & Donahue, M. L. (1997). Conversational and social problem-solving skills in adolescents with learning disabilities. Learning Disabilities Research & Practice, 12((4),), 213-220. https://eric.ed.gov/?id=EJ559519

Haydon, T., Mancil, G. R., Kroeger, S. D., McLeskey, J., & Lin, W.-Y. J. (2011). A Review of the Effectiveness of Guided Notes for Students who Struggle Learning Academic Content. Preventing School Failure: Alternative Education for Children and Youth, 55(4), 226–231. https://doi.org/10.1080/1045988x.2010.548415

IRIS Center. (2013). Study skills strategies (part 2): Strategies that improve students' academic performance. Vanderbilt University.

IRIS Center. (2018). Page 1 : Accommodations. Iriscenter.Com or Iris.Peabody.Vanderbilt.Edu TX CPE #902-506, MA #2016F0011. https://iris.peabody.vanderbilt.edu/acc/

Jeong, H., & Hmelo-Silver, C. (2016). Seven Affordances of Computer-Supported Collaborative Learning: How to Support Collaborative Learning? How Can Technologies Help? Educational Psychologist, 51(2), 247–265. https://doi.org/https://doi.org/10.1080/00461520.2016.1158654

Jimenez, B. A., Browder, D. M., Spooner, F., & Dibiase, W. (2012). Inclusive inquiry science using peer-mediated embedded instruction for students with moderate intellectual disability. Exceptional Children, 78(3), 301–317. https://doi.org/10.1177/001440291207800303

Kaptan, K., & Timurlenk, O. (2012). Challenges for Science Education. Procedia - Social and Behavioral Sciences, 51, 763–771. https://doi.org/10.1016/j.sbspro.2012.08.237

Kaskaloglu-Almulla, E. (2018). Preservice Teacher Attitudes and Beliefs of Academically Diverse Preservice Teacher Attitudes and Beliefs of Academically Diverse Student Education in Mainstream Classrooms. Journal of Teaching and Education, 8(2), 497–512. https://www.researchgate.net/publication/330509196_PRESERVICE_TEACHER_ATTITUDES_AND_BELIEFS_OF_ACADEMICALLY_DIVERSE_STUDENT_EDUCATION_IN_MAINSTREAM_CLASSROOMS

Kim, Y. W. (2013). Inclusive education in Korea: Policy, practice, and challenges. Journal of Policy and Practice in Intellectual Disabilities, 10((2),), 79–81.

King-Sears, M. E. (2001). Three steps for gaining access to the general education curriculum for learners with disabilities. Intervention in School and Clinic, 37(2), 67–76. https://doi.org/10.1177/105345120103700201

Kippels, S., & Ridge, N. (2019). International and other migrant schools in Gulf Cooperation Council countries. https://doi.org/http://dx.doi.org/10.18502/aqf.0132

Knight, S. M. (2017). The self-reported relationship between a teacher's perception of learner characteristics for students with disabilities and a teacher's use of differentiated instruction in Georgia public schools grades 6-12. (Vol. 77, Issues 8-A(E)) [Liberty University]. https://digitalcommons.liberty.edu/cgi/viewcontent.cgi?article=2190&context=doctoral

Knight, V. F., Spooner, F., Browder, D. M., Smith, B. R., & Wood, C. L. (2013). Using systematic instruction and graphic organizers to teach science concepts to students with autism spectrum disorders and intellectual disability. Focus on Autism and Other Developmental Disabilities, 28(2), 115–126. https://doi.org/10.1177/1088357612475301

Kortam, N., Basheer, A., Hofstein, A., & Hugerat, M. (2018). How Project-Based Learning promotes 7 th grade students ' motivation and attitudes towards studying biology. Action Research and Innovation in Science Education, 1(2)(August), 9–17.

Lee, S., Palmer, S. B., & Little, T. D. (2008). Self- Determination and Access to the General Education Curriculum. The Journal of Special Education, 42(2), 91–107. https://doi.org/10.1177/0022466907312354

Loewen, G., & Pollard, W. (2010). The social justice perspective. Journal of Postsecondary Education and Disability, 23((1)), 5–18. https://files.eric.ed.gov/fulltext/EJ888640.pdf

Ma, J., & Nickerson, J. V. (2006). Hands-on, simulated, and remote laboratories: A comparative literature review. ACM Computing Surveys, 38(3), 1. https://doi.org/10.1145/1132960.1132961

Mastropieri, M. A., Scruggs, T.E., &, & Magnusen, M. (1999). Activities-oriented science instruction for students with disabilities. Learning Disability Quarterly, 22((4),), 240–249.

Mastropieri, M. A., Scruggs, T. E., Norland, J., S., B., McDuffie, K., & T., & Ornquist, E. H. (2006). Differentiated curriculum enhancement in inclusive middle school science: Effects on classroom and high stakes tests. Journal of Special Education, 40,(3), 130–137. https://files.eric.ed.gov/fulltext/EJ758174.pdf

McNamara, D. S. (Ed. . (2007). Reading comprehension strategies: Theory, interventions, and technologies. Lawrence Erlbaum Associates Publishers. https://psycnet.apa.org/record/2007-15600-000

Ministry of Education. (2019). Ministry of Education Strategic plan 2017-2021. Online. https://www.moe.gov.ae/En/AboutTheMinistry/Pages/MinistryStrategy.aspx

Miranda, R. J., &, & Hermann, R. S. (2018). Innovative Inclusive Science Teacher Education. InnovationsInnovations in Science Teacher EducationThe Practitioner Journal of the Association for Science Teacher Education, 3(3), 1–4. https://innovations.theaste.org/innovative-inclusive-science-teacher-education/

Mittal, R. (2017). WeSchool Knowledge Builder - The National Journal. January 2014, 2–6.

Murtaza, N. (2018). preceptions of students with learning disabilities learning science: a narrative study [University of Ottawa]. https://ruor.uottawa.ca/handle/10393/37820

Nasir, S. (2022). Focus on science and maths in UAE public schools "will create innovators." The National Newa. https://www.thenationalnews.com/uae/education/2022/06/11/focus-on-science-and-maths-in-uae-public-schools-will-create-innovators/

NRC. (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. The National Academies Press. https://doi.org/10.17226/13165

Olçay Gül, S. (2014). Differentiated Instruction and Adaptations. Ufuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 3(5), 111–123. https://ufuk.edu.tr/uploads/page/enstituler/sosyal-bilimler/ensdergi/say-5/serayolcay_gl.pdf

Oliver, M. (2004). Mike Oliver. In C. Barnes & G. Mercer (Eds.), Implementing the Social Model of Disability: Theory and Research (Vol. 2, pp. 18–31). The Disability Press. https://disability-studies.leeds.ac.uk/wp-content/uploads/sites/40/library/Barnes-implementing-the-social-model-chapter-2.pdf

Olsen, J. K. (2007). Impacts of Technology -Based Differentiated Instruction on Special Needs Students in the Context of an Ativity-Based Middle School Science Instructional Unit.[THE UNIVERSITY OF ARIZONA]. https://www.researchgate.net/profile/Julia-Olsen-2/publication/253119921_Impacts_of_technology-based_differentiated_instruction_on_special_needs_students_in_the_context_of_an_activity-based_middle_school_science_instructional_unit/links/53d027290cf2f7e53c

Oregon State University. (2021). Note-Taking: Science, Strategies & Tips. Academic Success Center. https://success.oregonstate.edu/learning/notes

Park, S. H., Lee, H., &, Heo, S. (2015). Current status of the instructional practices of special and inclusive classes in nationwide middle schools in Korea. Special Education Research, 14((1),), 27–62.

Porter, J. (2015). Understanding and responding to the experience of disability. Routledge.Abingdon Oxon,.

Rimando, M., Brace, A. M., Namageyo-Funa, A., Parr, T. L., & Sealy, D. A. (2015). Data collection challenges and recommendations for early career researchers. Qualitative Report, 20(12), 2025–2036. https://doi.org/10.46743/2160-3715/2015.2428

Rogers, A. (2019). The Best Ways to Inspire Your Students to Learn Science ⬜. MAGNA PUBLICATIONS. https://www.facultyfocus.com/articles/effective-teaching-strategies/inspire-your-students-to-learn-science/

Rudiyati, S., Mumpuniarti, & Pujaningsih. (2017). Teachers' Knowledge and Experience Dealing With Students With Learning Disabilities in Inclusive Elementary School. Advances in Social

Science, Education and Humanities Research (ASSEHR), 66, 272–279. file:///D:/PhD doc a/research folder/research folder c/new ref/25880121.pdf

Sharma, A., & Chunawala, S. (2013). Marching towards inclusive education: Are we prepared for inclusive science education? Fifth International Conference to Review Research on Science, TEchnology and Mathematics Education (EpiSTEME 5), 1–8. http://episteme.hbcse.tifr.res.in/index.php/episteme5/5/paper/view/127/20

Spooner, F., Knight, V. F., Browder, D. M., Jimenez, B., & DiBiase, W. (2011). Evaluating evidence-based practice in teaching science content to students with severe developmental disabilities. Research and Practice for Persons with Severe Disabilities, 36, 62–75.

Steele, M. (2007). Teaching science to students with learning differences. The Science Teacher ; Platinum Periodicals, 74((3),), 24-27. https://resources.finalsite.net/images/v1571404235/resanet/xqer3nah7uym3c9kiyze/Teachingsciencet ostudentswithlearningdifferences.pdf

Street, C. D., Koff, R., Fields, H., Kuehne, L., Handlin, L., Getty, M., &, & Parker, D. R. (2012). . Expanding access to STEM for at-risk learners: A new application of universal design for instruction. Journal of Postsecondary Education and Disability, 25((4),), 391-408.

Stronge, J. H., Ward, T. J., Tucker, P.D., &, & Hindman, J. L. (2007). What is the relationship between teacher quality and student achievement? An exploratory study. Journal of Personnel Evaluation in Education, 20((3–4),), 165–184. http://dx.doi.org/10.1007/s11092-008-9053-z

Teo, T. W. (2021). A Survey of Science Teachers' Perception and Practices in Inclusive Science Classrooms. Asia-Pacific Science Education, 6(2), 388–426. https://doi.org/10.1163/23641177-bja10013

Therrien, W. J., Hughes, C., & Hand, B. (2011). Introduction to Special Issue on Science Education and Students with Learning Disabilities. 26(4), 186–187.

Todd, B. C. (2020). Factors Influencing Student Interest in Science at School by Submitted in Partial Fulfillment of the Requirements for the Master of Arts Degree In Education [California State University San Marcos]. https://scholarworks.calstate.edu/downloads/gh93h3907

Tomlinson, C.A. (2000). Differentiation of Instruction in the Elementary Grades. ERIC Digests, 1–7. https://files.eric.ed.gov/fulltext/ED443572.pdf

Tomlinson, Carol Ann, Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. Journal for the Education of the Gifted, 27(2–3), 119–145. https://doi.org/10.1177/016235320302700203

Trundle, K. C. (2008). Inquiry-Based Science Instruction for Students With Disabilities. In J. Luft, R. L. Bell, & J. Gess-Newsome (Eds.), Science as Inquiry in the Secondary Setting (pp. 79–87). NASTA press. https://static.nsta.org/pdfs/BookBeat201301ThePlaceOfInterpretationAndArgumentation.pdf

Tugli, A. K., Klu, E. K., & Morwe, K. (2014). Critical Elements of the Social Model of Disability: Implications for Students with Disabilities in a South African Institution of Higher Education. Journal of Social Sciences, 39(3), Pages 331-336. https://doi.org/10.1080/09718923.2014.11893295

UAE Ministry of Education. (2015). Aspiring to Achieve a World Class Education in the UAE TIMSS 2015 Results. In TIMSS 2015 media report.

UNESCO. (2016). Education 2030: Incheon Declaration and Framework for Action for the implementation of Sustainable Development Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. https://unesdoc.unesco.org/ark:/48223/pf0000245656

Villanueva, M. G., Taylor, J., Therrien, W., & Hand, B. (2012). Science education for students with special needs. In Studies in Science Education (Vol. 48, Issue 2, pp. 187–215). https://doi.org/10.1080/14703297.2012.737117

Watt, S. J., Therrien, W. J., Kaldenberg, E., & Taylor, J. (2013). Promoting Inclusive Practices in Inquiry-Based Science Classrooms. TEACHING Exceptional Children, 45(4), 40–48. https://doi.org/10.1177/004005991304500405

Wong, B. Y. L., Harris, K. R., Graham, S., & Butler, D. L. (2003). Cognitive strategies instruction research in learning disabilities. In In H. L. Swanson, K. R. Harris, & S. Graham (Eds.), Handbook of learning disabilities (pp. 383–402.). The Guilford Press. https://psycnet.apa.org/record/2003-02238-022

Wood, A. L. (2014). Effects of systematic instruction on listening comprehension of science e-texts for students with moderate intellectual disability [The University of North Carolina]. In ProQuest Dissertations and Theses (Issue December). http://search.proquest.com/docview/1554347857?accountid=26642%5Cnhttp://link.periodicos.capes.gov.br/sfxlcl41?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertations+%26+theses&sid=ProQ:ProQuest+Dissertations+%26+Theses+Globa