8-2021

Developing Instructional Methods in Science Class for Students with Learning Disabilities

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Developing Instructional Methods in Science Class for Students with Learning Disabilities

by

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A Starred Paper

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

for the Degree

Master of Science in

Special Education

August, 2021

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Chapter 1: Introduction

Secondary school science class is one of the most challenging subjects for students who have learning disabilities (LD). In most science classes, educators use textbooks that are aligned with state standards to teach concepts (Huber & Moore, 2002; Scruggs et al., 2007). This textbook-driven curriculum is comprised of numerous science concepts, heavily laden vocabulary, and related facts (Cawley et al., 2002; Scruggs et al., 2007; Scruggs et al., 2008). Instructors have strived to help students with LD to understand the content with the least restrictive environment (LRE); however, students with LD in the secondary school science class encounter a lot of challenges during the lecture. Educators aim to deliver the lecture to elicit their students' abilities.

Explicit practice and reading intervention in science text for the students with LD yield high rates of success in comprehension of the text (Mason & Hedin, 2011). Now, the Next Generation Science Standard (NGSS) supports teaching science through inquiry. Teaching in this method is abstract, but it enables students to discover science by "acting as a scientist." Most students with LD acknowledged that abstract lessons hindered their understanding of science concepts, but the nature of the inquiry task may have played a role in student understanding of science process knowledge. Puttick and Mutch-Jones (2015) discussed the difficulty in making concepts accessible to all students due to the "invisible" phenomena studied in secondary school science classrooms. Students with LD were more successful understanding challenging vocabulary when instruction enabled students to discover vocabulary through inquiry-based instruction.

Research Question

What factors can help students with learning disabilities (LD) improve their achievement in the science class?

Focus of the Review

In Chapter 2, the review of literature is comprised of 10 studies. Publication dates of the studies range in dates from 2010 to 2019. Studies were included in the review if the participants were secondary school students with LD. I used keywords and different combinations of keywords related to the topic: *Least Restrictive Environment, Strategic Note-Taking Skills, peer tutoring, Peer-Assisted Learning Strategies, PALS, instructional strategies, content-area instruction, class-wide peer tutoring, cross-age peer tutoring, culturally and linguistically diverse, CLD, Individuals with Disabilities Education Act* (IDEA, 2004).

Importance of the Topic

Teachers' failure to provide proper IEP accommodations to students with LD may be due to a lack of knowledge of how to effectively provide support to students with LD in the classroom. The National Assessment of Student Progress state this: Students with LD perform significantly worse in science and math compared to the general education students even before entering high school (U.S. Department of Education, 2009).

As a middle school and high school science teacher, I work with students who struggle significantly more with comprehension in science compared to their classmates. Intervention and additional supports in other subject areas are well developed and researched; however, not many studies are conducted to find out what works best for science education.

The Individuals with Disabilities Education Act (IDEA, 2004) required that all students with disabilities have access to the general education environment as much as possible. In order to provide adequate education services to the students with LD, teachers need to implement various learning strategies to enhance students' achievement. Using strategic note-taking skills in the science class improves learners' comprehension levels after the class. Since note-taking is one of the key elements in the class to help students' understanding of the subject matter, teaching students how to use strategic note-taking skills will be important for the students with LD. Moreover, strategic note-taking skills helps students understand the abstract concepts that are required to comprehend the main idea.

One of the prominent programs in schools is involvement with the International Baccalaureate (IB) program. Students in public schools in the USA are becoming more culturally and linguistically diverse (CLD) and IB offers a continuum of international education. The IB program encourages both personal and academic achievement, and challenges students to excel in their studies and in their personal development. Inquiry-Based learning is one of the key elements in the IB program and in order to provide appropriate education to the students with LD, teachers need to understand Inquiry-Based learning and many other strategies.

Definitions of Terms

Learning Disabilities (LD) is a generic term that refers to a heterogenous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities.

Least Restrictive Environment is the legal term that a child with a disability must be educated, as much as possible, with non-disabled peers.

Strategic Note-Taking Skills is a note-taking strategy that was developed to assist students as they listen to lectures by incorporating steps that help them focus attention on teacher cues and vocabulary in the lecture. This strategy also helps students organize lecture content such as clustering similar lecture ideas and summarizing clustered lecture points (Boyle, 2010).

Culturally and Linguistically Diverse (CLD) represents the different cultural values and backgrounds from the mainstream culture (Swanson, 2016).

Individuals with Disabilities Education Act (2004) is the federal special education law that ensures public schools serve the educational needs of students will disabilities.

Universal Design for Learning (UDL) is a type of a curriculum and pedagogical design framework that proactively addresses the student diversity in today's inclusive classrooms (Kirk, 1963).

The *PCI Reading Program* is a scientifically research-based curriculum created specifically to teach students with developmental disabilities, autism, and significant learning disabilities to read (PCI Education, 2007).

Think before reading, While reading, After reading (TWA) is multicomponent strategies illustrate the powerful effects of integrating strategies that good readers use into a single instructional package (Mason, 2004).

Limited-English proficiency (LEP) are those whose native or dominant language is other than English and who have difficult in speaking, reading, writing, or understanding the English language (Nichols, 1975).

Chapter 2: Review of the Literature

Scope of Review

The purpose of the literature review was to find out instructional methods for students with learning disabilities that help to improve achievement in secondary school science classroom. The review of literature includes effective instructional strategies that result of successful interventions. Table 1 is located after the review of the literature and shows the summary of findings of the studies in chronological order.

Review of the Literature

In a national survey of middle school science teachers, nearly two-thirds of their science classes include note-taking during class time (Fulp, 2002). Instructors use a variety of instructional methods in classes and note-taking comprise a major portion of the lecture time. Seventy-nine percent of teachers answered that they “regularly use” or “mostly use” note-taking times during their teaching (Vogler, 2006). Students with LD must learn from lectures and move at a quick pace on concepts and science vocabulary in order to be successful in courses (Scruggs et al., 1992; Vaughn et al., 1993). These students struggle with note-taking and recording a key point from the lecture is one of the major obstacles for their learning. One study (Boyle, 2009) found that middle school students with LD recorded only 13% of the total lectures points (TLP) for a science class while general education students recorded 25% of the TLP in the same class. Boyle (2010) conducted the research to examine the effect of strategic note-taking skills in science class. Forty students who had LD were randomly assigned to either an experimental or a control group. Students in the experimental group were taught to record notes independently while viewing a videotaped science lecture. The students in the control group were not taught

any kind of note-taking skills. There was a difference in the result between two groups in immediate free recall, long-term free recall, comprehension, and number of lecture points and words recorded in their notebooks. The experimental group received higher scores in each area than the control group who used conventional note-taking skills.

For the second study, Mason and Hedin (2011) examined the data of students with learning disabilities in the educational databases (e.g., Exceptional Children, Journal of Special Education, Learning Disabilities Quarterly) from 2001 to 2010. The complexity of scientific concepts and information conveyed through print makes reading science tests the greatest challenge for the students with learning disabilities in school. This is because science literacy requires world knowledge (Graesser et al., 2002). Rich background knowledge of science concepts and the ability to make a variety of types of inferences is important for students' achievement in reading of science text (Mason & Hedin, 2011). Without substantial explicit practice with high rates of success, reading interventions are not helpful for students with learning disabilities to understand scientific information in challenging text (Mason & Hedin, 2011). The focus of reading comprehension instruction should be to improve how students approach difficult reading material so that active processing occurs (Gersten et al., 2001).

For the third study, Dexter et al. (2011) investigated 23 standardized mean effect sized from 271 participants in sixth through twelfth grades students. The data from the six articles were analyzed by the research team. Secondary school science class requires students to use inductive and deductive thinking skills and critical thinking that are often challenging for students with learning disabilities (Mastropieri et al., 2001; Mastropieri et al., 2006). The National Assessment of Student Progress found a gap between students with and without LD in of the proficient level

for science. Thirty-five percent of general education students in eighth grade are above the proficient level but only 11% of students with learning disabilities are above this same level (NAEP; U.S. Department of Education, 2009). The data show that the students with LD need more supports and interventions with science classes. One of the strategies to assist students with LD that has been recommended is a graphic organizer (GO) (Bos & Vaughn, 2002; Dexter, 2010; Dexter & Hughes, 2011; Kim et al., 2004; Nesbit & Adesope, 2006; Rivera & Smith, 1997).

Previous research found that GOs have significant impacts on comprehension of terms for students with LD (Gajra et al., 2007; Kim et al., 2004). Dexter et al. (2011) conducted a meta-analysis of GO research with focusing on the overall effects of Graphic Organizers (GOs). The analysis was conducted with posttest measures to investigate effects of GOs in science class. Cohen's (1988) criteria for interpreting strength of effect sized (small $ES < 0.20$, medium $ES = 0.50$, large $ES > 0.80$) were used. There was a large overall effect of GOs on the posttest score of students with LD in all studies ($ES = 1.052$) that were analyzed (Dexter et al., 2011).

For the fourth study, Seifert and Espin (2012) analyzed the effects of differentiated interventions on text reading. Twenty students with learning disabilities participated in the research. The students read content from a biology textbook similar to what may be used in a science class (Miller & Levine, 2004). Seifert and Espin designed four conditions to examine the effectiveness of interventions. There were three interventions and one control condition. In a reading fluency analysis, students in text-reading and a combined condition group read 280 words. Students in control condition read 240 words. Result proved that intervention showed positive effect on students' achievement. ANOVA revealed a significant treatment effect, $F(3, 57) = 11.97$,

p = .000. Students read more correct vocabulary words in the vocabulary learning and combined conditions than in the control conditions.

For the fifth study, Mutch-Jones et al. (2012) examined the effects of the Lesson Study for Accessible Science (LSAS) project. The goal of this study was to create middle school teams comprised of both science and special education instructors who engaged in collaborative work to improve instructional methods in inclusive classrooms. Without opportunities and supports in science education, chances that capable students with learning disabilities will pursue STEM careers are greatly reduced. There was significant change between the baseline and mid-point assessments; teachers involved in the LSAS intervention successfully enhanced their teaching skills to generate accommodations for students with learning disabilities. Assessments were coded independently by project researchers, with discrepancies resolved to reach 100% coder agreement. Four dependent variables were generated from this coding process and were defined. The first dependent variable is science knowledge that the comprehension level of the science content and process skills included in a teacher's responses. The second variable is the number of different learning challenges, which inhibit access to the science content and achieving the science learning goals. The teacher identified the students with LD for participation. The third dependent variable is the number of adaptations a teacher identified to the science lesson instructional plan that were necessary to meet the given science learning goals. The fourth one is number of accommodations that the total number of accommodations a teacher developed for the profiled LD student to address their challenges for the given lesson (Mutch-Jones et al., 2012).

For the sixth study, Marino, et al. (2014) conducted a research to examine the achievement of 57 students with LD from four middle schools. They compared the effect of the performance

with the use of traditional curricular materials for the inclusive science classroom with and without the use of video games which are closely aligned with Universal Design for Learning (UDL) guidelines. From the previous studies, scholars have tried to enunciate the role of technology in UDL curricular resources. King-Sears (2009) noted that the UDL curricula provides instructors with more opportunity to integrate pedagogy with technology. This integration helps students ~~to~~ access the specific content. This study used a mixed-method design (Creswell & Plano Clark, 2007). When the quantitative and qualitative data were analyzed individually, they were tested collectively to elicit conclusions about the efficacy of the curriculum. Participants in the research followed an ABAB model. 'A' represents non-UDL units and 'B' represents UDL-aligned units. The total number of students involved with the study were 341. Fifty-seven students with LD were included in the students group. The topics that were covered with the UDL curricula were cells, heredity and reproduction, bacteria and viruses, and plants. Other topics: organisms, classification, evolution, protists and fungi, and animals were covered without the video games and followed traditional curricula. Marino et al. (2014) compared the pretest and posttest data. The average pretest score of the students with LD was 36.3% and general education students' average score was 39.7%. The posttest result of students with LD was 58.4% and 53.9% with general education students. Students with LD showed a greater increase in their achievement compared to the general education students during the research. The posttest scores were significantly higher than pretest in both game enhancement units and without game enhancement units.

For the seventh study, Williams et al. (2015) analyzed 559,300 instances within the Schools and Staffing Survey Teacher Questionnaire (SASS TQ) dataset to determine the mean service capacity of the students with disabilities and limited-English proficiency (LEP) of STEM teachers.

The research focused on the differences between technology, science, and mathematics education teachers' mean service capacity of the students with disabilities and LEP. The SASS of the National Center for Education Statistics (NCES) datasets allows for weighted identification and data analysis between contributions concerning accommodation services of STEM educators from a national perspective. The importance of STEM education programs increases. At the same time, the instructional needs for the students with disabilities would be substantially improving. Students with disabilities continue to struggle with STEM courses (Basham & Marino, 2013), and perform at a lower achievement level than general education students. Additionally, these students often become disenfranchised from STEM courses because of their struggles (Marino, 2010). Due to the lower achievement in core courses than non-core courses, students with learning disabilities are often placed in technology and communication courses (Shifrer & Callahan, 2010). STEM teachers are not commonly positioned to lead the way in intervention on behalf of students at-risk with curricula focused on vocational training, academic knowledge, and skills (Shifrer & Callahan, 2010). Students at-risk who have dropped out of school did not get enough opportunity to receive appropriate instructional strategies so they could succeed. An integration of instructional models such as hands-on activities, interactive learning environment with direct skills instruction and practice can help students with specific needs (Cardon, 2000).

For the eighth study, McGrath and Hughes (2018) conducted research to analyze instructional strategies for students with LD in inquiry-based science class in middle school. The National Research Council (2006) stated that a lot of people in the United States lack the basic understanding of science which influence their decisions on scientific issues in lives. This lack of understanding is one of the factors that few students with LD seek their future careers in STEM

area in the United States (Next Generation Science Standards [NGSS] Lead States, 2013). The inquiry-based learning becomes more prominent in science courses and few researchers have studied the acquisition of scientific knowledge for students with LD (Jimenez et al., 2012). Additionally, educators face the challenge of holding all students' educational needs; however, students with LD keep struggling with the demands of science curriculum (Mastropieri et al., 2006).

For the ninth study, Gottfried and Sublett (2018) analyzed the relationship between applied STEM courses into the curriculum and long-term pursuits in STEM areas for students' future careers. One of the findings from this study is that students with LD are less likely to take applied STEM courses than general education student population. The applied STEM courses in high school requires a high achievement level on core content area and advanced level of understanding in math and science. High school STEM courses play a significant role in STEM pipeline outcomes. For example, a student who takes STEM courses during high school has advantages on choosing more advanced coursework in high school, selecting a college major, and picking a STEM-based career (Adelman, 2006; Brody & Benbow, 1990; Burkam & Lee, 2003; Csikszentmihalyi & Schneider, 2000; Federman, 2007; Lee & Frank, 1990; Long et al., 2012; Riegle-Crumb, 2006; Schneider et al., 1998; Trusty, 2002; Wang, 2013; Wimberly & Noeth, 2005). Gottfried and Sublett (2018) used a nationally representative, longitudinal data set developed by the National Center for Education Statistics (NCES). The data set, the Education Longitudinal Study (ELS; 2002), included grade 10 students in 750 public and private schools in the United States over time. The first follow-up of the data occurred 2 years later when the students entered the twelfth grade.

The results of study revealed that students with LD were much less likely to take an applied STEM course and more likely to take a non-STEM Career Technical Education (CTE) program compared to general education students. Another finding from this study was a differential benefit or loss for the students with LD who took applied STEM courses during high school. There was no remarkable difference in the chances of taking advanced math or science courses when having taken applied STEM courses for those students with LD (Gottfried & Sublett, 2018). The interpretation of the data suggests that a STEM gap continued to persist between students with LD who are taking applied STEM courses compared to general education students. In other words, there was no statistically significant difference in the end of school outcomes for students with LD who took applied STEM courses and letting them take these courses is not a proper solution to reduce the gap (Gottfried & Sublett, 2018). One suggestion for students with LD is for teachers to use hands-on instruction. Students with LD made substantial gains in science comprehension through a hands-on instruction intervention (Palincsar et al., 2001). The activity-based learning and hands-on modes of learning courses appear to have promising benefits for students with LD (Brigham et al., 2011).

For the tenth study, Williams et al. (2018) investigated the STEM education. They found that special education teachers have the appropriate teaching credentials to effectively support students' needs and curriculum in inclusive STEM courses. As the number of students with disabilities increases, an emphasis on STEM education within the current educational system has given rise to an unprecedented number of inclusive classrooms within the STEM disciplines (Ernst et al., 2014; Ernst & Williams 2015; Williams et al., 2015). The Schools and Staffing Survey (SASS) is conducted by the NCES on behalf of the United States Department of Education to

collect extensive data on schools. This study examined teacher credentials concerning STEM education and special education. Williams et al. (2018) used 559,290 instances for STEM educators and 430,600 instances for special educators. At the secondary school level, 504,630 instances for STEM educators and 191,310 instances for special education educators were collected. The data showed that there is very little overlap between STEM education teachers and special education teachers on their credentialing. For example, in a secondary school, only 5.5% of STEM educators have a teaching credential of special education (SPED). Ten-point eight percent (10.8%) of SPED teachers have STEM teaching certification. More than 90% of all secondary STEM and SPED teachers reported having students with disabilities on their caseloads (Williams et al., 2018). Over the last 20 years there has been a movement that creating a more interdisciplinary, hands-on approach, and focusing on STEM instruction for all student population. The research indicates that students with disabilities are still encountering a great deal of difficulty understanding STEM content (Basham & Marino, 2013). Students with disabilities performing lower than the students without disabilities and this low achievement is leading students with disabilities to become discouraged with STEM content as early as middle school (Marino, 2010). With inclusive classroom of STEM, both SPED and STEM educators play significant roles in instructions. As the importance of preparedness, educators should understand the students' needs and appropriate instructional methods. Teaching credentials represent knowledge and experiences obtained that indicate instructional preparedness for interdisciplinary and inclusive classroom environments (Williams et al., 2018).

Table 1

Summary of Chapter 2 Findings

Author(s)	Study Design	Participants	Procedure	Findings
Boyle (2010)	Quantitative	40 students with learning disabilities in six through eighth grade.	This research used two videotaped lectures and examined the effect of strategic note-taking skills. Four dependent variables; immediate free recall (IFR), a long-term free recall (LFR) measure, test score (TS), and students' notes were used to assess the effectiveness of strategic note-taking skills.	Students who used the strategic note-taking skills wrote more lecture points on both LFR and IFR than students who used conventional note-taking strategies. The experimental group also wrote more words than the control group and lastly, their test scores were higher than the control group students.
Mason & Hedin (2011)	Qualitative	The data of students with learning disabilities in the educational databases (e.g., Exceptional Children, Journal of Special Education, Learning Disabilities Quarterly) from 2001 to 2010.	This study reviewed several articles in order to analyze the evidence on science text reading comprehension instruction within the context of reading difficulties for students with learning disabilities. Six reading comprehension interventions with instructional elements were analyzed from the reviewed articles.	Without substantial explicit practice with high rates of success, reading interventions are not helpful for students with learning disabilities to understand scientific information in challenging text.

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Dexter, Park, & Hughes (2011)	Quantitative	271 students with learning disabilities (LD) in grades six through 12.	This article analyzed 23 unique posttest effect sizes to measure the effects of graphic organizer (GO)s in students' performance in science class. First, instructor presented the GO to students and described how it illustrated relationships. Second, instructor guided the students in creating or filling out the GO. Lastly, individual students were prompted in labeling blank visual displays.	The article found that graphic organizer (GO)s improved the vocabulary knowledge and factual comprehension of the content of students with learning disabilities in science class. There was a strong effect for maintenance of science content for students with learning disabilities.
Seifert & Espin (2012)	Quantitative	20 students with learning disabilities in 10th grade.	Participants received three types of reading interventions. Participants were from five different high schools across four school districts. This study assessed the effect of the reading interventions on the biology textbook (Miller & Levine, 2004) reading.	According to the repeated-measures ANOVA, differential interventions effects on reading fluency and vocabulary learning. There were no significant effects for passage comprehension performance. The study implies that students' understanding of science text can be improved with differentiated instructions.

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Mutch-Jones, Puttick, & Minner (2012)	Quantitative	16 active teams (five members and include at least one special educators) with 37 teachers on intervention teams and 46 teachers on comparison teams.	The eight teams in the intervention group were comprised of 32 teachers from 10 middle schools across 5 different urban and suburban districts, and the 8 teams in the comparison group were comprised of 41 teachers from 7 middle schools across 4 different urban and suburban districts. The assessments were designed to measure teachers' ability to adapt an instructional plan. Identifying goals or the lesson, aligning the classroom activity with the goal, anticipating student responses to the activity, and designing instruction to address these anticipated responses.	Lesson Study for Accessible Science (LSAS) intervention showed impacts on teaching students with learning disabilities in science class. Based on their review of science teaching and special education literature as well as their own research study, Grumbine and Alden (2006) assert that "learning is enhanced when teachers recognize and teach to diverse learning styles and strengths". There was significant change between the baseline and mid-point assessments, teachers involved in the LSAS intervention successfully enhanced their teaching skills to generate accommodations for students with learning disabilities.

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Marino, Gotch, Israel, Vasquez III, Basham, & Becht (2014)	Quantitative	57 students with learning disabilities from four middle schools.	Participants studied the content area with the middle school life science games developed by Filament Games. Each of the materials and outcome within the game-enhanced and nonenhanced units was highly varied,	The average percentage of correct scores were significantly higher for units without game enhancement than units with game enhancement across pretests and posttests. No significant differences in performances were observed between students at the below basic and basic levels or between students at the basic and proficient levels.
Williams, Ernst, & Kaui (2015)	Quantitative	559,300 technology, science, and mathematics education teachers' data if service capacity of students with disabilities and students with Limited English proficiency (LEP)	Independent-sample t-tests were used to establish statistically significant difference in the mean number of students in at-risk service capacity.	Technology Education teachers have a higher mean number of students at-risk compared to Science Education and Mathematics Education teachers. Due to low achievement in science and math courses, students with learning disabilities placed in non-core courses like technology. Integration of instructional models, such as hands on, interactive learning environment help students with learning disabilities to improve their outcomes. A collaborative and interactive learning environment allows students to use existing knowledge to create new knowledge.

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
McGrath & Hughes (2018)	Qualitative	Six students with learning disabilities in the middle school.	This study used multiple instruments for data collection, including student portfolios, observations, and interviews. Students task behavior, completion of class works, contribution to group work, and analyzing and interpreting data. This research measured student's ability to identify a scientific question which is related to their inquiry task.	Participants continued to express a lack of understanding of academic vocabulary even they engaged in inquiry. When the instruction enabled students with learning disabilities to find the meaning of each vocabulary through inquiry-based learning, the outcomes were more successful.
Gottfried & Sublett (2018)	Quantitative	10^{th} grade students (with or without LD) in 750 public and private schools in the United States. The sample size is approximately 16,200 observations.	This study analyzed nationally representative data set developed by the National Center for Education Statistics (NCES). This study collected official high school transcripts for students in the sample and compared the grades earned, and credits earned (including passing grade).	The article found that students with learning disabilities benefit from activity-based learning rather than skills-based curriculum, such as an applied STEM course. All LD coefficients in the data statistics were statistically significant which indicate students with learning disabilities continued to have lower outcomes of taking applied STEM courses compared to those students without learning disabilities.

Table 1 (continued)

Author(s)	Study Design	Participants	Procedure	Findings
Williams, Ernst, & Rossi (2018)	Quantitative	559,290 STEM educators (54,660 in Elementary and 504,630 in Secondary) and 430,600 SPED educators (239,290 in Elementary and 191,310 in Secondary).	This study examined teacher credentials concerning STEM education and Special education teachers. This research analyzed the credentials of STEM educators collectively compared the credentials of special education teachers.	The data indicated that there is little overlap between STEM education teachers and Special education teachers on credentialing. 5.3 % of STEM educators in elementary school have SPED certification (5.5% in secondary) and 4.8 % special education teachers have STEM certification (6.5% in secondary).

Chapter 3: Conclusions and Recommendations

The purpose of the literature review was to examine the instructional methods that can help students with learning disabilities (LD) to improve their achievement in science class. Chapter 1 provided background information of the topic with key terms that were used throughout the paper. Chapter 2 examined 10 different studies that were reviewed and summarized. Chapter 3 reviews and discusses the research along with recommendations for future implications.

Conclusions

I reviewed eight articles that examined instructional strategies for students with LD and specific needs in a secondary school science class and two articles that influence the achievement level of the students with learning disabilities. I explored and analyzed the benefits for each instructional method that were presented in the articles. One used strategic note-taking skills (Boyle, 2010), two of the articles used reading intervention and explicit practice (Mason & Hedin, 2011; Seifert & Espin, 2012), one used graphic organizer (Dexter et al., 2011), one used LSAS (Mutch-Jones et al., 2012), one used UDL with game enhancement instruction (Marino et al., 2014),

Out of the eight articles that were reviewed, two of the articles analyzed the factors that can impact the achievement level of the students with LD. One analyzed the students in at-risk and educational service capacity (Williams et al., 2015), one compared teaching credentials in the inclusive STEM classroom (Williams et al., 2018).

Recommendations for Future Research

Although the review provided several factors that can improve the achievement level of science content for students with LD, there is not much research that focuses specifically on students with LD in the science classroom. Additionally, the reviewed articles showed several limitations in the research. Due to the lack of language proficiency, students with LEP showed lower achievement levels in science content than their general education peers. Even though students understand the core scientific concepts, their language proficiency restricts the accurate measurement of their achievement scale. The instructor's ability to implement an appropriate instructional method to the class is important but collecting and analyzing the instructor's ability is a challenge.

One of the recommendations for the future research is a long-term goal for students with LD in the science classroom. Even though numerous researchers have revealed a significant gap between general education students and special education students, many school districts are still experiencing challenges to minimize this gap. The first step would be setting goals with strong integration between the STEM area and special education.

Implications for Current Practice

Review of research supports various types of instructional methods that are effective in improving the achievement of the students with LD in science class. As a science teacher who taught in the secondary school for 4 years, I struggle to differentiate the learning materials and provide appropriate instruction to students with LD. One of the strategies that I implemented in my class was graphic organizers and visuals. Students with LD frequently struggle to understand the invisible things such as energy, molecules, properties of matter, and cells. Their comprehension and achievement level of understanding also improved with more GOs during the

session. The use of GOs for the development of background knowledge also enhances the retention of scientific information from the lecture.

Explicit instruction and effective instructional method acquisition are crucial for teachers when they are teaching students with LD in science class. In order to provide the least restrictive environment to students with LD, it is important to let students interact with general education students during the group work session as much as possible. In this case, the instructor should prepare differentiated materials for students with LD and explicit instruction so that the students with LD can follow each step to complete their task with general education group students.

Lastly, review of prior skills and knowledge that students with LD already have would be one of the effective instructional methods during the science class. The use of example and nonexamples of the concept facilitate the review of their prior skills and background knowledge.

Summary

Several instructional methods contributed to successful achievement in the level of science content for students with LD and specific needs based on the articles that I have reviewed. Explicit instruction, hands-on and interactive activities, strategic note-taking skills, GOs, reading intervention, vocabulary activities, and UDL with game enhancement instructions resulted in the increase of the achievement level of science content of the students with LD. The instructor's preparedness of the content area based on students' specific needs is one of the significant factors. In conclusion, numerous instructional methods such as interactive, visuals, explicit instruction, graphic organizers, and reading interventions help the achievement level of students with LD in science class.

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