International Journal of Business Marketing and Management (IJBMM)
Volume 8 Issue 5 Sept-Oct 2023, P.P. 31-41
ISSN: 2456-4559
www.ijbmm.com

Analyzing the relationship between innovative teaching practices and the conceptual understanding of science in elementary school

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Abstract: *- This research seeks to explore the relationship between innovative teaching practices and the conceptual understanding of science in elementary school. The study's nature and focus are on determining how employing creative teaching methods affects students' conceptual understanding of science. It aims at providing educators with important information for developing effective strategies to ensure that every student is receiving the needed resources to be able to achieve better and not lose interest in science subjects.*

A qualitative study has been conducted, including obtaining information from interviews and focus groups, to continue our analysis. The chosen research technique employs a logical method and is interpretivist in nature. In the meantime, judgmental sampling procedures were developed for selecting certain experts for the interviews, and the cross-sectional time ranges were easily picked. Results validated the existence of a link between the use of innovative teaching practices and the conceptual understanding of science. Through studying the relationship at hand, this link exhibited a noticeable positive relationship between innovative teaching practices and the level of student's conceptual understanding of science in elementary school. The results showed that teachers who use non-traditional teaching tools such as audiovisuals presentations, videos, translation application and others help their students better understand science concepts.

Index Terms*: - Conceptual understanding of science, Foreign Language, Innovative teaching practices, Lebanon.*

I. INTRODUCTION

Located on the eastern shore of the Mediterranean Sea, Lebanon is renowned for the diversity of its population and tolerance toward various cultures. It is a nation with several used languages, and has Arabic as its official language. Unofficial reports state that by the time they are adults, the majority of Lebanese people have learned to speak either English or French, or even both [5]. Mainly, the French and the British educational systems have had a major influence on the Lebanese educational system. As a result, not all of Lebanon's educational institutions adhere to or rely on the same criteria [3].

A. Aims and objectives

This research aims to determine how using innovative teaching practices such as audiovisual presentations, videos and translational tools will improve the students' conceptual understanding of science. It intended to do so through the use of mono-qualitative research method. This is due to the fact that the study required interviewing educators and conducting open discussions with students about how the use of modern techniques can be effectively implemented to enhance the comprehension level of science.

While there are many suggestions in the literature on how to improve the conceptual understanding of science of students at the elementary level, the selected teachers and students have given detailed and diverse opinions on this issue. In particular, the study did pinpoint the strengths and weaknesses of the current curricula and how they can be improved. Meanwhile, in terms of scope, this paper sets to assess the current situation in applying modern techniques and innovative teaching practices to learning science, and to see the extent of the willingness of the Lebanese educators in doing this.

B. Research problem

While the research problem covered issues about education and innovative teaching practices, the rationale of the study or reasons to carry it out is to propose a solution to a pressing issue. While this could be part of the rationale, it is better to label the problem, which the actual study wishes to resolve, and then discuss reasons why to resolve it. Therefore, by discussing the problem statement the authors seek to identify the best ways in doing so.

In terms of adverse impacts, visual representations have an important role in the learning and teaching of science by grabbing the attention of the students and keeping them motivated [8]. On the other hand, these representations help the students acquire knowledge not only from the text book but also from graphics and others. However, anticipated results did indicate a positive relationship between innovative teaching practices and conceptual understanding of science. Lebanese schools should be aware of this; the results might offer the teachers, and school principals, tips on how to enhance teaching science in a second language.

Since our study's aim was to identify the best teaching practices that instructors in schools should follow to increase the students' conceptual understanding of science, the researchers conducted a mono-qualitative study to best answer this question.

C. Research questions

While the study seeks to undergo action research, the current paper will be using interpretivist methods, and therefore will only seek to answer the research question(s). While being qualitative, hypotheses therefore will not be needed. Yet, postulates (if needed, and designed after the research ends) will be shown in the recommendation section.

The objective of this paper is rephrased as follows: How do teachers satisfy both their commitment to develop appropriate and innovated teaching practices for students to better understand science. The research question to be answered is: what is the relationship between innovative teaching practices and the conceptual understanding of science?

D. Study Context

This research work took place in four public and private Lebanese schools located in Beirut northern suburbs. It focused on what schools are doing to improve the level of the students' conceptual understanding of science, especially when science is taught in a language different than the students' main spoken language.

As literature found out, and while it is common practice that "students must be exposed to a language different than their main spoken language when learning science concepts and facts", they need to be more motivated and less tense about it, stressing that using visual presentations will enhance their comprehension level of science [8]. This point will help in discussing the question about the relationship between innovative teaching practices and conceptual understanding of science, while some experts believe the link exists and needs further investigation [8].

II. Literature review

In this section, the *innovative teaching practices* and *conceptual understanding of science* are discussed independently forming the theoretical framework of the study. Some of the gaps listed above will call for a more detailed explanation of the connections between the innovative teaching practices and the conceptual understanding of science, through curricula [16]. For this reason, innovative teaching practices is our independent variable (IV), while students' conceptual understanding of science is our dependent variable (DV).

E. Students' conceptual understanding of science

Conceptual understanding entails the growth of a profound and related grasp of fundamental concepts and principles in a certain subject area [24]. It includes drawing links between many concepts and using these ideas to address challenging issues. Conceptual understanding is the capacity to think critically, evaluate knowledge, and draw connections between various bits of information. It goes beyond simple memorizing. It is frequently seen as a primary objective of education since it enables people to use their knowledge in practical settings and to keep learning and growing throughout their lives [24].

Moreover, conceptual understanding can be defined as the ability to comprehend the underlying concepts of a particular subject or topic. Conceptual understanding involves making connections between new information and prior knowledge and being able to apply this knowledge to solve problems and make predictions [7].

Furthermore, the conceptual understanding of science involves a deep understanding of the underlying concepts and principles of science. It goes beyond memorization of scientific facts and involves understanding the relationships between different scientific concepts and how they apply to real-world situations [24].

There are several challenges associated with developing conceptual understanding in science, including the complexity of scientific concepts, the need for students to be able to apply these concepts to real-world situations, and the role of language in science education [13]. Additionally, research has shown that many students struggle with developing conceptual understanding in science, particularly in areas such as physics and chemistry [23].

Research has shown that the language of instruction can have a significant impact on students' conceptual understanding of science. When science is taught in a language that is different from the student's primary language, it can create additional challenges for students, particularly with regard to language comprehension. In some cases, this can lead to lower levels of conceptual understanding and academic achievement in science [15].

In summary, conceptual understanding is an important aspect of science education, and developing this understanding can be challenging. The language of instruction can also have a significant impact on a student's ability to develop a conceptual understanding of science, highlighting the need for further research in this area [24].

F. Academic Achievement of Students

Academic achievement is a term used to describe a person's level of academic success in a particular topic or overall academic performance [1]. Exams, coursework, research papers, projects, and other evaluations that quantify the knowledge, abilities, and competencies students have acquired in a particular subject or educational program are often used to measure it [18]. Amrai et al. (2011) referred in their study to academic achievement as the attainment of academic degrees, certificates, or other academic credentials that signify the successful completion of a course of study [1]. On another hand, academic achievement refers to the level of accomplishment of learning outcomes that a student attains in school" [31].

Many factors play a major role in the academic achievement of students and have either a positive effect or a negative effect. Singh (2011) examined in his study of "Achievement Motivation in Relation to Academic Achievement of Students" the relationship between achievement motivation and the academic performance of students [28]. Motivation was defined as goal-oriented behavior and viewed as a function of value and expectations of success. The success was linked to different types of goals, including learning goals, performance goals, task goals, and mastery goals, and the role of beliefs in expectations of success was emphasized. The motivation was categorized as intrinsic or extrinsic. The study indicated that individuals who are intrinsically motivated to learn, do so for the pleasure of learning, while those who are extrinsically motivated are motivated to learn for external rewards. The study revealed that students with high academic motivation are more likely to have higher levels of academic achievement and lower dropout rates. Therefore, the study suggests that motivation should be encouraged due to the benefits it offers [28].

Also, a study by Amrai et al. (2011) found a relationship between motivation and academic achievement, which is consistent with previous research. Students with high interest in tasks tend to have more academic achievement because they use more cognitive and monitoring strategies. The competitiveness component showed a high correlation with the total average [1].

Moreover, in another study, Hakimi et al. (2011), It was found that personality traits accounted for 48% of the variance in academic achievement. Conscientiousness was the most reliable predictor of academic performance, explaining 39% of the variance. Extroversion had a negative relationship with academic achievement, accounting for 6.8% of the variance. Neuroticism also had a negative relationship with academic achievement, accounting for 2.4% of the variance [18].

Nonetheless, teaching educational subjects in a foreign language has been identified as a major contributing factor to the lower scores. El Takech & Sinno (2020) found that many students who learn science in their non-native language achieve less than those who learn in their native language [14]. Whereas Diab (2000) stated that in Lebanon, religion plays a major role in learning English because, for some religions, Arabic is sacred, and therefore students consider English as inferior which affects their learning process [12].

G. Cognitive Development in Early Childhood

Early childhood cognitive development refers to the steady and gradual changes that take place in a child's brain functions and capacities for understanding, learning, remembering, reasoning, and logical thought throughout the first few years of life [25]. The basis for eventual scholastic success and success in life is laid by this development, which encompasses the growth and improvement of a variety of cognitive abilities, including attention, perception, memory, language, problem-solving, and critical thinking. Social interactions, play, and exposure to a range of stimuli and experiences are just a few examples of the experiential variables that form it in addition to genetic, environmental, and environmental influences [20].

In his most famous contribution to developmental learning, the cognitive development hypothesis, the well-

known Swiss scientist Jean Piaget contends that children actively create their knowledge of the world by their experiences and that their cognitive development takes place over the course of several phases [25].

According to Fleming, Piaget's theory stated that all children pass through four stages of mental development: a sensorimotor stage, a preoperational stage, a concrete operational stage, and a formal operational stage. Piaget believed that children demonstrate new intellectual abilities and an increasingly complex understanding of the world depending on each level of cognitive development [6]. Not only natural sciences grabbed Piaget's attention, but also the learning of a language for he said: "learn the language as directly as possible, to master it; then reflect on it to extract grammar" (as quoted by Fleming). Linking Piaget's theory to the current study, it is important that children learn a second language in early childhood and master it to be able to reflect it on other subjects [6].

Early infancy is a crucial time for cognitive development, and language acquisition is a key factor in determining how a kid perceives the world [4]. According to Barman (2014), Piaget believed that each of the four phases of cognitive development, is defined by unique cognitive capacities [4].

Sensorimotor stage (birth to 2 years): Infants and young children learn about the world via their sensations and actions throughout the sensorimotor period, which lasts from birth to two years of age. They start to employ symbols to represent things and events as well as acquire object permanence.

Preoperational stage: Children in the preoperational period (2 to 7 years old) begin to acquire language and symbolic reasoning. They start to think about the world using mental models, but their thinking is still egocentric, and they struggle to comprehend other people's viewpoints. Concrete operational stage (7 to 11 years): During this stage, children can reason logically in concrete terms and start to comprehend conservation (the idea that a quantity doesn't change even while its appearance does).

Formal operational stage (11 years and older): During this stage, people may use hypothetical thinking and abstract reasoning.

Piaget held the view that language and mind are inextricably linked in terms of the relationship between learning a language and comprehending academic disciplines like science. Children must be able to use language to express and convey their thoughts about difficult topics, such as those in science, in order to grasp those concepts. Children are able to think more sophisticatedly about scientific topics as their language skills advance, and they can also explain such concepts to others. Because it gives students the tools to interact with and comprehend complex scientific concepts, the language of instruction has a significant impact on how well students perform academically in science [20].

Noam Chomsky is another philosopher who has written on the subject of language learning. The idea of Universal Grammar, which Chomsky, a prominent linguist, devised, contends that language learning is intrinsic in humans and that language acquisition is innate [4]. Children are born with a language acquisition device (LAD), according to Chomsky's hypothesis, which enables them to pick up the grammar of any language they are exposed to [4]. Also, Barman (2014) stated that Chomsky's theory contends that there are universal principles underlying all languages, and the LAD enables kids to pick up on these principles naturally and unconsciously. To put it another way, children are naturally able to learn language by exposure to their surroundings rather than needing to have it expressly taught to them.

In accordance with Chomsky's view, learning a language involves both creativity and memory rather than only memorization or repetition. Children may construct fresh phrases that they have never heard before, indicating that they are not only copying what they hear but rather employing the principles they have learned to construct new expressions [27].

Overall, Chomsky's theory of Universal Grammar suggests that language acquisition is innate and that humans have a unique ability to learn a language that is not found in other animals. In terms of language acquisition, Noam Chomsky's theory of universal grammar suggests that humans have an innate ability to learn language, and that language acquisition is not solely dependent on environmental factors [17].

On the other hand, a study by Tamis-LeMonda, Kuchirko, and Song (2014) found that early exposure to science concepts can facilitate cognitive development in young children. The study found that children who were exposed to scientific language and concepts at a young age showed better cognitive development than children who were not [29], [30].

In the same study, the researchers investigated the role of the parents in promoting their infant's language development. The researchers stated that when parents respond sensitively and contingently to their infants' vocalizations and gestures, they provide a rich language-learning environment that supports the child's acquisition of language [29], [30].

Another theory that tackled cognitive development and language acquisition is Lev Vygotsky's theory of language development. This theory is based on the idea that social interactions and cultural context play a

critical role in the acquisition and development of language. Vygotsky believed that language is not simply a means of communication, but also a tool for thinking and problem-solving. According to his sociocultural theory of development, language acquisition is a process that is closely tied to children's interactions with their social and cultural environment, including interactions with more knowledgeable peers and adults [21].

In Vygotsky's view, children learn language by engaging in social interactions with others who are more advanced in their language use. These interactions provide children with opportunities to receive feedback on their language use and to learn from the language models provided by more experienced speakers. Through these interactions, children gradually internalize the rules and structures of language and develop their own language skills [21].

Vygotsky's theory also emphasizes the role of cultural science context in language development. According to Nicoladis and Genesee, Vygotsky argued that the meanings and uses of language are deeply embedded in the cultural practices of a given society and that children's language development is shaped by the cultural practices and values of the communities in which they grow up [22].

Several scientific articles have explored the relevance of Vygotsky's theory for understanding language acquisition and development. For example, in a study published in the Journal of Educational Psychology, researchers found that children's social interactions with peers and adults were strongly associated with their language development, supporting Vygotsky's emphasis on the importance of social context for language learning [19]. Another study, published in the journal Child Development, found that children's language development was influenced not only by their interactions with others but also by the cultural practices and values of their families [22].

In their study, Pathan et al. highlighted the significant contribution of Vygotsky's socio-cultural theory to the field of education, psychology, and applied linguistics. Vygotsky's theory emphasizes the importance of social and cultural factors in a child's cognitive development and performance in language learning. Vygotsky identified the role of the dynamic social environment in the connection between teacher and child and the significance of social, cultural, and historical artifacts in children's cognitive development. The major concepts of Vygotsky's theory, including language use, the zone of proximal development (ZPD), peer interaction, and learning as a mediated process, have a significant impact on second language learning (SLL) and second language acquisition (SLA). Overall, Vygotsky's innovative and original ideas have influenced various fields of psychology, including developmental, educational, and art psychology. The study concludes that the application of Vygotsky's sociocultural theory provides valuable insights into the practices of SLL and SLA [26].

III. METHODOLOGY

The correspondent strategy necessitates gathering interview data and evaluating secondary survey findings. Following a descriptive analysis of secondary data, instructors' interviews and student focus groups were gathered (through purposive and targeted sampling). Thus, deductive methods are the preferred methodological designs to use, since we will need to interpret human opinions [9] [10] [11].

The researchers choose respondents using a non-random sample technique, then employ a cross-sectional time horizon (one-time study) to examine if, *the current implementation of innovative teaching practices affects the conceptual understanding*, and if so, *how*. The study was conducted using interpretive philosophies and reliable hypothetico-inductive methods [9] [10] [11] based on interviews with 20 science teachers, and 4 focus groups discussions. Each focus group consisted of 15 students from both elementary and secondary levels. All the participants come from Lebanese schools that have adopted French as the teaching language of science.

IV. FINDINGS

This section pertains to the findings of the research. Several themes and important field notes were collected, along with the interview and focus group results. All results represented reality, as the sample population on which we based our research already reflected the views of the Lebanese students and teachers on the importance of using innovative teaching practices and non-traditional tools such as audiovisual presentations, videos, and translational tools to enhance the students' level of comprehension of science.

H. Results from Teachers' Interviews

Based on the data collected from the interviews with science teachers, it was observed that the use of nontraditional teaching tools is essential for helping students comprehend science concepts. When answering the first question of the interview "On a personal level, in what language did you study science? How was your performance? What were the main challenges you faced? How do you think the teacher back then could have acted to limit these challenges?", all the teachers answered that they studied science in French at school. Some

of them had excellent performance while the rest achieved good, but none of them answered that s/he achieved poorly in science. Regarding the challenges they faced, two out of twenty of the teachers answered that they faced some difficulties related to the language barrier which affected negatively their academic achievement in science. These two teachers assured that the difficulties they faced started to show up in grade 9 where they had to analyze scientific texts and write paragraphs, however this challenge didn't face them at the elementary level. Five out of twenty of the teachers mentioned that the teachers back then should have included experiments and visuals to facilitate the learning process. For them, scientific facts and concepts are easier to be learned with hands-on activities. The majority of the teachers participating in this study answered that they didn't face any challenges related to science back at school, and that's why they are science teachers.

Based on the answers given to the second question, which is "Based on your experience, what is the ratio of students who seek after-school tutoring, especially in scientific subjects? To what extent is after school parent or tutor's support helping the students increase their comprehension level of science when using a language different than the teaching language used at school?", it seems that there is a range of opinions regarding the ratio of students seeking after-school tutoring or parental support in scientific subjects, as well as the effectiveness of using a language different than the teaching language.

Some respondents believe that few students seek after-school support at the elementary level, while others suggest that as much as 70% of students seek such support. Similarly, opinions vary regarding the effectiveness of using a language different than the teaching language, with some suggesting that it may be beneficial at the elementary level, while others believe that it is not recommended at the secondary level. Overall, the answers suggest that after-school support can be helpful in improving students' comprehension of science concepts, particularly for those who struggle with teaching language especially when the teacher is obliged to teach using the teaching language mandated by the school.

Moving on to the third question of the interview "Can you describe what strategies you use to help your students better understand what they read in a science text? Please elaborate." This question focused on the strategies that teachers use to help students better understand what they read in a science text. The majority of the teachers mentioned using visual aids such as photos, videos, and exhibitions to enhance students' comprehension. Some teachers also emphasized the importance of finding the general idea in the text, circling the keywords, and schematizing the text or transforming it into a table. Additionally, some teachers mentioned the use of annotated diagrams or transforming the text itself into schemes to facilitate understanding.

However, the fourth question "To what extent you think that using technological tools such as translation software or audiovisual presentations might help your students better understand science concepts? Please elaborate." inquired about the use of technological tools such as translation software or audiovisual presentations and how they might help students comprehend science concepts. All the teachers agreed that technological tools could help students better understand science concepts and play a major role in active and cooperative learning. The use of technological tools was perceived as particularly useful for making the lesson more realistic and concretizing abstract concepts especially when the teacher uses video/multimedia lessons and presentations or educational games. Moreover, the use of technological tools was seen as a way to cater to different learning styles, as each student has a different intelligence from the others.

When asked the fifth question "In your opinion, what subject is easier to communicate to the students? And which one is the hardest (biology, chemistry, physics)? Why?", the majority of the teachers answered that biology is the easiest subject because it is more related to real life facts than chemistry and physics that require mathematical knowledge. However, only one teacher answered that Biology is the hardest because it requires mastering the teaching language of science to be able to analyze or write scientific texts.

On the other hand, when asking the teachers, the sixth question "Do you face any difficulties when communicating the subject that you teach to your students?", some of the teachers answered sometimes, while others answered never. The teachers think that the level of difficulty depends on the objective given. Some objectives are hard to understand because they are related to daily life uses, while others require a very good analysis skills, and therefore a good level of French.

When asked about the number of languages used inside the classroom, the majority of the teachers replied that the use only French as mandated by the school's administration. Only 6 teachers out of 20 said that they use "Lebanese Arabic" when explaining new objectives to help students better understand. One of the teachers at the secondary level stated that he is completely against using a language different than the teaching language of science mandated by the school, even if that language was the main spoken language of the students. In his opinion, it is very toxic to explain to the students' science facts in a language different than French because they won't be able to communicate their analysis or their findings later during the tests.

Overall, the findings suggest that the teaching language of science might affect the level of the students'

conceptual understanding of science at the secondary level more than at the elementary level because the objectives discussed at this latter are simpler and more related to daily life events. However, the language becomes a barrier at the secondary level, mainly in Biology, where students must analyze texts.

For this reason, using many languages in the classroom has its advantages and disadvantages for the students. Explaining in "Lebanese Arabic" might ease the learning process and help the students better understand science, especially complicated facts. However, this will affect their skills in writing complete and clear sentences in French. Based on this, mastering the teaching language of science at early age is very important because it helps the students comprehend clearly the teaching objectives, as it helps the students in formulating clear and correct sentences when analyzing scientific documents.

In summary, the data collected from the interviews suggest that the use of nontraditional teaching tools, including visual aids and technological tools, is essential for enhancing students' comprehension of science concepts. The teachers' responses highlight the importance of catering to different learning styles and finding innovative ways to make the lesson more engaging and realistic.

I. Results from the Focus Groups with students

Firstly, based on the answers provided by the focus groups for the first three questions:

Question 1: What is the most spoken language at home from your birth till now (with your parents, your siblings, the helper, …), and what language do you usually speak (with your friends, while watching TV, listening to songs, …)?

Question 2: In what language do you study science now? How is your performance? What are the main challenges you face? How do you think the teacher can act to limit these challenges?

Question 3: How do you rate your language skills (reading, speaking, listening, writing) related to the teaching language of science adopted by your school? (From poor to excellent).

The main teaching language of science in the schools included in this study is French. However, most of the students' home language is the "Lebanese Arabic" with some exposure to other languages like French, English, German, and Russian. This shows the students' background and their diversity regarding to their exposure to different languages. Students who achieve low in French attribute it to their lack of exposure to the language, finding it hard to express themselves, and disliking the language. On the other hand, students who achieve well in French attribute it to being accustomed to the language from a young age and having supportive teachers. Regarding the students' language skills in French, most of them rated their skills as very good, while others rated them as poor or fair.

Based on the students' feedback, some suggestions to improve comprehension of science concepts could be providing additional resources in French and encouraging communication in French both inside and outside the classroom. Additionally, it might be helpful for the teachers to take into account the students' varying levels of proficiency in French and provide appropriate support accordingly.

Secondly, the answers to question 4: "Do you seek after-school tutoring, especially in science or do you know someone who does? To what extent is after-school parent or tutor's support helping the students increase their comprehension level of science when using a language different than the teaching language used at school?", showed that after-school tutoring and parental support play an important role in helping students increase their comprehension level of science concepts when using a language different than the teaching language mandated by their school. Half of the students in the focus group are registered in a tutoring center after school, and they need assistance mainly in math, physics, and chemistry, which suggests that these subjects are more challenging for them. The rest of the students seek their parents' assistance at home, but only a few of them seek help in scientific subjects. This could indicate that parents may not have enough knowledge or education to support their children in scientific subjects.

The students agreed that tutoring or parental support is needed mainly in math and Arabic/French homework, but they do not take Science homework only revision before exams. This could mean that students may not be motivated to seek assistance in science outside of class, possibly because they do not see the relevance or importance of the subject.

The focus group also revealed that most of the students understand science lessons because of the figures and videos the teacher uses, which suggests that visual aids and multimedia resources are effective in helping students comprehend scientific concepts. However, few students mentioned that they needed assistance in analyzing graphs, charts, or texts in Biology, which suggests that these skills could be emphasized more in the classroom.

It is interesting to note that students who spoke French as their second language found genetics in Biology as a challenging objective because, besides having a complex content, it requires a mastery of the French language.

This highlights the potential language barriers that students may face in comprehending scientific concepts when taught in a foreign language.

Thirdly, the answers to question 5 "Do you think that teaching science in different languages, especially if the teacher re-explains using your first spoken language, will help you increase your conceptual understanding of the subject?", it can be concluded that teaching science in different languages and re-explaining the concepts in the students' main spoken language can help increase their conceptual understanding of the subject. The students agreed that when the science teacher explains complicated ideas in their main spoken language, which is the "Lebanese Arabic", it becomes easier for them to understand. Additionally, when teachers explain in both Arabic and French, the students tend to understand better, but they face difficulty in understanding technical scientific words that cannot be translated into Arabic.

The students also mentioned that the science teacher always explains in both French and Arabic, which suggests that the teacher is making efforts to accommodate students' language needs. However, the students also mentioned that translating technical scientific words into Arabic may not be possible, which highlights the limitations of teaching science in a foreign language.

In terms of the impact of teaching language on academic achievement, the majority of the students felt that teaching in Arabic would not help them achieve better in math or physics due to the need to memorize formulas. However, they found it helpful to explain scientific texts in "Lebanese Arabic", especially when it comes to complicated sentences, which can improve their comprehension and overall academic achievement. Before starting the discussion in one of the schools in the secondary level, one of the students took permission to present a special request. Quoting her words, the student said: "Please, can we have this discussion in Arabic rather than French? Because only then, we will be able to really express our thoughts."

Lastly, when answering question 6: "Can you describe what strategies and tools you use to better understand what you read in a science text? Please elaborate."

question 7: "To what extent you feel that using technological tools such as translation software or audiovisual presentations might help you more understand science concepts? Please elaborate."

It can be inferred that the use of non-traditional teaching tools, such as translation software or audiovisual presentations, can have a positive impact on the students' comprehension of science concepts. However, it seems that their science teachers do not use such tools regularly.

The students expressed that they usually rely on their science teacher for explanations and sometimes use Google Translate to understand complicated scientific terms (in secondary level). They also mentioned that they wished their science teacher would use more audiovisual presentations, show them videos, and conduct hands-on experiments to help them better understand science concepts.

Furthermore, the students shared that they found lab experiments and audiovisual presentations, such as videos, helpful in understanding science concepts better than just reading from a book. This suggests that incorporating such tools in science teaching could have a positive impact on students' comprehension and academic achievement.

Overall, the findings suggest that teaching science in a foreign language can be challenging for students, but efforts to explain concepts in their main spoken language can help increase their understanding of the subject. Therefore, it is important for science teachers to make an effort to accommodate students' language needs to enhance their academic achievement. Moreover, the results suggest that the use of non-traditional teaching tools in science education can have a positive impact on students' comprehension of science concepts. Therefore, it may be worthwhile for science teachers to incorporate more audiovisual presentations, videos, and hands-on experiments into their teaching practices.

J. Interpretations

The results of this study agree with a large body of the literature. To answer the research question, there is a positive relationship between the level of the students' conceptual understanding of science and the appropriate and innovative teaching practices.

The analysis showed also that advanced teaching methods will likely lead to a higher level of comprehension and therefore higher science scores. On the other hand, a confounding variable effect must be taken into consideration where some teachers are better than others. Those teachers tend to result in higher scores and tend to use more advanced teaching methods. Weak French speaking students benefit greatly from these methods, while Strong French speaking students don't. This supports what was previously stated that advanced teaching methods have a strong positive causal effect on the level of conceptual understanding of science and the academic achievement of students in science. So, using advanced teaching methods is very important to support students with low proficiency in the teaching language of science.

In general, our study did conform with several previous research done in other countries. A study by Aslan and Ciftci (2019), summarizes it all as; visual aids, hands-on activities and peer support can assist the students struggling with the teaching language of science to overcome this barrier and achieve better in science [2].

V. CONCLUSION

Using innovative teaching practices need to be adapted in order to facilitate the learning process of science especially when the teaching language is different than the main spoken language of the students.

There is a direct positive relationship between the conceptual understanding of science and the use of innovative teaching practices. However, the less the tendency to rely on non-traditional teaching tools, the less are the students' scores in science.

Using non-traditional tools such as audiovisual presentations, videos and translational tools enhance the level of comprehension of science concepts and facts. The ministry of education, along with all the science coordinators, should ensure that the use of these techniques will help students, not only at the elementary level, but also at the secondary level, better understand scientific concepts and facts.

Most of the times students are taught about natural phenomena and scientific facts in a language that they don't use frequently using a curriculum that doesn't focus on visuals and hands-on activities. Thus, teachers are not yet aware of the best practices for encouraging students to learn science.

A. Responses to Research Questions

The authors respond to the research questions and present a summary of the findings. It was found that *there is a relationship between the conceptual understanding of science and the innovative practices*. As such, *enhancing science education curricula will improve the students conceptual understanding of science and thus, increase their scores and improve their academic achievement.*

While *the Lebanese curriculum will need to be updated to meet the students' needs and interests*, for many students are losing interest in science because they find it hard to understand. These points explain why the curricula need to be updated.

While using audiovisual presentations, videos, hands-on activities and translational tools are the ways for a *remarkable shift in the curriculum to make the students more interested in science*, among other options instructions could do, like proposing French sessions, and increasing the exposure of students to the French language by adding more listening and speaking sessions. This shift will be much needed for the students to gain back their interest in science.

Finally, and as evidenced, it was shown *that there is a link between the conceptual understanding of science and innovative teaching practices*, as proven in the study.

B. Recommendations

The findings of this study have significant implications for educators and curriculum designers in multilingual education contexts. The study's results suggest that teaching science with the use of non-traditional tools such as audiovisuals or translational software, might have a positive impact on the students' conceptual understanding of science when this latter is taught in a language different than the student's main spoken language.

Based on the findings, there are several recommendations that can improve science education and promote better conceptual understanding among students.

1. Develop teaching materials: Education institutions should invest in developing teaching materials that are appropriate for students who are learning science in a second language. These materials should be designed to help students understand science concepts using their language proficiency level.

2. Use visual aids and hands-on activities: Teachers should use visual aids and hands-on activities to help students understand science concepts. These strategies can help students who are learning science in a second language to visualize abstract concepts and develop a deeper understanding of science.

By implementing these recommendations, educational institutions can promote a better conceptual understanding of science among students who are learning science in a second language. These recommendations can also help teachers create a more inclusive and supportive learning environment for all students.

C. Future studies

Future research is proposed in a number of areas based on the limitations of this study on the relationship between the conceptual understanding of science and the employment of cutting-edge instruments and teaching methodologies in a trilingual context.

Future studies might use longitudinal designs to examine the long-term impacts of multilingual instruction on

students' scientific comprehension.[9] [10] [11].

Incorporating an experimental research design, on the other hand, can offer a thorough grasp of how to apply cutting-edge teaching strategies to enhance students' conceptual understanding of science.

REFERENCES

[1] Amrai, K., Motlagh, S. E., Zalani, H. A., & Parhon, H. (2011). The relationship between academic motivation and academic achievement students. Procedia - Social and Behavioral Sciences, 15, 399–402. https://doi.org/10.1016/j.sbspro.2011.03.111

[2] Aslan, E., & Ciftci, H. (2019). Synthesizing research on learner perceptions of CMC Use in EFL/ESL writing. calico journal, 36(2), 100-118.

[3] Bahous, R., Bacha, N. N., & Nabhani, M. (2011). Multilingual educational trends and practices in Lebanon: A case study. International Review of Education, 57(5–6), 737–749. https://doi.org/10.1007/s11159-011-9250-8

[4] Barman, B. (2014). The Linguistic Philosophy of Noam Chomsky. Philosophy and Progress. https://doi.org/10.3329/pp.v51i1-2.17681

[5] Bayloun, H. (2016, March). The Effect of Teaching and Learning in Native and Foreign Language on Students' Conceptual Understanding in Science in a Lebanese Context (No. c2015). LAUR. https://doi.org/10.26756/th.2015,45

[6] Boeree, G. (2006). Personality Theories: An Introduction. Personality Theories. http://webspace.ship.edu/cgboer/Introduction.pdf

[7] Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How people learn (Vol. 11). Washington, DC: National academy press.

[8] Cook, M. P. (2006). Visual representations in science education: The influence of prior knowledge and cognitive load theory on instructional design principles. Science Education, 90(6), 1073–1091. https://doi.org/10.1002/sce.20164

[9] Creswell, J. W., Plano Clark, V. L., Gutmann, M. L., & Hanson, W. E. (2003). Advanced mixed methods research designs. In A. Tashakkori & C. Teddlie (Eds.), Handbook of mixed methods in social and behavioral research (pp. 209-240). Sage Publications.

[10] Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications.

[11] Creswell, J. W., & Plano Clark, V. L. (2017). Designing and conducting mixed methods research (3rd ed.). Sage Publications

[12] Diab, R. (2000). Political and Socio-Cultural Factors in Foreign Language Education: The Case of Lebanon. Texas Papers in Foreign Language Education, 5(1), 177–187. https://files.eric.ed.gov/fulltext/ED468315.pdf

[13] Dori, Y. J., & Herscovitz, O. (1999). Question-posing capability as an alternative evaluation method: Analysis of an environmental case study. Journal of Research in Science Teaching, 36(4), 411–430. https://doi.org/10.1002/(sici)1098-2736(199904)36:4

[14] El Takach, S. & Sinno, S. (2020). The efficacy and relevancy of the language courses in the preparation of elementary science and mathematics prospective teachers. International Journal of Research in Education and Science (IJRES), 6(1), 179-201.

[15] Furnham, A., & Bochner, S. (1986). Culture shock: Psychological reactions to unfamiliar environments. http://ci.nii.ac.jp/ncid/BA19237982

[16] Garcia-Nevarez, A., & Biddle, K. A. G. (2021). Developmentally Appropriate Curriculum and Instruction. Taylor & Francis.

[17] Goldsmith, J. A., & Huck, G. J. (2013). Ideology and Linguistic Theory: Noam Chomsky and the Deep Structure Debates. Routledge.

[18] Hakimi, S., Hejazi, E., & Lavasani, M. G. (2011). The Relationships Between Personality Traits and Students' Academic Achievement. Procedia - Social and Behavioral Sciences, 29, 836–845. https://doi.org/10.1016/j.sbspro.2011.11.312

[19] Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first-grade classroom make a difference for children at risk of school failure? Child Development, 76(5), 949-967.

[20] Huitt, W., & Hummel, J. (2003). Piaget's theory of cognitive development. Educational psychology interactive, 3(2), 1-5.

[21] Lantolf, J. P., & Appel, G. (Eds.). (1994). Vygotskian approaches to second language research. Greenwood Publishing Group.

[22] Nicoladis, E., & Genesee, F. (1996). A longitudinal study of pragmatic differentiation in young bilingual children. Language learning, 46(3), 439-464.

[23] Novak, J. D., & Gowin, D. B. (1984). Learning how to learn. Cambridge University Press.
[24] Osborne, R., & Gilbert, J. K. (1980). A Method for Investigating Concept Understanding in Science. European Journal of Science Education, 2(3), 311–321. https://doi.org/10.1080/0140528800020311
[25] P. Johnson, A. (2014). Education Psychology: Theories of Learning and Human Development. National Science Press. https://www.academia.edu/12527895/PIAGETS_STAGES_OF_COGNITIVE_DEVELOPMENT?email_work_card=view-paper
[26] Pathan, H., Memon, R. A., Memon, S., Khoso, A. R., & Bux, I. (2018). A critical review of Vygotsky's socio-cultural theory in second language acquisition. International Journal of English Linguistics, 8(4), 232.
[27] Putnam, L. R., & Chomsky, N. (1994). An Interview with Noam Chomsky. The Reading Teacher, 48(4), 328–333. http://www.jstor.org/stable/20201430
[28] Singh, K. (2011). Study of achievement motivation in relation to academic achievement of students. International Journal of Educational Planning & Administration, 1(2), 161-171.
[29] Tamis-LeMonda, C. S., Kuchirko, Y., & Song, L. (2014). Why is infant language learning facilitated by parental responsiveness? Current Directions in Psychological Science, 23(2), 121-126.
[30] Tamis-LeMonda, C. S., Song, L., Luo, R., Kuchirko, Y., Kahana-Kalman, R., Yoshikawa, H., & Raufman, J. (2014). Children's vocabulary growth in English and Spanish across early development and associations with school readiness skills. Developmental neuropsychology, 39(2), 69-87.
[31] Wang, C. Y., Zhang, Y. Y., & Chen, S. C. (2021). The empirical study of college students' E-learning effectiveness and its antecedents toward the COVID-19 epidemic environment. Frontiers in Psychology, 12, 573590. doi: 10.3389/fpsyg.2021.573590

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