Teaching Science to Elementary Students Using Mother Tongue versus a Foreign Language: The Case of Lebanon

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Abstract

This study examines the attitudes of science teachers in Bekaa-Lebanon towards the language of instruction of science in the elementary level. Data was collected by a five-point Likert scale questionnaire. 79 science teachers were chosen by convenient sampling. Data was analyzed by descriptive statistics and content analysis. Results revealed that 45% of teachers supported the use of Arabic language in instructing science and 41% supported the use of English language. Furthermore, teachers had an attitude that the use of English language increases students' application and explanation skills and increases their ability to link information between subjects. In addition, teachers had an attitude that matching the language of instruction with students' mother tongue doesn't increase their achievement.

Keywords: Attitudes; science instruction; science teachers; mother tongue; foreign language; Lebanon.

1. Introduction

Nowadays, learning a second language like English is a necessity for everyone who is looking for improvement. This need resulted in people using lingua franca, a language that people whose first languages differ use to understand, communicate, and interact with each other and this language was the English language (Tarhan, 2003).

The need for learning a second language to keep up with the progress and development, and the need to save mother tongue have put countries between two opposing poles. One pole calls for the development and improvement of the society, through teaching its members a second language (Vu & Burns, 2014). This second language enriches the knowledge and experience of society members by making them more open to the world. And another pole (Telli, 2014) had a vision that teaching in a foreign language and introducing it in basic education leads to the breakdown of culture, sense of belonging, and national identity represented by mother tongue.

In Lebanon, the new structure for developing the educational curricula was launched in 1996 where schools have had a choice of teaching sciences in either mother tongue (Arabic), or a foreign language which can be English or French (CERD, 1998).

By definition, the word "attitude" is what you think and feel about something (Izzat, Ayyad, &Alzini, 2007). The American psychologist Allport (1935) defined an attitude as a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence on the individual's response to all objects and situations to which it is related. This study aims at investigating the attitudes of science teachers towards the language of instruction of science in the elementary level.

2. Theoretical framework

Attitudes towards understanding, communication, and achievement

Language plays a very important role in thinking, communication, and is also a tool for exchanging concepts and ideas (Saeed, Iqbal, & Azam, 2012). In terms of the importance of language, Vygotsky said that language serves to mediate higher order thinking (Jones & Araje, 2002). To learn science in mother tongue or foreign language is a debate. Studies by Rollnick and Rutherford (1993) revealed that learning academic courses through English language poses problems for students whose mother tongue is not English. Studies exploring the underlying psychological problems indicate that second language learners are frustrated by failure to see meanings in texts and start to have a tendency toward rote-

learning. Therefore, not much information is stored in memory since what is learned by rote-learning is easily forgotten and hence understanding is minimized (Kocakulah, Ustunluoglu, & Kocakulah, 2005).

Communication is tightly related to language as well. For instance, the mastery of the language of instruction facilitates the reaction and interaction process between teachers and students (Dandashly, 2014). Therefore, a limited proficiency in the language of instruction hinders students' scientific reasoning and limits their interaction with each other (Lee, 2005). Furthermore, students have difficulties in participating in class discussions when the language used in the discussion is not their first language even after they learn the second language (Gorgorio & Planas, 2001).

The effect of the language of instruction is extended to the university level. In a study in Jordan (Al-Asal & Smadi, 2011) comparing the use of English and Arabic as a language of instruction in medicine and engineering, 30% of the students failed when English was used as a language of instruction compared to a 3% failure when Arabic was used.

A study in Philippines (Vela, 2015) over a group of students learning science in mother tongue and another in English revealed that the group of students who were taught science in Filipino were more at ease in learning and eager to participate in recitation. Those students were easily understanding what their teacher was explaining, and were able to justify their answers with ease and confidence. However, the group that learned science in English had facial expressions signifying that they are trying to understand what the teacher was explaining. Few of those students participated in recitation, and they took more time to explain their answers, and they were unsure of their ability to speak. Also students who were taught in English performed the least in tests and had difficulty in writing answers using their own words.

A study in Nigeria (Ethe, Avbenagha, & Akpojisheri, 2014) revealed that the use of mother tongue in teaching science has a significant effect on students' academic achievement when compared to the use of English. This is due to the lack of proficiency of English. On the other hand, when low proficiency of language exists, students face many challenges in achieving well in science (Dandashly, 2014).

Uncertainty about the language of instruction

Many countries around the world are still not certain about the best language to use in teaching science. This uncertainty has been reflected in the practices of countries. Countries that supported teaching science in a foreign language included Kenya, Australia, and United Arab Emirates. In Kenya, starting from grade four of elementary education, English is the language of instruction of all subjects, and English is taught as an independent language subject from the first day the child enters school (Khejeri, 2014).

The Austrian Ministry of Education supported the concept of using English as a medium of instruction. From the implementation of English as the language of instruction in schools, theyconcluded that there was a huge need for having foreign language learning in schools and educational institutes (Tamtam, Naher, & Olabi, 2013).

In the United Arab Emirates, English language was introduced as the language of instruction for science and mathematics in the elementary school in the emirate of Abu-Dhabi and other emirates. Although both parents and teachers appreciate the advantages of mother tongue, but parents are more reluctant to let their children follow their education in mother tongue (Ismail & Shaban, 2015).

On the other hand countries like Philippines, Malaysia, and Ghana supported mother tongue instruction. Philippines (Al-Manei, 2015) abandon bilingual education after 37 years where science was taught in English. Ocambo (2011), professor in the University of Philippines, declared that a large number of studies worldwide indicated that children learn best if the language of instruction was the same as the language they use in their daily life and at home (Harthi, 2010).

Malaysia (Gooch, 2009) also switched between English and Malay languages in teaching science and abandoned a six-year experiment in using English in public schools to teach mathematics and science and decided to use Malay language. The Malaysian minister of education, found out that teaching science and mathematics in English is undermining the students' grasp of the first language, the Malay, and found that the academic grades of students had gone down since English was introduced (Gooch, 2009).

The same controversy in Ghana (Ofosu, Mahama, Dosoo, Kumador, & Toku, 2015) was prominent that in 2002 a law was promulgated mandating the use of local languages as the medium of instruction to replace the use of English.

Very few studies (Dandashly, 2014; Mirza, 2015) were found in Lebanon about the language of instruction of science in the elementary level. This study will present new data with the findings to contribute to the Lebanese Educational System. After placing the study in a historical perspective the following research questions were addressed:

1. What is the attitude of science teachers towards the use of mother tongue/ foreign language as a language of instruction of science in elementary education?

2. What are the beliefs science teachers have towards the effect of the language of instruction of science in elementary education on students' understanding / achievement?

Hypotheses

Two hypotheses were set for this research and were as follows:

1. Science teachers support the use of English as a language of instruction of science in the elementary level instead of the use of Arabic

2. Science teachers believe that students who are taught science in English understand and achieve more than students who are taught in Arabic.

3. Methodology

In the Lebanese Educational System, students in the elementary level learn a subject called "Science" which includes the simple basics of Physics, Chemistry, and Biology. As students move to the intermediate and secondary levels they take Physics, Chemistry, and Biology as three separate subjects in three separate books.

Participants

The sample of 79 participants chosen by purposive and convenience sampling included science teachers teaching science for the elementary level from grade 1 to grade 6, and teachers teaching physics, chemistry, and biology in the intermediate level in the academic year 2015-2016 from both public and private schools. The research targeted both genders, male and female teachers, with teaching experiences varying from 1 year to more than 15 years, and whose ages varied from 20 years to more than 45 years. The sample distribution is shown in Table 1.

The distribution of participants over public and private schools

		Publicschools		Private schools	
		Number of schools	Number ofteachers	Number ofschools	Number ofteachers
Bekaa District	Zahle	0	0	4	18
	West Bekaa	3	14	3	21
	Rashaya	5	22	1	4
Total		8	36	8	43

Instrument and procedure

The instrument used in this research to collect the quantitative data is a self-developed questionnaire consisting of 24 questions, based on a 5-point Likert scale. The questionnaire was piloted and checked for validity and reliability. The questionnaire questions were mainly divided to target the different facets of understanding variably (Wiggins & McTighe, 2005) and its design was based on different questionnaires viewed throughout the literature review (Saeed, 2012; Ife, 2014; Ismail and Shaban, 2015).

According to Wiggins and McTighe (2005) when the word "Understand" is used, it doesn't mean one aspect rather several aspects revealing the real understanding of a concept. So, "Understand" means that students can explain via generalizations and principles. Students also can interpret through telling meaningful stories and providing personal dimension towards ideas and events. Students can apply and use what they learn in diverse contexts; students have a perspective through hearing different points of view to generate the big picture, they can empathize or find value of what others find odd, and have self-knowledge that is knowledge of habits of mind and show metacognitive awareness. However, it is important to mention here that it is usually hard toseparate the question to being fully "Explain" or fully "Interpret" because of the deep relation between the two. Hence, one question can be viewed at the same time "Explain" and "Interpret", and/ or "Analysis" and "Interpret".

Analysis

All the obtained data from the questionnaires were recorded on SPSS for windows, version 19 software. Quantitative procedures involved statistical analysis of the collected data, and descriptive statistics methods were adopted including frequencies and percentages, along with categorization of responses to be used for analysis.

The frequencies and percentages of a question or a group of related questions were calculated and relationships were later analyzed to reach the general goal of the questionnaire.

4. Results

The data collected was studied according to the total score each participant got and then the overall results were compared. Different criteria were used to analyze the data separately and they are presented in the following section.

Classification according to questionnaire scores

Each questionnaire had 20 questions which are related to the research topic besides the biodata. The score of each questionnaire was calculated according to the response on each question and the overall score from the questionnaire was calculated. Schools were first divided into public and private schools from which those who support Arabic and those who support English were calculated along with those who had a neutral attitude. The overall score from public and private schools was calculated as well.

Eight public schools were included in the research having 36 teachers. After studying the overall responses of participants in the questionnaire, 6 participants (16.6%) were neutral regarding the use of mother tongue or foreign language in instructing science, 6 participants (16.6%) supported the use of English language, and 24 (66.6%) supported the use of Arabic language.

In the private schools included in the research, 8 private schools with 43 teachers had been a part of the sample. Five participants (11.6%) had a neutral overall score regarding the language of science instruction, 12 teachers (27.9%) were supportive of the use of Arabic language, and 26 teachers (60.5%) were supportive of English language.

The overall questionnaire results from public and private school were 11 with a neutral attitude (13.9%) regarding the language of science instruction, 32 teachers (40.5%) supported the use of English language, and 36 teachers (45.5%) supported the use of Arabic language. Table 2 shows the tabulated results.

Attitudes of teachers towards the language of instruction of science according to school type

	With Arabic	**Neutral**	**With English**	**Total**
Public schools	24 (66.8%)	6 (16.6%)	6 (16.6%)	36 (45.6%)
Private schools	12 (27.9%)	5 (11.6%)	26 (60.5%)	43 (54.4%)
Total	36 (45.6%)	11 (13.9%)	32 (40.5%)	79 (100%)

Attitudes according to the facets of understanding

The attitudes of teachers as whether they prefer the use of English language or Arabic language in instructing science were studied according to the overall questionnaire scores as a start, and then each domain was studied alone. The different domains targeted were the facets of understanding, age, years of experience, language used by teachers in instructing science, and gender.

In the following section the questions were divided according to the different facets of understanding. Questions 5, 6, 10, 14 and 18 targeting the explain facet. Questions 7, 13, 20, and21 targeting the interpret facet. Questions 8, 9, 11, 15, 19, and 22 targeting the apply facet.

Questions 12, 17, and 24 targeting the communication facet along with two questions targeting achievement which are questions 16 and 23.

Attitudes towards the ability of students to explain

The following section discusses teachers' attitudes towards the ability of students to explain knowledge; it is elaborated in 5 questions in the questionnaire (Questions 5, 6, 10, 14, and 18). The ability of students to explain is evident when students provide a justified account of facts and data learned and they are able to make insightful connections providing examples and illustration (Wiggins & McTighe, 2005). Table 3 shows the responses and the percentages followed by data analysis.

The responses of teachers towards the questions targeting the explain facet in relation to language

	Strongly Agree + Agree	Neutral	Strongly Disagree + Disagree
Information analysis	34.2%	10.1%	55.7%
Justifying situations	51.9%	13.9%	34.7%
Judging new information	16.7%	12.8%	70.5%
Occurrence of misunderstandings	11.4%	17.7%	70.9%
Logical justification of information	11.4%	16.5%	44.3%

Based on the above data, 70.9% of participants responded with "disagree" that teaching science in Arabic increases in-class misunderstanding and reduces as well the ability of students to judge and evaluate new knowledge. On the other hand, 55% of participants responded with "disagree"that teaching science in Arabic allows students to analyze information better than when taught in English.

Attitudes towards the ability of students to interpret

The following section discusses teachers' attitudes towards the ability of students to interpret, and the results are shown in Table 4. These attitudes were illustrated in 4 questions in the questionnaire (Questions 7, 13, 20, and 21). The ability of students to interpret means that students are able to tell meaningful stories, and are able to provide a personal dimension to ideas and events as well (Wiggins & McTighe, 2005).

The responses of teachers towards the questions targeting the interpret facet in relation to language

	Strongly Agree + Agree	Neutral	Strongly Disagree + Disagree
Sharing stories	19%	15..2%	65.8%
Acquiring information	31.6%	21.5%	46.9%
Sharing information	43.6%	24.4%	32%
Route learning	40.3%	18.2%	41.6%

What was evident from the above data is that 65.8% of participants disagreed that teaching science in Arabic makes students share real life stories in class.

Attitudes towards the ability of students to apply

The following section discusses teachers' attitudes towards the ability of students to apply. This was illustrated in 6 questions in the questionnaire (Questions 8, 9, 11, 15, 19, and 22). The ability of students to apply means that students effectively use and adapt what they learn in diverse and real contexts (Wiggins & McTighe, 2005). Table 5 represents the responses and percentages of participants on specified questions.

The responses of teachers towards the questions targeting the apply facet in relation to language

	Strongly Agree + Agree	Neutral	StronglyDisagree + Disagree
Applying acquired information	53.8%	17.9%	28.8%
Improving application skills	45.5%	20.3%	34.2%
Linking information	67.1%	15.2%	2.8%
Applying information outside school	15.2%	24.1%	60.6%
Problem solving skills	33.8%	21.1%	38.1%
Using information effectively	43.6%	21.8%	34.6%

According to the above data, 67.1% agreed that teaching science in English makes it easier for students to link information between one subject and the other. However, 60.6% of participants disagreed that teaching science in Arabic makes it easy for students to apply what they learned in school in diverse contexts outside school.

Attitudes towards the ability of students to communicate with others

The following section discusses teachers' attitudes towards the ability of students to communicate. This was illustrated in 3 questions in the questionnaire (Questions 12, 17, and 24). The ability of students to communicate means that students are effectively interacting with each other and with their teachers as well. Table 6 shows the distribution of participants' responses on the questions targeting the communication abilities of students.

The responses of teachers towards the ability of students to communicate in relation to language

	Strongly Agree + Agree	**Neutral**	**Strongly Disagree + Disagree**
Student-Teacher communication (English)	48.7%	16.7%	34.6%
Student-Teacher communication (Arabic)	26.6%	15.2%	58.2%
Expressing thought	68.9%	20.3%	8.9%

According to the above data, 68.9% of participants agreed that teaching science in Arabic makes it easier for students to express their ideas and thoughts about new scientific situations easily.

Attitudes towards the achievement of students in relation to language

The following section discusses teachers' attitudes towards the achievement of students according to the language of instruction of science. This was illustrated in 2 questions in the questionnaire (Question 16 and 23). Table 7 shows the responses of teachers relating the language of instruction of science to students' achievement.

The responses of teachers in relating the language of science instruction to students' achievement

	Strongly Agree + Agree	**Neutral**	**Strongly Disagree + Disagree**
Achievement increases in Arabic	40.5%	19%	40.5%
Achievement increases in English	11.5%	6.4%	82%

5. Discussion

Evidence from Teachers According to Overall Questionnaire Scores

The overall scores collected from the 79 questionnaires were close to each other between the use of English and the use of Arabic where 45.5% supported the use of Arabic and 40.5% supported the use of English and 13.9 % participants were neutral. What is evident here is the approximately equal division between teachers on the smaller scale which reflects the contradiction on a larger scale at the level of countries.

Public schools supported the use of Arabic in 66.6% compared to 60.5% support towards English language in private schools. The difference between public and private schools in this sense might be referred to the language used in instructing science since most public schools use Arabic more than private schools who had already switched to the use of English in instructing science in the elementary level.

The attitudes of teachers who supported English, mainly in private schools which is a foreign language for elementary students in Lebanon contradicted with the findings of researchers worldwide. Studies had shown that the students who learn science in a foreign language lose at least 20% of their capacity to reason and understand in the process of learning and pose many problems to them because of linguistic and psychological reasons (Kocakulah, Ustunluoglu, &Kocakulah, 2005). Also children become disadvantaged when English is used as a medium of instruction because students don't understand the teachers or the textbooks in Sub-Saharan African countries (Vu & Burns, 2014). Such cases do apply in Bekaa-Lebanon because the mother tongue of students is Arabic and science is being taught in English which is a foreign language for them. On the other hand, teachers of public schools who mostly supported the use of Arabic language were with what researches found with no contradiction because learning science in mother language makes it easier for students to learn because neither teachers nor students have to go through the process of translation to deliver the information (Saeed, Iqbal, & Azam, 2012).

Evidence from Participants According to the Different Facets of Understanding

Regarding the achievement section of the questionnaire, participants were divided equally on agreement and disagreement in question 16 which states that teaching science in Arabic and not in English increases the achievement of students whose mother tongue is Arabic. However 82% of participants completely disagreed that teaching science in English increases the achievement of students if their mother tongue was English. So, most participants disagreed that matching the language of instruction and mother tongue increases achievement.

This also contradicted with many studies like the research of Harthi (2010) which showed that students who learn science in Arabic have higher achievement than those who learn it in English. Also, in the long run, studies showed that students who learn science in their mother tongue hadthe highest university grades and were the most successful compared to those who learned in a foreign language in their elementary level (Al-Jondi, 2013). Add to this, the use of mother tongue in instruction enhances science learning and achievement and reserves one's culture (Bala, 2014). So matching mother tongue with the language of instruction of science increases the achievement of students in this subject and this was the opposite to the attitudes of teachers in the chosen sample.

Unexpected results were collected in the communication section where 50% of participants agreed that when science is taught in English the interaction between teachers and students increases. More than half agreed that when the Arabic language is used for communication, the interaction decreases knowing that the mother tongue of students is Arabic. On the other hand, three quarters of participants agreed that when science is taught in Arabic students would easily express their thoughts and ideas about new real scientific situations easily. So we question here how can a person express ideas and thoughts if there is failure in the communication process in class?

These results were unexpected, especially the one related to that the use of English increases the communication between teachers and students whose mother tongue originally is not English. Learning involves communication between teachers and students, and between students themselves. Harthi (2010) showed that children learn best if the language of instruction was the same as the language used in daily life (Harthi, 2010). Add to this, students show difficulties in participating in class discussions when it is not their first language, even if they learn a second language (Dandashly, 2014)). Consequently, students will be able to express their thoughts and ideas more, can share more stories, and interact in the classroom more whenever the language of instruction is the same as the mother tongue of students and this was completely the opposite of the attitudes of the sample.

More than half of the participants agreed that the use of English in instructing science increases the ability of students to apply information in science, also more agreed that the ability to link information learned in science and other subjects increases as well and hence there is more effective use of information when English is used, compared to few who supported Arabic. So, most participants agreed that the use of English increases the application abilities of students than when this subject is taught in Arabic.

Sharing real life stories in class, and sharing information learned in the school with the outside environment increases according to participants' attitudes when science is taught in English.

Most participants (70%) agreed that the use of Arabic language increases the ability of students to evaluate and judge new ideas. Also participants agreed that the use of Arabic language reduces the occurrence of misunderstandings of new explained content. Half of the participants as well agreed that teaching science in Arabic increases the ability of students to justify situations outside school. Also about half of participants agreed that the use of English doesn't make students acquire information faster.

As a general conclusion, most participants had a positive attitude towards the use of English in increasing achievement, communication, application abilities, and communication skills. Also, most participants had a positive attitude towards the use of Arabic in enhancing the ability of students to judge newly learned content.

However, according to literature, it was found that students who learn science in their mother tongue were easily understanding what the teacher was explaining and were able to justify their answers with ease and confidence compared to those who learned in English who had facial expressions signifying that they are trying to understand, they took more time to explain theiranswers and they were unsure about their ability to speak (Vela, 2015). This is in agreement with the attitudes of teachers who agreed that teaching science in Arabic enhances the ability of students to explain newly learned content.

6. Conclusion

The results of the questionnaire were studied as the overall questionnaire score and then each of the domains was studied separately. For hypotheses, according to the first set hypothesis which was "Science teachers support the use of English as a language of instruction of science in the elementary level instead of the use of Arabic", it was partially validated with a 40.5% support by science teachers towards the use of English language in instructing science. According to the second hypothesis which was "Science teachers believe that students who are taught science in English understand more than students who are taught in Arabic" it was validated in the sense that teaching science in English increases the ability of students to interpret, apply, and analyze however the use of Arabic increase the ability of students to explain and have perspective. The third hypothesis which was "Science teachers believe that students who are taught science in English achieve more than students who are taught in Arabic" was validated.

General Findings

According to the overall questionnaire scores, 45.5% of the participants supported the use of Arabic language in instructing science and 40.5% supported the use of English in instructing the above subject, with 13.9% of participants with a neutral attitude towards the issue of language. Additionally, 66.6% of the supporters of the use of Arabic language were from public schools and 60.5% of the supporters of the use of English language were from private schools.

Specific Findings

Regarding communication, teachers believed that the use of English language increases communication between teachers and students whereas the use of Arabic doesn't.

The application of knowledge, the linkage of information between subjects, and the sharing of real life stories in class were thought to be increased when English language was used.

Evaluating and judging new ideas was thought to be enhanced when Arabic is used, like justifying observations outside school.

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Conflicts of interest

The authors affirm that they have no potential conflicts of interest in the research.

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