

---

## An Exploratory Study of Reported Bilingual Pedagogical Practices in Science Class at Lower Secondary Level

---

Saima Jabeen<sup>1</sup>, Nisha Kumari<sup>2</sup>, Ali Hussain Bangash<sup>3</sup>

<sup>1</sup>M.Phil Education (Allama Iqbal Open University Islamabad) Email: [saimayasir13@yahoo.com](mailto:saimayasir13@yahoo.com)

<sup>2</sup>M.Phil English Linguistics (Iqra University Karachi) Email: [nishawadwani1@gmail.com](mailto:nishawadwani1@gmail.com)

<sup>3</sup>PhD Scholar (IIUI Pakistan) Email: [ahbangash.edu@gmail.com](mailto:ahbangash.edu@gmail.com)

---

### KEYWORDS

*Bilingualism,  
Bilingual teaching,  
effectiveness,  
concept building,  
science education.*

### ABSTRACT

*The main feature of bilingual teaching is to provide instruction through two different languages. Keeping in mind the cultural background, improving students learning with clear concepts is highly necessary especially in lower secondary classes. If the achievement gap widens, students failed to achieve the learning objectives and, in many cases, these junior students have to repeat the same grade. The prime concern of the study was to explore teachers' attitudes, expectations and perceptions towards bilingual teaching at lower secondary level in science class. The informants in this research were teachers from private and public schools of Masroor, Karachi. In order to elicit data, a semi-structured interview was conducted. Data was analysed using NVivo software. It was found from the responses of the informants that they have a positive attitude towards the adaptation and implementation of bilingual teaching in their science classes.*

---

### INTRODUCTION

Language is not only a means of knowledge and communication, but also it is an important component of cultural identity and self-determination, both for the individual and the collective. The main feature of bilingual teaching is to provide instruction using two different languages. Bilingualism has been a controversial topic in the field of education for many years. The existence of bilingual education in the present day has sparked discussion and investigation on the advantages, best models and characteristics.

When teachers use students' national/native language in teaching, it helps students develop self-confidence and positive attitude towards learning (Álvarez, Paz-Albo, Escobar, & Montes, 2022). It is well recognized that receiving an education in one's national language increases academic success, facilitates learning, and helps in the acquisition of a second language. The instruction is more successful when the students may communicate more effectively in their own language and the learning process can be realized as a reciprocal engagement.

Ramirez & Ross (2019) that students need to learn English (language of instruction) before learning Science. With the rapid growth of schools which offer English as a medium of instruction and class room teaching to young learners, some teachers use direct method of teaching in their classes. If learners are taught only in English and L1 is replaced completely, negative consequences are likely to happen, including low self-esteem, social isolation, a possible loss of identity and a sense of belonging to a community (Durán-Martnez & Beltrán-Llavador, 2016).

In Pakistan, different institutions use different strategies. In Science class, there can be use of English and Urdu languages. Many teachers teach using only English language in their classrooms, especially in private schools or only Urdu in most of the government schools. This situation causes different problems. At middle grade, if taught through only using English, a number of students feel difficulty to understand the true concept; they acquire partial or incomplete concept. Direct method of teaching without explaining in Urdu can become a barrier for these junior learners. The subjects like science need proper understanding and clearance of the concepts (Westerville, 2010). If they are taught only in Urdu, it creates another critical issue. The medium of instruction is English. Students are supposed to attempt the questions exclusively in English. Thus, bilingual teaching may help students in building concepts as well as in attempting questions when they appear for exams. The primary goal of this study is to explore teachers' attitudes, expectations and perceptions towards bilingual teaching in science at middle school level.

### The objectives of the study were:

- To explore the teachers' attitudes towards the implementation of bilingual teaching at middle school level.
- To investigate the teachers' viewpoint about impact of using bilingual teaching on students.
- To investigate the teachers' expectations and perceptions about the effectiveness of bilingual teachings for students of science class.

This study deals with the use of bilingual teaching in science class at lower secondary level. The researcher wants to explore teachers' attitudes, expectations and perceptions towards bilingual teaching in science at middle school level where students come from different lingual, cultural and educational background. It may be helpful for those institutions where direct method of teaching is focused. The study may make a contribution by outlining and addressing issues that must be taken into account when organizing and teaching science class where the teacher and the students do not to speak the same language.

### **LITERATURE REVIEW**

The practice of teaching the content using two languages—a student's national language and a second language—is referred to as bilingual teaching. Bilingual teaching involves two languages; each language is used in accordance with the program when required. In every subject, communication is done in a specific language. The importance of bilingual teaching has been emphasized in many studies. According to Sert (2008), when students find it difficult to understand the content, it may inhibit the learner from developing critical thinking skills. A meta-analysis conducted by (Lo & Lo, 2014) expressed the students' failure in academic achievement is due to their insufficient language training and deficiency in teacher's teaching skills.

Dong & Du(2013) reveals the relationship between students' scores and academic performance in bilingual classes. He claims that Bilingual education is a gate way to sustainable development of the learners in an environment where two languages are used simultaneously. One main language is language of instruction and that is English and the other is the language understood by most students. Such teaching is very helpful for the students who aim to have a sustainable development in their career which demands bilingual practices in their workplace. In science class, students need to develop their concepts in order to apply them at higher levels, regardless of whether LI or L2 are used.

A report by Jin & Zhuang (2002) expresses that the educators need to teach the science topics using bilingual instruction, because of the students' performance which is poor in assessments. Keeping in mind the institutional background, improving students learning with clear concepts is highly necessary especially in middle grades, if the achievement gap widens, students failed to achieve the learning objectives and, in many cases, these junior students continue to study at the same level again. Young learners have distinct developmental needs which can be fulfilled using bilingual teaching (Westerville, 2010). A main advantage of using bilingualism in teaching is that students

which belong to different backgrounds learn content and its concepts with better understandings. It is very common to use bilingual teaching today and it continues to increase (Garcia, 2009). In Science class, teachers also use physical artifacts, models and gestures. Studies related to learning and teaching science in classes with bilingual students are predominately focused on language, while other resources receive less emphasis (Zhang, 2016).

Morton (2012) asserts that teachers need to employ classroom discussion effectively through dialogic engagement with their students to achieve the learning objectives, which include developing explanations and interpreting various frameworks to serve as a guide for experimentation. But while working with monolingualism dialogic engagement becomes more difficult. In this regard, Vygotsky's theory is very important. Vygotskian theories of learning emphasize the importance of social contact in a person's conceptual growth. The students internalize information that is different from their own information and that completes and enhances the previous knowledge through interacting with the teacher and their classmates. Mahan (2020) stressed that educators must begin "where the student is". In terms of science education, our current understanding of the beginning point is very different from what was thought to be the case fifty years ago. The fundamental challenge nowadays is not what the student lacks, but rather what the student contributes to the classroom. Students come into science classes with ideas that are very different from what they hope to learn from studying science (Lewis & Kattmann, 2004).

The attainment of conceptual change in learners is a fundamental learning outcome in constructivist methods to science education, where learners are considered as active participants who construct new understandings based on the information they already had. The only way for students to participate fully in class and be able to communicate is through bilingual instruction (Morton, 2012). Although researchers have emphasized that learning a new language is facilitated when it is integrated with content acquisition, many teachers still believe that bilingual students must first learn the language of instruction before learning science. As a result, many emerging bilinguals receive more language instruction at the expense of science instruction (Buxton & Lee, 2014).

Larsson (2011) looked at the science learning potential of bilingual students. The investigation was carried out in a biology lesson at an upper secondary school in Sweden. There were bilingual and monolingual students in the lesson. The lessons were taught exclusively in Swedish. All of the

monolingual students finished the semester with a passing grade; however, some of the bilingual students did not. An analysis of the written tests, which served as the primary basis for grades, indicated a broad pattern: bilingual students were good at reproducing factual knowledge, but they struggled with other conversational skills like debating, discussing, and generalizing.

However, the ability to use common language and draw from prior experiences is not a must for learning science. Instead, students' own ability of reasoning must be connected to the lesson's objectives. Johansson & Wickman (2011) observed a science class of fifth grade students who were 12 years old to see the interactions between the teacher and the students through different activities. The purpose of the lecture was to assist the students comprehend how friction may either accelerate or slow down motion, therefore the researchers examined whether and how the teacher made connections between the students' words and experiences. According to researchers (Johansson & Wickman, 2011; Hu & de Saint-Georges, 2020; Rolletschek, 2021) it is necessary to draw connections between students' ordinary language and the language of science. However, some bilingual students still struggle with the language of instruction since they are not native speakers (Garcia & Kleifgen, 2010). This suggests that everyday language is just as difficult as scientific language. As a result, teachers must consider what resources, outside from the language of instruction, might be employed to promote emergent bilingual students' science learning (Buxton & Lee 2014). Bilingual education is supported by many researchers for bilingual students in the classroom (Cummins, 2005; Anghel, Cabrales, & Carro, 2016; Lachance, 2018).

Ünsal, Jakobson, Molander & Wickman (2018) also investigated how bilingual students conceptualize relationships between daily language and the language of science in a Swedish class where all of the students spoke Turkish and the teacher spoke Bosnian, both of which are minority languages in the context of Swedish schools. Gonzalez-Aller & Paz-Albo (2016) argue that teachers in bilingual education settings need be fully trained and ready to apply a variety of approaches. Teachers regularly complain that programmes are being implemented on them without their consent (Brochin 2019; Palmer, Zuiga, & Henderson 2015; Romo & Durán 2019), this may cause discomfort, frustration, and worry. If we want to effectively assist aspiring teachers, we need to learn more about the viewpoints of the teachers who engage with students in bilingual education programmes (Wheeler, 2020).

Theoretical background of the study lies in pragmatic theory (Dewey, 1925/1998) and

sociocultural theory (Leontev, 1981; Vygotskij, 1978) as well as utilizing the term of translanguaging (Garcia, 2009). All three of them view language and learning as an activity taking place in a particular historical, cultural, and social setting. By concentrating on their use and effects in a particular context, a pragmatic approach on learning has made it possible to analyze language, gestures, and physical artifacts. These materials can now be viewed as mediation tools with benefits and drawbacks for the scientific learning of developing bilingual students thanks to sociocultural perspectives. The concept of translanguaging has improved our understanding of the various discursive practices used by bilinguals to interpret their language.

## METHODS AND MATERIALS

### *Informants*

The population of the study was science teachers from Masroor, Karachi. Only those teachers were considered as informants who were teaching at the middle level and possess the minimum qualification of M.Sc or B.SC. There were some informants who were having M.Phil degrees as well. Ten teachers who were teaching science at the middle level were contacted to get information for the study. The researcher used convenience sampling technique for this purpose. The researcher used the feedback of these informants in her study as they are teaching the middle grade students in classroom situation. So, only they can give information in a comprehensive way. Descriptive statistics are presented in Table 1.

Table 1  
Descriptive Statistics on Demographic Variables

| Variable                    | n | %  |
|-----------------------------|---|----|
| Males                       | 4 | 40 |
| females                     | 6 | 60 |
| B.Sc or Equivalent          | 2 | 20 |
| M.Sc                        | 7 | 70 |
| M.Phil                      | 1 | 10 |
| Age below 35                | 3 | 30 |
| Age 35-40                   | 4 | 40 |
| Age 41-45                   | 3 | 30 |
| Teaching in private schools | 5 | 50 |
| Teaching in public schools  | 5 | 50 |
| Experience 6-10 yrs         | 6 | 60 |
| Experience 11-15 yrs        | 4 | 40 |

### *Procedure*

The researcher conducted in-depth interviews to access the respondents' perspectives. Before conducting the interview, the researcher conveyed the research purpose, method and content to the interviewees. Subjects were told that the purpose of the study was to investigate teachers' attitude and perspectives towards the use of bilingual teaching in Science class at lower secondary level. During interview statements of great significance were

extracted. The researcher listened to those statements carefully and asked questions according to the interview outlines. The content and changes of the interviewees' moods and tones were also recorded. The interviewee did not be interrupted during the interview unless they were deviated from the main subject of the study. The general duration of interview was about 20 minutes per participant. The study followed the principle of informed consent and confidentiality. The interviews were transcribed and analyzed using NVivo software. Conclusions were drawn on the basis of the results.

### Measure

This study was based on qualitative paradigm. This was an exploratory case study. The survey method was used to conduct this study. A semi-structured interview outline was prepared to meet the requirements of the study. Qualitative research interviews are efforts to understand the world from the subjects' viewpoint, to disclose the meaning of the people's experiences to uncover their lived world prior to scientific explanations (Kvale, 1996). Interviews were a valuable addition to survey results since they allow better understanding of phenomenon (Darling-Hammond, Newton & Wei, 2010). The semi-structured interview was used because it allowed the researcher to ask the participants for more information in response to interesting or significant responses that emerged unexpectedly from planned questions. The semi-structured interview outline was based on questions derived from the literature review. It was developed on the basis of measures used in some previous researches (Landum, 2014; Said, Djafar, & Iskandar, 2019; Álvarez, Paz-Albo, Escobar & Montes, 2022). It consisted on total 10 questions. The interview guide was validated by two experts before administration. S-CVI value was computed which was 1. The data was analyzed using NVivo Software.

### DATA ANALYSIS

The researcher obtained qualitative data in the form of detailed descriptions and explanations. NVivo software was used to analyze the data. NVivo is a qualitative framework for data analysis that enables us to transcribe, analyze, organize, and display unstructured or semi-structured data. The detail of activity performed on the software by the researcher is depicted below. After the researcher had finished the interview procedure, the data was uploaded into the NVivo-12 for analysis. Following that, a query on the imported data was run, and the detailed word frequency query results are shown below:

Table 1  
Word Frequency Chart

| Word | Length | Count | Weighted |
|------|--------|-------|----------|
|------|--------|-------|----------|

|                |    |    | Percentage (%) |
|----------------|----|----|----------------|
| Bilingual      | 9  | 28 | 5.96           |
| Teaching       | 8  | 28 | 5.96           |
| Science        | 7  | 22 | 4.68           |
| Use            | 3  | 15 | 3.19           |
| English        | 7  | 14 | 2.98           |
| Level          | 5  | 13 | 2.77           |
| Students       | 8  | 13 | 2.77           |
| Class          | 5  | 11 | 2.34           |
| Language       | 8  | 11 | 2.34           |
| Learning       | 8  | 11 | 2.34           |
| Think          | 5  | 10 | 2.13           |
| Effective      | 9  | 9  | 1.91           |
| Method         | 6  | 8  | 1.70           |
| Applied        | 7  | 7  | 1.49           |
| Approach       | 8  | 7  | 1.49           |
| Middle         | 6  | 7  | 1.49           |
| understanding  | 13 | 7  | 1.49           |
| Different      | 9  | 6  | 1.28           |
| Direct         | 6  | 6  | 1.28           |
| room           | 4  | 6  | 1.28           |
| also           | 4  | 5  | 1.06           |
| concepts       | 8  | 5  | 1.06           |
| institutes     | 10 | 5  | 1.06           |
| make           | 4  | 5  | 1.06           |
| teach          | 5  | 5  | 1.06           |
| bilingualism   | 12 | 4  | 0.85           |
| comparison     | 10 | 4  | 0.85           |
| implemented    | 11 | 4  | 0.85           |
| institutions   | 12 | 4  | 0.85           |
| interest       | 8  | 4  | 0.85           |
| languages      | 9  | 4  | 0.85           |
| subject        | 7  | 4  | 0.85           |
| acquisition    | 11 | 3  | 0.64           |
| beneficial     | 10 | 3  | 0.64           |
| capacities     | 10 | 3  | 0.64           |
| chances        | 7  | 3  | 0.64           |
| classes        | 7  | 3  | 0.64           |
| grade          | 5  | 3  | 0.64           |
| improve        | 7  | 3  | 0.64           |
| junior         | 6  | 3  | 0.64           |
| minds          | 5  | 3  | 0.64           |
| prefer         | 6  | 3  | 0.64           |
| quite          | 5  | 3  | 0.64           |
| Urdu           | 4  | 3  | 0.64           |
| using          | 5  | 3  | 0.64           |
| ask            | 3  | 2  | 0.43           |
| behind         | 6  | 2  | 0.43           |
| checked        | 7  | 2  | 0.43           |
| children       | 8  | 2  | 0.43           |
| clear          | 5  | 2  | 0.43           |
| communicate    | 11 | 2  | 0.43           |
| convey         | 6  | 2  | 0.43           |
| especially     | 10 | 2  | 0.43           |
| experimental   | 12 | 2  | 0.43           |
| give           | 4  | 2  | 0.43           |
| helpful        | 7  | 2  | 0.43           |
| helps          | 5  | 2  | 0.43           |
| implementation | 14 | 2  | 0.43           |
| improves       | 8  | 2  | 0.43           |



The font size appears on the basis of the frequency of occurrence of words. It is the quick summary of

the responses of the informants.

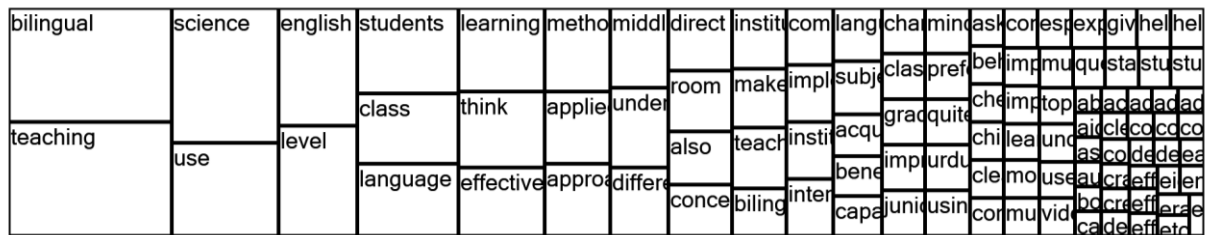


Figure 2: Tree Mapping

The above figure displays the words as a series of rectangles. The more frequently occurring words are in larger rectangles. A node is a collection of references about a specific theme, case, or relationship. Nodes were created from the responses of the informants. These nodes were labeled as effectiveness, concrete concepts, abstract concepts and knowledge. The detail is depicted below.

Table 2  
*Effectiveness*

| Type     | Name         | In Folder | References | Coverage |
|----------|--------------|-----------|------------|----------|
| Document | informant 10 | Files     | 4          | 87.70%   |
| Document | informant 2  | Files     | 2          | 33.78%   |
| Document | informant 3  | Files     | 4          | 70.26%   |
| Document | informant 4  | Files     | 2          | 53.26%   |
| Document | informant 5  | Files     | 1          | 45.75%   |
| Document | informant 6  | Files     | 2          | 29.21%   |
| Document | informant 7  | Files     | 3          | 34.87%   |
| Document | informant 8  | Files     | 2          | 35.86%   |
| Document | informant 9  | Files     | 2          | 52.68%   |

Table 3  
*Concrete Concepts*

| Type     | Name        | In Folder | References | Coverage |
|----------|-------------|-----------|------------|----------|
| Document | informant 6 | Files     | 1          | 20.97%   |
| Document | informant 7 | Files     | 2          | 45.80%   |
| Document | informant 8 | Files     | 2          | 32.70%   |
| Document | informant 9 | Files     | 2          | 45.89%   |

Table 4  
*Abstract Concepts*

| Type     | Name         | In Folder | References | Coverage |
|----------|--------------|-----------|------------|----------|
| Document | informant 10 | Files     | 1          | 29.02%   |
| Document | informant 2  | Files     | 2          | 64.47%   |
| Document | informant    | Files     | 1          | 28.14%   |

|          |           |       |   |        |
|----------|-----------|-------|---|--------|
| Document | informant | Files | 2 | 27.98% |
|----------|-----------|-------|---|--------|

Table 5  
*Knowledge*

| Type     | Name      | In Folder | References | Coverage |
|----------|-----------|-----------|------------|----------|
| Document | informant | Files     | 1          | 10.66%   |
| Document | informant | Files     | 1          | 9.22%    |
| Document | informant | Files     | 3          | 51.85%   |
| Document | informant | Files     | 3          | 47.57%   |
| Document | informant | Files     | 1          | 18.07%   |
| Document | informant | Files     | 1          | 28.90%   |

Tables 2, 3, 4, and 5 demonstrate the presence of nodes in the documents of different informants, each of whom was placed in the appropriate category. References and percentage are also there.

### Results and Discussion

From above findings and results it is clear that mostly teachers have positive attitude towards bilingual teaching in science at middle school level. They think that it improves students' learning capacity. According to teacher's viewpoint bilingual teaching should be implemented as it enhances the learning curve for children at young age. In comparison to direct method it is quite beneficial and increases the chances of learning. It develops learning and teaching capacities of the minds. Bilingual teaching develops students' abstract concepts. It is very effective for quality learning. This approach reduces the chances of second language for children. The study is consistent with the findings of Swanson, Kang & Bauler (2020) who highly recommend the use of bilingual teaching in science education in order to "shake" teachers' practices. These early linkages

may be a step in the right direction towards assisting students in deepening their comprehension of scientific concepts. The relative effectiveness of content and language integrated learning in biology for students with weak English proficiency is examined in this classroom-based study of Rolletschek (2021). His findings reveal that there was no significant difference in knowledge or motivation between the two groups in classes but only in English language proficiency, and students from multilingual backgrounds even seemed to benefit from bilingual instruction as long as specially designed lessons were used to meet the students' learning needs.

The students' adoption of unfamiliar words in second language in content is one of great learning barriers according to the findings of Ünsal (2017). In general, this helped the students in scientific learning. On rare occasions, they mistranslated scientific ideas. The student interviews illustrated how monolingual tests may restrict the scientific achievements of emerging bilingual students. The students used gestures to convey their meaning when their language skills made it difficult for them to speak. The teacher used the physical artifacts to demonstrate how the phenomenon or process in question could be stated in scientific language since they suggested that the students experienced the science content by really experiencing it. Using physical artifacts gave pupils the opportunity to relate new words to the science topic and understand what they meant when their ability to understand the language of instruction was limited.

The study was inconsistent with the findings of Ünsal, Jakobson, Molander & Wickman, (2018) where it was found problematic to translate scientific ideas, which caused the students' explanations of the ideas to differ from how they are perceived in science. It was illustrated how monolingual exams might restrict the scientific achievements of bilingual students. In the present study, only a few teachers think that we should not adopt bilingualism in science teaching at middle grade because our medium of instruction is English so students should be taught in English. They think bilingual teaching is not beneficial for learning of scientific terms.

### Conclusion

It is concluded from the discussion and findings that bilingualism is an effective approach for teaching science as most of the teachers show positive attitudes towards the adaptation and implementation of bilingualism, and their expectations from bilingualism were that it covers all the areas which are not fully covered through direct method of teaching. They advocated bilingual teaching as an effective and efficient

approach to teach in science class. Concept building in learners is very important in science education. Moreover, when learners are active participants and construct new understandings based on the information they already had, they achieve learning outcomes more easily. To enable students to communicate and participate actively in class teachers need bilingual teaching.

### Recommendations

It is recommended to use didactic approach for bilingual teaching for various topics in science class. Teachers should define the objectives and content and give demonstration. Additionally, it requires teachers who are qualified in the subject who can support students of mixed abilities. It is also recommended to use a pragmatic or sociocultural approach to analyze language, gestures, and physical artifacts in order to use them as mediation resources for the science learning of developing bilingual students.

### REFERENCES

- Álvarez, M. F., Paz-Albo, J., Escobar, A. H. & Montes, A. L. (2022). Bilingual education teachers' perceptions of the educational climate and policies in the United States and Spain. *Revista Complutense de Educación*. 33. 13-25. 10.5209/rced.70926
- Anghel, B., Cabrales, A., & Carro, J. M. (2016). Evaluating a bilingual education program in Spain: The impact beyond foreign language learning. *Economic Inquiry*, 54(2), 1202-1223.
- Brochin, C. (2019). Queering bilingual teaching in elementary schools and in bilingual teacher education. *Theory into Practice*, 58(1), 80-88
- Buxton, C. A., & Lee, O. (2014) English learners in science education. In Lederman, N. G., & Abell, S. K. (Eds.). *Handbook of Research on Science Education, Volume II*, (pp-204-222). New York: Routledge.
- Cummins, J. (2005). A proposal for action: Strategies for recognizing heritage language competence as a learning resource within the mainstream classroom. *The Modern Language Journal*, 89, 585-592.
- Darling-Hammond, L., Newton, X., & Wei, R. C. (2010). Evaluating teacher education outcomes: A study of the Stanford Teacher Education Programme. *Journal of Education for Teaching*, 36(4), 369-388.
- Dewey, J. (1925/1998). *Experience and nature*. New York: Dover Publications Inc..
- Dong, C.Y. & Du, C.H., (2013). Survey on relationship between Bilingual Education,



- Effectiveness and Students' proficiency, 5, 128-130
- Durán-Martínez, R., & Beltrán-Llavador, F. (2016). A regional assessment of bilingual programmes in primary and secondary schools: The teachers' View. *Porta Linguarum*, 25, 79-92. <https://doi.org/10.30827/Digibug.53890>
- García, O. (2009). *Bilingual education in the 21st century: A global perspective*. Malden, MA: Blackwell Pub.
- García, O. and Kleifgen, J. (2010). *Educating Emergent Bilinguals. Policies, Programs and Practices for English Language Learners*. New York: Teachers College Press.
- González-Aller, M. M., & Paz-Albo, J. (2016). English teaching methodologies for early childhood education. *Revista Internacional de Didáctica y Organización Escolar*, 2(1), 4-23
- Hu, A., & de Saint-Georges, I. (2020). Multilingualism a resource for learning – Insights from a multidisciplinary research project. *European Journal of Applied Linguistics*, 8(2), 143-156.
- Jin, K. & Zhuang, Y.X., (2002). Bilingual Education is spreading like a prairie fire, 6.
- Johansson A. M. & Wickman P. O. (2011). A pragmatist understanding of learning progressions. In B., Hudson, & M. A., Meyer (Eds.) *Beyond Fragmentation: Didactics, Learning and Teaching in Europe* (pp 47-59). Leverkusen: Barbara Budrich Publishers.
- Kolb, D. A. (1984). *Experiential Learning: Experience as the source of Learning and Development* (vol. 1). Eaglewood Cliffs, NJ: Prentice-Hall
- Kvale, S. (1996). *Interviews*. Thousand Oaks: SAGE Publications.
- Lachance, J. (2018). A Case Study of Dual Language Teaching in Science Class: Implications for Middle Level Teachers, *RMLE Online*, 41:5, 1-14, DOI: 10.1080/19404476.2018.1460231.
- Landum, J. N. (2014). [Bilingual education teachers' perceptions of the educational climate and policies in the United States and Spain](https://www.researchgate.net/publication/357702310)<https://www.researchgate.net/publication/357702310>
- Larsson, N. (2011) SB Method and SB Tool for 2011—Overview. iiSBE Inc.
- Leontev, A.N. (1981). The problem of activity in psychology. In J. V. Wertsch (Ed.). *The concept of activity in Soviet Psychology* (pp. 37–71). Armonk, NY: M. E. Sharpe
- Lewis, J. & Kattmann, U. (2004). Traits, genes, particles and information: re-visiting students' understandings of genetics. *International Journal of Science Education*, 26, (2), 195-206.
- Lo, Y.Y. & Lo, E.S.C., (2014). A meta-analysis of the Effectiveness of English Medium Education in Hong Kong, 84, 47-73.
- Mahan, K. R. (2020). The comprehending teacher: Scaffolding in content and language integrated learning (CLIL). *Language Learning Journal*, 48(1), 1-15. <https://doi.org/10.1080/09571736.2019.1705879>
- Morton, T. (2012) Classroom talk, conceptual change and teacher reflection in bilingual science teaching. *Teaching and Teacher Education*, 28, 101-110.
- Palmer, D. K., Zuñiga, C. E., & Henderson, K. (2015). A dual language revolution in the United States? On the bumpy road from compensatory to enrichment education for bilingual children in Texas. In W. E. Wright, S. Boun, & O. García (Eds.), *The handbook of bilingual and multilingual education* (pp. 449-460). Malden, MA: Wiley-Blackwell. <https://doi.org/10.1002/9781118533406.ch26>
- Ramirez, P., & Ross, L. (2019). Secondary dual-language learners and emerging pedagogies: The intersectionality of language, culture, and community. *Theory Into Practice*, 58(2), 176-184
- Rolletschek, H. (2021). Effects of Bilingual Biology Teaching at Middle Schools. *Language Teaching Research Quarterly*, Vol. 23, 23–44.
- Romo, B., & Durán, R. (2019). The human factor in primary bilingual programs: The management teams' perspective. *Porta Linguarum*, 31, 131-145
- Said, L., Djafar, M. B. & Iskandar, M. A. (2019). The Teachers' Perception on Bilingual Education Program at an Indonesian Senior High School.
- Sert, N. (2008). The Language of Instruction dilemma in the Turkish Context, 36, 156-171
- Swanson, L., Kang, E.J.S. & Bauler, C. (2020). Revealing a bilingual science teacher's dynamic views and practice about science and language teaching through dialogic reflections. *Cult Stud of Sci Educ* 15, 523–543. <https://doi.org/10.1007/s11422-019-09937-8>
- Ünsal, Z. (2017). *Bilingual Students' Learning in Science, Language gestures and physical artefacts*. Academic Dissertation for the



- Degree of Doctor of Philosophy in Science Education at Stokholm University.
- Ünsal, Z., Jakobson, B., Molander, B. O., & Wickman, P. O. (2018). Science education in a bilingual class: problematising a translational practice. *Cultural Studies of Science Education*. 13. 10.1007/s11422-016-9747-3.
- Vygotskij, L. S. (1978). Mind in society: The development of higher pedagogical processes. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.) Cambridge, Mass.: Harvard University Press.
- Westerville, O.H., (2010). This we believe: Keys to Educating Young Adolescents. National Middle School Association.
- Wheeler, D. (2020). Teacher perceptions of the challenges of teaching English language learners in bilingual education versus English immersion (Doctoral dissertation). Retrieved from [https://digitalcommons.csp.edu/cup\\_commons\\_grad\\_edd/458](https://digitalcommons.csp.edu/cup_commons_grad_edd/458)
- Zhang, Y., (2016). Multimodal Teacher input and Science Learning in a Middle School sheltered classroom. *Journal of research in Science teaching*, 55 (1),7-30.