DUAL-LANGUAGE INSTRUCTION: ITS EFFECT ON STUDENTS' PERFORMANCE IN SCIENCE EDUCATION

Jasmine D. Cubillan, John Manuel C. Buniel, Kyla Rita A. Mercado
North Eastern Mindanao State University, North Eastern Mindanao State University, North Eastern Mindanao State University,
cubillanjasmine@gmail.com;johncotaresbuniel@gmail.com; kylarita14@gmail.com

ABSTRACT: *This study investigated the impact of dual-language instruction on science education using a pretest-posttest equivalent group research design. The participants included one-hundred (100)students from the Bachelor of Science in Industrial Technology, and is divided into two groups: the control group and the experimental group, withFifty (50) from Electrical Technology and Fifty (50) from Automotive Technology majors. The study utilized a 50-item multiple-choice test from the Science, Technology, and Society (STS) Learners' Module. Findings revealed improved performance in both experimental and control groups, with significant differences observed in mean scores between pretest and post-test assessments. Initially, pretest scores showed no significant variation between the groups, whereas post-test scores exhibited notable differences. Analysis of mean gain scores highlighted significant differences between the control and experimental groups. With the results revealed, the study recommend that educators should prioritize strong science content knowledge to create classrooms where students can confidently discuss and clarify concepts in their preferred language and emphasize integrating bilingual or multilingual elements into science curricula to enhance learning absorption, as well as conduct of further research to strengthen evidence supporting the integration of dual-language approaches in science education.*

Keywords: Dual-LanguageInstruction, Students' Performance, Science Education,

INTRODUCTION

The language of instruction often plays a crucial part in the learning and teaching process in schools. It profoundly impacts the students' comprehension to the lessons, and in result, affect the cognitive development and the performance of the students. Thus, the choice of instructional language is pivotal in creating a conducive learning space for the students.Some countries opt for English due to its global status, others use their national languages, while some adopt bilingual approaches.Tran *et. al* [1] stated that dual language programs can have a profound impact on student outcomes.

On the other hand, the Philippines implemented dual-language, which has become the foundation of bilingual education and Filipinos are considered as non-nativeEnglish speakers. With this, science teaching and learningrequire both the teacher and the learner to communicate effectively.

An international study by Durga [2] uderscores the bilingual approach for Indian students in her study. This method enables teachers and students to utilize two languages: the target language, English, and the mother tongue, which aids in learning English. The teacher frequently translates and interprets texts into the students' mother tongue. A significant advantage of this approach is its effectiveness in developing both quantitative and qualitative language skills among students. Likewise, Dixon [3] stated that when students interpret what educators teach, their understanding is shaped by their language proficiency. Language proficiency in science education is crucial for understanding complex concepts, communicating effectively, accessing scientific resources, and promoting cultural understanding and collaboration in a global scientific context.

Looking at research in mathematics and science education, learning environments that support deep learning must engage and support students in inquiry, discovery, reasoning, sense making, communication, and reflection (Marx *et al*., Minner, Levy, & Century, National Council of Teachers of Mathematics, 1999; National Research Council, 2000, 2007; Tarr *et al.*, [4-7]. Moreover, local studies show there is an increase in student comprehension, interest, performance, and faster learning in using a bilingual medium of instruction for Hiligaynon (Launio [8] as well as English-Meranaw [9].

A core principle of dual language programs is that both language-majority and language-minority students learn content concepts together through language acquisition principles, resulting in demonstrated academic proficiency in both languages [10-12].

Dual language educational programs are shaped by additive biliteracy, the theory that multilingualism is beneficial for all learners [13-15].This study investigated the effect of dual-language in learning science education and its effects in the comprehension and performance of students.

With the likelihood that implementing dual-language in teaching and learning can contribute greatly to the students' academic performance, the researcher came up with the idea of investigating the impacts of dual-language in science education. This study focused on evaluating thestudents' performance in science learning using pure English and is compared with the experimental English supplemented with Mother Tongue asa medium of instruction. Specifically, this study sought to answer the following questions:

1. What are the average pretest and posttest performances of the respondents in both the control and experimental groups?
2. Do the pretest and posttest mean performances differ significantly between the control and experimental groups?
3. Is there a significant difference in the mean gain scores between the control and experimental groups?

Hypothesis

The following hypotheses were tested at a 0.05 level of significance:

*Ho_1:*There is nosignificant difference between the pretest and posttest mean performance of the control and experimental group.

Ho_2: There is no significant difference in the mean gain scores of the control and the experimental group.

MATERIALS AND METHODS

This study utilized an Experimental design, specifically adopting the pretest-posttest equivalent group design, which mirrors the classic controlled experimental design. The design included a single treatment group being modeled as follows:

Groups	Pre-test	Treatment	Post-test
Using Dual-Language	O_1	T_1	O_2
Using pure English	O_1		O_2

This study was conducted atNorth Eastern Mindanao State University (NEMSU) Cantilan Campus, specifically in the Department of Information Technology.Purposive sampling was used by the researcher in selecting one-hundred (100) respondents for the said study.The respondents were comprised of Fifty (50) students from the Electrical Technology major (control group) and Fifty (50) were from the Automotive major (Experimental group). The control group is exposed to pure English discussions during Science, Technology, and Society (STS) classes, while the experimental group is exposed to dual-language, English and native language, during class sessions.

Table 1. Distribution of the Respondents of the Study

Classes/ Section	No. of Respondents
Electrical Technology (Control)	50
Automotive (Experimental)	50
TOTAL	**100**

The pre-test and post-test are comprised of the same set of 50 items multiple choice questionnaire, under the subject Science, Technology, and Society (STS). The coverage of the test includes lesson 1 *"The interaction between Science, Technology, and the Society"* and lesson 2 *"Science and Technology Fields".*

Data Gathering Procedure

The data collection process employs a structured approach. Permission to conduct the pretest and posttest to the respondents was obtained from the Department of Industrial Technology of NEMSU – Cantilan Campus through formal communication letters. Upon approval of request, the researcher had a discussion with the teachers handling the STS subject, and was informed with the lesson plan for the subject. Lessons 1 "*The interaction between Science, Technology, and the Society"* and lesson 2 *"Science and Technology Fields"* were the chosen coverage for the conduct of the study, as well as the orientation of the research methodologies. It was agreed through discussion that the control group will be the respondents from the electrical technology major, and the experimental group will be the respondents from the automotive major. Pretests were conducted for both groups before the class discussions. The control group was only exposed to pure English or monolingual setup during discussions, while the experimental group was exposed to both English and native language or bilingual. At the end of the discussion, posttests were given to both groups. Data collected during the pretest and the posttest were statistically analyzed and interpreted.

Statistical Treatment

Following data collection, statistical methods were applied. Mean and standard deviation calculations were employed to analyze the average performances of both the control and experimental groups before and after the tests. A T-test was then used to ascertain significant differences in performance between the pretest and posttest scores of the control and experimental groups, and also to determine any significant disparities in the mean gain scores between these groups.

RESULTS AND DISCUSSION

Table 2: The mean performance of the control and experimental group

Type of Group	Pretest			Posttest		
	N	Mean	SD	N	Mean	SD
Control	50	7.72	1.32	50	36.12	2.36
Experimental	50	7.54	1.84	50	41.16	2.06

The table above illustrates the mean performance of both the control and experimental groups in their pretest and post-test assessments. It shows that during the pretest, the experimental group had a mean score of 7.54, while the control group had a mean score of 7.72, indicating similar levels of performance initially. In contrast, during the post-test, the experimental group achieved a mean score of 41.16 compared to 36.12 for the control group, indicating superior performance by the experimental group in the post-test phase. Additionally, the standard deviation values (post-test) provided in the table were 2.06 for the experimental group and 2.36 for the control group. This suggests that scores in the experimental group were more tightly clustered around the mean compared to those in the control group, indicating greater consistency in performance among students exposed to bilingualism.

These results suggest that students exposed to bilingualism exhibited higher performance levels compared to those exposed solely to pure English.

Skuka *et al* [16] stated that bilingual education represents a valuable educational approach that enhances language proficiency, cultural appreciation, and cognitive development. This method offers students a variety of advantages and opportunities, contributing to a more inclusive and diverse society.

Table 3: Significant values on the difference between the pretest and posttest mean performance of the control and experimental group.

	Group	Mean Score	SD	t-value	p-value	Decision	Interpretation
Pretest	Control	7.72	1.32	0.561	0.576	Failed to reject H_0	Not Significant
	Experimental	7.54	1.84				
Experimental	Control	36.12	2.36	10.716	0.000	reject H_0	Significant
	Experimental	41.16	2.06				

The table 3 presents the statistical significance of differences between the pretest and posttest performances of the control and experimental groups. Initially, the t-test for the pretest yielded a t-value of 0.561 with a p-value of 0.576, indicating no significant difference between the groups' initial performances. This suggests that both groups started with similar levels of understanding of the subject matter.

However, during the post-test phase, the computed t-value was 10.716 with a p-value of 0.000, revealing a significant difference in mean performances between the groups. This indicates a substantial variation in their scores. Specifically, the experimental group, which used bilingual instruction in teaching science, showed significantly better performance compared to the control group, which used English exclusively.

The results highlight that bilingual instruction had a significant positive impact on the experimental group's comprehension of the subject matter, leading to improved performance compared to the control group. This can be supported by Collier *et. al* [17], who have extensively studied the long-term effects of bilingual education on academic achievement. Their studies haveshown that well-implemented bilingual programs can lead to improved academic outcomes for students, includinghigher test scores and increased graduation rates.

Table 4: Significant value on the difference between the mean gain scores of the control and experimental group

Group	Mean Gain Score	SD	t-value	p-value	Decision	Interpretation
Control	28.4000	3.194	8.662	0.000	Reject H_0	Significant
Experimental	33.6200	2.820				

As depicted in the table above, the experimental group achieved a mean gain score of 33.6200, surpassing the control group's score of 28.4000. Additionally, the experimental group exhibited a smaller standard deviation (2.820) compared to the control group (3.194). These results highlight that the experimental group performed notably better than the control group after being exposed to bilingualism.

Moreover, the computed t-value of 8.662 with a p-value of 0.000, which is below the conventional significance level of 0.05, leads to the rejection of the null hypothesis. This indicates a significant difference in gain scores between the control and experimental groups. Consequently, it can be inferred that both groups significantly varied in their comprehension of the subject matter when bilingual instruction was introduced in teaching science.

CONCLUSIONS

From the data collected and the results analyzed, the study revealed that using dual-language during classes help in improving the performance of the students. Also, the results showed an increase in the comprehension of the students exposed to dual-language where they can express and attain lessons freely using the native language than with the restrictions of having only pure English during classes.

RECOMMENDATIONS

Based on the conclusions, the following recommendations are given:

1. Educators should focus in acquiring sufficient science content knowledge to foster classroom environments where students can confidently articulate their understanding and address misunderstandings in their preferred language.
2. The science curricula should be developed and equipped with dual-lingual or even multi-lingual freedom to comprehend for students to be able to absorb the lessons more effectively.
3. Further studies may be conducted to support the claims of this research and enhance the evidence that would back up the relevance of dual-language in science education.

REFERENCES

[1] Tran, Natalie A.; Behseta, Sam; Ellis, Mark; Martinez-Cruz, Armando; Contreras, Jacqueline*eJEP: eJournal of Education Policy*, spec iss p57-77 2015

[2] Durga, Satya Sri V. (2018). English Language Teaching: The Bilingual Method. *Journals for Research Scholars and Professional at English Language Teaching.* Issue 8.Vol. 2, 2018

[3] Dixon, L. (2011). Bilingual education policy in Singapore: An analysis of itssocio-historical roots and current academic outcomes. *International Journal of Bilingual Education and Bilingualism*, 8:1, 25-47, DOI: 10.1080/jBEB.v8.i1.pg25

[4] Marx, R.W., Blumenfeld, P.C., Krajcik, J.S., Fishman, B., Soloway, E., Geier, R., & Revital, T.T. (2004). Inquiry-based science in the middle grades: Assessment 76 http://nau.edu/COE/eJournal/ of learning in urban systemic reform. Journal of Research in Science Teaching, 41(10), 1063-80. doi: 10.1002/tea.20039

[5] Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction— what is it and does it matter? Results from a research synthesis years 1984 to 2002. Journal of Research in Science Teaching, 47(4), 474-496. doi: 10.1002/tea.20347

[6] National Research Council. (2000). How people learn: Brain, mind, experience, and school. J. A. Bransford, A. L. Brown, & Cocking, R. R., Eds. Washington, D.C.: National Academies Press.

[7] Tarr, J. E., Reys, R. E., Reys, B. J., Chavez, O., Shih, J., & Osterlind, S. J. (2008). The impact of middle-grades mathematics curricula and the classroom learning environment on student achievement. Journal for Research in Mathematics Education, 39, 247-80. Retrieved from http://www.jstor.org/stable/30034970

[8] Launio, R. (2015). *Instructional medium and its effect on students' mathematics achievement*. Capiz State University, Philippines.

[9] Aman J., and Tawantawan, J. (2018). *Bilingual medium of instruction: Effects onstudents conceptual understanding, problem-solving performance andinterest in mathematics*. Mindanao State University, Marawi, Philippines

[10] Bickle, K., Hakuta, K., & Billings, E. S. (2004). Trends in two-way immersion research. In J. A. Banks & C. A. McGee Banks (Eds.), *Handbook of research on multicultural education* (2nd ed., pp. 589–604). New York, NY: Macmillan.

[11] Collier, V. P., & Thomas, W. P. (2007). Predicting second language academic success in English using the Prism Model. In J. Cummins & C. Davison (Eds.), *International handbook of English language teaching, Part 1* (pp. 333–348). New York, NY: Springer.

[12] Lindholm-Leary, K. J. (2001). *Dual language educaiton*. Clevedon, England: Multilingual Matters.

[13]de Jong, E. (2004). After exit: Academic achievement patterns of former English language learners. *Education Policy Analysis Archives*, 12, 50. doi:10.14507/epaa.v12n50.2004

[14] García, O. (2009). *Bilingual education in the 21st century: A global perspective*. West Sussex, UK: Wiley-Blackwell.

[15] Lindholm-Leary, K. J. (2012). Successes and challenges in dual language education. *Education, Theory Into Practice*, 51(4), 256–262. doi:10.1080/00405841.2012.726053

[16] Skuka, H., Lulzim, M. (2023), *The Effects Of Bilingual Education On Academic Achievement Of Students In School Settings*, IOSR Journal Of Humanities And Social Science (IOSR-JHSS) Volume 28, Issue 9, Series 6 (September, 2023) 32-35 e-ISSN: 2279-0837, p-ISSN: 2279-0845. www.iosrjournals.orgA

[17] Collier, V. P., & Thomas, W. P. (2004). The Astounding Effectiveness Of Dual Language Education For All. NABE Journal Of Research And Practice, 2(1), 1-20.