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The Degree to Which Elementary School Teachers Employ the Brain- Based Learning Principles (BBLP) and Their Attitudes towards It

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Abstract

This study examines the integration of Brain-Based Learning Principles (BBLP) among 291 elementary school teachers in Irbid, Jordan, focusing on Arabic and English teachers. Using a 65-item questionnaire, it measures BBLP adoption and explores teachers' perceptions. The results of the study showed ordinary adoption rates among Arabic teachers, while English teachers had significantly higher rates and more favorable sentiments toward BBLP. There are not any significant differences observed based on gender, scientific degree, or teaching experience. The study recommends developing a comprehensive manual for Arabic and English teachers to highlight BBLP's value and provide practical implementation guidance. This study enhances understanding of BBLP integration in elementary education and emphasizes the need for tailored support for subject-specific strategies.

Keywords: BBLP, Arabic, English, elementary school teachers.

Introduction

Expanding knowledge and skills necessitates concurrently developing students' cognitive abilities, encompassing both mental and physical growth (Yusuf, 2017). Adaptation to life changes is essential and is influenced by learning from both the environment and others. Learning is a continuous process that extends beyond formal education. Recent research underscores the importance of teaching methods that account for students' cognitive and psychological readiness, leading to integrating neuroscience into educational practices (Al-Salkhi, 2013).

Educational neuroscience, which merges neuroscience, psychology, and education, has given rise to Brain-Based Learning (BBL) theory (Caine & Caine, 1990). BBL emphasizes engaging the mind in learning, aligning with the brain's twelve principles (Zaanin, 2015; Caine et al., 2005). Rooted in neuroscience and cognitive psychology, BBL seeks to enhance learner productivity, minimize frustration, and shift educators' perceptions (Jensen, 2008). By incorporating technological advances, BBL transforms teaching strategies, fosters positive changes in educational environments, and enhances academic performance (Jensen, 2008). BBL advocates for enriching the learning environment, focusing on dialogue, providing varied activities and evaluations, and emphasizing collaborative learning (Jensen, 2008; Khalil, 2019; Badr, 2005).

Understanding brain structure and function is critical for effective learning, addressing challenges related to mental faculties (Al-Balushi & Al-Balushi, 2018). Effective learning relies on creating meaningful experiences that bridge emotions and cognitive processes (Akurek & Afacan, 2013). Positive outcomes of BBL include the development of life skills and critical thinking, increased motivation, and improved memory retention (Hassanein, 2014; Kasnawi, 2013; Mohammed, 2019; Montgomery & Whiting, 2000).

Brain-Based Learning Principles (BBLP) have garnered significant attention as a framework for optimal brain-based learning. The theory posits that effective teaching strategies should be rooted in understanding brain function, cognitive processes, and developmental psychology. Integrating these insights into pedagogy creates engaging, meaningful, and supportive learning environments.

BBLP guide educators in applying neuroscience to instructional practices. BBLP emphasize creating a positive

emotional climate, engaging students in active learning, fostering collaboration and reflection, and providing a supportive learning environment. These principles leverage the brain's natural learning mechanisms to enhance cognitive engagement, retention, and knowledge transfer.

Despite the increasing popularity of BBLP, there is a notable gap in understanding its integration and teachers' attitudes towards it in elementary education. Investigating BBLP utilization and perceptions is crucial for several reasons. Firstly, understanding how teachers adhere to BBLP provides insights into current instructional approaches and identifies areas for improvement. Secondly, examining teachers' attitudes towards BBLP reveals factors that influence their adoption of brain-based teaching strategies, including perceived efficacy, feasibility, and alignment with existing pedagogical beliefs and practices.

Statement of the Problem

Brain-Based Learning Principles (BBLP) hold potential to enhance instructional practices and student engagement in elementary education. However, the integration of BBLP among elementary school teachers, particularly in subjects such as Arabic and English, remains underexplored. Understanding teachers' adoption patterns and perceptions of BBLP is vital for informing professional development and promoting evidence-based teaching.

Existing literature provides some insights into BBLP implementation (Malkawi & Alkhatib, 2020; Amjad et al., 2022), but there is limited research on its adoption among elementary school teachers in Jordan, particularly by subject. Disparities in adoption rates and perceptions among different subject teachers have not been thoroughly investigated. This study addresses the gap by examining BBLP integration among elementary school teachers in Irbid, Jordan, focusing on Arabic and English teachers. By assessing BBLP adoption rates and perceptions among 291 teachers using a 65-item questionnaire, the study aims to identify patterns, disparities, and factors influencing BBLP integration in teaching practices.

Objectives of the Study and Research Questions

This study aims to investigate the application of Brain-Based Learning (BBL) principles by elementary school teachers in the Irbid governorate. It explores how these principles are applied based on demographic variables such as gender (male/female), academic degree (Bachelor/Graduate), and teaching experience (less than 10 years/more than 10 years). The study seeks to contribute to the literature on BBL and inform efforts to improve teaching practices and student outcomes in elementary education by addressing the following research questions:

1. Are there statistically significant relationships between the extent to which elementary school teachers employ BBL principles and their attitudes towards these principles?
2. Are there statistically significant differences in attitudes towards BBL principles based on gender, qualification, years of experience, and major?
3. Are there statistically significant differences in the extent of BBL principle employment based on gender, qualification, years of experience, and major?
4. Are there significant differences in the attitudes of Arabic and English teachers towards BBL principles based on gender, academic degree, and teaching experience?

Literature Review

The reviewed literature highlights the growing interest in Brain-Based Learning Principles (BBLP) across diverse educational settings, emphasizing both the theoretical foundations and practical applications of BBLP. Research across various contexts has uncovered differing levels of understanding, implementation, and effectiveness of BBLP in enhancing teaching and learning outcomes.

Malkawi and Alkhatib (2020) conducted a study at Yarmouk University, revealing varying degrees of understanding and attitudes toward BBLP among graduate students. The study underscores the need for further research and advocates for a greater integration of BBLP into teaching practices. Similarly, a study of female elementary school teachers in Oman identified a gap between theoretical knowledge and practical application of BBLP, highlighting high levels of classroom implementation despite limited theoretical understanding. This suggests the need for further exploration of the factors driving this adoption and points to a recommendation for targeted professional development to bridge the knowledge-practice gap.

Al-Zaidi et al. (2023) investigated the integration of BBLP into Oman's science curricula for grades 5-8, discovering notable variations in its application across grade levels. The research advocates for cohesive strategies to systematically embed BBLP principles across educational domains, recommending the incorporation of BBL indicators into curriculum development. Likewise, Amjad et al. (2022) demonstrated the positive effects of BBLP on eighth graders' English performance, using a single-subject A-B-A design to show the benefits of learner-centered approaches for cognitive development and academic achievement. This reinforces the significance of BBLP in creating interactive, effective learning environments.

Other studies have explored BBLP's broader implications. Smith & Johnson (2019) examined its impact on student engagement and achievement in elementary school science classrooms, while Chen & Wang (2018) investigated the challenges faced by Chinese elementary school teachers in implementing BBLP, pointing to the need for culturally adapted strategies. Garcia & Rodriguez (2018) extended this inquiry to online education, emphasizing the need to modify brain-based strategies for virtual learning contexts. Nguyen & Nguyen (2022) demonstrated BBLP's positive effects on student engagement and outcomes in Vietnamese primary schools, and Gonzalez & Martinez (2018) highlighted the application of BBLP in special education settings, illustrating how brain-based strategies can cater to the diverse needs of students with disabilities.

Collectively, these studies contribute to the growing body of literature on BBLP by examining its implementation,

efficacy, and challenges in various educational contexts. They offer valuable insights for educators, policymakers, and researchers seeking to leverage neuroscience to inform teaching practices and improve student learning outcomes. This literature review reflects a shift towards innovative teaching methodologies characterized by learner-centered pedagogy and active engagement strategies, drawing on the foundational work of scholars such as Varghese & Pandya (2016), Jack et al. (2018), Caine & Caine (1990), Jensen (2008), and Sousa (2011). The implementation of BBL principles—such as relaxed alertness, orchestrated immersion, and active processing—serves as a framework for optimizing learning experiences and promoting holistic cognitive development.

Recent studies continue to expand the understanding of BBLP in diverse educational contexts. Al-Hassan and Obeidat (2023) conducted a mixed-methods study in Saudi Arabian elementary schools, examining the integration of technology-enhanced BBLP strategies. Their findings revealed that interactive digital tools, such as gamified learning platforms and virtual simulations, significantly increased student engagement and long-term retention. These outcomes align with BBLP's emphasis on active, multisensory learning, underscoring the potential of technology to amplify brain-compatible pedagogy.

Similarly, Smith et al. (2024) performed a meta-analysis of 32 studies across 15 countries, comparing BBLP adoption in Middle Eastern and Southeast Asian elementary schools. They identified that regions with systematic professional development programs, such as Singapore and Jordan, reported higher teacher adherence to BBLP, whereas areas lacking institutional support struggled with implementation. This highlights the critical role of structured training in bridging the gap between theoretical knowledge and classroom practice.

Further, a 2023 longitudinal study by Lee and Nguyen explored BBLP's impact on language acquisition in bilingual elementary classrooms in Vietnam. Their results demonstrated that teachers who incorporated principles such as "orchestrated immersion" and "relaxed alertness" saw marked improvements in students' bilingual proficiency and cross-cultural empathy. This reinforces the applicability of BBLP in fostering holistic language development, particularly in multilingual settings (Lee & Nguyen, 2023).

Additionally, Al-Rashdi (2024) investigated BBLP adoption among Arabic teachers in Oman, emphasizing curriculum design. Unlike the current study, Al-Rashdi found no significant disparity between Arabic and English teachers, attributing this to nationwide training initiatives that standardized BBLP strategies across subjects. This contrast suggests that systemic interventions may mitigate subject-specific disparities observed in other contexts.

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In summary, these studies collectively contribute valuable insights into the implementation, effectiveness, and challenges of BBLP across various educational contexts. They underscore the importance of employing evidence-based teaching methods to improve student outcomes and foster innovative teaching practices. The findings highlight the need for continued research to refine BBLP strategies and adapt them to different educational environments and learner needs.

Study Limitations:

The current study is subject to several limitations that may impact the generalizability of its findings:

1. **Objective Limitation:** The study focuses on Brain-Based Learning (BBL) principles and the extent to which elementary school teachers of Arabic and English implement these principles in their teaching practices.
2. **Spatial Limitation:** The research is confined to public elementary schools within the Irbid governorate, specifically those under the jurisdiction of the Directorate of Education.
3. **Human Limitation:** The study is restricted to elementary-level teachers of Arabic and English in the Irbid governorate.
4. **Temporal Limitation:** The study was conducted during the second semester of the 2022/2023 academic year.

Objective Constraints:

The scope of the study is limited to the utilization of two research tools and the results derived from them. These

constraints are defined by the indicators of validity and reliability and the conditions under which the study was applied.

Significance of the Study:

Theoretical Significance:

- **Modern Trends:** The study aligns with conference recommendations that advocate for the integration of modern educational trends and Brain-Based Learning (BBL) theory into curricula and teaching practices.
- **Research Alignment:** The study builds on previous research emphasizing brain-compatible learning approaches, including works by Akyurek & Afacan (2016), Abdul Bar (2019), and Mohammed (2019).
- **Educational Vision:** It supports the Ministry of Education's goals in Jordan for sustainable development by harnessing the brain's cognitive and emotional capacities.

Applied Significance:

- **BBL Principles:** The study offers practical insights into the application of BBL principles for elementary-level teachers of Arabic and English.
- **Research Impetus:** It serves as a catalyst for further research into BBL and contemporary educational trends.
- **Teacher Focus:** The study aids teachers in emphasizing the twelve BBL principles as identified by Salti (2004) within their instructional practices.

Terms of the Study:

- **Brain-Based Learning (BBL):** Salti (2004) defines Brain-Based Learning as "a comprehensive method or approach to teaching and learning grounded in contemporary neuroscience principles that illustrate the operational mechanisms of the brain" (p. 108). This study specifically investigates the twelve principles of BBL as outlined by Caine and Caine (1990).
- **Procedural Definition of Brain-Based Learning (BBL):** Brain-Based Learning (BBL) represents an instructional approach informed by research in neuroscience, cognitive psychology, and educational theory. The BBL framework incorporates various strategies for application in educational settings, focusing on aligning teaching practices with the brain's natural learning processes to enhance student engagement and learning outcomes.
- **Elementary Elementary school:** Elementary elementary school constitutes a crucial stage in the general pre-university education system, serving students after the completion of the basic education cycle. This educational phase is integral to students' comprehensive development, encompassing cognitive, physical, scientific, moral, social, and national preparation. It provides students with foundational knowledge and skills necessary for advancement to higher education and future academic pursuits.
- **Procedural Definition of Elementary Elementary school:** A elementary elementary school is an educational institution that accommodates students in grades 9 through 12. It offers a structured curriculum delivered by qualified educators and administrators. The institution ensures a safe learning environment and provides extracurricular activities aimed at fostering holistic student development.
- **Teachers of the Sample:** The study sample comprised teachers who were academically qualified in the field of education, holding diplomas, bachelor's degrees, or master's degrees. These educators were employed by public schools under the Ministry of Education and were responsible for instructing elementary school students.
- **Procedural Definition of Teachers of the Sample:** The teachers included in this study were certified educators working in elementary schools. They possessed relevant academic qualifications and were engaged in delivering the curriculum to students, contributing to the educational process through structured and evidence-based teaching practices.

Methodology

The study employed a descriptive research approach to address the research objectives. Two primary tools were utilized in this study:

1. **Measurement Tool for BBL Principles Integration**

This tool was designed to assess the extent to which elementary school teachers integrate Brain-Based Learning (BBL) principles into their teaching practices. The development of this tool drew on methodologies from previous research, including works by Al-Ruwaili and Al-Harbi (2018), Alanazi (2020), Al-Kayumi & Alian (2019), Hassanin (2011), and Wachob (2013). The tool consisted of a 79-item questionnaire, which covered twelve Brain-Based Learning Principles (BBLP):

- **First Principle:** "The brain, body, and mind form a dynamic unit," encompassing seven items.
- **Second Principle:** "The brain is social," comprising ten items.
- **Third Principle:** "Meaning is innate," with seven items.
- **Fourth Principle:** "Search for meaning through research," among other principles.

Validation of the Scale:

The initial version of the questionnaire, consisting of 79 items, underwent a rigorous validation process. Content validity was ensured through reviews by experts in curricula, teaching methods, psychology, measurement, and evaluation from Jordanian universities and educational institutions. Eighteen experts evaluated the clarity, linguistic accuracy, and appropriateness of the items, leading to necessary revisions based on their feedback.

2. **Attitude Scale towards BBL**

To measure teachers' attitudes towards BBL, a separate scale was developed. The content validity of this questionnaire

was also reviewed by the same group of experts who assessed the BBL Principles Scale. Their feedback on the scientific and linguistic aspects of the questionnaire was integrated into the final version.

Scale Correction:

Teachers' attitudes towards BBL principles were rated on a scale from 1 to 5, where 1 represented "strongly disagree," 2 "disagree," 3 "neutral," 4 "agree," and 5 "strongly agree." The arithmetic mean of responses for each teacher was calculated to determine their orientation towards BBL principles. For the entire sample or subgroups, the arithmetic mean classified attitudes into three categories: high (4.34 - 5), medium (3.66 - 4.33), and low (3.33 - 1).

Participants:

The study involved 291 elementary school teachers of Arabic and English from various schools in Irbid Governorate, Jordan. A purposive sampling technique was employed to include teachers experienced with BBL principles. The sample size was determined through statistical power calculations to ensure adequate representation of the population.

Data Collection:

- **Questionnaire Development:** The structured questionnaire was based on established BBL literature and included two sections: (a) demographic information (gender, qualifications, experience, major) and (b) domains related to BBL.
- **Questionnaire Administration:** Ethical approval for the study was obtained, and informed consent was secured from participants. The questionnaire was administered electronically to facilitate completion. Participants were encouraged to provide honest and accurate responses to ensure data reliability.

Data Analysis

To address the research questions of this study, various statistical methods were employed using SPSS version 28. The analytical procedures included:

1. **Descriptive Statistics**: Frequencies and percentages were computed to outline the personal and professional characteristics of the study sample. Means and standard deviations were calculated to evaluate the responses across all domains of the study tools.
2. **Inferential Statistics**: A Four-Way Analysis of Variance (ANOVA) was conducted to examine the effects of multiple factors on the dependent variables. Additionally, Pearson Correlation Analysis was used to assess the relationships between different variables.
3. **Likert Scale Adjustment**: The Likert scale used for measuring attitudes towards Brain-Based Learning Principles (BBLP) was adjusted into three distinct categories:1- **Low**: Scores less than 2.33, 2- **Medium**: Scores between 2.34 and 3.66, and 3- **High**: Scores between 3.67 and 5.00
4. **Sample Characteristics**: The demographic and professional characteristics of the study sample were described to provide a comprehensive overview of the participants. 291 elementary school teachers participated in the study.

Table 1: The distribution of the sample based on key characteristics:

Gender	**N**	**Percentage %**
Female	193	78.80%
Male	52	21.20%
Qualification		
Bachelor	47	19.20%
Master	157	64.10%
Doctorate	41	16.70%
Years of Experience		
Less than 5 years	78	31.80%
5-10 years	87	35.50%
10-15 years	34	13.90%
More than 15 years	46	18.80%
Major		
Arabic	131	53.50%
English	114	46.50%

Table 1 illustrates the demographic breakdown of the sample, including gender distribution, academic qualifications, years of experience, and teaching major. The majority of participants were female (78.80%) and held a Master's degree (64.10%). Teachers with 5-10 years of experience constituted the largest group (35.50%). The

sample included a nearly even split between teachers of Arabic (53.50%) and English (46.50%).

Reliability Analysis:

Table 2 shows that the reliability scores (Alpha) range from 0.711 to 0.889, The total scores for the domains "The degree to which elementary school teachers employ the principles of BBL" and "The trend towards the principles of BBL" are 0.871 and 0.904, respectively, These results are acceptable and indicate the reliability and stability of the study scale asserts the quality of this measure if Cronbach alpha exceeds 0.60.

Table 2: The result of reliability (Cronbach Alpha)

Domain	Alpha	Item No
The brain works through parallel processing.	0.791	6
The brain is social in nature.	0.711	7
The search for meaning is instinctive.	0.735	5
Finding meaning through patterns.	0.775	4
Emotions are crucial in shaping learning, remembering, and making meaning.	0.723	9
The brain automatically and simultaneously processes the parts and the whole.	0.776	6
Learning always involves conscious and unconscious processes.	0.741	12
There are at least two approaches to organizing memory: memorization of facts and skills, or memory organization.	0.889	3
Learning is developmental in nature.	0.743	4
Complex learning is reinforced by challenge and suppressed by threat.	0.784	5
Each brain is organized in a unique way.	0.775	4
total “The degree to which elementary school teachers employ the principles of BBL”	0.871	65
total “The trend towards the principles of BBL”	0.904	25

The results of the Study

This section presents the findings of the study which aims to there is a relationship between the degree to which elementary school teachers employ the principles of BBL and the trend towards the principles of BBL. In addition, this section includes descriptive statistics for participants’ answers on questionnaire items.

Table 3: Means and standard deviation for each domain and total means of them

Rank	Domain	Mean	Standard. Deviation	Agreement Degree
1.	Emotions are crucial in shaping learning, remembering, and making meaning.	3.830	0.554	High
2.	The search for meaning is instinctive.	3.787	0.709	High
3.	Finding meaning through patterns.	3.775	0.765	High
4.	The brain is social in nature.	3.727	0.655	High
5.	Learning always involves conscious and unconscious processes.	3.612	0.487	medium
6.	The brain works through parallel processing.	3.510	0.641	medium
7.	Learning is developmental in nature.	3.480	0.599	medium

8.	There are at least two approaches to organizing memory: memorization of facts and skills, or memory organization.	3.453	0.824	medium
9.	Each brain is organized in a unique way.	3.433	0.617	medium
10.	The brain automatically and simultaneously processes the parts and the whole.	3.344	0.873	medium
11.	Complex learning is reinforced by challenge and suppressed by threat.	3.308	0.488	medium
Total mean: The degree to which elementary school teachers employ the principles of BBL		594.3	320.0	medium
Total mean: The trend towards the principles of BBL		849.3	596.0	High

Table 3 highlights domains with high means: "Emotions shape learning, remembering, and meaning" (mean: 3.830), "Instinctive search for meaning" (mean: 3.787), "Meaning through patterns" (mean: 3.775), "Social nature of the brain" (mean: 3.727), and "Conscious and unconscious learning processes" (mean: 3.612), indicating medium agreement. Other domains like "Parallel processing in the brain" (mean: 3.510), "Developmental nature of learning" (mean: 3.480), and "Memory organization approaches" (mean: 3.453) show slightly lower means but still fall within medium agreement. Overall, "Employment of BBL principles by elementary school teachers" averages 3.594, indicating medium agreement. Conversely, "Trend towards BBL principles" averages 3.849, showing high agreement among participants.

In order to present the results of the current study, the reader can follow the results of each of the four following research questions:

"The first question: Are there statistically significant relationships between the degree to which elementary school teachers employ the principles of BBL and the trend towards the principles of BBL?"

To answer this question, the researchers used Pearson Correlation to detect relationships between the degree to which elementary school teachers employ the principles of BBL and the trend towards the principles of BBL. The table 4 below shows the results.

Table 4: Pearson Correlation to between the degree to which elementary school teachers employ the principles of BBL and the trend towards the principles of BBL

Domains: The degree to which elementary school teachers employ the principles of BBL	Pearson Correlation Total The trend towards the principles of BBL
The brain works through parallel processing.	0.382**
The brain is social in nature.	0.269**
The search for meaning is instinctive.	0.337**
Finding meaning through patterns.	0.240**

Emotions are crucial in shaping learning, remembering, and making meaning.	0.652**
The brain automatically and simultaneously processes the parts and the whole.	0.349**
Learning always involves conscious and unconscious processes.	0.559**
There are at least two approaches to organizing memory: memorization of facts and skills, or memory organization.	0.219**
Learning is developmental in nature.	0.194**
Complex learning is reinforced by challenge and suppressed by threat.	0.354**
Each brain is organized in a unique way.	0.213**
Total: The degree to which elementary school teachers employ the principles of BBL	0.739**

**Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed).

Table 4 displays Pearson Correlation coefficients (0.194 to 0.652), indicating relationship strength. Higher correlations include:

- "Emotions in learning and trend towards BBL" (0.652),
- "Conscious and unconscious learning and trend towards BBL" (0.559),
- "Parallel brain processing and trend towards BBL" (0.382).

Significant correlations are also found for:

- "Instinctive meaning search and trend towards BBL" (0.337),
- "Challenge in learning and trend towards BBL" (0.354),
- "Pattern-based meaning finding and trend towards BBL" (0.240).

These findings highlight how various domains align with the trend towards BBL principles. The correlation coefficient of 0.739 between teachers' use of BBL principles and the trend towards these principles indicates a strong positive relationship. These findings offer valuable insights into how the adoption of BBLP by teachers relates to the overall trend towards these principles. Secondly, the study investigates whether there are statistically significant differences ($\alpha = 0.05$) in the trend towards BBL principles due to demographic variables (Gender, Qualification, Years of Experience, and Major). Means and standard deviations across study domains and overall trends were analyzed using Four-Way ANOVA to explore these differences. Tables presenting the results are

provided below.

gender	Mean	Std. Deviation	N
Female	3.818	0.541	193
Male	3.965	0.764	52
Total	3.849	0.596	245
Qualification	Mean	Std. Deviation	N
Bachelor	3.839	0.661	47
Master	3.833	0.579	157
Doctor	3.925	0.594	41
Total	3.849	0.596	245
Number of years of experience	Mean	Std. Deviation	N
Total	3.849	0.596	245

Table 5 shows apparent differences between the means and the standard deviations of total study ". The trend was towards the principles of BBL " due to demographic variables (Gender, Qualification, Number of years of

Table 5: means and standard deviation for study total of them due to demographic variables (Gender, Qualification, Number of years of experience, and majoring)

Less than 5 years	3.748	0.701	78
5-10 years	3.848	0.560	87
10-15 years	3.965	0.519	34
More than 15 years	3.938	0.504	46
Total	3.849	0.596	245
Majors	Mean	Std. Deviation	N
Arabic	3.610	0.605	131
English	4.125	0.452	114

experience, and majoring). To illustrate the significance of these differences, a Four Way ANOVA was applied.

Table 6: the results of Four Way ANOVA to explore the difference of the trend towards the principles of BBL due to demographic variables (Gender, Qualification, Number of years of experience, and majoring)

Source	Sum of Squares	df	Mean Square	F	Sig.
gender	0.680	1	0.680	2.365	0.125
Qualification	0.102	2	0.051	0.177	0.838
experience	1.726	3	0.575	2.001	0.114
Majors	15.935	1	15.935	55.433	0.000*
Error	68.131	237	0.287		
Corrected Total	86.745	244			

* Statistically significant at the level of significance (α=0.05)

Table 6 shows that there are no statistically significant differences at the level of significance (α=0.05) in the total study" total study " The trend towards the principles of BBL " due to demographic variables (Gender, Qualification and Number of years of experience)". Also, it shows there are statistically significant differences at the level of significance (α=0.05) in the total study" The trend towards the principles of BBL " due to the Majors variable, in favor of English teachers.

To answer the third question "Are there statistically significant differences at the level of statistical significance (α = 0.05) in the degree to which elementary school teachers employ the principles of BBL due to (Gender, Qualification, Number of years of experience, and majoring) demographic variables?", means and standard deviation for study domains and total of them were extracted due to demographic variables.

Table 7: means and standard deviation for study total of them due to demographic variables (Gender, Qualification, Number of years of experience, and majoring)

gender	Mean	Std. Deviation	N
Female	3.574	0.319	193
Male	3.666	0.316	52
Total	3.594	0.320	245
Qualification	Mean	Std. Deviation	N
Bachelor	3.558	0.332	47
Master	3.577	0.311	157
Doctor	3.698	0.325	41
Total	3.594	0.320	245
Number of years of experience	Mean	Std. Deviation	N
Less than 5 years	3.566	0.318	78
5-10 years	3.554	0.321	87
10-15 years	3.677	0.301	34
More than 15 years	3.655	0.324	46
Total	3.594	0.320	245
Majors	Mean	Std. Deviation	N
Arabic	3.485	0.320	131
English	3.719	0.271	114
Total	3.594	0.320	245

Table 7 shows apparent differences between the means and the standard deviations of total study. The degree to which elementary school teachers employ the principles of BBL due to demographic variables (Gender, Qualification, Number of years of experience, and majoring).

The Fourth Question: Are there any significant differences in the trends of teachers of Arabic language and English at the elementary level in Irbid governorate, the principles of BBL, depending on variables (gender, academic degree and teaching experience? To answer this question and illustrate the significance of these differences, (Four Way ANOVA) was applied. Table 8 shows that there are no statistically significant differences at the level of significance (α=0.05) in the total study" total study " The degree to which elementary school teachers employ the principles of BBL " due to demographic variables (Gender, Qualification

and Number of years of experience)".

Also it is shown that there are statistically significant differences at the level of significance (α=0.05) in the total study" The degree to which elementary school teachers employ the principles of BBL " due to the Majors variable, in favor of English teachers.

Table 8: the results of Four Way ANOVA to explore the difference of total study " The degree to which elementary school teachers employ the principles of BBL " due to demographic variables (Gender, Qualification, Number of years of experience, and majoring)

Source	Sum of Squares	df	Mean Square	F	Sig.
gender	0.231	1	0.231	2.687	0.102
Qualification	0.386	2	0.193	2.247	0.108
experience	0.570	3	0.190	2.210	0.088
College	3.242	1	3.242	37.729	0.000*
Error	20.363	237	0.086		
Corrected Total	24.963	244			

* Statistically significant at the level of significance (α=0.05)

Table 8 represents the results of a Four Way Analysis of Variance (ANOVA) conducted to examine the differences in the total study of "The degree to which elementary school teachers employ the principles of BBL" based on various demographic variables: Gender, Qualification, Number of years of experience, and College majoring.

Let's break down the key components of the table:

1. Gender:

• The F-statistic is 2.687 with a p-value of 0.102.

• Since the p-value is greater than the significance level (α=0.05), there is no statistically significant difference in the total study based on Gender.

2. Qualification:

• The F-statistic is 2.247 with a p-value of 0.108.

• Similar to Gender, the p-value is greater than 0.05, indicating that there is no statistically significant difference in the total study based on Qualification.

3. Experience (Number of years):

• The F-statistic is 2.210 with a p-value of 0.088.

• Again, the p-value exceeds the significance level, suggesting that there is no statistically significant difference in the total study based on the Number of years of experience.

4. College Majoring:

• The F-statistic is 37.729 with a p-value less than 0.001 (indicated by 0.000*).

• The low p-value indicates a statistically significant difference in the total study based on College majoring. This is a notable finding, suggesting that the College major of teachers has a significant impact on the degree to which they employ the principles of BBL.

5. Error and Corrected Total:

The Error sum of squares is 20.363 with 237 degrees of freedom, and the Corrected Total sum of squares is 24.963 with 244 degrees of freedom.

In summary, the key finding is that the demographic variable "College Majoring" significantly influences the total study, while Gender, Qualification, and Number of years of experience do not show a statistically significant impact. The results provide valuable insights into the factors that may contribute to variations in the application of BBL principles among elementary school teachers.

The findings of this study align with recent research on subject-specific BBLP adoption. Mahmoud and Ali (2023), in a study of Egyptian elementary teachers, similarly reported that English instructors employed BBLP more frequently than their Arabic counterparts. They attributed this discrepancy to English curricula's inherent flexibility, which accommodates collaborative and experiential activities, whereas Arabic curricula often prioritize rote memorization. This echoes the current study's observation that English teachers in Irbid utilize systematic, scaffolded lessons (e.g., concept maps) more effectively. Conversely, Al-Rashdi's (2024) work in Oman challenges these findings, showing equitable BBLP application across subjects due to centralized training programs. This divergence underscores the influence of institutional support in shaping pedagogical practices.

Moreover, the minimal impact of demographic variables (gender, experience) on BBLP adoption resonates with Lee and Nguyen's (2023) conclusion that teacher mindset, rather than tenure or qualifications, is the primary predictor of BBLP implementation. Their study emphasized that educators with growth mindsets were more likely to experiment with brain-based strategies, regardless of experience level. This parallels the current study's observation that doctorate-holding teachers, though a small

subset, exhibited marginally higher BBLP adoption, potentially reflecting a proactive approach to professional development.

Discussion of the Results

Discussion of the First Research Question:

The findings of this study provide insights into the extent to which elementary school teachers of Arabic and English apply Brain-Based Learning (BBL) principles. According to the Ministry of Education's initiative since 2003, Arabic language teachers demonstrate a moderate level of BBL principle application. This reflects an emphasis on integrating modern strategies into curricula and teacher training. Teachers recognize the importance of linking new information to prior knowledge to facilitate meaningful learning. Nonetheless, a segment of teachers continues to rely on traditional pedagogical methods, which may hinder effective language acquisition. This discrepancy may be attributed to a focus on connecting information without adequately demonstrating its relevance in forming correct and comprehensive understanding.

Discussion of the Second Research Question:

The study reveals significant differences in the application of BBL principles among Arabic and English teachers in elementary schools in Irbid Governorate, influenced by variables such as gender, qualification, years of experience, and subject area. As shown in Table 4, uniformity in teaching practices may stem from shared professional

development and adherence to contemporary educational trends. Teachers employ strategies such as storytelling, humor, and emotional engagement to capture students' attention, in line with Salti's (2004) observations. Despite challenges such as large class sizes and limited resources, teachers prioritize maintaining student engagement, reflecting Jensen's (2005) emphasis on the importance of focus for enhanced learning outcomes. The diverse instructional methods used address various learning styles, facilitating interaction between both hemispheres of students' brains. However, occasional issues with lesson closure or preparation for subsequent sessions may arise due to insufficient planning, lack of clarity, or time constraints.

Discussion of the Third Research Question:

Table 7 provides statistical data on the participating teachers categorized by gender, qualification, years of experience, and subject area. The data are summarized as follows:

1. **Gender:**

- Female Teachers: Mean score of 3.574, standard deviation of 0.319.
- Male Teachers: Mean score of 3.666, standard deviation of 0.316.
- Combined Mean: 3.594, standard deviation of 0.320.
- The gender difference in BBL principle application is minimal, with male teachers showing a slightly higher but statistically insignificant tendency towards BBL principles. The score distribution is similar for both genders.

2. **Qualification:**

- Bachelor's Degree: Mean score of 3.558, standard deviation of 0.332.
- Master's Degree: Mean score of 3.577, standard deviation of 0.311.
- Doctorate Degree: Mean score of 3.698, standard deviation of 0.325.
- The level of qualification does not significantly impact the use of BBL principles, although teachers with Doctorate degrees have the highest average score.

3. **Years of Experience:**

- Less than 5 years: Mean score of 3.47.
- 5-10 years: Mean score of 3.48.
- 10-15 years: Mean score of 3.77.
- 15-20 years: Mean score of 3.46.
- More than 15 years: Mean score of 3.71.
- Overall Mean: 3.49.
- Teachers with 10-15 years of experience scored the highest, followed by those with over 15 years of experience.

These results indicate that demographic variables have a minimal impact on the application of BBL principles.

Discussion of the Fourth Research Question:

The study finds that Arabic teachers use BBL principles less frequently compared to English teachers, potentially due to a lack of interactive activities that engage both hemispheres of the brain. English teachers organize content systematically, advancing from simple to complex and from concrete to abstract concepts, utilizing concept maps and aligning with the Jordanian curriculum. This structured approach reflects a higher level of awareness and application of BBL principles among English teachers, highlighting their deeper understanding of the educational value of BBL. Gender differences are minimal, suggesting similar educational experiences for both male and female teachers. English teachers excel in delivering knowledge, fostering critical thinking, logical reasoning, and problem-solving skills, while also integrating historical perspectives into English education. Proficiency in language language is essential for effective communication, underscoring the importance of a language mindset (Salti, 2004; Khattash, 2015).

Conclusion & Recommendations

This study examined the application of Brain-Based Learning (BBL) principles among elementary school teachers in Jordan and their attitudes towards these principles. The research focused on teachers of Arabic and English, utilizing two instruments: one to measure the extent of BBL principle implementation and the other to assess attitudes towards BBL. The study aimed to contribute to the body of research on BBL by exploring its application in elementary education. The research addressed the following questions:

1. What is the level of adoption of BBL principles among

elementary school teachers in Irbid, Jordan, specifically those teaching Arabic and English?

2. Are there significant differences in the adoption rates and perceptions of BBL principles between Arabic language and English teachers?
3. What factors contribute to variations in teachers' adoption rates and perceptions of BBL principles, including gender, academic qualification, and teaching experience?
4. What recommendations can be made to enhance the integration of BBL principles among Arabic language and English teachers in elementary schools in Irbid, Jordan, and how can future professional development initiatives support this integration?

The results indicate that while Arabic Language teachers exhibit a moderate application of BBL principles, English teachers demonstrate a higher level of implementation. Significant differences were noted at the 0.05 significance level, favoring English teachers regarding their attitudes towards BBL principles. No significant disparities were found based on gender, academic qualification, or teaching experience.

Recommendations:

1. Conduct future research to develop a comprehensive guide for both Arabic Language and English teachers, detailing BBL principles and their application.
2. Design and implement Professional Development Training Programs that explain BBL concepts, highlight their importance, and offer practical strategies for effective implementation.
3. Undertake additional studies investigating the application of BBL principles among elementary teachers of other subjects and elementary school teachers to broaden understanding and application.

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