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Fostering Decision-Making and Ethics: Problem-Based Learning for Female Tertiary Learners in Israel

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Abstract: This study aimed to evaluate the impact of problem-based learning (PBL) within a teaching unit on the advancement of ethical reasoning and decision-making skills among Israeli female tertiary students. Employing a quasi-experimental design, 48 female students were distributed into three groups, with two serving as control groups receiving conventional curriculum-based instruction and one as an experimental group exposed to the PBL methodology. Both before and after implementation, all groups underwent assessments using a decision-making competency test and an ethical reasoning scale. The results unequivocally demonstrated the significant enhancement of decision-making abilities and ethical thinking through the implementation of the PBL strategy. Comparative analysis revealed substantial improvements in the experimental group compared to the control groups, emphasizing the efficacy of PBL in fostering comprehensive skill development. Furthermore, a positive correlation between ethical thinking and decision-making skills further reinforces the beneficial outcomes associated with PBL. These findings advocate for the widespread integration of PBL techniques across various academic disciplines.

Keywords: *Decision-making, developing a teaching unit, ethical thinking, problem-based learning.*

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Introduction

Unprecedented scientific advancements in the current day have brought about profound transformations in many dimensions of human existence (Tavanti, 2023). The technological revolution and the ensuing flood of information that permeated all knowledge strata are what characterize this era's rapid and ongoing changes (Assadi & Murad, 2017). Progressive educational systems have been forced by this dynamism to proactively adapt to these quick changes, which has called for strategic planning, a variety of program offerings, and the allocation of both human and financial resources to raise the standards of the educational process (Novalia & Malekpour, 2020).

The intricate interplay of political, social, educational, economic, and cultural factors has been notably magnified by the complexities of global dynamics (Goddard & Puukka, 2008). From the inception of the 20th century, challenges have escalated markedly, attaining a zenith of intricacy (Robertson & Wu, 2023). In navigating this milieu characterized by rapid changes, effective decision-making has emerged as an indispensable tool to address these burgeoning global issues (Howard-Hamilton et al., 2009). Decision-making, in this context, transcends randomness, embodying a purpose-driven strategy with clearly delineated objectives (Levy, 2022).

Decision-making is a complex cognitive process aimed at selecting the most favorable options or solutions within specific circumstances. (Heard et al., 2020). Decision-making requires a series of stages that involve a range of higher-order cognitive skills like analysis, appraisal, extrapolation, and deduction (Dickison et al., 2016). Because it depends on a variety of higher-order thinking abilities, researchers contend that decision-making can be seen as a component of complex cognitive processes, similar to problem-solving and conceptualization (Lombardi, 2023).

Concurrently, deviant behavioral patterns like egoism, anger, jealousy, and animus have increased around the globe, making the development of ethical reasoning essential for modern learners (Gould, 2014). The process through which people arrive at moral judgments and value orientations, separating right from wrong, is referred to as ethical thinking

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(Schank & Rieckmann, 2019). It is essential to moral growth and involves judging things and situations morally (Valverde-Berrocoso et al., 2021).

The ability to distinguish between morally right and wrong behavior is at the heart of ethical thought, which also involves building a framework of moral principles that govern moral behavior. A normative framework for choosing appropriate attitudes and activities is provided by this construct. Ethical reasoning plays a pivotal role in the moral growth of adolescents, as it fosters the cultivation of robust moral principles that enhance trust within a community. (Holmes et al., 2022).

The importance of ethical thinking is made clear by the enormous impact it has on each person's personality (Herman et al., 2020). The intersection of socialization and education with ethics, which are essential to both individual and societal well-being, encompasses human conduct and its ramifications for society (Howard-Hamilton et al., 2009). Moral principles create the foundation for societal continuity and stability, and ethical reasoning becomes a motivating factor.

A complex intellectual, psychological, and behavioral process, ethical reasoning and decision-making share a complex interplay (Zollo et al., 2017). To enable wise decision-making, this process comprises traveling through many possibilities, gathering in-depth knowledge about these options, and then selecting the best option (Lent & Brown, 2020).

Behavioral paradigms and cognitive frameworks have changed as a result of the complex history just outlined, and this has forced educators to consider new knowledge paradigms and give priority to highly successful teaching strategies. The traditional pedagogical methods fall short in achieving this; in order to be effective, the curriculum must include a variety of educational ideas. This change depends on incorporating cutting-edge ideas into educational modules, which will then permeate the practical aspects of learners' life (Pretorius et al., 2019).

The major research question that the study strives to answer is "How does the choice of teaching approach, specifically problem-based learning versus traditional methods, influence decision-making skills and ethical thinking, and is there a significant correlation between decision-making skills and ethical thinking?"

Literature Review

The modern period is seeing an unmatched scientific upheaval that is bringing about substantial changes in many aspects of human existence. This era is marked by rapid and ongoing changes that affect every aspect of life and are mostly caused by technology developments and the deluge of information from different fields of study (Lipson, 2020). As this dynamism takes shape, educational institutions are sincerely working to keep up with these quick changes by implementing novel tactics, broadening their program offerings, and investing resources to raise educational standards.

This age's complex evolution has given rise to a wide range of problems in the political, social, educational, economic, and cultural spheres (Assadi et al., 2019). Since the beginning of the 20th century, there has been an increase in problems, which has led to an unparalleled level of complexity (Assadi & Murad, 2017). Effective decision-making has therefore become a crucial tool for tackling the complex global concerns marked by quick changes (Ramírez-Montoya et al., 2021). Decision-making is a goal-driven process that seeks specified objectives, far from being a random activity.

The ability to make decisions involves a complex cognitive process designed to identify the most suitable alternatives or solutions within particular contexts, with the goal of achieving desired results. (Siebert et al., 2021). Given the intricacy inherent in decision-making, a sequential array of actions necessitates the application of diverse higher-order cognitive capacities, including analysis, appraisal, extrapolation, and deduction. Owing to its reliance on an array of sophisticated thinking abilities, decision-making is posited by researchers as constituting a constituent element of complex cognitive processes, akin to problem-solving and conceptualization (Ghanizadeh et al., 2020).

Simultaneously, this time period has seen an increase in aberrant behavioral tendencies like egoism, anger, envy, and animus, making it imperative for modern students to develop ethical reasoning as a crucial ability (Ramírez-Montoya et al., 2021). Methodologies for arriving at moral judgments and value orientations, separating right from wrong, are included in ethical reasoning (Lipson, 2020). It is integral to moral growth and involves morally assessing situations and things.

By establishing a framework of moral principles that serves as a guide for ethical behavior, ethical reasoning involves distinguishing between activities that are morally right and wrong (Kuenzi et al., 2020). It is essential to adolescent moral development because it instills solid moral values and promotes cooperation among members of society (Assadi & Kashkosh, 2022). A complex intellectual, psychological, and behavioral process, ethical reasoning also interacts with decision-making abilities (Assadi & Murad, 2017).

Due to these changes, educators must investigate novel paradigms for the dissemination of knowledge and give top priority to highly successful approaches (Lent & Brown, 2020).It has become essential to reform pedagogy that many educational concepts are incorporated into the curriculum (Assadi & Murad, 2017). This transformation depends on

incorporating cutting-edge ideas into educational modules and infiltrating learners' daily lives on a practical level (Pelletier et al., 2022).

The science, technology, society, and environment (STSE) approach stands out as a key channel for educational development in this situation (Pedretti, 2003). By producing responsible citizens who are able to handle global difficulties, this strategy addresses societal and environmental challenges (Blessinger & Carfora, 2015). Another well-known pedagogical technique is problem-based learning (PBL), which involves students in real-world issues to promote active learning and practical application (Silva et al., 2018). The main component of this strategy is problem-solving, which is intrinsic to PBL and entails applying newly learned knowledge and abilities to address novel problems (Savery, 2006).

The combination of the STSE approach and PBL shows promise for improving students' capacity for ethical reasoning and decision-making (Plummer et al., 2022). PBL has a good effect on a variety of cognitive skills, including problem-solving and critical thinking, according to prior study (Alvionita et al., 2020). The intersection of these educational strategies offers a cutting-edge way to foster rounded competencies in line with the complexity of the modern world (Andersen et al., 2019).

Study Objectives

The current study sought to achieve the following objectives:

1. Identifying the effect of applying a problem-based learning approach to decision-making and ethical thinking skills.
2. Identifying the correlation between the skills of decision-making and ethical thinking.

Study Questions

The study sought to achieve its objectives by answering the following questions:

1. Are there statistically significant differences at the level of significance ($\alpha = .05$) between the means of the performance of the two experimental groups and the control group in decision-making skills attributable to the teaching approach (problem-based learning, traditional)?
2. Are statistically significant differences at the significance level ($\alpha = .05$) between the means of the experimental and control groups' performance in ethical thinking attributable to the teaching approach problem-based learning (traditional)?
3. Is there a statistically significant correlation at the level of significance ($\alpha = .05$) between decision-making skills and ethical thinking?

This study aims to assess the impact of problem-based learning PBL on ethical decision-making among female tertiary students in Israel. The research questions are carefully crafted to fulfill this objective. The initial inquiry assesses the average performance levels of both the experimental and control groups, evaluating the effectiveness of problem-based learning (PBL) in improving decision-making skills. The second question delves into ethical reasoning, exploring whether PBL significantly differs from conventional teaching methods in shaping this aspect. Recognizing the interconnectedness of ethical reasoning and decision-making, the third question investigates their relationship. These inquiries are designed to systematically unveil PBL's specific contributions to the development of cognitive skills in the context of Israeli female tertiary education.

The prior paragraph provides a succinct overview of the study's objectives and research questions, outlining the focus on assessing the impact of problem-based learning (PBL) on ethical decision-making among female tertiary students in Israel. It highlights the structured approach of the research questions, emphasizing comparisons between experimental and control groups, as well as the examination of PBL's effectiveness in enhancing ethical reasoning. The paragraph also underscores the interconnectedness between ethical reasoning and decision-making while emphasizing the significance of uncovering PBL's specific contributions to cognitive skill development in this context.

Significance of the Study

This study carries both theoretical and applied significance. The theoretical value resides in its examination of problem-based learning's contemporary teaching approach and its impact on pivotal elements such as decision-making and ethical reasoning. By constructing a comprehensive theoretical framework for problem-based learning, the study not only contributes to future research initiatives but also enriches Arabic literature in these critical domains. Moreover, it represents a pioneering initiative in addressing problem-based learning within Arab societies, thereby augmenting educational research and methodologies. Conversely, the applied significance is evident in the study's potential tools, which hold utility for analogous investigations in diverse societal contexts.

The study's outcomes and recommendations serve as valuable resources for researchers, stakeholders, and decision-makers. Moreover, the research aims to guide educational institutions, educators, and specialists in implementing strategies that foster decision-making skills and ethical thinking in students. The findings demonstrate how well female tertiary students' decision-making and ethical reasoning are improved by problem-based learning (PBL). Scholars may utilize these results to investigate PBL in various academic fields, and educators may think about incorporating PBL into their curricula to enhance students' skill development. Furthermore, the necessity for integrated educational approaches is shown by the favorable association that has been found between ethical thinking and decision-making.

Conceptual and Procedural Definitions

The study encompasses pivotal concepts, notably the Problem-Based Learning PBL approach—an educational strategy exposing students to novel problems in unfamiliar contexts, stimulating intellectual engagement for the evaluation and selection of optimal solutions (Dakabesi & Luoise, 2019). Operationally, the research employs a science curriculum module titled "Fire and Diabetes" to investigate how PBL influences the development of decision-making and ethical reasoning abilities.

Decision-making abilities, conceptualized as intricate cognitive processes directed towards selecting the most pragmatic alternatives to achieve specific objectives, are practically measured through student responses to fifteen diverse scenarios. Ethical thinking, described as a systematic logical process guiding decision-making in moral dilemmas and aligning behavior with societal norms (Macfarlane, 2004), is operationally defined as the cognitive process employed by college students to assess and make ethical decisions.

The existing literature in the field emphasizes how complicated global issues are becoming and how important it is to have the ability to make ethical decisions and think critically when faced with these difficulties. Nonetheless, a research vacuum exists in the scant investigation of the precise influence of problem-based learning PBL on the concomitant enhancement of ethical reasoning and decision-making skills among Israeli female tertiary students. Previous research frequently ignores the interdependence of these cognitive processes by concentrating on either ethical reasoning or decision-making in isolation. In order to fill this knowledge vacuum, this study will look at the synergistic impacts of PBL on ethical thinking and decision-making. This will provide researchers a full understanding of how this pedagogical approach supports the development of all necessary skills.

An overall assessment of the presented studies shows that the article provides a thorough analysis of the difficulties brought about by the continuous scientific revolution in the modern period, highlighting the necessity for educational institutions to quickly adjust by implementing novel strategies and increasing the scope of their program offerings. It deftly draws attention to the growing complexity of global concerns and emphasizes the importance of sound decision-making as a key strategy for tackling these complex problems. The story deftly blends the growth of moral thinking with decision-making, acknowledging that kids must learn to deal with abnormal behavioral inclinations. Problem-based learning PBL and the Science, Technology, Society, and Environment (STSE) approach are introduced as pedagogical tools that add depth and provide a strong justification for their inclusion in the curriculum.

Methodology

Students who were actively engaged in problem-based learning (PBL) collaborated in groups to solve problems, engaged in critical analysis of ethical dilemmas, and explored various perspectives. It is probable that students proactively identified and researched issues while working in small groups to address real-world scenarios. The focus on systematic thinking motivated by moral issues implies that pupils participated actively in deliberate decision-making. Furthermore, the transformative shift alluded to suggests that students were not merely passive users but rather actively participated in creating and processing knowledge, which enhanced their capacity for making decisions.

To achieve the study's objectives, a quasi-experimental approach was used through two quasi-experimental designs (prior post-design) for three unequal groups, and the groups were randomly assigned.

To answer the first question, a design consisting of two unequal groups, one experimental and the second control group, was created. The first experimental group was taught through the problem-based learning approach, while the control group was taught traditionally. The decision-making skills of the two groups were measured before and after treatment and according to the following experimental design:

In the assessment of decision-making aptitude (O1), the study employed distinct instructional methodologies for various groups. The second group was instructed using the problem-based learning approach (X1), a pedagogical strategy focused on fostering critical thinking and collaborative problem-solving. In contrast, the third group received instruction through the conventional method (-), which typically involves traditional didactic teaching techniques. The first experimental group (EG1) experienced the problem-based learning approach, while the second control group (EG2) adhered to the conventional teaching method. These diverse teaching methods were implemented to evaluate and compare their effects on enhancing decision-making skills.

A design consisting of two unequal groups (experimental and control groups) was created to answer the second question. The first experimental group was taught the problem-based learning approach, while the control group was taught the traditional way. The ethical thinking of the two groups was measured before and after treatment and according to the following experimental design:

The primary objective (O1) of this study was to assess participants' decision-making abilities. To achieve this, two distinct teaching approaches were employed among different groups. The first group was instructed using the problem-based learning approach (X1), a pedagogical strategy known for its emphasis on critical thinking and collaborative problem-solving. Conversely, the second group received traditional method instruction (X2), which typically involves conventional didactic teaching techniques. The study constituted two key groups: the first experimental group (EG1), which underwent the problem-based learning approach, and the second control group (EG2), subjected to traditional teaching methods. By implementing these diverse instructional methodologies, the research aimed to analyze and compare their impact on enhancing participants' decision-making skills.

Students in the first experimental group (EG1) of the study actively participated in group problem-solving and critical thinking exercises after being introduced to the problem-based learning (PBL) approach (X1). As they tackled real-world issues in small groups, they promoted independence and self-reliance in making decisions. Instructors in EG1 took on a supportive and facilitating role, assisting students as they worked through the PBL process and promoting careful examination of ethical issues in decision-making. Students in the second control group (EG2), on the other hand, who were taught using conventional methods (X2), engaged in more didactic learning activities and learned material through lectures and planned classes.

Instructors in EG2 used traditional teaching methods, presenting material in a more ordered way. Both students and teachers participated in the data collection and analysis stages of the correlational approach used to study the relationship between ethical thinking and decision-making abilities. This allowed for a thorough understanding of the educational effects of the various teaching philosophies.

To answer the third question, a correlational approach was used to investigate the relationship between decision-making skills and ethical thinking.

Study Population and Sample

The study community consisted of all the female students in the second year at Sakhnin College for Arab Teachers Qualification in Israel. It consisted of 60 students studying to obtain a teacher certificate qualified to teach science at the primary level in the Department of Curricula and Methods of Teaching Science in the academic year (2019-2020).

The study sample was selected by selecting 48 female students from the study population and by using the simple random method, with a percentage of 80% from the entire study population.

Study Tool

This research presents an ethical decision-making assessment focused on biology-related scenarios, consisting of 15 questions categorized into five main areas. Each scenario delves into intricate moral dilemmas, accompanied by pertinent questions and open-ended inquiries. Influenced by ethical principles such as compassion, equity, honesty, integrity, confidentiality, and humanitarianism, the test aims to evaluate individuals' competency in making ethical decisions. Drawing from a variety of references, the framework emphasizes subjective interpretations rather than the pursuit of absolute answers. The evaluation encompasses various ethical situations spanning environmental, societal, technological, and scientific domains, including genetically modified foods, animal behavior, end-of-life decisions, resource extraction, bioengineering, cultural customs, the trade in illicit substances, assisted reproduction, the effects of urbanization, disease research, sustainable energy, biological exploration, and wildlife trade.

Validity and Stability of the Decision-Making Test

To ensure the structural reliability of the decision-making test, an initial sample of 12 participants was utilized, calculating correlation coefficients between individual case complexities and the overall test score. Content validity was confirmed through evaluation by a panel of 10 experts from reputable institutions. This panel critically assessed the accuracy and appropriateness of the test's content, leading to linguistic refinements based on their feedback. Construct validity was further established in an exploratory subgroup of 12 participants, involving calculations of Pearson correlation coefficients (R1) between individual case complexities and the cumulative test complexity score, as well as the corrected item-total correlation (R2) between individual case complexities and the overall test score, detailed in Table (1).

Table 1. Relationship Between Case Degree and Total Test Degree in Decision-Making Test: Correlation Coefficients (R1) and Adjusted Correlation Coefficient (R2)

Issue Order	R1	R2
1st	.822**	.7
2nd	.837**	.73
3rd	.783**	.64
4th	.755**	.61
5th	.742**	.62
6th	.804**	.71
7th	.802**	.71
8th	.755**	.64
9th	.815**	.73
10th	.779**	.66
11th	.685**	.52
12th	.755**	.63
13th	.780**	.67
14th	.764**	.64
15th	.710**	.56

** Statistically significant at (p <.01).

As noted in Table 1, the correlation coefficients ranged between the degree of the issue and the total degree for the decision-making test from .685 to .837, all of which are statistically significant at the level of significance (p <.01), and higher than the cut-off point .35. The corrected correlation coefficients ranged between the degree of the issue and the total degree of the decision-making test from .519 to .730, all of which are higher than the cut-off point .30, and this indicates homogeneity is present. Functionally in students' performance on the test paragraphs, in other words, the test has an acceptable degree of construct validity.

Evaluation of the Decision-Making Test

The following model was adopted to correct the decision-making test, which was developed according to what has been found in the theoretical literature and related studies, such as the Association of American Colleges and Universities website. A rubric rating scale was prepared, as shown in Table 2, after monitoring the ethical considerations that were covered by the respondent and adopted by the researcher in the study:

Table 2. Grading Criteria Scale for Crafting the Decision-Making Test

Statement	Low degree (two marks)	Medium degree (four marks)	High degree (six marks)
The skill to assess and comprehend the circumstances	The student lacked knowledge about possible ethical concerns	The student recognizes certain ethical issues but struggles to analyze them accurately	The student grasps significant ethical issues in the situation and applies learned standards in analysis.
Identifying the individuals involved in the scenario	The student struggles to identify the individuals involved in the scenario.	The student recognizes the parties in the situation but doesn't utilize them in their approach	The student recognizes the involved parties and fully adopts their viewpoints in their thinking
Evaluating options and anticipated outcomes	The student failed to apply the ethical principles she acquired in order to discern alternatives and potential results	The student's choices revolve around a single ethical principle she has been taught	The student presents several options, utilizing a variety of ethical principles
Decision Making	The student struggles to ascertain a suitable choice	The student makes a choice without drawing upon any particular ethical guideline	The student reaches her decision guided by the ethical principles she has acquired

Test of Ethical Thinking

This study adapted the ethical thinking test through a meticulous review of relevant theoretical literature and prior research, drawing on sources such as Assadi and Kashkosh (2022), Assadi and Murad (2017), Holmes et al. (2022), Pedretti (2003), Pelletier et al. (2022), Plummer et al. (2022), Pretorius et al. (2019), and Ramírez-Montoya et al. (2021).

Aligned with Kohlberg's theoretical framework, the modified test places a heightened emphasis on response-based evaluation and ethical comprehension within a moral context. Complex scenarios are presented, eliciting moral conclusions consistent with Kohlberg's ethical stages. Participants select from six randomly generated responses corresponding to Kohlberg's stages and articulate their justifications. The test comprises five scenarios, each with varying question numbers, capturing nuanced ethical development levels marked incrementally from one to six. To ensure the ethical thinking test's validity and stability, a pilot sample of 12 participants underwent assessment, with correlation coefficients computed between individual case complexities and the overall test score, as well as the adjusted correlation coefficient between individual case complexities and the total test score.

Table 3. Associations Between Scenario Intensity and Overall Test Score (R1), and Coefficient Along With Adjusted Correlation of Scenario Intensity With Total Test Score (Corrected Item-Total Correlation) (R2) in the Ethical Thinking Examination

Issue	**R1**	**R2**
First	.737 **	.56
Second	.751 **	.58
Third	.806 **	.74
Fourth	.796 **	.71
Fifth	.699 **	.69

**Statistically significant at the level of p <.01.

As noted in Table 3, the correlation coefficients between the degree of the situation and the overall degree of the ethical thinking test ranged between .699 and .806. All of them were statistically significant at the level of significance (p <.01), and higher than the cut-off point of .35. The correctional correlation coefficients ranged between the degree of the situation and the overall degree of the decision-making test from .563 to .736, all of which are greater than the cut-off point 0.30, and this indicates that there is functional homogeneity in the performance of students on the test paragraphs, in other words, the test has an acceptable degree of construct validity.

Evaluation of the Test of Ethical Thinking

The correction test shown in Table 4 was adopted according to the order of thinking stages by Kohlberg regarding the options that the study sample was asked to answer.

Table 4. Ethical Thinking Test Adjustment Assessment

First scenario								
Question No.	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**
First question	A	5	Third question	A	2	Fifth question	A	5
	B	1		B	4		B	2
	C	4		C	1		C	1
	D	2		D	6		D	3
	E	6		E	3		E	4
	F	3		F	5		F	6
Second question	A	2	Fourth question	A	2			
	B	1		B	6			
	C	3		C	5			
	D	4		D	1			
	E	5		E	4			
	F	6		F	3			

Table 4. Continued

Second Scenario								
Question No.	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**
First question	A	5	Fourth question	A	5	Seventh question	A	4
	B	3		B	3		B	3
	C	1		C	2		C	2
	D	4		D	1		D	1
	E	2		E	4		E	6
	F	6		F	6		F	5
Second question	A	4	Fifth question	A	3	Eighth question	A	5
	B	1		B	4		B	1
	C	6		C	1		C	6
	D	2		D	6		D	2
	E	5		E	2		E	4
	F	3		F	5		F	3
Third question	A	3	Sixth question	A	4	ninth question	A	4
	B	1		B	5		B	2
	C	4		C	1		C	3
	D	2		D	6		D	1
	E	5		E	2		E	6
	F	6		F	3		F	5
Third scenario								
Question No.	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**
First question	A	4	Second question	A	4	Third question	A	5
	B	5		B	1		B	6
	C	6		C	5		C	1
	D	1		D	6		D	3
	E	3		E	2		E	2
	F	2		F	3		F	4
Fourth scenario								
Question No.	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**
First question	A	3	Second question	A	5			
	B	4		B	2			
	C	5		C	1			
	D	1		D	3			
	E	6		E	6			
	F	2		F	4			
Fifth scenario								
Question No.	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**	**Question No.**	**Answer No.**	**Degree**
First question	A	2	Second question	A	4			
	B	6		B	5			
	C	3		C	1			
	D	5		D	6			
	E	1		E	2			
	F	4		F	3			

Stability of Moral Decision-Making and Thinking Tests

To verify the consistency of the decision-making and ethical thinking tests, they were applied and re-applied to a sample of 12 participants from outside the study sample. Table 5 shows the coefficients of internal consistency stability by the Cronbach alpha method and the stability coefficient of stability (test and retest).

Table 5. Coefficients of Reliability for Internal Consistency and Stability Index for Decision-Making and Ethical Reasoning Assessments

Test	Stability Coefficient	Stability of Retest
Decision-making skills	.79	.78
Ethical thinking	.81	.82

As can be seen from Table 5, the Cronbach alpha reliability coefficient of the decision-making test was .79 and the retest stability coefficient .78, which is higher than the cut-off point .70, indicating that the decision-making test has an acceptable degree of reliability. The Cronbach Alpha Reliability Coefficient of the Ethical Thinking Test was .81, and the Retest Reliability Coefficient was .82, which is higher than the Cut-off point .70. This indicates that the Ethical Thinking Test has an acceptable degree of reliability.

The Educational Material

The goals of the study were achieved by a methodical procedure. First, important subtopics and indicators were extracted from the biology and ecology content of the elementary science curriculum. The development of a problem-based learning unit with an emphasis on diabetes and forest fires followed. The control group received this lesson using conventional means, while the experimental group received it utilizing problem-based learning. Understanding causes and effects, fostering attitudes, offering solutions, and encouraging responsible conduct were all objectives of the forest fire section. The section on diabetes sought to understand its numerous kinds, causes, effects, and ethical implications. Over the course of 18 hours, different teaching techniques, including brainstorming, discussion, questions, group work, and dialogues, were used, adapting to pandemic restrictions through remote solutions like Zoom and Classroom apps.

Findings

This chapter presents the outcomes of the study, which aimed to investigate the influence of a problem-based learning program on enhancing decision-making skills and ethical thinking among Israel's college students. The findings are methodically presented with respect to the research questions. The initial question examines significant differences in the average performance of the experimental and control groups in decision-making skills due to the teaching approach. To address this, the means and standard deviations of both groups' decision-making skill performances were calculated based on the teaching approach (problem-based learning and traditional), as outlined in Table 6.

Table 6. Mean and Standard Deviation of Pre- and Post-Performance Scores for Decision-Making Skills across Three Groups

Teaching approach	Prior performance		Post-performance	
	Mean	Standard Deviation	Mean	Standard Deviation
Problem-based learning	42.063	3.696	75.563	5.452
Traditional	43.188	9.16 7	53.313	8.987
Total	43.604	7.085	68.667	12.623

* Highest degree (90)

Table 6 reveals obvious distinctions in the mean performances of the two groups (experimental and control) based on the teaching approach (problem-based learning, traditional). Specifically, the mean performance of the problem-based learning group surpasses that of the traditional control group in decision-making skills. Notably, the mean performance of the science, technology, society, and environment subgroup also exceeds that of the problem-based learning group in decision-making skills. To assess the significance of post-performance differences between the groups in decision-making skills, controlling for prior performance impact, Analysis of Covariance one-way ANCOVA was employed, as detailed in Table 7.

Table 7. Outcomes of the Consequent One-Way Analysis of Covariance (ANCOVA) for Evaluating Significance in Variation Among the Three Groups' Decision-Making Skill Performance While Accounting for Prior Performance Influence.

Source of variance	Squares sum	Degrees of freedom	Squares average	Value *F*	*p* value	ETA square
The pretest	70.748	1	70.748	1.789	.188	.039
Teaching-approach	5730.939	2	2865.469	72.444	.000	.767
Error	1740.377	44	39.554			
Total	233814	48				
Adjusted total	70.748	47				

It is noted from Table 7, that there are statistically significant differences at the level of significance (α =.05) between the average performance of the two groups (experimental and control) in decision-making skills. In order to compare the

performance averages of the two groups (experimental and control) after adjusting the effect of prior differences in decision-making skills, the adjusted means of the performance of the two groups in decision-making skills were calculated, as shown in Table 8.

Table 8. Mean and Standard Deviation of Decision-Making Skill Performance for the Three Groups Before and After Addressing Prior Disparities

Group	Before Adjustment		After Adjustment	
	Means	Standard Deviation	Means	Standard Deviation
Problem-based learning	75.563	5.452	75.29	1.585
Traditional	53.313	8.987	53.239	1.573

Table 8 illustrates notable disparities in the mean performances of the three groups regarding decision-making skills, favoring the experimental group. The outcomes of the one-way ANCOVA analysis indicate that the problem-based learning educational program exerts a statistically significant impact on enhancing decision-making skills, accounting for 76.7% of the variance in this skill domain.

Table 9. Bonferroni Examination Findings for Post Hoc Contrasts Amid the Aligned Mean Averages of Decision-Making Skills across the Three Groups, Based on the Pedagogical Methodology

Teaching Approach	Adjusted Means	Problem-Based Learning	Traditional
Problem-based learning	75.29	----	24.233 *
Traditional	53.239	-----	---

*Statistically significant at the level of p <.05.

The outcomes from the Bonferroni test for post hoc comparisons, as detailed in Table 9, reveal a statistically significant divergence in mean performances between the problem-based learning group and the traditional learning group, with a notable advantage favoring the former. This consolidates the substantial impact of the problem-based learning approach in augmenting decision-making skills. In addressing the second research question concerning disparities in ethical thinking among the experimental and control groups, mean performances and standard deviations for ethical thinking were computed for both groups based on the teaching approach (problem-based learning and traditional), elucidated in Table 10.

Table 10. Mean and Standard Deviation of Pre- and Post-Performance Scores for Ethical Thinking Skills Across Two Groups

Teaching approach	Prior performance		Post-performance	
	Mean	Standard deviation	Mean	Standard deviation
Problem-based learning	78,000	3.847	112.75	3.044
Traditional	72.75	3.804	84.563	3.916
Total	76.563	5.027	101.583	13.037

*Highest degree(126)

Table 10 reveals evident disparities in the mean performances of the two groups (experimental and control) in ethical thinking based on the educational approach variable (problem-based learning, traditional). The mean performance of the problem-based learning group surpasses that of the traditional control group in ethical thinking. Additionally, the problem-based learning group's mean performance in ethical thinking outpaces that of the science, technology, society, and environment subgroup. To evaluate the significance of post-performance differences in ethical thinking among the three groups, controlling for prior performance influence, the one-way ANCOVA was employed. The results of this analysis are presented in Table 11, evaluating the significance of performance differences while considering the impact of prior performance.

Table 11. Outcomes of One-Way ANCOVA for Examining Significance in Variation Among the Three Groups' Ethical Thinking Performance While Accounting for Prior Performance Impact

Variation Source	Squares Sum.	Degrees of Freedom	Squares Average	F Value	p Value	ETA Square
The pretest	8.545	1	8.545	.47	.497	.011
Teaching-oriented	5457.934	2	2728.967	150.03	.000	.872
Error	800.33	44	18.189			
Total	503308.000	48				
Adjusted total	7987.667	47				

It is noted from Table 11, that there are statistically significant differences (α =.05) between the average performance of the two groups (two constituting the experimental group, and a single group constituiting the control counbterpart) which are referred to as (experimental and control) in ethical thinking. Therefore, to compare the performance averages of the two groups (experimental and control) after adjusting the effect of prior differences in ethical thinking, the modified mean of the performance of the two groups in ethical thinking were calculated. Table 12 shows the means and standard deviations of the performance of the two groups in ethical thinking before and after adjusting prior differences.

Table 12. Mean and Standard Deviation of Ethical Thinking Skill Performance for the Two Groups Before and After Addressing Pre-existing Disparities.

Group	Before adjustment		After adjustment	
	Mean	Standard Deviation	Mean	Standard Deviation
Problem-based learning	112.75	3.044	112.896	1.087
Traditional	84.563	3.916	84.176	1.206

Table 12 indicates a favorable difference in ethical thinking performance averages for the experimental group compared to the control group. The one-way ANCOVA results highlight a statistically significant effect of the problem-based learning approach on ethical thinking development, elucidating an impressive 87.2% variance explanation. The Bonferroni test for Post-Hoc comparisons, detailed in Table 13, unveils bilateral differences in ethical thinking means between the two groups, categorized by the teaching approach variable (problem-based learning and traditional learning).

Table 13. Bonferroni Examination Outcomes for Post-Hoc Contrasts Among the Adjusted Mean Averages of Ethical Thinking Within the Two Groups, Based on the Pedagogical Methodology.

Teaching Approach	Adjusted Means	Problem-Based Learning	Traditional
Problem-based learning	112.896	----	28.720
Traditional approach	84.176		

* Statistically significant at the level of (p =.05)

Table 13 demonstrates significant differences favoring the problem-based learning group in ethical thinking outcomes, as indicated by the Bonferroni test for post-hoc comparisons. This reinforces the notable impact of the problem-based learning approach on ethical thinking development. Regarding the third research question, a Pearson correlation coefficient was computed to assess the connection between decision-making skills and ethical thinking. The calculated correlation coefficient is presented in Table 14, offering insights into the relationship between these two skill domains.

Table 14. Pearson Correlation Coefficient Between Decision-Making Test Scores and Ethical Thinking Test Scores.

Dependent Variable	Pearson Correlation Coefficient	Statistical Significance
Decision-making skills Ethical thinking	.813	.01

It is noted from Table 14 that there is a positive statistically significant relationship between the degrees on the decision-making test and the degrees on the ethical thinking test; in other words, the degrees for decision-making skills increase with the increase in the degrees of ethical thinking.

Discussion

This chapter provides a comprehensive analysis and interpretation of the study's findings, which aimed to unveil the transformative impact of an educational program grounded in problem-based learning principles on the enhancement of decision-making skills and ethical thinking among students in Israel's colleges.

The findings of the study unambiguously confirm the significant contribution of the problem-based learning methodology to the development of strong decision-making abilities (Alvionita et al., 2020). This effectiveness is supported by the method's extraordinary capacity to increase students' motivation; which was not thouroughly examined in this study, but observed in the practical behavior of the study's population, which gives them a renewed sense of confidence and is consistent with the findings of (Assadi & Murad, 2017). This increased commitment motivates students to actively interact with complex problems, sharpening their ability to solve complexities accurately and safely (Blessinger & Carfora, 2015). According to Dickison et al. (2016), the use of problem-based learning also intimately nourishes learners' cognitive landscape, enabling them to master both creative thinking and the purposeful use of a scientific analytical approach.

According to the research of Savery (2006), a crucial aspect of this achievement is related to the paradigm change brought about by problem-based learning. Students are propelled from their conventional position as passive knowledge consumers to that of active participants in their own educational process. In pursuit of knowledge production, a step

necessary for well-informed and successful decision-making, students are empowered by this transformative journey (Assadi *et al.*, 2019). This alignment of approaches supports Lombardi's (2023) claim that problem-based learning has a powerful impact on developing decision-making ability.

Additionally, problem-based learning grants students greater autonomy and self-reliance that go beyond traditional pedagogical norms, giving them enhanced abilities in critical analysis and discernment (Kuenzi et al., 2020). The ability of the problem-based approach to pique students' interest and encourage them to strategically use information resources serves as evidence of its effectiveness in improving the educational experience (Plummer et al., 2022).

When problem-based learning PBL was being implemented, students had the opportunity to actively participate in cooperative and independent learning activities. They may have worked in small groups to address issues in the real world, using their critical thinking and discernment abilities to consider various approaches. Students most likely assumed responsibility for seeking pertinent information sources, performing research, and applying their findings to meet the given difficulties thanks to the autonomy afforded by the PBL approach. The focus on independence and the intelligent use of information resources implies that students in the PBL group would have been motivated to look for different viewpoints, resulting in a more in-depth comprehension of the subject.

The study underscores significant differences in ethical thinking performance between the experimental and control groups, aligning with the findings of Siebert et al. (2021) and emphasizing the pivotal role of the problem-based learning program in nurturing ethical acumen. This trend is attributed to the program's facilitation of active engagement with pertinent ethical and social challenges, contributing to the maturation of ethical reasoning, a pattern consistent with the broader insights from (Heard et al., 2020). The inseparable link between proficient decision-making and ethical thinking is reinforced within the framework of problem-based learning, as corroborated by (Kuenzi et al., 2020), echoing the conclusions drawn by (Holmes et al., 2022; Zollo et al., 2017). Through diligent exploration of ethical considerations and exposure to diverse viewpoints, students are equipped to make informed decisions, solidifying an organized and ethically-driven thought process in this intricate interplay.

The study's findings unquestionably reveal that the problem-based learning strategy has a statistically significant impact on promoting the development of decision-making abilities, which is supported by the research of (Alvionita et al., 2020). As also demonstrated by Assadi and Murad (2017), the effectiveness of this technique resides in its capacity to increase learners' motivation levels and build a sense of confidence. As a result, students are encouraged to actively recognize and investigate problems, which improves their capacity to successfully solve these problems (Blessinger & Carfora, 2015). Additionally, problem-based learning fosters learners' ability to think creatively and analyze information using scientific principles (Dickison et al., 2016).

This result can also be linked to the transformative shift brought about by problem-based learning, which makes students active participants rather than passive users of knowledge (Savery, 2006). This change equips students with the skills necessary to methodically build and digest knowledge, which supports sound decision-making (Assadi et al., 2019). This is consistent with Pelletier et al.'s (2022) claims that problem-based learning improves decision-making skills.

Additionally, the problem-based learning approach fosters greater autonomy and self-reliance than traditional teaching methods, giving students the ability to critically analyze and make judgments based on evidence (Kuenzi et al., 2020). The ability of problem-based learning to hold students' attention and encourage the strategic use of information is what makes it an effective teaching method (Plummer et al., 2022; Ramírez-Montoya et al., 2021).

The study's findings show that the experimental group performed ethically better than the control group on average, with statistically significant differences between the two groups (Siebert et al., 2021). This emphasizes how important the problem-based learning approach is in promoting ethical thinking. The ability of problem-based learning to encourage student engagement with relevant issues may be responsible for this tendency (Heard et al., 2020).

Students' dedication to structured thinking informed by ethical considerations strengthens the relationship between ethical thinking and sensible decision-making (Kuenzi et al., 2020). Moral judgment is guided by ethical thought, which acts as a cognitive and affective framework (Holmes et al., 2022; Zollo et al., 2017).

Additionally, the problem-based learning capacity to promote objective and logical examination of situations is credited for the symbiotic relationship between decision-making and ethical thinking (Lombardi, 2023; Siebert et al., 2021). The emphasis on cognitive development, which is consistent with the ideas of Lent and Brown (2020), is what leads to the convergence of ethical reasoning and decision-making.

Conclusions

The analysis and interpretation of the research data highlight the transforming influence of the problem-based learning approach on encouraging ethical thinking and decision-making among female college students. Leveraging the powerful connection between these components, the researcher offers useful recommendations for putting these findings into practice in the classroom. This suggests concrete suggestions for teachers to apply problem-based learning techniques

that specifically improve ethical reasoning and decision-making abilities, resulting in a more workable framework for use in educational environments.

Recommendations

Based on the findings of this study, several recommendations emerge for educators, researchers, and educational institutions seeking to enhance ethical reasoning and decision-making skills among tertiary students using problem-based learning (PBL) techniques.

1. *Implementation in Diverse Contexts:* Extend the application of problem-based learning (PBL) methodologies beyond the current study's context.
2. *Faculty Development:* Provide training and resources to educators to design and implement PBL modules effectively.
3. *Longitudinal Studies:* Conduct longitudinal studies to track the enduring impact of PBL on ethical reasoning and decision-making skills. The studies could include both school and university levels with a focus on literary subjects where laboratory and field practices are not normally a part of the educational process. The studies could also include students of all genders, with more attention to special education students, who could, in fact, benefit greatly from such scenarios.
4. *Interdisciplinary Collaboration:* Foster collaboration between educators from various disciplines to exchange insights and experiences related to PBL implementation.
5. *Ethical Dilemma Diversity:* Incorporate a range of ethical dilemmas in PBL scenarios to ensure students are exposed to various challenges.
6. *Mixed-Methods Evaluation:* Utilize mixed-methods approaches to evaluate the effectiveness of PBL.
7. *Educational Policy Integration:* Advocate for the integration of problem-based learning techniques in educational policies and curricula.
8. *Assessment Alignment:* Align assessment strategies with PBL objectives.

Conflict of Interest

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