Impact of EPSS Supported Instruction on Ethical Decision Making and Theoretical Computer Ethics

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Abstract – The concept of Electronic Performance Support Systems (EPSS) has been created to refer to systems that provide general support. This study focuses on the impacts of the BILEP system, an EPSS, on students' learning in a computer ethics class. Realizing that there is lack of research done on evaluating EPSS in terms of educational value in relation to ethical decision-making skills and theoretical knowledge, this study sought to establish the effectiveness of EPSS in improving the skills. This research employed a quasi-experimental design, which included 40 participants grouped into the experimental group and the control group. The experimental group was taught using the newly developed BILEP system and the control group was taught in a traditional method. Knowledge was evaluated before and after the intervention regarding Ethical Decision Making (EDM) and Theoretical Computer Ethics (TCE). The t-tests and Mult-variate Analysis of Variance (MANOVA) showed the significant improvement of both groups, while the experimental group demonstrated the greater improvement in ethical decision-making skills, but not in the TCE. We concluded that practices that are supported by EPSSs enhance ethical resolution skills, which is in line with the performance-based nature of EPSSs, and, at the same time, traditional approaches are as effective in enhancing theoretical knowledge. Therefore, our findings highlight the implementation of EPSS tools in ethics education to promote practical application skills.

Keywords – Electronic Performance Support System, Educational Evaluation, Educational Intervention, Internet-Based Communication Features, Multivariate Analysis of Variance, Ethical Decision Making.

I. INTRODUCTION

The sub-standard academic achievement of students is a matter of worry and is shown in the below-average rates of graduation [1]. A matter of specific concern is the subpar graduation rate attained by students hailing from educationally and socially deprived families. Tertiary institutions have implemented several academic progress programs and courses to help students achieve their maximum academic capabilities in response to this issue. The objective of an academic progress course in finance and computer science, as observed in [2], is to empower underprivileged students to enhance their quantitative, writing, learning, and study abilities. This will enable them to attain success in a specific course and in future courses in typical economics and computer engineering. Furthermore, they are specifically crafted to enhance the pupils' comprehension of the subject matter.

Nevertheless, there has been a lack of extensive research conducted to evaluate the efficiency of educational intercessions in improving the academic performance of students enrolled in academic progress courses across several disciplines. Educational evaluation [3] is the methodical assessment of the excellence of instruction and acquisition. Evaluation plays a crucial role in shaping and modifying curricula in various ways. Essentially, evaluation aims to assist medical educators in enhancing education [4]. Evaluation can serve either a formative function, by identifying areas in which teaching can be enhanced, by assessing the success of teaching. While educational assessment employs comparable methodologies and tools as educational study, the findings of study are more applicable to a wider context and greater emphasis is placed on the interpretation of assessment outcomes. It is important to distinguish among assessment, evaluation, and monitoring. Assessment pertains to the criteria employed to evaluate the performance of an individual medical student [5].

Monitoring refers to the systematic collection and documentation of information pertaining to courses, students, or teachers, which is conducted on a regular basis at the institutional level [6]. Evaluation involves the utilization of data collected during the monitoring process to assign a numerical or qualitative assessment to an activity [7]. According to

Spooren, Brockx, and Mortelmans [8], evaluation aims to accurately depict and elucidate the experiences of teachers and students, and to form judgments and interpretations of their efficacy. In recent years, as seen in [9, 10, 11, 12], the application of information and communication technology has undergone significant transformations due to the proliferation of personal computers, e-mail, and mobile technologies. These enhancements present novel and uncommon challenges that require distinct methods and answers. The advancement of technology has given rise to new ethical dilemmas. People who utilize information systems in software development are now required to possess the capacity to make ethical decisions due to the emergence of ethical challenges. Consequently, individuals are expected to be knowledgeable about ethical concerns [13]. An examination of the ethical dilemmas arising from computer technologies should involve an evaluation of established moral standards and their fundamental principles, as well as the application of these concepts to novel scenarios resulting from advancements in computer and communication technology [14].

Computer ethics should be promoted in school curricula as society increasingly relies on computers and the decisions made regarding their use have major consequences in the lives of people and society as a whole. This study discusses the impact of the Electronic Performance Support System (EPSS), namely BILEP, on students' learning progression in a computer ethics class. Stemming from the identified need for improved ethical training, the study examines how the application of EPSS tools can be effective in increasing learning performance in ethical decision-making and theoretical content knowledge. Thus, the results of this study are significant for educators and policymakers as the study offers practical data on EPSS application in ethics education and the differences in the academic progress of control and experimental groups. Section II reviews prior literature works on electronic performance support systems, and its application in enhancing learning. In Section III, a description of the research design, analysis and evaluation has been provided. Section IV and V provide a detailed analysis and discussion of results. Lastly, final remarks and summary has been provided in Section VI.

II. RELATED WORKS

Although there is ongoing discussion about the precise definition and purpose of electronic performance support systems (EPSS) [15], they are generally understood as electronic systems or infrastructures that offer access to data and tools that empower individuals to attain a superior level of performance. Gery [16] used the term "electronic performance support systems" (EPSS) to describe an approach that facilitates human performance by providing timely learning and job support. She claimed that EPSS had the ability to produce "day-one performance...for inexperienced performers" [17]. According to Towns et al. [18], the ideas of EPSS have been implemented in various work interfaces, such as tax preparation automation software, financial planning websites, and travel planning and purchasing tools.

Frenk et al. [19] argue that EPSS has been suggested as a potential alternative to traditional professional development. It is designed to support instructors in their most important tasks, such as curriculum development and lesson design, by using a performance-centered approach. EPSS has been described in multiple ways; yet, there is consensus on the primary objectives of an EPSS. The objectives are as follows: (1) to provide "just-in-time training systems" [20], which offer whatever is necessary for immediate performance and learning; (2) to facilitate "day-one performance," ensuring that novice users can be prolific from the moment they start using a system; and (3) to enhance current work performance while simultaneously contributing to the development of the knowledge infrastructure for future work [21].

Within the education sector, as described by Stone and Villachica [22], numerous electronic performance applications have been developed that either fully or closely align with the common objectives of EPSS, although they may not necessarily be explicitly referred to as such. The applications encompass tools for developing educational materials, grade books, and systems that enable behavioral control. According to Faghihi et al. [23], EEPSS is a comprehensive support system that encompasses various instructional activities, tools, databases, and expert systems. It is designed to aid teachers precisely when and where they require assistance. By providing support to instructors when they require it, it assists them in enhancing their professional abilities. According to Fama and Jensen [24], electronic performance applications are individual tools designed to assist teachers in carrying out certain duties. These technologies are largely designed as additional instructors, rather than as tools for teacher proficient progress, that typically aid students' studying events. Furthermore, these behaviors are rooted in conventional classroom methods that presuppose education to be a process of imparting or transmitting knowledge [25, 26, 27].

Parikh and Verma [28] argue that the recent progress of the Web and other computer technologies has opened up possibilities for educators to utilize diverse Web-based communication features, like forums, distribution lists, and emails. With the use of these tools, instructors can now seek guidance from specialists in their areas of inquiry and effectively and quickly exchange their knowledge and experiences with other educators. There are currently numerous instances of EPSSs that make use of these communication functions and may be found on the internet. The fast proliferation of knowledge and technological progress necessitates the replacement of static knowledge structures with easily updatable dynamic ones. Ingram, Hathorn, and Evans [29] posit that the dynamic structures are crucial for systematically advancing the process of acquiring knowledge or improving performance from an initial stage to a desired degree. Acquiring extensive knowledge and sophisticated skills is necessary to achieve the target level with greater ease. These criteria can be fulfilled by utilizing a range of information and skill sources, such as apprenticeship programs, printed materials, simulations, virtual learning environments, electronic performance support systems, and massive open online courses.

Teng and Zhang [30] argue that learning strategies empower students to independently control their learning, and learning strategy interventions are designed to enhance student performance by strengthening their self-regulated learning abilities or metacognition. There are three primary classifications of learning strategies that can be identified. According to Leutwyler [31], metacognitive learning strategies encompass the deliberate and systematic processes of planning, monitoring, and evaluating a learning assignment. Additionally, there exist cognitive learning mechanisms such as rehearsal, elaboration, and organizing. The third category pertains to management measures that facilitate students in navigating the complete learning process with greater success. In order for students to effectively employ these learning strategies for self-regulated learning, it is crucial to possess metacognitive knowledge and motivation. Covington [32] reviewed other research that looked at the effects of features of educational interventions, in addition to reporting on meta-analyses of these tactics.

Little [33] posit that the purpose of education for all children is to facilitate the acquisition of skills necessary for achieving "individual autonomy and societal accountability". Educational interventions [34] aim to offer students with the necessary assistance to acquire the skills taught by the educational system. These interventions should focus on functional skills, academic abilities, cognitive capabilities, behavioral patterns, and social skills that directly impact the child's ability to access education. According to Ceccarelli et al. [35], interventions for students with autism spectrum disorders often target the fundamental impairments related to communication, social skills, and behavioral variations. The interventions should target the acquisition or increased frequency of skills that are necessary for achieving effective outcomes. McConnell [36] argue that students with autism require educational interventions that are precise and focused on addressing their individual weaknesses, with the goal of promoting generalization and maintenance.

Greenhalgh et al. [37] argue that the resolution of emerging ethical dilemmas encountered during the utilization of an information system necessitates meticulous and consequential decision-making procedures. Most persons have the challenge of making difficult decisions in order to differentiate between right and wrong, good and terrible, or useful and destructive. When faced with difficult decisions, employing certain methodical frameworks can simplify and enhance the understanding of the process. The process of making ethical decisions in Computer Ethics relies on Ethical Decision-Making Models [38]. According to Schwartz [39], guides are essential for resolving ethical difficulties or anticipated challenges. Ethical decision-making models are procedural frameworks designed to fulfill this criterion. The utilization of heuristics has been a prevalent concept in ethical decision-making models for an extended period of time.

Clancey [40] illustrate that heuristics are systematic methods that are likely to achieve the desired outcome when provided with the correct input. Heuristics have been developed to guide case studies, narrow down ethical scenarios, and formulate answers for moral difficulties [41]. Various ethical decision-making frameworks have been established in literature to address this challenge [42, 43, 44, 45, 46]. Ethical decision-making models can be approached using a broad framework or tailored for a specific domain. For example, Mokander et al. [47] proposed a model for Social Science, whereas Mokander et al. [48] formulated a model for Clinical Psychology. In 1994, Maner created a model for Computer Ethics and proposed a series of processes to follow when making ethical decisions [49].

However, there is a significant lack of research into the electronic performance support systems' effects on student achievement in computer ethics as the subject is increasingly incorporated in educational curricula. As for the use of EPSS tools, including BILEP system, in the improvement of educational processes, the existing research is still rather scarce concerning the positive effects of such instruments on the ethical decision-making and the theoretical knowledge in computer ethics. Previous research has targeted conventional methodologies of schooling, whereas little is known regarding the impact of performance-related informative aids on students' understanding and implementation of ethical principles in computing. This study fills this void by presenting a comprehensive examination of students' academic progress with EPSS-supported practices, which includes recommendations for future curriculum and instructional methods for computer ethics education.

III. DATA AND METHODS

Research Design

The assessment of the intervention in the form of the EPSS, particularly the BILEP system, for student learning in Computer Ethics, involved the use of a quasi-experimental design with post and pre-test measures. Participants were alienated into two groups: a group of students that went through conventional teaching and learning and another group of students who went through the BILEP system. The design to be used sought to establish the extent to which instruction supported by EPSS could be effective based on the alteration among the pretest and post-test means of the two groups. The sample consisted of forty undergraduate students from a mid-sized university registering for a computer ethics class. The subjects of the study were divided into two groups, an exploratory group of twenty students and a control group of twenty students. Random assignment helped to guarantee that any observed differences in results could be attributed to the instructional method and not to the initial differences in students' abilities. An academic success test was created by the scientists to evaluate students' acquaintance and skills in two subcategories: The relationships between Ethical Decision-Making (EDM) [50] and Theoretical Computer Ethics (TCE) [51].

The test included questions formulated in the form of multiple choices and case studies aimed at assessing the knowledge of ethical norms and their application. This way, we guaranteed that multiple aspects of computer ethics education were captured in this test. The research procedure consisted of three main phases: The pretest stage involves assessment of the participants' knowledge on the particular issue or topic, which is followed by the intervention stage where the participants are taught and/or influenced in some way in order to change their knowledge or behavior as regards the particular issue or topic. To begin with, all the participants sat for the pretest to measure their knowledge in EDM and TCE. This pretest gave the researcher the initial assessment of each student's level of understanding and abilities in these subject matters. As for the control group, the traditional instruction in the form of lectures, discussions and cases was used during the intervention phase. On the other hand, the experimental group used the BILEP system that provided performance-based assistance by including modules, feedback, and exercises. This phase lasted for three months to allow the instructional methods enough time to influence the students' performance. All the subjects in the study were given the same academic success test after the intervention to evaluate the academic improvement of the students. Hence, in order to assess the impact of the practices that are supported by the EPSS, the scores that were achieved in the posttest were compared with the scores achieved in the pretest.

Data Analysis and evaluation

Descriptive data and inferential data both were used for analyzing the data that were collected. Using the independent-samples t-test, the sovereign treatment and control groups' pretest means were found to be significantly different. This test assisted in determining if there was any existence of inequality in the groups of the study before the formulation of the intervention. Equation (1) was used to arrive at the test statistic, which is the result of the independent samples t-test equation.

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \tag{1}$$

where $\overline{X_1}$ and $\overline{X_2}$ indicates the mean of control and experimental clusters, S_1^2 and S_2^2 represent the changes of the groups and n_1 and n_2 are the model size. MANOVA was used to compare the changes of posttest of each cluster and find the result of it. Before applying this analytical method, three preconditions of MANOVA were checked: Heteroscedasticity is not expected because the equality of error variances, covariance matrices should also be homoscedastic, and the dependent variables should also be normally distributed. Hence, the MANOVA Equation (2) was employed.

$$F = \frac{MSbG}{MSwG} \tag{2}$$

$MSwG$ represents the sum of squares inside groups separated by the degree of freedom within groups, while $MSbG$ represents the sum of squares between groups. Moreover, the analysis of variance paired models t-tests were employed to determine the level of academic promotion within the group. Lastly, the scores gotten from the pretest and posttest were used to analyze the efficiency of the instructional methods in each group. For the paired samples t-test, Equation (3) was used.

$$t = \frac{\overline{D}}{s_D/\sqrt{n}} \tag{3}$$

where s_D is the standard deviation of the alterations, $\overline{D}$ is the mean of the alterations between paired observations and n is the number of paired observations. We also had to note the p-value and Cohen's d for the autonomous samples t-test and the paired models t-test, to make sure that the statistical measures applied were appropriate. The formula for the calculation of Cohen's d of the independent samples t-test is expressed as in Equation (4).

$$d = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}} \tag{4}$$

where, $\overline{X_1}$ and $\overline{X_2}$ are the mean of two groups, n_1 and n_2 are the model size and S_1^2 and S_2^2 are the changes. The t-test for the two models paired samples is computed using Cohen's d in Equation (5).

$$d = \frac{\overline{D}}{s_D} \tag{5}$$

where s_D these differences and $\overline{D}$ is the mean of the disparities between the two observations. In addition, as a last step of the study, the reversion analysis was conducted to predict the posttest scores based on the pretest scores and the group (control and experimental). The regression model used was calculated using $Y = \beta_0 + \beta_1 X + \beta_2 G + \epsilon$ where; Y represents the posttest score, β_0 is the intercept, β_1 is the coefficient for pretest score X, β_2 is the coefficient for the group G which was coded as 0 for the control group and 1 for the experimental group and ϵ was the error term. The results of the participants posttest and pretest are presented in **Table 1** below.

Table 1. Posttest and pretest scores of undergraduate students

Group	Subcategory	Pretest SD	Pretest Mean	Posttest SD	Posttest Mean
Experimental Group	Theoretical Computer Ethics	6.65	33.40	9.02	38.40
	Ethical Design Making	5.52	21.20	7.52	31.20
Control Group	Theoretical Computer Ethics	6.15	30.00	7.28	35.80
	Ethical Design Making	6.20	19.00	5.78	25.00

In the study, the results indicated that posttest scores of the control and treatment groups increased. The improvement of EDM skills was higher in the experimental group which used BILEP system. The MANOVA results revealed significant difference in the EDM in favour of the treatment group F (1,380) = 8.53, $p < .050$, $\eta^2 = .183$, however there was no significant difference in TCE F(1,38) = 1. 005, $p > .05$, $\eta^2 = .026$. Independent samples' t-tests also provided evidence of significant academic improvement within both groups for TCE and ethical decision-making.

IV. RESULTS

To evaluate the academic progress of students enrolled in the computer ethics course, the researchers created an academic achievement test. The test comprised of two distinct segments, each with different subtitles: Ethical Decision-Making (EDM) and Theoretical Computer Ethics (TCE). Due to the contextual disparities between these two subjects, the scores were examined individually. Prior to the three-month experimental implementation phase, the students' pre-existing knowledge was assessed. After the process concluded, the students underwent academic success assessments both before and after. The posttest and pretest results of the students in various categories were then compared. **Table 2** displays the outcomes of the pretest and posttest.

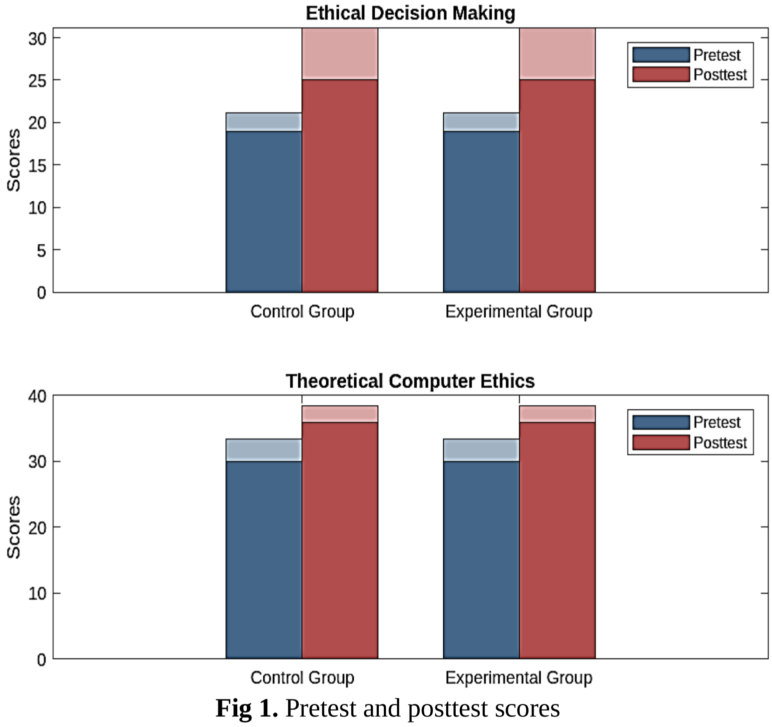

Fig 1. Pretest and posttest scores

Table 2 reveals that there were only minimal disparities observed in the groups` pretest scores at the sub-groups level. The sovereign trials t-test was employed to assess the statistical implication of the disparity among pretest results. The t-test findings indicated that no statistically substantial alterations was evident among the groupings in any of the two sub-groups ($p > .05$). Following the acquisition of these results, the decision was made to employ MANOVA to examine the disparities among the posttest scores of the various groups. Before employing the MANOVA analytical method, it was ensured that three crucial criteria were met: the dependent variables followed a normal circulation, the covariance matrixes were standardized, and the fault alterations were identical. The MANOVA findings for the posttest grades are presented in **Table 3**.

Table 2. Posttest and Pretest scores of the contestants

Computer ethics-related subcategories of the academic success exam	Pretest	Posttest		
	Mean	Standard Deviation	Mean	Standard Deviation
Control Group				
EDM	19.000	6.200	25.000	5.780
TCE	30.000	6.150	35.800	7.280
Experimental Group				
EDM	21.200	5.520	31.200	7.520
TCE	33.400	6.650	38.400	9.020

Fig 1 shows the results of the pretest and posttest of EDM and TCE of both the Control and Experimental groups. For the Control group, the score for Ethical Decision-Making Pretest = 19. 00 (SD = 6. 20) while for the Ethical Decision-Making Posttest it is 25. 00 (SD = 5. 78). For TCE, the Control group has the pretest mean of 30. 00 with SD of 6. 15 and the posttest mean of 35. 80 with SD of 7. 28. For the EDM, in the Test group the pretest mean is 21. 20 (SD = 5. 52) and posttest mean is 31. 20 (SD = 7. 52).

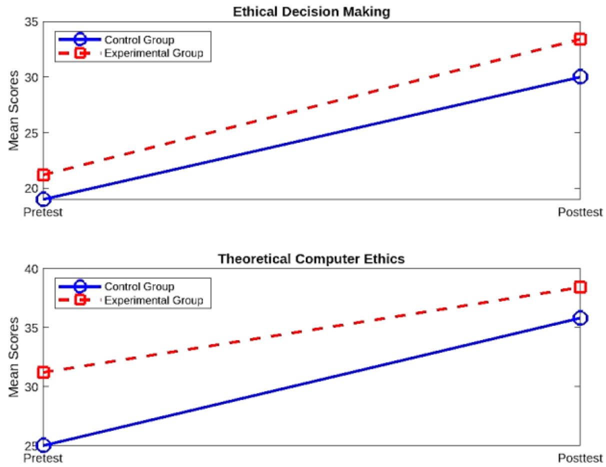

Fig 2. Average scores on the pretest and posttest for the experimental group

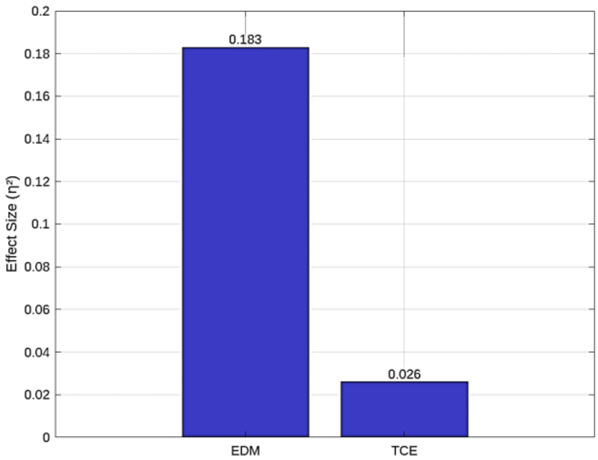

Fig 3. Effect sizes (η²) for EDM and TCE

In TCE, the Experimental group's pretest was 33. 40 (SD = 6. 65) while the posttest was 38. 40 (SD = 9. 02). This graph depicts the pretest to posttest change in scores within each group and subcategory and shows that both groups raised their scores after the intervention, although the Experimental group had a much higher increase in EDM. **Fig 2** depicts the mean posttest and pretest scores of EDM and TCE among the Treatment and Control groups. The Control group pretest mean scores are 19.00 for EDM and 30.00 for TCE, post test scores are 25.00 and 35.80 respectively.

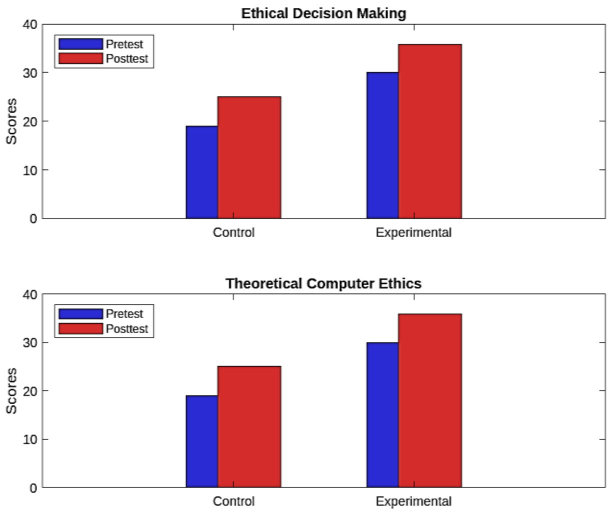

Fig 4. Pretest and posttest scores

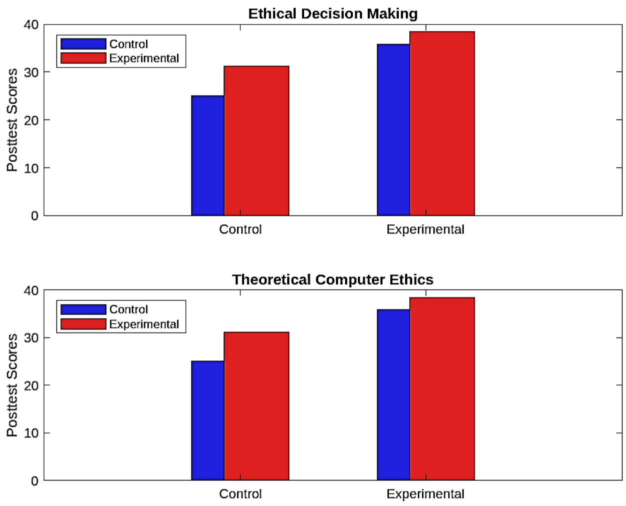

Fig 5. Posttest scores for control and experimental group

The Experimental group means on the pretest are 21.20 for EDM and 33.40 for TCE while the posttest means are 31.20 and 38.40 respectively**. Fig 3** employs the radar chart to represent the MANOVA results of each subcategory and the effect size (η^2) of EDM and TCE. The analysis of the scores indicates that there is a statistical difference in EDM ($F(1,38)=8.536$; $p < .05$; $\eta^2 = .183$) in the favour of the treatment group; however, no statistical difference was found regarding TCE ($F(1,38)=1.005$; $p > .05$; $\eta^2 = .026$). **Fig 4** analyses the academic development of each group for EDM and TCE by comparing the scores of pretests and posttest. This graph shows the increased scores post the intervention and notes the growth of both groups in both the subcategories. The last of the radar charts, **Fig 5**, shows the normalized MANOVA of subcategory scores, which provides a clearer comparison of the amount of change due to the intervention relative to other subcategories. The paired samples t-tests for each group and subcategory presented in **Fig 6** also showed that there were substantial alterations in the scores from pretest to posttest on each group.

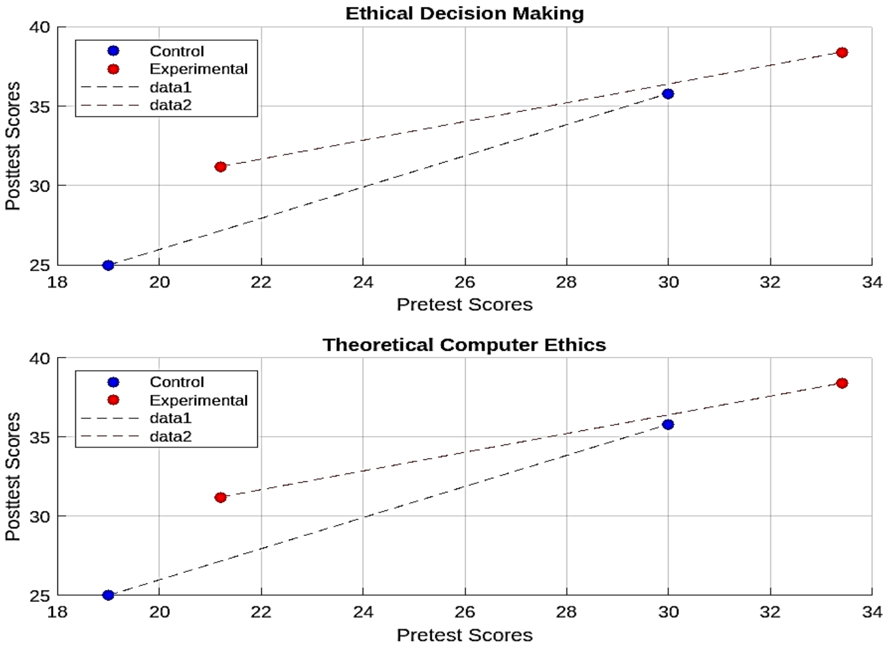

Fig 6. Pretest and posttest scores for groups

Fig 7 shows the results of EDM and TCE posttest and pretest for both Control and Experimental groups. For the Control group, the pretest and posttest mean scores for EDM are 19.00 (Standard Deviation = 6.20) and 25.00 (Standard Deviation = 5.78) respectively while the scores for TCE are 30.00 (Standard Deviation = 6.15) and 35.80 (Standard Deviation = 7.28) respectively. In the Experimental group, the outcomes of the t-test for EDM pretest and posttest are $t = -4.15$, $p < 0.05$ and $t = -3.83$, $p < 0.05$, respectively; and for TCE, $t = -3.61$, $p < 0.05$ and $t = -3.07$, $p < 0.05$. **Table 3** shows that there were no substantial variations in the scores of the contestants in "TCE" ($F(1,38) = 1.005$, $p > .05$). Nonetheless, it was found that the experimental group scored higher on the "Ethical decision-making" assessment, with a substantial difference among the groups ($F(1,380) = 8.53$, $p <.050$). To clarify, the logical findings demonstrated that the BILEP structure had a beneficial impact on enhancing the students' comprehension of ethical resolution. Furthermore, the study revealed that the overall exam results were influenced by the scores in "EDM" ($\eta 2 = .183$) rather than "TCE". The value of the coefficient of determination is 0.026. (see **Fig 3**). Paired samples t-test analyses were undertaken after the posttest comparisons to determine the extent of academic growth within the in-group.

Table 3. MANOVA analysis findings from the posttest grades

Variance Source	Dependent Variable	Summation of Squares	*df*	Mean Squares	*F*	*p*	Eta Squared (η^2)
Altered Model	Ethical resolution	384.400a	1	384.400	8.536	.006	.183
	TCE	67.600b	1	67.600	1.005	.322	.026
	EDM	31584.400	1	31584.400	701.383	.000	.949
	TCE	55056.400	1	55056.400	818.522	.000	.956
Group	TCE	67.600	1	67.600	1.005	.322	.026
	EDM	384.400	1	384.400	8.536	.006	.183
Error	EDM	1711.200	38	45.032			
	TCE	2556.000	38	67.263			
Total	TCE	57680.000	40				
	EDM	33680.000	40				

According to the t-test results, students' academic growth in the areas of "TCE" (experimental group: t = 2.54, p <.05; control group: t = 4.650, p <.050) and "EDM" (experimental group; t = 6.039, p <.050; control group: t = 4.17, p <.05) was significantly impacted by the computer ethics education procedure. Based on the comprehensive quantitative analyses, it can be settled that activities supported by EPSS have a favorable impact on the degree of knowledge related to ethical decision-making. However, TCE education did not see the same benefit. This finding aligns with performance-driven attributes of EPSSs. Following the exploratory operation, semi-structured interview processes were carried out to gather participants' feedback and propositions about computer ethics education and the utilization of the BILEP system.

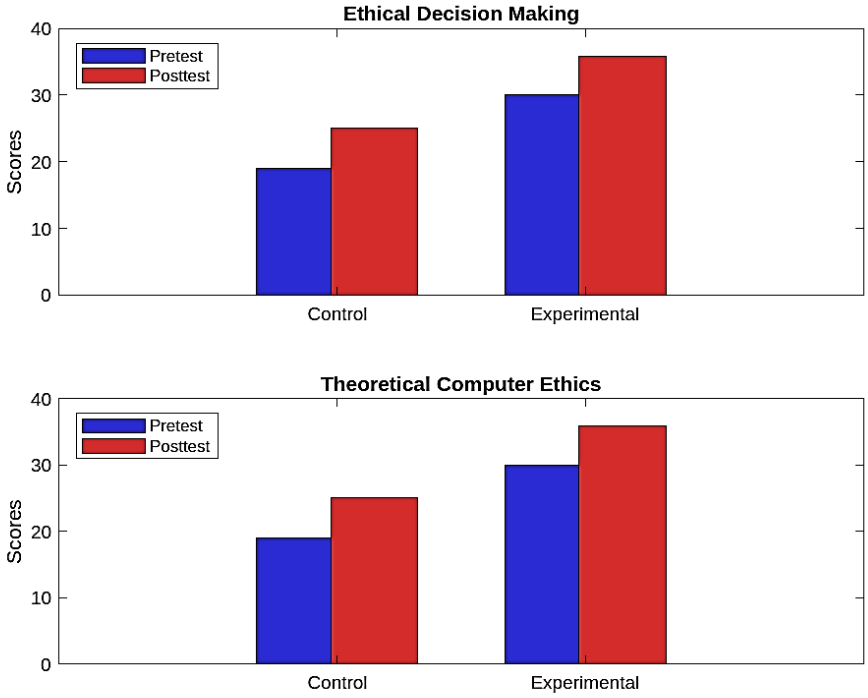

Fig 7. Mean pretest and post test scores for groups

V. DISCUSSION

The electronic framework known as EPSS is used within an organization to effectively collect, store, and distribute corporate and individual knowledge assets. Its purpose is to enable persons to attain the essential performance levels in the shortest possible timeframe and with minimal reliance on assistance from others [52]. These systems provide assistance and direction to users during the execution of their duties. EPSSs offer timely help by providing task performers with relevant and context-specific information in their actual work environment. GAIDA (Guided Approach to Instructional Design Advising) [53] is considered one of the early instances of EPSS in teaching [54]. The automated performance support tool GAIDA was found to be helpful in assisting courseware designers (NIDs) according to Ugur-Erdogmus and Cagiltay [55]. Research conducted by Abuhassna and Alnawajha [56], Davis [57], and Ndou [58] has shown that EPSSs (Electronic Performance Support Systems) have a beneficial impact on the instructional material design practices of NIDs (Novice Instructional Designers). These insights were gathered by CASCADE initiatives that are designed to help teachers in the creation of the curriculum. These and related programs can be considered to have been successful due to aspects such as time, relevance, adequacy and extent of support provided. Nonetheless, there was evidence of the effectiveness of EPSSs, but the components needed to make EPSS work was not clearly illustrated in research.

The purpose of this research was to identify the effectiveness of EPSS in improving the delivery of computer ethical knowledge and the support of the ethical processes of decision making. Based on the findings of the study, it can be stated that there is no significant variation in mean grades for "TCE" among the participants. However, there is a substantial discrepancy in the scores for "EDM" across the groups. This demonstrates that the EPSS effectively aided students in carrying out activities associated with EDM. Upon reviewing the relevant literature, it can be concluded that this discovery aligns with the research conducted by Ludwig, Nagel, and Lewis [59], which suggests that EPSS can serve as a valuable tool in guiding ethical resolution. EPSS offers both precise data and immediate access to that data when the task needs to be executed [60]. Therefore, this outcome aligns with the features of EPSS. Karakaya-Ozyer and Yildiz [61] created an EPSS specifically for the field of 'quantitative research techniques' in psychology degree programs. They discovered that the EPSS effectively aided students in completing tasks relevant to quantitative research methods. According to Sinitsa [62], users of EPSS exhibit strong drive to acquire knowledge, possess autonomy in the learning process, and demonstrate a greater need for specialized information compared to standard training methods.

Nunes and Jannach [63] categorized performance support structures into three types: internal, extrinsic, and external support. Content utilized for task execution is stored in an exterior database by external systems. This content is not incorporated into a user's work connection. Consequently, users are compelled to actively search for pertinent data in the exterior EPSS. Typical instances of exterior performance support structures comprise frequently asked question (FAQ) pages, help indexes, and search engines. Furthermore, external performance support can either involve the use of computers or not, as stated by Gery [64]. Job documentation or aids are often used non-digital interventions that provide support for performance. Extrinsic performance assistance is combined with the system; however, it is not located in the main workspace [65]. Extrinsic systems are designed to seamlessly interact with the user's work connection, allowing the EPSS to accurately determine the user's site within a structure and the specific job they are engaged in. Given this setting knowledge, the extrinsic structure can effectively identify content that might be pertinent in assisting with the current job. Similar to external performance support structures, the content utilized to assist a task is located outside of the work connection.

The students' perspectives on the BILEP system and computer ethics were explored through the use of partially organized interview questions. Initially, the scholars were asked to offer their opinions on the importance of computer ethics instruction. Papert [66] emphasized the importance of computer ethics edification. The scholars also expressed their opinions regarding the crucial aspects of the ethical decision-making procedure, focusing on practical and case-specific methodologies. Interviewed students also provided their assessments and suggestions regarding the BILEP system. Several students had positive opinions on BILEP, noting that the system prompted them to approach issues in a systematic manner. As previously mentioned, EPSS has the ability to offer assistance and enhance performance in the learning process [67, 68, 69]. Furthermore, certain students reported encountering technical difficulties during the process. One student also discussed the intricacy of the expert element within the structure. This finding corroborates the research conducted by Prado and Vincenzi [70], which indicated that although most participants had favorable opinions regarding EPSS, a few individuals found it perplexing. Nevertheless, Sezer [71] did not observe a substantial association between students' performance and their success in utilizing the EPSS. During the semi-organized interview, students engaging in this study proposed the incorporation of social contact into the system. This has the potential to be a prospective inclusion in EPSS.

Ritter [72] establishes that there is a substantial disparity in ethical resolution scores, which is corroborated by the theoretical findings. The contestants who willingly took part in the test group and stated their opinions on the BILEP system as a tool for moral resolution said that the system encouraged them to engage in more thorough and systematic thinking. Additionally, Weber [73] expressed that their comprehension of the ethical decision-making procedure was enhanced. The BILEP system facilitated students in engaging in more profound ethical decision-making processes, as they expressed. In addition, Kert, Uz, and Gecu [74] discussed the significance of considering many viewpoints and emphasized the need of empathy. The chances offered by the BILEP system may have had further effects on the divergence between the groups in relation to EDM.

VI. CONCLUSION

Various instructional methods have been employed to teach ethics in various domains, including teacher education ethics, work ethics, and medical ethics. Nevertheless, computer ethics is a moderately novel area of research, and currently, it is challenging to envision a wide range of informative techniques for this field. EPSS is employed to save staff training expenses while simultaneously enhancing productivity and performance. This study shows that the implementation of the EPSS, more specifically the BILEP system, has a positive outcome on the students’ learning progress in a Computer Ethics class. The results of the study highlight that control as well as the experimental group increased their posttest scores but the experimental group, which used EPSS had a greater improvement in their ethical decision-making skills. The MANOVA analysis also revealed a significant multivariate main effect for the experimental group in ethical decision-making. In addition, the findings of the paired trials t-tests showed significant academic improvements within both groups regarding TCE and noble resolution. Thus, it can be concluded that the application of practices supported by EPSS is most beneficial in strengthening students’ ethical decision-making skills while the effect on the improvement of their theoretical knowledge is not very substantial. This study provides a much-needed contribution to current knowledge and applications of EPSS tools in ethics education and will be highly beneficial for educators and policymakers intending to incorporate novel instructional technologies into computer ethics.

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The author reviewed the results and approved the final version of the manuscript.

Data Availability
No data was used to support this study.

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