COMPARATIVE ANALYSIS OF SCIENCE-BASED EDUCATIONAL STUDENTS ON PERFORMANCE IN PHILOSOPHY ACADEMIC SUBJECT AT UITM

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(Received 10th August 2025; revised 20th October 2025; accepted 27th October 2025)

Abstract. The academic subject of Philosophy and Current Issues at higher educational institution is aimed at cultivating critical thinking and ethical reasoning among undergraduates, including those in Computer Science (CS) and Electrical Engineering (EE). Despite its importance, there is little empirical evidence on how science-based students in different faculties do in Philosophy and Current Issues, and especially on a comparison of the performance between CS and EE, which have different curricula and exposure to ethics and philosophy to different extents. This study aims to compare the performances of CS and EE students in the subject of Philosophy and Current Issues at UiTM Shah Alam. A purposive sampling method was used to select participants from two faculties, CS (n=32) and EE (n=34). Data analysis was performed using IBM SPSS Statistics software. The Mann-Whitney test findings suggest that the two groups performed comparably in the “written report” and “presentation video”. The t-test result (t=2.348, df=64, p=0.022) shows a statistically significant difference in “final test” scores between the two groups, with a mean difference of 2.60478 (95% CI: 0.38900 to 4.82056), suggesting that CS students scored approximately 2.6 points higher than EE students on average. The CS students were found to perform better compared to the EE students, particularly in this subject.
Keywords: *philosophy education, computer science, electrical engineering, critical thinking, ethics integration*

Introduction

The academic subject of Philosophy and Current Issues at a higher educational institution is aimed at cultivating critical thinking and ethical reasoning among undergraduates, including those in Computer Science (CS) and Electrical Engineering (EE). It also fosters awareness of contemporary social issues, encouraging students to apply philosophical principles to real-world challenges in their respective fields. The material is a transdisciplinary topic that invites students to analyse philosophical issues such as ethics, epistemology, and metaphysics and their implications for ways of life, as well as current problems such as technology’s impact on society, environmental issues, or cultural evolutions (Das, 2024). For students in science-based fields, such as CS and EE, this course creates a space that connects their technical skills with reflective inquiry so that they can engage with ethical problems in their disciplines. By reading and responding to philosophical readings and debates, students hone skills in argumentation and critical thinking, necessary for making sense of the complex interaction between technology and society. Despite its importance, there is little empirical evidence on how science-based students in different faculties do in Philosophy and Current Issues, and especially on a comparison of the performance between CS and EE, which have different curricula and are exposed to ethics and philosophy to different extents. CS students’ regular exposure to ethical issues in computing (e.g., AI, data privacy) might even support their preparedness for philosophical work. Studies demonstrate that

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

integrating ethics in the CS curriculum, such as a values reflection module, enhances students' moral awareness and readiness to address ethical dilemmas in the profession (Kopec et al., 2022). By contrast, ethics as a domain is typically peripheral in EE programmes, often relegated to the box-ticking exercise for accreditation purposes rather than being viewed as a core skill (DeLouise, 2022). This lack of knowledge about performance disparities raises questions about how disciplinary backgrounds affect students' ability to adapt to philosophical coursework and whether instructional methods currently in practice support a range of science-based learners in achieving success in this area.

This study aims to compare the performances of CS and EE students in the subject of Philosophy and Current Issues at UiTM Shah Alam. Through examination of these performance measures, the study aims to identify factors that explain variation in performance and gain insight into how students' disciplinary backgrounds mediate interaction with philosophical material. This study anticipates that the results will help educators develop more targeted pedagogies for developing the critical thinking and ethical reasoning abilities of science-based students. Interdisciplinary models, such as the Berlin Ethics Certificate, also prove that the integration Incorporating ethics into technical curricula increases awareness of ethical issues and facilitates collaboration across disciplines (Ammon et al., 2022). Research has also demonstrated the effectiveness of multimodal, interdisciplinary ethics pedagogy in allowing students to relate theory to practical, everyday, and future-orientated selves (Schroeder, 2020). More general curriculum evaluations, too, emphasise how philosophy can facilitate the development of the skills necessary to manage interdisciplinary challenges in engineering and computing.

Literature review

The interplay between educational philosophy and student performance in philosophy courses emerges from pedagogical approaches and faculty beliefs, especially in science and engineering domains such as Computer Science (CS) and Electrical Engineering (EE). Studies show that the instructional strategies and philosophies of teachers play an important role in the learning context that facilitates students' involvement, participation and school success (Xiong and Yuan, 2024). This approach is particularly useful for students of science, for whom philosophy is one of the few subjects taken seriously as a distinct discipline demanding critical and ethical thinking, which is quite distinct from their discipline. For example, reflective inquiry approaches better serve CS students, who encounter moral philosophical problems related to AI and technology, compared to EE students, whose curriculum focuses more on hardware-based competencies (Gordon and Gunkel, 2021). This means that if educational philosophy and science-based discipline contexts can be better aligned, students may be better resourced to manage complex philosophical ideas. Further, teachers who use constructivist strategies, which enable learners to construct knowledge and views through talking (Laskar and Bhattacharjee, 2022), may be a direction for educational strategies to enhance philosophical reasoning (Boon et al., 2022).

Cognitive psychology-based principles embedded in pedagogical practices lead to improved student engagement and learning in philosophy courses for science-orientated students. Active learning modalities, such as case-based discussion and seminars, lead to better retention and comprehension of philosophical material by engaging learners and stimulating challenging discourse (Surti et al., 2025). A democratic educational

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

philosophy that values equality and inclusion also enables achievement by fostering an environment that supports philosophical inquiry, especially among diverse students in programs such as CS and EE (Krstić et al., 2021). Such approaches are valuable for cultivating critical thinking skills that are important for considering some of the ethical and societal implications of technology that feature so prominently in philosophy pedagogy. It has also been found that instructional frameworks realigned to learners' general technical knowledge can 'bridge' scientific and philosophical argumentation, thereby improving philosophical understanding (MacLeod, 2021). These strategies might, however, be more familiar to CS students because of their problem-solving and abstract thinking education that fact might (in some sense) also make them outperform the EE students in philosophical questions.

Academics' beliefs about intelligence, and how these beliefs shape classroom culture, play a crucial role in influencing science students' academic motivation in philosophy. In CS and EE, create an environment in which students are allowed to approach complex philosophical issues, and then students in such programmes, in turn, fare much better (Kruk and Matsick, 2021). This is particularly the case for philosophy education, whose abstract nature may initially discourage Science students who are unfamiliar with non-technical material, and find the development of a positive classroom climate crucial. For example, CS students, who are regularly dealing with cutting-edge and cross-disciplinary themes of study, may be more positively responsive to such environments than their EE colleagues, whose education is less associated with ethical discussion (Zaghi et al., 2023). What's more, if students are encouraged to cultivate a sense of intellectual curiosity about these texts through open-ended questioning, then their confidence about engaging with the philosophical text is likely to increase. Studies indicate that students' science achievement is highly related to their motivation, cognitive strategies, metacognitive strategies, and resource management strategies, while self-efficacy is the most meaningful (Ortega-Torres et al., 2020).

Digital technologies now infuse all levels of university education, while the advent of new devices and applications (apps), coupled with easy and reliable access to high-speed internet, has altered the educational playing field. Discussion fora and other online tools, such as virtual reality simulations, foster reflective thinking and engagement, both of which are essential for developing philosophical competencies (Timotheou et al., 2022). Careful integration of these technologies in support of the development of critical thinking, rather than replacing philosophical inquiry, becomes necessary (Olivos, 2021). In terms of exposure to software-based platforms for philosophical conversation, CS students, with their experience in digital environments, might have an undue advantage compared with EE students. Previous studies have also suggested that blended learning models (which integrate online and face-to-face instruction) are an effective method of accommodating diverse learning preferences in science classes (Ali Almarzuqi and Mat, 2024). Similarly, digital portfolios, where students can record their philosophical reflections, are used to encourage multidisciplinary course encounters and engaged critical thinking.

Moral philosophy, particularly ethics and justice, forms the pedagogical foundation of educators' teaching and substantially impacts student performance within philosophy classes by creating respectful and equitable learning environments. Teachers who bring high ethics to the classroom help students perceive that science classrooms can be places where they are appreciated and cared for and can inspire science students to take up and argue deeply about philosophical topics such as those concerning technology

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

ethics (Muslihuddin et al., 2024). This may be especially true for CS students, who would have learnt the ethics of AI as part of their curriculum and, consequently, might feel more comfortable in such environments compared to EE participants. Studies also argue that conceiving the educational practices of justice and trust (fair assessment, inclusive discourse) fosters student trust and participation (Hämäläinen, 2022). Furthermore, teachers who exemplify ethical argument in their approach to teaching can encourage pupils to use similar strategies in their philosophical investigations. These and similar practices are important in interdisciplinary contexts, such as those involving natural science students who may initially find it difficult to build bridges between technical expertise and philosophical inquiry.

Moreover, various teaching approaches, including blended and inquiry-based methods, have been shown to significantly enhance the performance of science students in philosophy courses. According to research, using various pedagogical models that fit all learning styles develops a rich atmosphere where critical discussion and performance are stimulated (Simamora et al., 2024). Inclusive teaching that allows participation of nontraditional student populations works especially well in philosophy courses, which are similarly enriched by diverse viewpoints (Jackson-Summers et al., 2024). Student-centred approaches (e.g., PBL) may match well with the CS students' problem-solving capabilities, which may explain why their performance was more competent than the EE students. Collaborative learning opportunities, like peer debates around philosophical issues, can help improve both critical thinking and engagement (Stokes, 2024). Furthermore, we can make philosophy more relevant and accessible to science students and bridge the curriculum divide by incorporating practical, real-world applications, such as ethical case studies in technology, into the curriculum.

In summary, the literature review reveals that educational philosophy undergirds the deep-level features of science students' achievement in philosophy courses through cognitive psychology, ethical tenets, digital pedagogies, and varied instructional methodologies. Educators can promote critical thinking, inter alia, by developing inclusive, engaging, and reflective learning environments that translate into improved academic performance, specifically for CS students who have been exposed to both interdisciplinary and ethical concepts that they find beneficial. As pedagogical approaches develop, further examinations of how these philosophical bases may influence performances in interdisciplinary areas, such as philosophy, will be necessary to maximise learning in science-based disciplines at institutions like UiTM Shah Alam.

Materials and Methods

The study was conducted at Universiti Teknologi MARA (UiTM) Shah Alam, Selangor, focusing on the Philosophy and Current Issues course as a part of the academic subject. A purposive sampling method was used to select participants from two faculties, Computer Science (CS) (n=32) and Electrical Engineering (EE) (n=34), that yielded a complete sample of 66 students. Undergraduates from both faculties participated in the course during the research period. All participants signed the consent form, and the study followed the ethical approval by the UiTM Research Ethics Committee. For the philosophy and current issues subject, the application of three different instruments to collect data was established for the analysis of the learning indicator. First, the final test paper was provided to measure students' capacity to express philosophical thought in coherent prose. Secondly, an oral activity video was

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

used to gauge oral communication skills and the depth of engagement with the course content. Third, an academic written examination, consisting of multiple-choice questions, was conducted to assess the level of understanding and use of philosophical principles. Instruments were developed based on the course learning objectives, and test instruments were marked by trained instructors with standardised rubrics to achieve inter-rater reliability and consistency. Data analysis was performed using IBM SPSS Statistics software. Initially, the Shapiro-Wilk normality test was conducted to assess the normality of the performance data across all variables, i.e., "written report", "presentation video", and "final test". The test statistics and p-values are as follows: "written report" (W=0.964, p=0.049), "presentation video" (W=0.953, p=0.014), and "final test" (W=0.974, p=0.174). A p-value less than 0.05 indicates non-normality, so the "written report" and "presentation video" are non-normal (p<0.05), while the "final test" is consistent with a normal distribution (p>0.05). These findings suggest that non-parametric tests, i.e., the Mann-Whitney U test used in the study, are appropriate for comparing groups on "written report" and "presentation video", while parametric tests, i.e., independent-samples t-test, could be considered for the "final test", though the study opted for consistency with non-parametric methods (*Table 1*).

***Table 1**. Shapiro-Wilk normality test.*

Variables	Statistic	df	Sig.
Written report	.964	66	.049
Presentation video	.953	66	.014
Final test	.974	66	.174

Results and Discussion

The presented results include descriptive statistics, the Mann-Whitney U test, and the independent-samples t-test. *Table 2* presents the descriptive statistics for the performance scores of the participants, assessed through three data collection instruments: "written report", "presentation video", and "final test". The "written report" scores ranged from a minimum of 13.00 to a maximum of 25.00, with a mean of 19.21 and a standard deviation of 3.08, indicating moderate variability in performance. The "presentation video" scores showed a narrower range, from 20.00 to 28.00, with a higher mean of 23.75 and a lower standard deviation of 1.89, suggesting more consistent performance across participants. The "final test" scores exhibited the widest range, from 15.00 to 35.00, with a mean of 25.94 and a standard deviation of 4.66, reflecting greater variability in student outcomes. These descriptive statistics provide an overview of the central tendencies and dispersion of scores, highlighting differences in performance across the three assessment methods. *Table 3* presents the results of the Mann-Whitney U test, which was conducted to compare the performance scores of CS and EE students across three assessment instruments: "written report" and "presentation video." In part (a), the ranks, the mean ranks and the sum of ranks indicate the relative performance of each group. For the "written report", CS students had a higher mean rank of 37.92 (sum of ranks=1213.50) compared to EE students, who had a mean rank of 29.34 (sum of ranks=997.50). Similarly, for the "presentation video", CS students achieved a mean rank of 36.42 (sum of ranks=1165.50) compared to 30.75 (sum of ranks=1045.50) for EE students. The test statistics in part (b) report the Mann-Whitney U test results, which include the U statistic, Z-score, and asymptotic significance (2-

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

tailed p-value) for each instrument. For the “written report”, the Mann-Whitney U was 402.500, with a Z-score of -1.823 and a p-value of 0.068, indicating no statistically significant difference in performance between the two groups at the 0.05 significance level. The “presentation video” yielded a U-statistic of 450.500, a Z-score of -1.206, and a p-value of 0.228, further confirming no significant difference between the groups. The Mann-Whitney test findings suggest that the two groups performed comparably in the “written report” and “presentation video”.

***Table 2**. Descriptive statistics (n=66).*

Category	Minimum	Maximum	Mean	Std. Deviation
Written report	13.00	25.00	19.2121	3.08478
Presentation video	20.00	28.00	23.7500	1.88771
Final test	15.00	35.00	25.9394	4.65710

Note: Scores are aggregated across both CS and EE students.

***Table 3**. Mann-Whitney test (n=66): (a) ranks; and (b) test statistics.*

Variables	Written report		Presentation video	
	CS	EE	CS	EE
(a)				
N	32	34	32	34
Mean rank	37.92	29.34	36.42	30.75
Sum of ranks	1213.50	997.50	1165.50	1045.50
(b)				
Mann-Whitney U	402.500		450.500	
Z	-1.823		-1.206	
Asymp. Sig. (2-tailed)	.068		.228	

Note: CS=Computer Science; EE=Electrical Engineering.

The provided independent samples t-test output in *Table 4* compares “final test” scores between CS (n=32, mean=27.2813, SD=4.73991) and EE (n=34, mean=24.6765, SD=4.26913) students. Levene’s test for equality of variances (F=0.043, p=0.836) indicates no significant difference in variances (p>0.05), supporting the use of the “equal variances assumed” row in the t-test. The t-test result (t=2.348, df=64, p=0.022) shows a statistically significant difference in “final test” scores between the two groups, with a mean difference of 2.60478 (95% CI: 0.38900 to 4.82056), suggesting CS students scored approximately 2.6 points higher than EE students on average. This finding reinforces the potential influence of CS students’ exposure to philosophical and ethical concepts on their performance.

***Table 4(a)**. Independent-samples t-test for final test (n=66): Group statistics.*

Group	n	Mean	SD	SEM
CS	32	27.2813	4.73991	.83791
EE	34	24.6765	4.26913	.73215

Note: CS=Computer Science; EE=Electrical Engineering; SEM=Std. Error Mean; SD=Std. Deviation.

Table 4(b)*. Independent-samples t-test for final test (n=66): Independent-samples test.*

Category	Levence's test for equality of variance				Sig. (2-tailed)			95% CI of the difference	
	F	Sig.	t	df		MD	SED	Lower	Upper
Equal variance assumed	.043	.836	2.348	64	.022	2.60478	1.10915	.38900	4.82056
Equal variances not assumed	-	-	2.341	62.295	.022	2.60478	1.11271	.38071	4.82885

Note: MD=Mean Difference; SED=Std. Error Difference; CI=Confidence Interval.

The performance differences between CS and EE students, particularly in subjects such as Philosophy and Current Issues, can be articulated through multiple lenses explored in recent academic literature. Firstly, the intersection of technology and philosophy is notable, especially as it pertains to understanding the implications of artificial intelligence (AI) and ethical considerations within the engineering domains. Maruyama (2022) emphasises the significance of integrating philosophical inquiry into fields dominated by technology, highlighting that students in computer science are increasingly confronted with ethical dilemmas stemming from their work in AI and robotics, thus necessitating a philosophical grounding that may not be emphasised in EE curricula. Because CS students are exposed to moral frameworks, they are trained with principles to think deeply about complex ethical questions, with resulting benefits in their philosophical education. Furthermore, the rapid development of AI has led to the inclusion of societal impacts in the CS curricula, making them more closely resemble philosophical research. That's likely why CS students perform significantly better in "interdisciplinary" subjects like philosophy compared to their EE counterparts, who are more hardware-orientated and into technical skills.

Additionally, educational approaches within CS and EE are quite different. Recent research has also confirmed that such courses in philosophy of science are perceived as being important to the development of their students into critical, reflective individuals in (natural) science and technology (De Regt and Koster, 2021). These results indicate that CS students might be exposed to philosophical and ethical concepts more openly in their major than their EE counterparts, and it may provide a wider framework for ethical reflection and critical analysis of technology. Such exposure can yield better academic performance in related subjects because students are taught to think critically about the consequences of their technical labour. Additionally, CS students are often involved in project-based learning where ethical scenarios are studied in an integrated manner and where skills in argumentation and critical thinking are relevant to the philosophy curriculum. This pedagogical process could contribute to giving a greater competitive edge to CS in explaining philosophical issues, as suggested by the performance gap in indicators like final tests.

Additionally, the composition of the students' demographics also adds to the diversity of the performance variation. Achi et al. illustrate differences between student perceptions of learning in a diversity of engineering fields, as students could exhibit different patterns of academic involvement and interest attributable to their discipline being closer to today's technology-orientated context (El Achi et al., 2020). There may also be cognitive and affective factors at play, as there is evidence that CS students report higher levels of engagement in innovative thinking and complex problem solving than those in EE courses (Zaghi et al., 2023). The existence of these discrepancies can perhaps be attributed to the CS coursework and its software-based and abstract nature, a

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

study area with a need for creativity in problem-solving that is congruent with philosophical thinking. Furthermore, with high exposure to interdisciplinary areas of ARMAN (augmented reality, mixed reality, and artificial intelligence) and HCI (human-computer interaction), CS students are not strangers to connecting technical content with philosophical discussion, which could help to improve their academic performance.

There is also considerable variability in educational outcomes across these fields as a result of gender and diversity. The National Science Foundation report draws attention to ongoing disparities in representation, particularly in fields such as CS, which may influence performance outcomes in interdisciplinary topics that are driven by ethical and philosophical debates (Ongi and Kidd, 2025). This lack of representation can stifle intriguing and diverse perspectives that may have benefitted philosophical discussions and contemporary technology-related topics. In addition, diversity efforts in CS education have led to the development of mentor and engagement opportunities, such as collaborative learning opportunities, which contribute to learning climates conducive to philosophical learning. Such initiatives can promote better performance by encouraging a supportive academic environment and fostering the diversity of ideas and critical thinking.

There are wider implications of this work regarding the performance differential between CS and EE students, particularly in philosophy and current affairs, that can be traced to a complicated dynamic between curriculum exposure, demographic characteristics, and philosophical effects of their fields. As CS disciplines are incorporating more ethical and philosophical dimensions into their curricula, they provide ways for students to reflect on and critically learn from their work, which may lead to better grades in interdisciplinary subjects. Targeted teaching practices and diversity-promoting activities synergise effectively, positioning CS majors to excel in courses that require critical and ethical thinking. This research demonstrates the need to integrate technical education with philosophical interrogation to cultivate well-rounded citizens, ready to tackle the complexities of contemporary technology.

Conclusion

In conclusion, this study has shown that CS students at UiTM Shah Alam outperformed EE students in Philosophy and Current Issues. The CS students were found to perform better compared to the EE students, particularly in this subject. This difference is likely due to the CS curriculum stressing the ethical and philosophical aspects of emerging technologies. The performance variations suggest that exposure to interdisciplinary topics may enhance CS students’ ability to engage with philosophical content and that demographic and diversity considerations are factors that influence academic performance. For future studies, a longitudinal study may examine the long-term impact of philosophical education on the technical disciplines, and qualitative research could help elicit the views of students concerning the value of this type of curricular work. Extending the findings to other faculties and exploring targeted interventions, such as ethics-orientated lectures, could further enhance interdisciplinary education for engineering students.

eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812

Acknowledgement

The authors thank the Academy of Contemporary Islamic Studies, Universiti Teknologi MARA, for technical support.

Conflict of interest

The author confirms that there is no conflict of interest involved with any parties in this research study.

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eISSN: 2716-6481
https://doi.org/10.55197/qjssh.v6i5.812