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A Study of the Dunning-Kruger Effect and Its Impact on Teaching and Learning of an Accredited University Curriculum

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Abstract—**This work investigates the Dunning-Kruger effect (DKE) in engineering students in an internationally accredited undergraduate program, including the Accreditation Board for Engineering and Technology (ABET) and the ASEAN University Network - Quality Assurance (AUN-QA). The study aims to explain why students score low on final exams despite high regular and/or midterm scores, even when the nature of the exam questions is consistent. Data analysis and survey results confirmed the observations of experienced faculty members that teaching an accredited program, compared to a traditional program, can lead to complacency in students when they are provided with too many learning resources, potentially causing negative impacts. Although only 36.96% of students were disappointed or very disappointed with their final exam results, indicating a small but significant Dunning-Kruger effect, this is a noteworthy finding. This suggests that even a prestigious, internationally recognized training program can have unintended side effects when implemented in a developing country, which warrants further research. This study aims to highlight these side effects to promote genuine lifelong learning, one of the primary goals of education.**

Keywords—**Dunning-Kruger effect (DKE), engineering education, accredited curriculum, ABET, AUN-QA, lifelong learning.**

JEET Category—**Research.**

I. INTRODUCTION

The Dunning-Kruger effect (DKE) suggests that individuals with lower abilities tend to overestimate their own capabilities (Kruger & Dunning, 1999). This cognitive bias was first clarified by Kruger and Dunning in 1999. If proven correct, this phenomenon has significant implications, as it implies that individuals with lower abilities not only struggle to perform tasks effectively but also have a false sense of self-worth. Dunning and Kruger proposed that this bias stems from a deficiency in metacognitive skills, in which individuals with lower abilities are unable to accurately assess their own performance (Hong, 2025). In their study, Kruger and Dunning assessed undergraduate students taking various psychology courses at Cornell University on their logical reasoning ability, sense of humor, and English grammar proficiency. After the exam, students were asked to self-assess their performance. Students were then divided into four groups based on their actual scores. By calculating the average cognitive ability within each group, Dunning and Kruger arrived at their conclusions as above. Notably, predictive accuracy was significantly higher in the first group compared to the last group, where predictions tended to be overestimated.

Numerous studies have acknowledged the existence of the DKE and offered psychological explanations for it (Guan, He, Su, & Zhang, 2025). Joyce Ehrlinger et al. (Ehrlinger, Johnson, Banner, Dunning, & Kruger, 2008) conducted five studies showing that individuals with poor performance often lack awareness of their shortcomings. Their research results indicated that individuals tend to be overly optimistic when assessing the quality of their performance in social and intellectual tasks. Notably, those with poor performance often overestimate their abilities, primarily due to a lack of competence that prevents them from recognizing those shortcomings. Odai Khasawneh (Khasawneh, 2020) investigated whether the problem of overestimating knowledge and ability is prevalent among younger generations, especially Generation Z, and how it might significantly impact companies' recruitment efforts. He examined the Dunning-Kruger effect on students' grade expectations in first year. Data analysis revealed that students tend to overestimate their knowledge and abilities. In another study, Rachel A. Jansen et al. (Jansen, Rafferty, & Griffiths, 2021) developed a plausible model of self-assessment, showing that the Dunning-Kruger effect may arise from two psychological mechanisms: prior beliefs about ability and the association between performance and skill in determining the correctness of each issue. These conclusions were drawn from a large-scale reproduction study, with approximately 4,000 participants in each study. That same year, Alana Muller et al. (Muller, Sirianni, & Addante, 2021) investigated the neural correlations of DKE. They developed an innovative method to produce the DKE effect through an object recognition test while simultaneously recording electroencephalography (EEG). Their results indicated that individuals who overestimated and underestimated their abilities engaged in different cognitive processes when evaluating their performance. Underestimaters appeared to rely on recall-based

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memory, while overestimaters appeared to rely on excessive familiarity when overestimating their performance. Subsequently, authors Matan Mazor and Stephen M. Fleming (Mazor & Fleming, 2021) expressed agreement and further explained DKE. They offered reasoning based on logical Bayesian inference: individuals with lower performance levels tended to overestimate their abilities because the noise data was insufficient to counteract the initial expectation that they would perform well.

However, there are still opinions that disagree with the Dunning-Kruger effect. Gilles E. Gignac et al. (Gignac & Zajenkowski, 2020) proposed through their research that while the phenomenon outlined in the Dunning-Kruger hypothesis might hold some validity for certain skills, its impact could be significantly less pronounced than previously suggested. Or Jan R. Magnus et al. (Magnus & Peresetsky, 2022) argued that the DK effect is a statistical artifact. In simpler terms, while there is an observed effect, it does not accurately represent human behavior. However, these results have also undergone analysis and have been met with counterarguments from other authors. In response to Gilles E. Gignac et al., Curtis S. Dunkel and his team (Dunkel, Nedelec, & van der Linden, 2023) reanalyzed the data, revealing a small yet significant DKE.

Regardless, the phenomenon of complacency is still a real phenomenon in human psychology. This phenomenon prevents people from continuing to learn, update new things, and become progressive. Both researching this psychological phenomenon and overcoming it in modern society are becoming increasingly urgent as science, technology, and management science are developing day by day. Meanwhile, in university education accreditation, Program Educational Objectives (PEOs) always have lifelong learning criteria. This shows the importance of studying DKE at university education to pursue university education accreditation such as the Accreditation Board for Engineering and Technology (ABET) or ASEAN University Network - Quality Assurance (AUN-QA). In addition, DKE has not been researched much for engineering or technology students but has only focused on psychology and social studies students (Khasawneh, 2020). This may result in meeting the PEO on lifelong learning of technology and engineering students under the ABET or AUN-QA assessment standards as insubstantial (Buhari, Suganya, & Rajaram, 2021). Therefore, this study was conducted to help fill this significant gap.

This research was conducted with two Design of Experiments (DOE) classes for mechanical engineering students in their 7th semester. The study aimed to explain why many students who received good grades during their studies scored lower than expected on the final exam. This output could be seen as a side effect of international accreditation at the university level, where students were given too many resources and provided with excessive information about the curriculum. Statistics and survey results revealed a small yet significant Dunning-Kruger effect, explaining the students' complacency when facing exams. This complacency prevented students from studying seriously for exams, leading to poor results. International accreditation and global integration are inevitable trends in developing countries (Jangali, Lakkundi, Gaitonde, Burli, & Madhusudhana, 2015; Le, Thi, Bach, & Duong, 2023). Along with that, the need to innovate approaches to educational methods (Thi, Van, Nguyen, & Nguyen, 2023) and the need to research student psychological phenomena in education for university lecturers (G. N. Nguyen, Nguyen, Nguyen, & Nguyen, 2026) who are only used to teaching according to traditional curriculums are becoming increasingly urgent.

II. Methods

A. Dunning-Kruger effect

The Dunning-Kruger effect refers to a cognitive bias in which individuals perceive themselves as more intelligent and capable than they actually are (Qazi et al., 2026). Essentially, those with lower capabilities lack the skill to recognize their own shortcomings (Carlos-Sánchez et al., 2026). The combination of limited self-perception and impaired cognitive abilities leads them to overestimate their abilities (McIntosh, Fowler, Lyu, & Della Sala, 2019). This term provides a scientific label and justification for a phenomenon that many readily acknowledge – that uninformed individuals often fail to recognize their own lack of wisdom. As Charles Darwin demonstrated in "The Descent of Man," "Ignorance more frequently begets confidence than does knowledge." (Kruger & Dunning, 1999). All of this is visually illustrated in Figure 1.

In engineering education, particularly at the university level, three issues arise when studying regarding DKE. First, it helps students identify the DKE phenomenon and recognize areas where their understanding of engineering and technological problems might be affected. Second, it provides emotional support to students facing psychological challenges and self-frustration. University-level teaching reveals that mechanical engineering students often fear fundamental subjects like Strength of Materials or Theoretical Mechanics, giving these subjects nicknames and considering repeated failures normal. Third, it guides and encourages students to continue studying diligently to acquire a substantial amount of knowledge, fostering sustainable learning.

B. Data collection

1) Beginning of the academic semester

Engineering students at the current university are required to complete 15 courses for specialized knowledge in mechanical engineering across the last four semesters to fulfill the graduation requirements, including both required and selection subjects. For this study, one specific course—Design of Experiments (DOE)—which is taught in the 7th semester and is mandatory for all mechanical engineering students was selected. The decision to focus on this course was based on several reasons. (i) DOE is offered at a relatively advanced stage in the program (7th semester), ensuring that students have already accumulated a foundational knowledge base and developed a consistent academic track record. (ii) DOE follows a standardized assessment format, including both

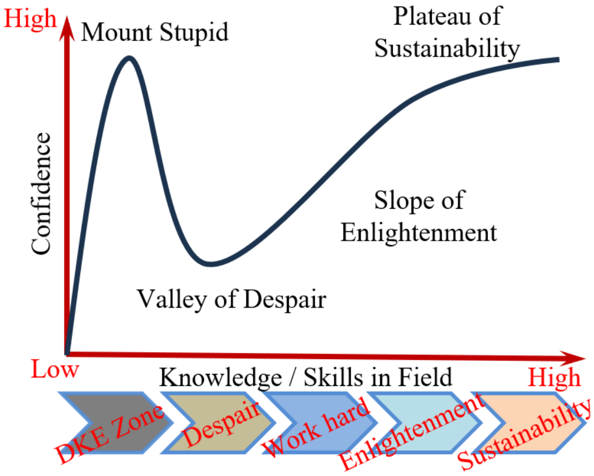

Fig. 1. The cognitive bias identified in the Dunning-Kruger effect.

TABLE I
INPUT STATISTICAL RESULTS

Statistical results	Class A	Class B
N	76	80
Mean	6.387	6.1253
SE Mean	0.101	0.087
StDev	0.881	0.7784
Minimum	3.625	3.775
Q1	5.944	5.675
Median	6.5	6.175
Q3	6.994	6.55
Maximum	8.4	8.025

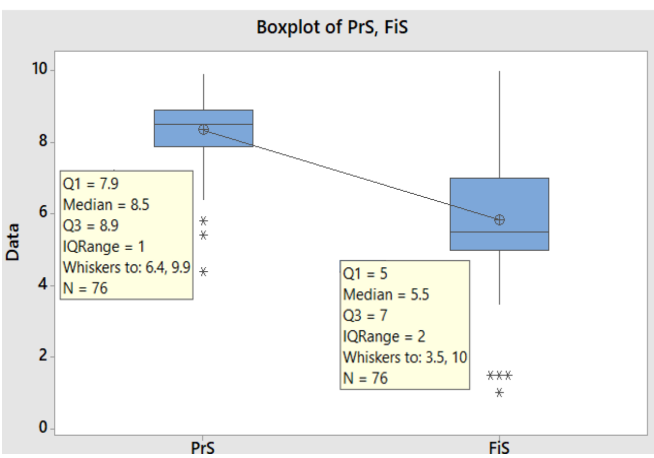

Fig. 3. Box-plot of PrS and FiS for Class A.

process (PrS) and final scores (FiS), which enabled us to compare student performance over time with high reliability. (iii) The two experimental classes (A and B) were composed of students who registered freely for the course, reducing the risk of selection bias. And (iv) The lecturers participating in the study teach this subject.

The two Design of Experiment classes chosen for the experiment were two classes randomly registered by students. The numbers for these two classes, named A and B, were 76 and 80, respectively. In addition, students were not informed about the experiment taking place to avoid intentional acts that

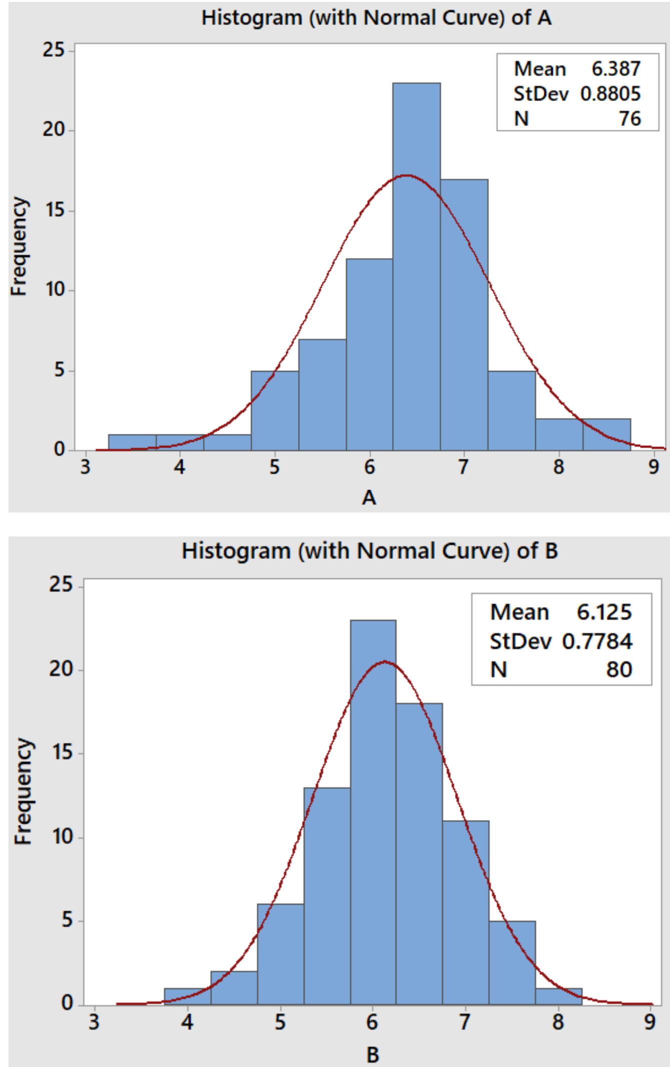

Fig. 2. Histograms with normal curves of the 2 classes (a) Class A; (b) Class B.

TABLE II
DESCRIPTIVE STATISTICAL RESULTS FOR CLASS A

Sample	PrS	FiS
N	76	76
Mean	8.35	5.84
StDev	1	1.97
SE Mean	0.12	0.23

TABLE III
ESTIMATION FOR DIFFERENCE FOR CLASS A

Difference	95% CI for Difference
2.507	(2.005, 3.009)

falsified the experimental results. Furthermore, as part of an ABET-accredited training curriculum, students were provided with a detailed course outline. This outline clearly specified the course learning outcomes (CLOs). (Thabassum, Thaha, Rajendran, & A. Abudhahir, 2022). In other words, the content of the final exam has been provided to students. At the same time, all students had their GPA checked by the lecturer at the beginning of classes. This check was intended to help ensure that the students for the experiment were at similar levels.

2) During the semester

During the study process, students received theoretical instruction and completed exercises before taking the test. The teaching and learning method followed the 2/3 principle. This meant that students received theoretical instruction and did reinforcement exercises before taking the test or exams to obtain their scores on the third attempt. These exercise scores were aggregated into regular scores (process scores - PrS).

3) End of semester

At the end of the semester, students took the final exam, which accounted for 50% of the overall course average score. The final scores (FiS) were then compared to the process scores (PrS) to examine the Dunning-Kruger effect (DKE). Additionally, a survey was conducted to assess student satisfaction with their final exam scores. The survey also explored their attitudes if the final exam score (FiS) was lower than expected, or in other words, lower than the process score (PrS). It should be noted that, in this study, we assumed that students expected final scores (FiS) to be equivalent to or greater than regular or process scores (PrS).

TABLE IV
T-TEST FOR CLASS A

NULL HYPOTHESIS		H_0: $\mu_1 - \mu_2 = 0$
ALTERNATIVE HYPOTHESIS		H_1: $\mu_1 - \mu_2 \neq 0$
T-Value	DF	P-Value
9.90	111	0.000

TABLE V
DESCRIPTIVE STATISTICAL RESULTS FOR CLASS B

Sample	PrS	FiS
N	80	80
Mean	7.47	5.02
StDev	1.16	1.91
SE Mean	0.13	0.21

III. RESULTS AND DISCUSSION

TABLE VI
ESTIMATION FOR DIFFERENCE FOR CLASS B

Difference	95% CI for Difference
2.450	(1.955, 2.945)

A. Input results

TABLE VII
T-TEST FOR CLASS B

NULL HYPOTHESIS		H_0: $\mu_1 - \mu_2 = 0$
ALTERNATIVE HYPOTHESIS		H_1: $\mu_1 - \mu_2 \neq 0$
T-Value	DF	P-Value
9.80	130	0.000

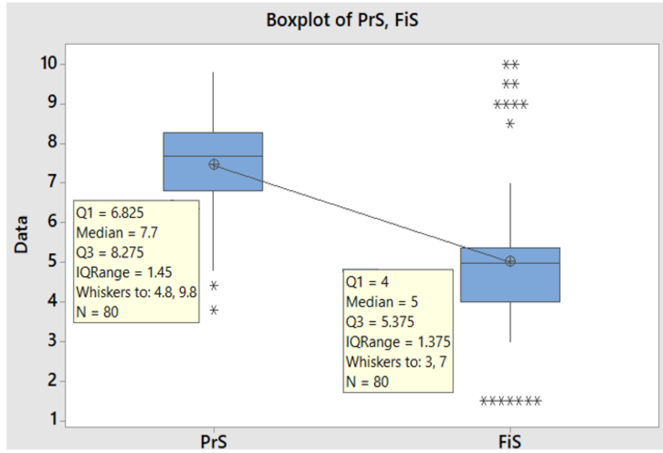

Fig. 4. Box-plot of PrS and FiS for Class B.

Table 1 and Figure 2 present the results of the input descriptive statistics. This was students' cumulative average score or grade point average (GPA) before entering the course. The results all followed the normal distribution. This confirmed that both classes were suitable for the experiment.

B. Score results

Table 2 presents the descriptive statistical results for class A's regular and final scores, PrS and FiS, respectively. The results showed that, in terms of average scores, the process results (8.35 ± 1.00) were much better than the final exam results (5.84 ± 1.97). This result is shown graphically in Figure 3. However, whether this difference was statistically significant or not remains to be analyzed further.

Next, a 2-sample t-test was used to test the difference to determine whether the population means of the two independent groups differed.

Table 3 presents the estimation for the difference for class A. Meanwhile, Table 4 presents the null hypothesis as well as the t-test results. In Table 4, the p-value represents the probability that assesses the strength of evidence against the null hypothesis. A lower p-value indicates stronger evidence against the null hypothesis. Since the p-value (0.000) was below the significance level (0.05), the decision was to reject the null hypothesis, or the difference between the population means did not equal the hypothesized difference. This meant that this difference was statistically significant. Or to put it another way, the final exam score (FiS) was significantly lower than the regular score (PrS) for class A.

Likewise, similar analyses were also performed for the results from class B. Table 5 presents the descriptive statistical results for class B's regular and final scores, PrS and FiS, respectively. The results showed that, in terms of average scores, the process results (7.47 ± 1.16) were much better than the final exam results (5.02 ± 1.91). This result is also shown graphically in Figure 4. However, whether this difference was statistically significant or not, again, remains to be analyzed further.

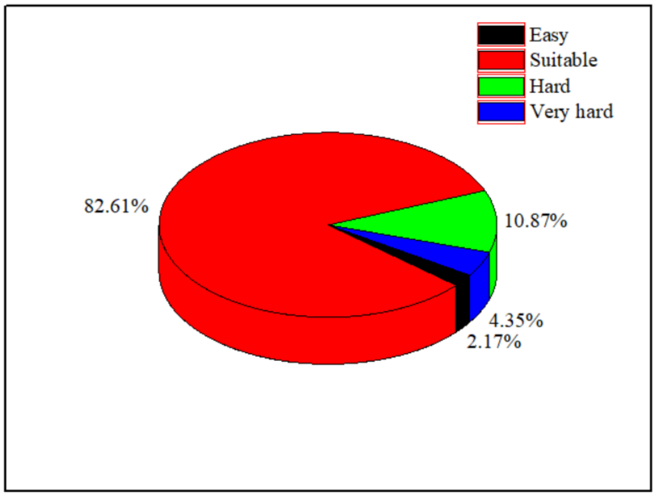

Fig. 5. The suitability of the final exam problems.

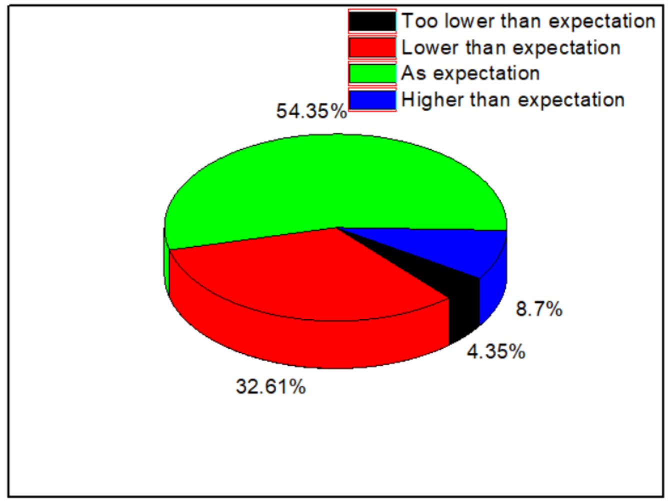

Fig. 6. Student satisfaction with final exam scores.

Table 6 presents the estimation for the difference for class B. Meanwhile, Table 7 presents the t-test results. The results for class B had the same properties as the ones for class A, the difference between the regular score and the final score was statistically significant (p-value = 0.000). These results confirmed previous calculations that this was not random but a regular phenomenon. This phenomenon was also frequently encountered while teaching courses in an ABET-accredited program, especially for the ones requiring calculation. The issue was that, given the same difficulty level, the scores on the final exam were lower than those on the exercises completed during the study process.

More than 10 years ago, in the engineering program, students faced difficulties in preparing for final exams in many basic courses and technical majors because the scope of knowledge was too broad, and the final exam was not limited. As a result, many students often selected a few key points to study for the exam while only briefly reviewing other parts. This challenge motivated students to study diligently to avoid failing the course and falling behind.

Meanwhile, in accredited programs such as ABET or AUN-QA, the situation is completely different. From the first class, students are provided with a detailed course outline. In practice, the course learning outcomes (CLOs), which specify the abilities students are expected to demonstrate, are often aligned with the key topics and structure of the course, thus giving students the impression that CLOs highlight the main content likely to be assessed. Typically, each course has 2 to 4 CLOs, and the content of the final exam is based on these CLOs. Since students already know the exam content in advance and have completed exercises and received exam preparation from lecturers, a sense of complacency has emerged in many students. Despite the final exam having the same difficulty level and problem types as the exercises, the input data and/or boundary conditions are different. Good grades on process exercises can lead to an overestimation of one's abilities, causing students to not take the final exam preparation seriously. As a result, students face difficulties during their final exams.

This is also a downside of the international accreditation of university education programs pursued by universities in developing countries. This problem is being recognized by lecturers with extensive practical teaching experience, who are calling for corrective measures. International accreditation of training programs is a step forward on the path to international integration for Vietnamese education (Thuan Kieu, Kirya, & Liu, 2023). However, accepting that every progress has its downsides and that nothing is perfect, researching and overcoming inadequacies when applying international accreditation programs to the specific conditions of Vietnam is extremely urgent. In addition, only by overcoming the phenomenon of complacency, or overestimating one's own abilities (DKE), will students be able to continue practicing and studying. In other words, the PEOs criteria for lifelong learning of ABET or AUN-QA can be achieved.

This phenomenon also reveals a pedagogical challenge that may arise during the implementation of international accreditation frameworks such as ABET or AUN-QA. These frameworks rightly emphasize transparency, learning outcomes, and structured course delivery, which are essential for ensuring quality and accountability in higher education. However, in practice, when students are provided with detailed course outlines and clearly defined learning objectives (CLOs) upfront, there is a risk that some students will become overly reliant on these materials. Many students may view

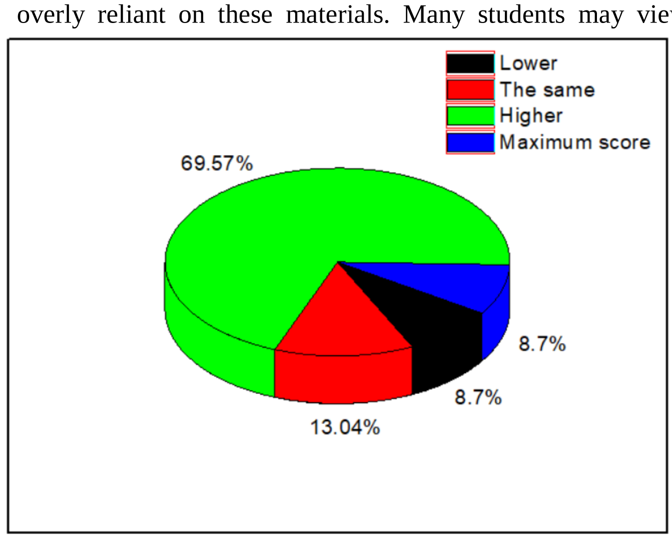

Fig. 7. Students' desire to solve the problems again.

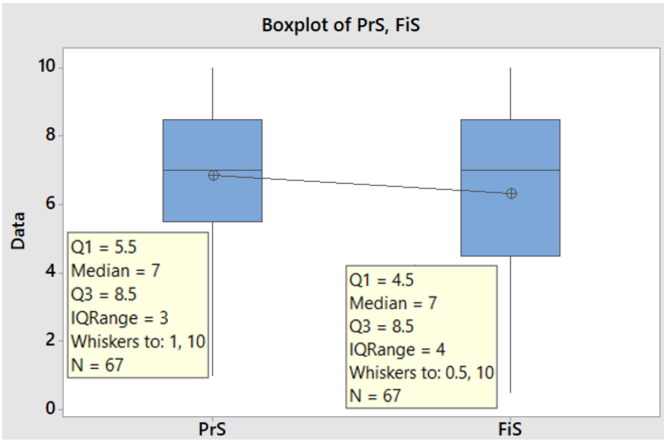

Fig. 8. Box-plot of PrS and FiS for 2 new DOE classes.

TABLE VIII
DESCRIPTIVE STATISTICAL RESULTS FOR 2 NEW CLASSES

Sample	PrS	FiS
N	67	67
Mean	6.85	6.32
StDev	2.02	2.74
SE Mean	0.25	0.33

TABLE IX
ESTIMATION FOR DIFFERENCE FOR 2 NEW CLASSES

Difference	95% CI for Difference
0.530	(-0.294, 1.354)

them as comprehensive exam preparation guides. This can inadvertently create complacency or overconfidence, especially when students believe that mastering the listed objectives guarantees success without further study. It is important to note that this is not a criticism of the accreditation systems themselves, which encompass numerous quality indicators, but rather a reflection on how they are implemented in the context of developing countries. Acknowledging and addressing these emerging teaching challenges is essential to ensuring that the full purpose of international accreditation, particularly its emphasis on continuous improvement and lifelong learning, is realized in practice.

Although the average final exam scores were significantly lower than the process scores, a small number of students demonstrated consistent or improved performance, suggesting that the Dunning-Kruger effect did not uniformly apply to all individuals within the class.

C. *Survey results*

After the course ended, a total of 46 students participated in the evaluation survey. Of these, 82.61% (38 students) said that the final exam was appropriate and no more difficult than the exercises they did during their studies as shown in Fig. 5.

Although the majority of students were satisfied with the exam problems, 36.96% of students were disappointed or very disappointed with their results. More than half of the students

TABLE X
T-TEST FOR 2 NEW CLASSES

NULL HYPOTHESIS		H_0: $\mu_1 - \mu_2 = 0$
ALTERNATIVE HYPOTHESIS		H_1: $\mu_1 - \mu_2 \neq 0$
T-Value	DF	P-Value
1.27	127	0.205

surveyed (54.35%) were not disappointed with their results even though their final exam scores were much lower than their scores during the course, as shown in Fig. 6. The reason was that although the scores were lower than expected, they still helped students pass the course. However, most of the students admitted that the problems on the final exam were not difficult. Additionally, 78.27% of them thought that their scores would improve or even be maximized if they were allowed to retake the exam, as illustrated in Fig. 7.

It should be noted that 84.8% of the students questioned had never heard of DKE, while the remaining 15.2% could not identify the DKE curve when asked further. This showed that all the students surveyed had not yet paid attention to this phenomenon, even though 95.7% of them had encountered the same issue in the past: overestimating their own abilities and then not being able to perform or meet expectations. This has been a concern for educators, as complacency prevents people from continuing to learn and progress. In the case of these two particular classes, after the final exam, the students were introduced to DKE. From there, the students learned which psychological phenomenon prevented them from studying hard for the final exam. Sometimes, students feel like they have had enough and are not motivated to continue studying for the exam. Therefore, they did not get the high exam scores they expected. It was not because the teachers trapped students in the exam problems, but rather due to a psychological phenomenon.

While DKE offers a compelling psychological explanation for the discrepancy between process scores (PrS) and final exam scores (FiS), it's important to acknowledge that other non-psychological factors may also have contributed to this performance gap. First, the nature of the different assessment formats: process scores are typically accumulated from assignments, short quizzes, and midterm exams that allow for more time, resources, or collaboration. The final exam, on the other hand, is an individual, time-constrained task under stricter conditions. Second, exam anxiety and stress may have hampered students' ability to perform to their full potential, especially in a highly competitive environment. Additionally, students may have become overly reliant on repetition and familiarity with solved problems, failing to adequately prepare them for the subtle variations in exam questions. Time management challenges and declining motivation near the end of the semester can also further impact performance. In summary, these factors suggest that while DKE is a core explanatory mechanism, differences in scores may stem from a complex interplay of psychological, pedagogical, and situational factors. Understanding these aspects contributes to a better understanding of the educational challenges facing accredited engineering programs.

IV. The Improvement of Teaching and Learning

Recognizing DKE as a psychological phenomenon has made teaching more effective, at least in terms of grades. Understanding student psychology helped lecturers have more empathy, similar to walking in someone else's shoes. A small but significant improvement was found in two DOE classes with 67 students the following semester. With similar teaching and learning conditions and constant level tests and exams, the difference between process scores (PrS) and final exam scores (FiS) has been significantly reduced, as shown in Figure 8. These results are also shown quantitatively in Table 8. Accordingly, the average values of PrS and FiS are 6.85 and 6.32, respectively. According to Table 9, the difference is 0.530, much smaller than the previous results, 2.507 for class A in Table 3 and 2.450 for class B in Table 6. Further analysis, the difference between the regular score and the final score was not statistically significant (p-value = 0.205) as shown in Table 10. This has demonstrated quantitatively the improvement in educational quality in accordance with international assessment standards. However, student progress in the final exam also has its drawbacks. According to experienced instructors, students failing the final exam due to their subjectivity can bring about a more profound experience. This may be more beneficial for them in the future in avoiding similar mistakes.

Furthermore, based on the insights from the initial intervention, several targeted initiatives were implemented in the following semester to mitigate the effects of complacency and improve student learning outcomes: (i) Explicit introduction to the DKE; (ii) Creating teaching - learning logs; (iii) Lecturer feedback on overconfidence indicators; (iv) Mock exams and peer feedback; (v) Explaning and reframing CLOs. These measures can be used alone or in combination depending on the lecturer, subject, and class.

However, the long-term implications of these findings warrant deeper reflection. When international accreditation programs (such as ABET or AUN-QA) offer transparent and predictable learning outcomes (CLOs) and examination formats, students may become overconfident and underestimate the need for sustained effort. This can diminish academic effort and cognitive engagement over time, both crucial for ensuring high-quality education and lifelong learning. In this context, the DKE can be seen as a psychological hindrance. If left unaddressed, it can persist beyond university graduation and into the workplace, leading to long-term performance deficits.

To mitigate these risks, our research suggests that curriculum designers need to implement metacognitive interventions and assessment techniques to help students understand their own capabilities and encourage reflection. Integrating adaptive tests, problem-based learning, and peer feedback mechanisms can help students better adjust their self-perception, reduce complacency, and enhance motivation for continuous improvement. This aligns better with the lifelong learning goals outlined in accreditation standards.

Conclusions

Survey results showed that 36.96% of students were disappointed or very disappointed with their final exam results, even though the final exam scores were statistically lower than the process scores: 8.35 ± 1.00 and 7.47 ± 1.16 compared to 5.84 ± 1.97 and 5.02 ± 1.91, respectively. From these analyses and survey results, a small yet significant Dunning-Kruger effect was found. This effect explained the complacency of students when facing exams, which prevented them from studying seriously and led to poor results. This could also be seen as a side effect of an accredited university curriculum, where students were given too many favorable conditions for the learning process. This study aimed to ensure the achievement of the PEOs of lifelong learning in an accredited university curriculum in a developing country. Beyond short-term exam performance, the findings carry long-term implications for educational quality. If left unchecked, the DKE may compromise students' capacity for self-assessment, thereby weakening their readiness for the workforce and diminishing the value of accreditation frameworks in producing globally competent engineers. Therefore, fostering metacognitive awareness and providing measures to encourage students to objectively evaluate their learning process is crucial to improving not only academic outcomes but also career preparation and lifelong learning capacity.

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Use the singular heading even if you have many acknowledgments. **Leave this section as is for the double-blind review process.**

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