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Analysis of the Lecturer’s Interest after Attending the Workshop STEM Design-Based Learning for Lecturers

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Abstract

The STEM (Science, Technology, Engineering, and Mathematics) approach has been widely adopted in schools but remains underutilized in higher education. Lecturers often perceive STEM as difficult to implement due to complex subject matter, time constraints, and limited personal interest. This study examined whether participation in a professional development program, *STEM Design-Based Learning for Lecturers*, could enhance lecturer’s interest in STEM. The workshop was conducted over two weeks with 18 participants from the Faculty of Mathematics and Natural Sciences. Data were collected using pre- and post-questionnaires designed to measure lecturer’s interest in STEM. Validity and reliability tests confirmed the instrument’s quality. Since the normality assumption was not met, the Wilcoxon Signed Rank Test was applied to assess differences before and after the workshop. The results indicated a statistically significant improvement in interest ($p = 0.001$) with a large effect size (Cohen’s $d = 1.266$). Specifically, 15 of 18 lecturers reported increased interest, while two remained unchanged and one experienced a slight decrease. These findings demonstrate that structured STEM workshops can effectively foster enthusiasm and engagement among lecturers. The study highlights the importance of integrating STEM-focused professional development into higher education to support curriculum innovation and encourage broader adoption of STEM approaches in teaching.

Keywords: STEM; The Lecturer’s Interest; Wilcoxon Signed Rank Test; Cronbach’s Alpha Test; Pearson Product Moment.

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INTRODUCTION

STEM education, which stands for Science, Technology, Engineering, and Mathematics, was first introduced in the United States as a response to concerns about declining student performance, particularly in mathematics and science. This educational approach was developed to integrate these disciplines to foster collaboration and innovation. The goal was to improve student learning outcomes and better prepare students with the skills needed for the modern workforce by providing an interdisciplinary method that connects mathematics, science, and engineering fields. STEM emphasizes hands-on learning, critical thinking, and problem-solving to address this challenge in education (Kennedy & Odell, 2014). This approach has since gained global recognition for its effectiveness in preparing students for careers in science and technology fields (Kelley & Knowles, 2016).

Currently, STEM has been developed in several countries, such as Australia, Finland, Vietnam, China, Taiwan, and Indonesia. Educational Curriculum in Taiwan has also been integrated with the STEM curriculum. In Indonesia, there have been many studies applying the STEM approach to classroom learning. The implementation of the STEM approach at school has been found in Indonesia, one of which is Suwarma, Astuti, and Endah (Suwarma et al., 2015), who have conducted a study on STEM-based Science learning. In this study, students were asked to design a balloon-powered car as learning media to understand the concept of uniform linear motion.

The implementation of the STEM approach can assist students in collecting, analyzing, and solving problems, as well as understanding the relationship between these problems. It can be stated that STEM can improve students' HOTS (Higher Order Thinking Skill) skills (Erdogan & Stuessy, 2015). Despite these findings, studies on STEM implementation in higher education remain scarce.

This imbalance reveals a significant gap in the literature. While much attention has been given to students and teachers in schools, relatively little is known about lecturer’s interest and attitudes toward STEM in universities. Yet, lecturers play a crucial role as curriculum designers and facilitators of learning in higher education. Their willingness to integrate STEM principles directly affects how students experience interdisciplinary learning at the university level. Understanding lecturer’s interest in STEM is therefore essential for advancing curriculum reform and professional development in higher education.

However, while the implementation of STEM in schools has been relatively well-documented, its integration in higher education remains underexplored. Studies that specifically investigate lecturer’s roles in implementing STEM are especially scarce. This gap is significant because lecturers serve as the key agents in adopting innovative teaching approaches in universities. Their interest, readiness, and motivation to engage with STEM strongly influence whether students in higher education will benefit from STEM-based learning. As highlighted by Abdioğlu, Çevik, and Koşar (Abdioğlu et al., 2021), five factors are essential in fostering STEM awareness: STEM readiness, STEM attitude, importance of STEM, STEM interest, and STEM activities. Among these, lecturer’s interest is fundamental, as it determines their willingness to integrate STEM into teaching practice.

Most existing research on lecturer’s interest in STEM has been descriptive, focusing on general attitudes or awareness levels, but has rarely examined whether targeted interventions such as professional workshops can meaningfully increase interest. Moreover, few studies have applied rigorous statistical testing to measure changes in lecturer’s perceptions before and after structured STEM training programs. Understanding these changes is critical, not only for designing effective professional development but also for informing higher education policies aimed at improving STEM capacity.

So, analysis to examine whether there is a difference in lecturer’s interest in STEM before and after participating in a STEM workshop is requiredIn this study, the data were obtained from research subjects, each of whom was systematically exposed to two different treatments on a regular basis.Thus, to examine whether there is a difference in lecturer’s interest in STEM before and after participating in a STEM workshop.

A paired t-test is a hypothesis-testing technique that involves the use of non-independent (paired) data (Xu et al., 2017). In the t-test, each subject is measured twice, thus resulting in paired observation. Thus, the researcher obtains two types of data samples: data from the first treatment and data from the second treatment (Hasija, 2023). In the t-test, there are several assumptions that must be met, such as the test variable (dependent variable) being on a continuous scale (interval or ratio) and being normally distributed (Kempf-Leonard, 2005). A paired t-test also assumes that objects are mutually independent and that variations in each group have similarities (Liptáková, 2021). If one of these assumptions is not met, a non-parametric method can be used (Imam et al., 2014).

Non-parametric methods to test differences in paired research objects from two data are the sign test and the Wilcoxon Signed Rank Test (Imam et al., 2014; Tanty et al., 2020). These two methods are non-parametric methods as alternatives to paired t-tests if the normality assumption is not met (Liu, 2018). A sign test is a simple and easy test to carry out. However, the sign test only considers the direction (positive + or negative -) of the difference for each paired data and does not consider the distance and magnitude of the observation, so it can reduce the power of the statistical test. Thus, the Wilcoxon Signed Rank Test provides more information than the sign test (Fadilatunnisyah et al., 2024; Whitley & Ball, 2002).

From this background, the present study proposes an analysis using the Wilcoxon Signed Rank Test to examine whether participation in a STEM design-based learning workshop significantly increases lecturer’s interest in STEM. By addressing this gap, the study contributes to a deeper understanding of how professional development interventions can enhance lecturer engagement with STEM, thereby supporting the advancement of higher education teaching practices and policies.

METHODS

Data

The data used in this study were primary data obtained by disseminating a questionnaire to lecturers who participated in the STEM Design-Based Learning for Lecturer workshop regarding the lecturer’s interest about STEM before (pre-test) and after (post-test) participating in the STEM workshop. The number of respondents in this study was 18. While this sample size provides useful insights, it remains small and thus limits the generalizability of findings.

Questionnaire

The questionnaire was used for data collection. There are two types of questionnaires, pre-test and post-test. The questionnaire had five-point Likert scale, 1-strongly disagree, 2-agree, 3-neutral, 4-agree, 5-strongly agree. The instrument was adapted from prior studies on STEM (Pathoni et al., 2022).

To evaluate quality, both validity and reliability tests were conducted. Validity was assessed using the Pearson product-moment correlation between each item and the total score. All items met the minimum criteria, indicating they were valid within the study context. However, the absence of more advanced construct validation techniques such as Exploratory Factor Analysis (EFA) or Confirmatory Factor Analysis (CFA) limits the strength of these claims. Reliability was tested using Cronbach’s alpha, which yielded a high coefficient, indicating strong internal consistency.

Data Collection

The researcher gave questionnaires to the participant of Fulbright STEM Design-Based Learning. The participant requested to complete the pre-test questionnaire before the workshop started and the post-test questionnaire is given to the participant after they attanding the workshop. For the respondents, about 32 questionnaires were given out. However, just 18 questionnaires were received and completed responses.

Research Design

The research design employed in this study follows a systematic sequence of data analysis procedures to ensure the validity, reliability, and appropriateness of statistical testing. The process began with data pre-processing, which involved preparing and cleaning the dataset for subsequent analysis. Following this step, a validity test was conducted on the research instrument items using the Pearson product–moment correlation. This was intended to examine whether each item accurately measured the intended construct. Next, a reliability test was performed using Cronbach's alpha to assess the internal consistency of the instrument and confirm its reliability for further use.

Once the instrument was confirmed valid and reliable, a normality test using the Shapiro–Wilk test was applied to determine whether the dataset met the assumption of normal distribution. The results indicated that the data did not meet this assumption. Consequently, to examine differences in lecturers' interest in STEM before and after participation in the STEM workshop, a Wilcoxon Signed Rank Test was employed. This non-parametric alternative to the paired sample t-test was chosen due to the violation of the normality assumption, ensuring that the statistical analysis remained robust and appropriate for the data characteristics. The research design shown in FIGURE 1.

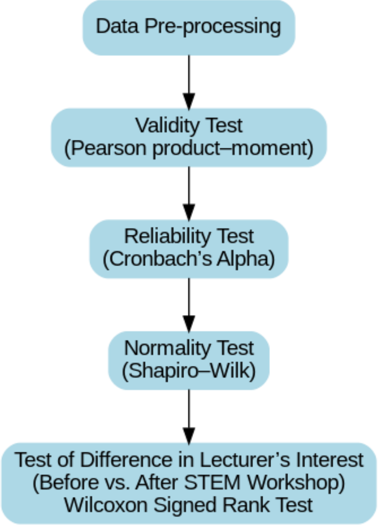

FIGURE 1. Research Design

RESULTS AND DISCUSSION

Before conducting an analysis to examine the difference in lecturer's interest in STEM before and after participating in the STEM workshop, stages that must be taken were to conduct variability and reliability tests on the research instrument used. The validity test is shown in TABLE 1.

TABLE 1. Validity Test

	Pre-Test		Post-Test	
	R	Sig.	r	Sig.
X_1	0.643	0.004	0.771	0.000
X_2	0.842	0.000	0.751	0.000
X_3	0.893	0.000	0.476	0.046
X_4	0.730	0.001	0.806	0.000
X_5	0.611	0.007	0.830	0.000
X_6	0.708	0.001	0.870	0.000
X_7	0.697	0.001	0.706	0.001
X_8	0.664	0.003	0.722	0.001
X_9	0.693	0.001	0.859	0.000
X_{10}	0.949	0.000	0.855	0.000

X_{11}	0.817	0.000	0.667	0.002
X_{12}	0.695	0.001	0.879	0.000
X_{13}	0.808	0.000	0.838	0.000
X_{14}	0.778	0.000	0.522	0.026
X_{15}	0.788	0.000	0.823	0.000
X_{16}	0.777	0.000	0.759	0.000

A validity test is a procedure used to indicate the extent to which an instrument can accurately measure what it is supposed to measure (Sanaky, 2021). The validity test in this study used Pearson product moment. The validity test of the Pearson product-moment was compared to the r-TABLE or comparing the Sig. value (P-value) with α value. From TABLE 1, it can be seen that the P-values for all items, both pre-test and post-test, are $< \alpha = 0.05$, which means that all items in the research instrument were valid. After the validity test, a reliability test was carried out, which is shown in TABLE 2.

TABLE 2. Reliability Test

	Cronbach's Alpha
Pre-Test	0.946
Post-Test	0.946

A reliability test was used to measure the extent to which the research instrument provides sTABLE results. If the indicators are used to repeat the measurement, they will provide the same results (Taherdoost, 2018). A reliability test usually uses Cronbach's Alpha, in which the higher the reliability value, the more reliable the instrument is. Thus, the research data will also be more accurate and precise. From TABLE 2 above, Cronbach's Alpha value is 94.6%, where all items in the research instrument are reliable and have a very high level of consistency.

One of the requirements for a paired sample test using a t-test is that the data must meet normal assumption. TABLE 3 shows the results of a normality test using Shapiro-Wilk.

TABLE 3. Normality Test

	Statistics	**Degree of freedom**	**P-Value**
Pre-Test	0.880	18	0.049
Post-Test	0.943	18	0.442

Based on TABLE 3, the sig value (p-value) for the pre-test variable is 0.049 < $\alpha = 0.05$, which means that H_0 is rejected. This indicates that the assumption of normality was not met. Because the normality assumption was not met, the test used was a non-parametric Wilcoxon Signed Rank Test. TABLE 4 shows the ranks output from Wilcoxon Signed Rank Test.

TABLE 4. Ranks

		N	**Mean Rank**	**Sum of Ranks**
Pre-Post	Negative Ranks	1	2.00	2.00
	Positive Ranks	15	8.93	134.00
	Ties	2		
	Total	18		

From TABLE 4, the negative rank value is 1, which indicates that 1 respondent had a decrease (reduction) in value from pre-test value to post-test value, where the decrease is 2 points. The positive rank value was 15, which indicates that 15 respondents had an increase in value from the pre-test to the post-test. This means that 15 respondents had an increase in interest in STEM after participating in the STEM workshop, where the average increase was 9 points. Moreover, there were 2 respondents who did not have a decrease or increase in interest in STEM after participating in the STEM workshop. The results of the Wilcoxon Signed Rank Test can be seen on the TABLE 5.

TABLE 5. Wilcoxon Signed Rank Test

	Pre-Post
Z	-3.413
P-Value	0.001

TABLE 5 shows the results of the test using the Wilcoxon Signed Rank Test. From the TABLE above, the p-value is 0.001, where $< \alpha = 0.05$ means that H_0 is rejected. Because H_0 was rejected, it can be concluded that there was a difference in lecturer's interest level before and after participating in the STEM workshop.

The results of the Wilcoxon Signed Rank Test showed a significant difference, indicated that the STEM workshop had a positive effect on increasing lecturer's interest in STEM. The results of this study provide strong evidence that STEM workshops can improve lecturer's understanding and interest in STEM. This is important to support further development in the application of the STEM approach in higher education, with the hope of improving the quality of higher education, especially in the fields of science, technology, engineering, and mathematics. To further evaluate the practical significance, an effect size was calculated using cohens'D as shown in TABLE 6.

TABLE 6. Effect Size

Statistic	**Value**
Cohens'D	1.266

The effect size was 1.266, which is considered large according to Cohen's guidelines. This means that, beyond being statistically significant, the workshop produced a meaningful and substantial improvement in lecturer's interest.

Overall, the results of the Wilcoxon Signed Rank Test showed a significant and practically important difference. The workshop effectively increased lecturer's interest in STEM, as evidenced by the fact that the vast majority of participants reported higher levels of interest after participation.

These findings suggests that the workshop not only increased enthusiasm but also reduced variability in interest among lecturers. The initially diverse perceptions of STEM (pre-test not normal) became more aligned after shared exposure to the workshop activities, indicating a unifying effect. The design of the workshop possibly including hands-on tasks, collaborative learning, and the contextualization of STEM in real-world teaching may have been key drivers of this positive shift.

It is also worth noting that the small number of unchanged or decreased scores can be informative. For example, the one participant with a decline in interest could reflect an individual mismatch between workshop content and prior teaching philosophy, while the ties may indicate that some lecturers already possessed high enthusiasm toward STEM, leaving little room for measurable growth. These nuances highlight the importance of considering individual differences when evaluating professional development outcomes.

From a practical perspective, the large effect size demonstrates that workshops of this type are not only statistically effective but also impactful in real terms. This provides strong justification for universities and policymakers to invest in similar professional development initiatives. Strengthening lecturer's STEM interest can translate into greater integration of STEM principles in teaching, which in turn supports student engagement and prepares graduates for the demands of science, technology, engineering, and mathematics-driven industries.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on the results and discussion, it can be concluded that the research instrument is valid and reliable. By using the normality test, it can be found that the assumption of normality was not met, so the Wilcoxon Signed Rank Test was used, showing a significamt and large effect (cohen's D = 1.266). Fifteen of 18 participants reported increased interest, indicating the workshop effectively motivated and engaged lecturers. This findings highlight the value of structured STEM workshops as professional development tools, enhancing enthusiasm and fostering more consistent, positive perceptions among lecturers, supporting the need for institutional investment in STEM-focused training.

Recommendations

Based on the findings, several recommendations can be made to enhance the effectiveness and sustainability of STEM training in higher education. Universities should integrate STEM workshops into regular professional development programs while diversifying workshop design through modular or flexible tracks to accommodate varying levels of prior knowledge and motivation. Interactive, hands-on, and collaborative learning should remain central to workshop activities, as these elements strongly contributed to increased interest. Institutions are also advised to conduct long-term follow-up through surveys or classroom observations to determine whether heightened interest leads to lasting changes in teaching practice. Finally, given the strong effect size observed, policymakers and university leaders should consider scaling up similar initiatives across departments and institutions to maximize impact at the systemic level.

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