A Comparative Study of Trained and Untrained Science Students' Attitude Towards Entrepreneurship, Innovation, Training, and Science Studies: Implications for Practical Education

Dr. Theresia Edward Busagara[1], Ms. Regina Vicent Mukama[2], & Dr. Petro Sauti Magai[3]
[1]Department of Finance, University of Dar es Salaam Business School, Dar es Salaam, Tanzania
[2]National Institute of Transport, Department of Education and Mathematics, Dar es Salaam, Tanzania
[3]Department of General Management, University of Dar es Salaam Business School, Dar es Salaam, Tanzania
Corresponding author[3]: sautimagai@gmail.com
ORCID ID: https://orcid.org/0000-0002-5782-7063

Abstract

This comparative study examines the attitudes of trained and untrained science students in advanced-level secondary schools towards entrepreneurship, innovation, training, and the relevance of science studies. Data were collected from eighty-five advanced-level secondary school students and analysed using descriptive and inferential statistics. In the inferential statistics, a t-test was used to establish the mean differences between the trained and untrained science students on their attitude towards the importance of entrepreneurship, innovation, science studies, and training. The findings revealed that trained students depicted a high attitude towards entrepreneurship (μ=8.72), innovation (μ=8.59), training (μ=8.29), and higher engagement with their science studies (μ=9.10) at a $p < 0.05$ significance level. The study underscores the importance of promoting scientific, entrepreneurial practices for sustainable scientific development. It also highlights the inadequacy of a formal education curriculum alone, advocating for supplementary entrepreneurial training to effectively translate formal knowledge into solutions for social problems.

Keywords: *Science students, attitude, entrepreneurship, innovation, education*

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Introduction

Efforts to promote entrepreneurship knowledge and its integration into education curricula have been commendable (Alamineh, 2022) for demonstrating a growing

awareness of the significance of entrepreneurial skills in today's world. The literature reveals the emphasis on entrepreneurship learning in the context of education programs and skill development (Von Graevenitz, Harhoff, Weber, 2010; Lin et al., 2023; Rajchamaha & Prapojanasomboon, 2022) mainly in higher learning education (Taatila, 2010; Oliveira, & Brown, 2022). A slight emphasis has been put on secondary schools to improve their entrepreneurial skills and innovation, more specifically when it comes to science-based subjects, which are fundamental to innovation. Although few studies reveal the strength of building science-based skills and attitudes through various programs (Setiawaty et al., 2018; Oliveira & Brown, 2022) and role models play in emphasising science-based entrepreneurship (Rajchamaha & Prapojanasomboon, 2022), studies on science-based entrepreneurship, specifically for secondary students lack viable explanations to inform on measures and best practices to enhance entrepreneurship and innovation through science. However, despite the relevance of science-based entrepreneurship in addressing community problems, a notable practical gap hinders its full advancement (Lin et al., 2023). This gap represents a critical challenge that must be addressed to harness the potential of science-driven innovations and entrepreneurship skills for societal development.

One potential solution lies in focusing on secondary school students, who form an ideal learning age group due to their active brains and ample time to grasp and apply science knowledge extensively (Indarti, 2021). Proper curricular reforms can serve as effective vehicles to drive attitudinal and behavioural changes among students, instilling an entrepreneurial mindset from an early age. While various forms of entrepreneurship education have been increasingly advanced across multiple educational levels, there remains limited dedicated attention to translating science knowledge into practical entrepreneurship and problem-solving for real-world community challenges. This highlights the need for targeted efforts that bridge the gap between scientific knowledge and entrepreneurial practices, ensuring that scientific innovations can be effectively utilised to address pressing societal needs and contribute to sustainable, practical education. Moreover, it is crucial to address the disparity in research focus within entrepreneurship literature, which predominantly centres around university students (Oliveira & Brown, 2022). Secondary school students represent a vital yet underexplored cohort in understanding the behavioural differences in their entrepreneurial and innovative attitudes before and after receiving training. Exploring these differences can offer valuable insights into the effectiveness of entrepreneurial education at the secondary school level, ultimately shaping evidence-based educational reforms that nurture the next generation of innovators and problem solvers.

For years, in numerous OECD countries, science curricula have been reformed to render science more accessible at a young age, aiming to equip children with the

knowledge, skills, and competencies essential for the future (OECD, 2020). This idea is corroborated by Wedell and Grassick (2017), who discuss how to live with curriculum change. Emphasising the instruction of fundamental principles, these curricula have undergone reforms to amplify their influence on the societies of the United Arab Emirates (UAE) (Alkaabi, Ramadani, & Zeqiri, 2023). Amoros and Bosma (2014) emphasised the role of learning in promoting self-employment for economic and social development. To be able to apply science and create self-employment, entrepreneurial training becomes crucial for students to grasp concepts, develop managerial skills, and influence their entrepreneurial attitude/ intention (Liñán, 2008; João & Silva, 2020). Education plays a pivotal role in fostering the entrepreneurial mindset and equipping students with the necessary skills for future success in entrepreneurship, becoming beneficial to both personal growth and societal advancement.

However, despite the undertaking of previous reforms, the curricula in Tanzania are yet to be fully synchronised with scientific knowledge to effectively address community problems and unlock science-based business opportunities at early learning stages. Science-based businesses have emerged globally as a potent source of innovation and entrepreneurship (Sharma, 2019) and as effective problem-solving mechanisms within communities (Mohd & Mahmood, 2011). Recognising this potential, institutions worldwide are now actively engaged in connecting science, entrepreneurship, and community problem-solving to elevate scientific knowledge and empower the young generation with entrepreneurial skills (Setiawaty et al., 2018). This intersection of education, science, and entrepreneurship holds great promise in fostering a generation of young minds capable of leveraging scientific knowledge to create sustainable businesses that address societal challenges, driving both personal development and societal progress. The intersection reflects a proactive approach towards improving practical education to nurture future leaders and innovators.

The paramount need to link scientific knowledge, entrepreneurship, and community problem-solving is recognised in science-based secondary schools (Atmojo, Ardiansyah, & Saputri, 2022). Initiatives such as the Future Science, Technology, Engineering, and Mathematics (STEM), as well as the Business Leaders' programme, have been training students in this direction since 2017 in several countries, including Tanzania. The training provides students with entrepreneurial and innovative skills, which empower them to tackle community challenges while creating business opportunities (Rajchamaha & Prapojanasomboon, 2022; Agu, 2021). Through the STEM project, there is an enhancement in the relevance of science and technology development and the cultivation of a skilled workforce, effectively addressing Tanzania's economic challenges.

As impact training becomes crucial, assessing its effectiveness in driving practical education becomes essential (Amoros & Bosma, 2014). Indeed, integrating scientific knowledge with entrepreneurship empowers students to contribute actively to societal progress and fosters a generation of innovative problem solvers. A study was therefore undertaken to compare the attitudes of the trained and untrained science students towards entrepreneurship, innovation, science studies, and training from advanced-level secondary schools in Tanzania. Eventually, the mean scores were compared to determine whether there were significant differences among the two groups of science students in the study.

The article underscores the importance of entrepreneurship training in science-related knowledge, influencing attitudes and mindsets towards science, entrepreneurship, and community problem-solving. Encouraging the young generation to establish science-based businesses can create job opportunities and contribute to the global sustainable agenda. The article's relevance lies in providing empirical evidence to institutions engaged in knowledge improvement through training, promoting connections to existing bodies of knowledge. Overall, this article reinforces the relevance of practical education by driving entrepreneurship as a means to address societal challenges and promote job creation through Science-based skills and knowledge.

Literature Review

Theoretical literature puts forward an argument that Science-based entrepreneurship facilitates technology-knowledge transfer between universities and industries (Blankesteijn, Bossink & van der Sijde, 2021; Oliveira & Brown, 2022). Entrepreneurship, especially in diverse fields, addresses youth unemployment and bolsters the economy (Alkaabi, Ramadani, & Zeqiri, 2023). While science-based entrepreneurship aims to tackle societal problems, its learning aspect is practical, needing a balanced fusion of knowledge and impact (Agarkar, 2019). Once more, ibid emphasised that learning is a behavioural process that is shaped by experiences. Formal education should inspire hands-on learning, skill development, and the meaningful organisation of new information. As Constructivism suggests, knowledge construction through personal experiences and interactions, with active roles, boosts knowledge for real-world problem-solving. These components (behavioural, cognitive, constructive) complement each other, which is crucial for outcomes (Agarkar, 2019). Science-based entrepreneurship must, therefore, balance theory and practice, infuse entrepreneurial education in universities, foster an entrepreneurial mindset, and cultivate spin-offs via diverse learning approaches (Blankesteijn, 2021). This approach of integrating academia and industry while nurturing practical skills enhances the transformative impact of science-based entrepreneurship.

Relevance of Science Studies with entrepreneurship

According to Das et al. (2014), science is an ideal subject for school students due to their innate curiosity, as it provides opportunities for them to explore and discover. It is an active field with hands-on labs and experiments, making it suitable for younger, active learners. Rull (2014) emphasises science's societal value, meeting basic human needs and enhancing living standards. Hannula (2002) delves into the complex nature of students' attitudes toward mathematics and how it influences their academic performance in the subject. It explores the emotional and cognitive dimensions of attitudes and their impact on learning outcomes in mathematics education. Students' interest in science and their beliefs about its utility influence problem-solving behaviour (Atmojo, Ardiansyah & Saputri, 2022; Mohd & Mahmood, 2011).

Moreover, science is presented as a driver of economic growth (Belitski & Desai, 2016), impacting business and social development (Urbano et al., 2016). This underscores the crucial link between science studies and entrepreneurship, where the innovative application of scientific knowledge can lead to new ventures and economic progress. It is essential to promote a change in attitude for those with negative perceptions of science, given its wide-ranging significance. Key influences on students' science attitudes include teachers and their methods, as highlighted by various authors (Duatepe-Paksu & Ubuz, 2009; Yilmaz et al., 2010). Teacher factors such as content knowledge, personality, real-life examples, and attitudes impact students' negative perceptions of science subjects (Marchis, 2013). However, students must apply appropriate strategies for scientific problem-solving (Effandi & Normah, 2009). Furthermore, achieving success in their goals encourages students to develop positive attitudes towards science and other scientific problem-solving endeavours.

Entrepreneurship and Training

The significance of entrepreneurial education in science is evident, but Von Graevenitz et al. (2010) noted limited exposure to this education, necessitating further studies for comprehensive understanding. Iwu et al. (2019) emphasise the need for universities to offer high-quality entrepreneurship courses taught by skilled instructors to enhance young people's entrepreneurial mindset, leading to economic and personal growth (Caggiano et al., 2016; Galvão et al., 2018; João & Silva, 2020). Diverse opinions exist: João & Silva (2020) stress instilling an entrepreneurial mindset in engineering students, while Bhatti et al. (2021) suggest using entrepreneurial education to identify students' entrepreneurial attributes. Liñán (2008) highlights its role in cultivating attitudes, intentions, and new company creation abilities. Alamineh (2022) notes its importance across fields, revealing higher entrepreneurial intentions among university students. Indeed, science-based

entrepreneurship bridges science to commerce, technology innovation, and business opportunities, boosting practical skills through evidence-based learning (Oliveira & Brown, 2022). Indarti (2021) underscores schools as the primary venue for nurturing entrepreneurial skills, while Galvão et al. (2018) conclude that varied entrepreneurial education levels significantly impact business start-ups. Alkaabi, Ramadani, and Zeqiri (2023) argue that entrepreneurial ecosystems catalyse family business performance.

Entrepreneurship and Innovation

In various studies, there is a concerted effort to establish a robust link between entrepreneurship and innovation as key drivers for economic development (Bhatti & McAndrews, 2021; Bell, 2019a; Blankesteijn et al., 2021a). According to Sharma (2019), entrepreneurship acts as a catalyst for economic progress by converting knowledge into valuable outputs, thereby fostering growth. Furthermore, Landström et al. (2012) advocate for a more profound integration of innovation and entrepreneurship to bolster economic expansion. Amoros and Bosma (2014) contend that entrepreneurial activity introduces competition, ultimately leading to heightened productivity, job creation, and enhanced national competitiveness. This innovative spirit involves the creation of new products, markets, organisations, or methods, as highlighted by Bhatti et al. (2021), a sentiment that Bell (2019) concurs with, emphasising the embrace of novel ideas, approaches, and processes by innovative individuals. Furthermore, a science-based entrepreneurship education plays a pivotal role in facilitating technology transfer, effectively diffusing innovations into the economy (Sharma, 2019; Blankesteijn, Bossink, & van der Sijde, 2021).

Methodology

Study design

This comparative study investigates the attitudes of science students who were trained in entrepreneurship and those who were not trained in entrepreneurship. Mean and hypotheses testing were used to study the differences in attitudes among science students in STEM Programs. STEM is an educational programme developed to prepare primary and secondary students for college, graduate study, and careers in the fields of science, technology, engineering, and mathematics. The programme is quite popular across the world in this era. In Tanzania, the programme was implemented at the University of Dar es Salaam through the Department of Physics. Through the STEM coordinator at the University of Dar es Salaam from the Department of Physics, researchers in this study found their access to relevant information necessary for data collection, including the number of students who attended the program and some of the available students' contacts. The coordinator provided the researchers with project details and facilitated communication with trained students, who, by the time of data

collection, were already in higher learning institutions and attaining university education.

At the time of data collection, these students were scattered in different universities across the country. Hence, a snowball method was employed, initiated by the project coordinator, to gather students who had attended the STEM programme at selected secondary schools in Dar es Salaam between 2017 and 2019 as the University of Dar es Salaam coordinated it. A total of 100 students participated in the training across six secondary schools over three years. However, the detailed list of attendees was unavailable, with only the aggregate number of participants recorded in the programme reports. Consequently, the snowballing sampling method was applied to identify and track respondents.

To obtain the second group of students for data collection for comparison purposes, the researchers chose similar students in the same study years and similar study characteristics so that the only difference remains to be receiving entrepreneurship training. Thus, science students were selected from each nearby school so that the trained students could help refer these students. In addition, teachers from these schools were also contacted to refer their students who completed school in the years 2017 to 2019. Thus, a snowball technique was also used to obtain the second group of respondents (Untrained Science students). This research, therefore, involved two groups of secondary school science students (Trained and Untrained science students) for data collection.

For each group, respondents were easily obtained by reference made from a few obtained students whose contacts remained with the UDSM project coordinator and some few whose contacts remained with their teachers. From there, these initial students put in a lot of effort to refer and search for the rest of the students who were able to respond to the research.

Sampling and data collection

Forty-five trained science students and forty untrained science students were surveyed in Dar es Salaam. A 10-level Likert scale questionnaire, based on literature and adjusted for comparison, was used for data collection for both trained and untrained science students. To ensure validity, a pre-focus group discussion was held with the trained students, facilitated by the project coordinator, who acted as a link between the researcher and students. A discussion guide featuring open-ended questions was utilised during these discussions, fostering a deeper understanding of participants' intentions to apply scientific knowledge in addressing community issues through science-based business ventures. The project coordinator's involvement instilled confidence in student participation, while the pre-focus group discussion oriented them to the research purpose. Almost all students were over eighteen

years of age and considered responsible adults capable of analysing, reflecting, and sharing their experiences voluntarily. After the pre-focus group discussion, the research tools were deemed ready for data collection.

Finally, each group (trained and untrained science students) was contacted separately to meet with the researchers for data collection. Before questionnaire administration, a briefing meeting was conducted to raise respondents' awareness of the research objectives. During the meeting, respondents were briefed about the research purpose, reminded about the training that took place in the past and recalled their project activities during the programme. Later, each student was provided with a questionnaire for completion. In the end, transportation costs for the briefing and the pre-focus group meetings were covered, respecting their time investment.

Hypotheses

The study sought to find out whether the means of the two groups (trained and untrained science students) were significantly different concerning their attitudes towards entrepreneurship, innovation, training, and the relevance of science studies. The following four hypotheses were tested:

H $_1$: *The trained science students have a significantly higher mean score than untrained science students in their attitude toward entrepreneurship*.

H $_2$: *The trained science students have a significantly higher mean score than the untrained science students in their attitude toward innovation.*

H $_3$: *The trained science students have a significantly higher mean score than the untrained science students in their attitude toward training.*

H $_4$: *Both trained and untrained science students have significantly high mean scores in their attitude toward the relevance of science studies.*

The study analysed two groups to examine the mean differences in which results were expected to depict significant mean differences by high mean values on trained students. As shown from attitude-related studies, entrepreneurial training stands as a catalyst for attitude change and a cause of the differences. It was assumed that trained science students are capable of practising scientific-related entrepreneurial activities through the use of scientific knowledge. This is based on the fact that the acquired training influences them to change their mindset, and the view of the relevance of science becomes different as these students are exposed to more practical issues on how science can change lives, solve problems, and create jobs through entrepreneurship.

Data analysis

Data were analysed using inferential statistics, which evaluated the aggregate score of the responses and their respective mean scores and subsequently tested the hypotheses. The trained science students were identified as group 1, and the untrained science students were identified as group 2. The group mean scores were key descriptive features to establish the level of attitude among students. The mean scores were compared to determine whether there were significant differences across the means within groups. A T-test was used to compare the mean scores of two independent groups on a particular variable. According to Sullivan and Artino (2013), Likert scale data can be transformed and considered continuous numerical data from their interval nature by using mean scores. Hence, the Likert scale data was deemed to be a continuous variable by mean computation. T-test was further appropriate for this study as it supports a small sample size and is applicable when comparing only two groups whose variables are independent and no relationship is measured among variables. Therefore, the t-test helps to determine whether there is a significant difference in attitudes between the two groups of science students. In contrast, all the basic assumptions of the method of analysis were observed. Moreover, Levene's test of equal variance ensured the equality of variance across groups; the independence of samples from one another and the normal distribution of the sample were measured.

Results

Description of the study sample

The overall sample of trained and untrained students was eighty-five students (85), of which sixty-one per cent (61%) were female and thirty-nine per cent were male (39%). Across groups, there were more female students than males, with ages ranging from 17 to 23 years. Being science students in secondary schools a few years ago, the majority were university students, either first years or second years. Across the groups, more than 50% showed prospects about science studies, and only forty-eight per cent (48%) of the students diverged from science-related studies. In addition, the majority of the students admitted to having experience in conducting business, although their business experience was not related to science practices. Table 1 indicates the main summary of the sample statistics, and Table 2 presents a summary of the mean score for all the measured variables.

Table 1

Respondents' Demographic Summary Statistics

Variable	***Trained***	***Untrained***	***All***
Gender			
Male	40%	38%	39%
Female	60%	63%	61%
Age			
17-20 years	78%	83%	80%
21+ years	22%	18%	20%
Prospects with science studies			
Yes	51%	53%	52%
No	49%	48%	48%
Business Experience			
Yes	78%	88%	82%
No	22%	13%	18%
Number of Respondents	45	40	85

Note: Numbers are reported as a percentage of column totals.

Table 2

Overall Summary of the Mean Scores

Variable	***Mean Score for Trained Students***	***Mean Score for Untrained Students***
Students' Attitude towards Entrepreneurship	8.72	7.54
Students' Attitude towards Innovation	8.59	7.97
Students' Attitude toward Training	*8.29*	*5.16*
Students' attitude towards the relevance of science studies	*9.10*	*5.50*

Hypotheses results

Attitude towards entrepreneurship

The study intended to compare two groups of science students in terms of their attitude toward entrepreneurship. According to previous research, the individual ability to run a business has been facilitated by individual entrepreneurial orientation. Being an entrepreneur requires individual effort to be able to work without being supervised, to work under pressure, to have self-control, and to oversee multiple business activities. With these attributes, students were also assessed on their ability to run a business, given their attitude towards entrepreneurial orientation. Results show that trained science students believe that they can solve community problems scientifically (89% vs. 45%), unlike untrained science students. The entrepreneurial attitude further describes how eager the trained science students are

towards solving community problems and what entrepreneurs do across the world. They normally become successful in taking on challenges and solving problems within the communities. This is in hand with risk-taking and being proactive in their living areas. Generally, the trained students indicate a higher entrepreneurial attitude compared to the untrained science students, as reflected in the mean scores of 8.72 and 7.54 for trained and untrained students. Table 3 further shows students' attitudes towards entrepreneurship as a function of all responses.

Table 3

Students' Attitude towards Entrepreneurship

S/n	Affirmations	Trained			Untrained		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
1	I use scientific knowledge to solve my problems	*4%*	*7%*	*89%*	*25%*	*30%*	*45%*
2	I am looking forward to making money through science	*13%*	*22%*	*64%*	*43%*	*25%*	*33%*
3	I take part in community problem-solving	*0%*	*13%*	*87%*	*15%*	*43%*	*43%*
4	I am inspired by those who solve problems in their communities	*0%*	*7%*	*93%*	*0%*	*25%*	*75%*
5	My acts are highly based on community needs and problems	*4%*	*9%*	*87%*	*5%*	*38%*	*58%*
	Aggregate score	*4%*	*12%*	***84%***	*18%*	*32%*	***51%***

With the above descriptive results, the first tested hypothesis (H_1) stated that "*The trained science students have a significantly higher mean score than untrained science students in their attitude toward entrepreneurship".* Its results show that the attitude of trained science students was higher as expected (M=8.72, SD=1.24) than that of the untrained science students (M=7.54; SD=1.15) whereas the independent t-test found this difference across the mean to be significant $t(82.811) = 4.520$, $p < 0.05$ which suggest that there is a significant difference between the mean score of trained and un-

trained science student in their attitude towards the importance of entrepreneurship. Hence, trained science students seem to have a higher attitude towards entrepreneurship than untrained students, and thus, H_1 is supported. The training appears to have an impact on the attitude of individuals as stipulated in other sources of the empirical literature.

Attitudes towards innovation

Attitude towards innovation is reflected in the student's ability to capture new opportunities and become flexible to changes and adaptation. Results in Table 4 indicate that both the trained and the untrained science students have a mindset that allows them to be flexible, with the ability to supervise themselves, adopt new ideas, and adjust themselves to the new environment. The aggregate responses (89%, 81%) do not deviate significantly from one group to the other, as indicated in Table 4.

Table 4

Students' Attitude towards Innovation

S/n	Affirmations	Trained			Untrained		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
1	I like working under my supervision	*0%*	*7%*	*93%*	*0%*	*5%*	*95%*
2	I prefer new ideas	*0%*	*4%*	*96%*	*0%*	*5%*	*95%*
3	I am not afraid of a new environment	*0%*	*4%*	*96%*	*0%*	*15%*	*85%*
4	I don't mind switching to another career	*0%*	*29%*	*71%*	*20%*	*40%*	*40%*
5	I will start a business despite any circumstance	*4%*	*4%*	*91%*	*3%*	*8%*	*90%*
	Aggregate score	*1%*	*10%*	***89%***	*5%*	*15%*	***81%***

With the above descriptive results, the second tested hypothesis (H_2) stated that "*The trained science students have a significantly higher mean score than the untrained science students in their attitude toward innovation".* Its results support the stated hypothesis. Since the trained science students depict high mean score

values (M=8.59, SD=1.44), unlike the mean scores for the untrained students (M=7.97, SD=1.91), while the independent t-test found this difference across the mean to be significant at t (75.238) = 2.382, $p < 0.05$. This suggests that there is a significant difference between the mean score of trained and untrained science students in their attitude towards innovation, and hence, H_2 is supported.

Attitude toward training in entrepreneurship

From the data presented in Table 5, trained science students acknowledge that training is a good source of knowledge with an aggregate response score of 73%, while only 33% of the untrained students agree. In terms of the mean scores in their attitude towards training, the mean score of the trained students is still higher than 8.28, compared to the mean score of the untrained science students, whose mean score is 5.16. In this aspect, the majority of trained students believed that seeking and attending business-related training has made a huge mindset impact in terms of being aware of the training opportunities in their environment, which consequently enhanced their exposure to business opportunities within their environment. This is not the case with the untrained students.

Table 5

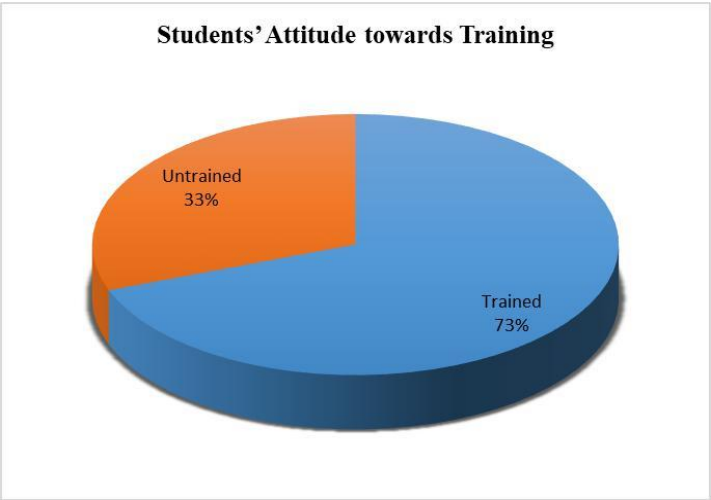
Students' Attitude toward Training

S/n	Affirmations	Trained			Untrained		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
1	I attend training related to business	*13%*	*20%*	*67%*	*10%*	*65%*	*25%*
2	I seek training opportunities everywhere	*13%*	*27%*	*60%*	*33%*	*33%*	*35%*
3	I am aware of the training opportunities in my environment	*13%*	*33%*	*53%*	*45%*	*33%*	*23%*
4	Training is relevant in science-related business opportunities	*7%*	*7%*	*87%*	*25%*	*43%*	*33%*
5	Training is the source of knowledge	*0%*	*0%*	*100%*	*0%*	*53%*	*48%*
	Aggregate average	*9%*	*17%*	***73%***	*23%*	*45%*	***33%***

In general, the trained students appreciate the role of training as part and parcel of skills that are necessary for career development, as depicted in Figure 1.

Figure 1

Students' Attitude towards Training



Furthermore, the independent t-test and mean results reflect that H $_3$ which states that "*The trained science students have a significantly higher mean score than the untrained science students in their attitude toward training"* was also supported by high mean values for trained students (M=8.29, SD=1.56) unlike the mean scores for the untrained students (M=5.16, SD=1.93), with the independent t-test of t (75.020) = 8.136, $p < 0.05$. This suggests that there is a significant difference between the mean score of trained and untrained science students in their attitude toward the importance of training; hence, H_3 is supported, such that the trained science students have a significantly higher mean score regarding training compared to the untrained science students.

Attitude towards the relevance of science studies

As presented in Table 6, the average scores from the Likert Scale results indicate that regarding the relevance of science studies, the trained science students scored higher (88%) than the untrained science students, who scored 18%. This suggests that trained science students realise the relevance of science studies compared to the low score on the relevance of science studies indicated by untrained science students. The high mean value of *9.10* compared to the mean of *5.5* from the untrained students depicts the differences in the level of attitude.

Table 6
Students' Attitude Towards the Relevance of Science Studies

Sn	Affirmations	Trained			Untrained		
		Disagree	**Neutral**	**Agree**	**Disagree**	**Neutral**	**Agree**
1	Science creates business opportunities		*7%*	*93%*	*43%*	*48%*	*10%*
2	Science offers more business opportunities		*13%*	*87%*	*50%*	*30%*	*20%*
3	Scientific knowledge solves community problems		13%	87%	*0%*	*90%*	*10%*
4	Learning science is important for future success		13%	87%	*0%*	*75%*	*25%*
5	With science, you can make more money		16%	84%	*55%*	*28%*	*18%*
6	Science has an exciting career		7%	93%	*70%*	*25%*	*5%*
7	Science offers more job opportunities		27%	73%	*58%*	*25%*	*18%*
8	Scientific knowledge facilitates the development		0%	100%	*25%*	*35%*	*40%*
9	The larger my scientific knowledge, the more I admire working with science		13%	87%	*40%*	*48%*	*13%*
	Aggregate score		*12%*	***88%***	*38%*	*45%*	***18%***

Thus, with the independent t-test results, the untrained science students depict a significantly lower mean value (M=5.502, SD=2.031) compared to (M=9.103, SD=1.060) at t (57.227) = 10.058, $p < 0.05$. This is to say, H_4 (*Both trained and untrained science students have a significant mean score in their attitude toward the relevance of science studies*) is also accepted to reflect the fact that the untrained

science students significantly have a low attitude on the relevance of science studies compared to the trained science students who depict a very high attitude towards the relevance of science studies.

Table 7

Summary Results of the Independent t-Test

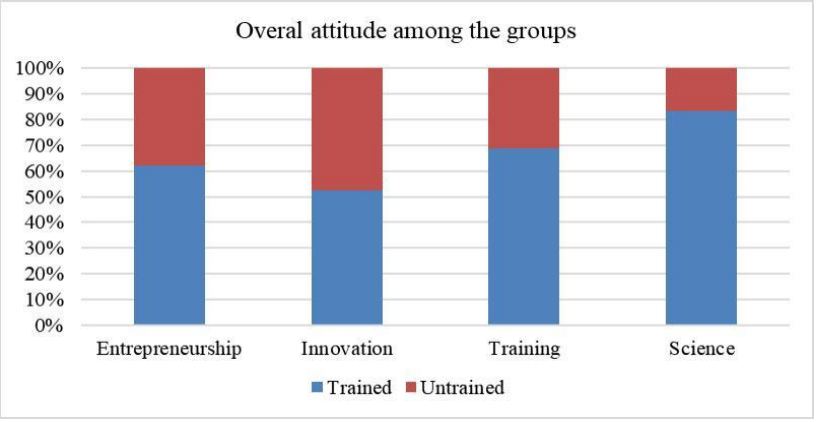
Independent Samples Test					
	Levene's Test		t-test for Equality of Means		
	F Sig.		t	Df	Sig. (2-tailed)
Relevance of Science	16.354	.000	10.406	83	.000
			10.058	***57.227***	***.000***
Innovation	8.061	.006	2.322	83	.023
			2.382	***75.238***	**.020**
Entrepreneurial attitude	.614	.435	4.501	83	.000
			4.520	***82.811***	***.000***
Training	.446	.506	8.238	83	.000
			8.136	***75.020***	***.000***

$p < 0.05$

Generally, trained science students exhibited the highest average scores in their attitudes towards science, entrepreneurship, and the relevance of training, with a strong affinity for science (see Figure 2). While attitudes toward doing business were similar across students, there was a slight difference in their attitudes towards innovation.

Figure 2

Attitude towards Entrepreneurship, Innovation, Training and Science Studies



Discussion

The study examined attitude differences among two groups of science students about entrepreneurship, innovation, training, and the relevance to science studies. The results noted differences between the two groups of students in their attitudes towards the relevance of science -related studies, entrepreneurship, innovation, and training, evident through high mean scores among trained science students, as summarised in Table 2. The trained science students have outperformed the untrained science students in all the measured variables (entrepreneurship, innovation, training, and relevance of science-related studies) by having significantly high mean scores. Notably, the significant mean differences in attitudes towards the relevance of science-related studies, entrepreneurship, and innovation were a result of the underlying control condition of being trained on named aspects. These results imply that providing extra knowledge and skills through practical education promotes change in attitude, as evidenced by the trained science students in this study, whose attitudes differed from similar untrained students.

The findings on attitudes towards entrepreneurship align with Taatila's (2010) assertion that the entrepreneurial learning cycle fosters the development of entrepreneurial competencies and skills through practical, real-life projects. These results underscore the potential of entrepreneurship-based training to catalyze changes in students' attitudes and mindsets. Similarly, Cui, Sun, and Bell (2021) found that entrepreneurial education significantly enhances students' entrepreneurial aspirations, which subsequently shifts their attitudes towards entrepreneurial activities. Additionally, Shah and Lala (2021) argue that successful entrepreneurship relies on support from various stakeholders, including supportive government policies and cultural, environmental, and social norms that shape individual entrepreneurial behaviors. Consequently, the differences in attitudes between trained and untrained students in this study indicate that providing and promoting entrepreneurship education in schools contributes to practical education and empowers students to become proactive contributors to economic growth and societal progress. By nurturing entrepreneurial mindsets from an early age, educational institutions can play a pivotal role in cultivating future leaders and innovators. Integrating extra engagement with alumni entrepreneurs, incubators, seed funding, scholarly research, and other support services into school curricula can further enhance the impact of such training (Rideout & Gray, 2013), thereby strengthening practical education and building sustainable and prosperous societies.

Furthermore, the results of attitude change on innovation are similar to Iglesias-Sánchez, Jambrino-Maldonado, and de las Heras-Pedrosa (2019), who found that training entrepreneurial skills and competencies to university students demonstrate the main role of open innovation enhancing motivation and improving their skills

to creativity. In most cases, it is the entrepreneurial attitude that determines the success of entrepreneurs; however, entrepreneurial training makes its most positive contribution to the development and growth of businesses (Indarti, 2021; Alamineh, 2022; Alkaabi, Ramadani & Zeqiri, 2023). These findings are consistent with the findings in this study as they share the positive impacts on both entrepreneurship and training in the innovation ecosystems. Meanwhile, Thorsteinsson (2013) also suggested that training through innovation education improves students' maturity growth and advances their way of thinking about their environmental issues, such as fighting resistance, creating opportunities, staying encouraged to make a difference, and solving the most necessary societal challenges, thus building strong entrepreneurial and innovation attitude.

In light of these findings, the promotion of entrepreneurial and innovative mindsets through education takes on heightened significance. This is further acknowledged by Dioneo-Adetayo (2012), who found that the education system and information technology development positively impact youth attitudes toward entrepreneurship. Thus, integrating entrepreneurial training into curricula and equipping individuals with the necessary skills and resources can drive attitude change and empower aspiring entrepreneurs to create impactful businesses. Policymakers and educators may carefully design training programs that consider the specific needs and contexts of aspiring entrepreneurs, ensuring that training interventions are effective in nurturing business success. By fostering a culture of entrepreneurship and innovation through education and development efforts, societies can unlock their full potential for economic growth, job creation, and social progress, propelling them toward a brighter and more sustainable future.

Conclusion, Recommendations, and Implications

Conclusions

To relate the two groups, this study provides very interesting results which can justify the need for more training for the young generation. Basically, across the groups, training has enabled the students to realise the importance and usefulness of science in creating business opportunities. Training is an essential component of learning that enhances competitiveness. The study found very significant mean differences between the trained and untrained science students in their various attitudes toward entrepreneurship, innovation, training, and the overall relevance of science among them. The trained science students were more aware of the opportunities that come with science-based studies, with the highest t value (10.058) $p < 0.05$, followed by training with the second largest t value (8.136) $p < 0.05$. However, the results of the innovation and entrepreneurial attitudes were significant, yet the magnitude of their differences was not as large compared to the two above.

These findings underline the importance of training in unlocking the hidden potential of science, enriching students' knowledge, and enhancing their overall awareness of the relevance of science in solving societal problems. Trainees consistently acknowledged the significance of science and business for future success and societal problem-solving. The acquired knowledge has resulted in a positive shift in students' attitudes toward science and its potential for creating business opportunities. To conclude, this study finds the vital role of entrepreneurial training in changing students' attitudes towards the relevance of science studies, which is essential in the entrepreneurship arena as it provides real-life solutions. These programs facilitate knowledge generation, attitude change, and increased awareness of the pervasiveness of science in daily life, forging a crucial link between science and business. Such training is fundamental in creating science-based future career choices and pathways.

Recommendations

Science studies, training, entrepreneurship, and innovation collectively play a pivotal role in stimulating economic activities and fostering employment opportunities. Promoting awareness of the value of science-based studies is crucial, as they serve as a foundation for innovation. Nurturing the right attitude in the youth is vital, as they hold the potential to bring about transformative change in the world. Empowering the young generation through entrepreneurial training equips them with essential skills to contribute meaningfully to society's development. Such training raises awareness among the trainees about the interconnectedness of science and business, fostering a mindset that seeks to apply scientific knowledge to address community problems. This study highlights attitude differences among trained and untrained science students, reflecting a shift towards viewing science as a means to drive business ventures and tackle societal challenges. To ensure the continued success of such training initiatives, several recommendations are proposed aimed at facilitating future effective training with long-term positive impacts. By integrating education and development efforts that prioritise science-based entrepreneurial training, societies can nurture a generation of innovative and forward-thinking individuals who actively contribute to economic growth and social progress. Creating an environment that fosters the convergence of science, training, entrepreneurship, and innovation will foster a culture of problem-solving and drive sustainable development, ensuring a prosperous future for generations to come.

This study recommends prolonged training programs to ensure sustained attitude change among youth. These programs can fetch different training levels, each level building on the previous one to foster continuity and the sustainability of knowledge creation such that the acquired knowledge can be monitored and shaped toward more business practices. To create more awareness of the relevance of science studies, this

study suggests national and regional strategies for promoting science-related studies by building awareness programs that are nationally disseminated through national media so that the direct impact and practical application of scientific knowledge can be easily understood. This may include the creation of special science programs where youth and children take part in promoting the adventures of science studies, which may also involve sharing various project results and activities such as STEM projects, which was the case in this study and many other projects of alike. Similarly, to promote innovation, schools could be better places for building up innovation clubs that promote creativity through scientific designs that are a result of project works or learning case studies found in formal education.

Meanwhile, researchers and funders may promote training projects that focus on building up practical education for youth. Furthermore, inclusive learning, case-based learning, and other forms of informal learning can be emphasised to enrich students with practical experiences, as emphasised by Rajchamaha and Prapojanasomboon (2022). Lastly, the importance of science can be stressed in the normal education systems to assist students in realising how science can change the world, as it is through science that we observe several of the world's best innovations and progressive developments. Thus, this article recommends a review of the science-based curriculum to encourage students to like and opt for science subjects at their lower school levels.

Implications for future research

This study's focus on attitudinal factors and a single variable limits its generalisability in predicting comprehensive behavioural change. Future research could explore the influence of additional subjective constructs on students' entrepreneurial behaviour. Furthermore, the current investigation did not directly address core entrepreneurial intentions, such as the desire to start a business or pursue innovative ventures. Integrating the theory of planned behaviour (TPB) within future studies could elucidate these intentions and inform interventions aimed at fostering entrepreneurial action. Furthermore, incorporating development theories into research designs may prove valuable for understanding and nurturing entrepreneurial behaviour in science-related fields.

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