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Resolving Misconception Challenges in the Teaching and Learning of Computer Science Amongst First-Year Undergraduate Students

Ismail Olaniyi Muraina*

*PhD in Data Science, Computer Science Department, Lagos State University of Education, Lagos Nigeria,
<https://orcid.org/0000-0002-9633-6080>*

*Correspondence email: murainaio@lasued.edu.ng

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Abstract: Misconceptions in the field of computer science can lead to confusion and loss of confidence for students. These misconceptions are based on students' concepts that are not scientifically accurate interpretations. One of the major reasons why students find certain computing and scientific concepts so tough to acquire is because they suffer an inequality or gap between their early classification of a concept and the new learning framework. Resolving misconception challenges in the teaching and learning of sciences is not new because according to the past studies, it is believed to manifest throughout the life of individuals where students are greatly involved when it comes to teaching and learning sciences. The study aims to resolve and correct students' misconceptions using a practical approach and its impact on students' gender differences. To address these misconceptions, an experimental design study was conducted in order to examine the effects of practical approach correcting misconceptions among students in computing. The study compared students' scores on Pre-Test and Post-Test, comparing their perceptions of computing and the effectiveness of practical methods to address them. The population of the study consisted of all undergraduate students in higher education institutions in Lagos State. Through the use of random sampling method, 75 undergraduate students from Lagos State University of Education were selected. The instrument was subjected to reliability index after it was validated by experts in computing. An index of .887 results showed significant highly reliable instrument. The results of findings established significant differences between the pre-and post-test scores, but only a slight difference between male and female scores observed. The study recommends that students should be given the opportunity to investigate and test their own

findings of computer science components and software functions in order to build a deeper understanding without preconceptions from their prior experiences.

Keywords: Computer science, Learning, Misconceptions, Practical activities, Teaching.

Introduction

The misconception has been researched and addressed in depth by a number of scientists working in the field of scientific education. First the term "misconception" should be identified. An individual experiences misconception throughout their entire life and it interferes with learning and frequently makes people dislike science subjects (Rose et al., 2023). The concept of the topic "sciences" is in an abstract form, which may cause misunderstandings or finally cause pupils to lose trust in the actual knowledge the teacher is trying to pass to them. The early identification of misconceptions can encourage interest in the subject and promote self-assurance in the learner. Since science is a subject that is correlated with many other subjects, the identification and treatment of problems are crucial for the science teacher (Patil et al., 2019). The word "Misconception" is complicated in description and has been conceptualised by researchers at various educational levels and geographical places as substitute conceptions, predeterminations, different ideas, conceptual uncertain blocks, mistaken concepts, and alternative scoff folds in various situations. Due to a variety of circumstances, including cultural context, individual characteristics, teaching-learning processes, students' personal experiences, etc., identifying misconceptions can be difficult (Chavan & Khandagale, 2022). Concepts with strange interpretations and meanings in students' non-scientifically accurate articulations are referred to as misconceptions.

To some scholars, the "scientific community sees the word "conceptions" from the different views held by them " are referred to as misconceptions and alternative conceptions (Ajayi, 2017; Schmidt et al., 2020). All pupils hold misconceptions due to their earlier knowledge. Alternative conceptions among students can prevent new learning, which causes issues for instructors. Therefore, teachers are essential in assisting pupils in building new knowledge on top of any preexisting foundations (Schmidt et al., 2020). According to the current theories that have been established by studies conducted over the previous three decades, students often enter postsecondary institutions having pre-conceptual beliefs that are not always validated by present scientific theories. One might contend that during the tertiary-level teaching and learning activities, pre-instructional notions that conflict with modern scientific concepts can be easily eradicated. However, educators have a dilemma if these ideas are strongly held and it is difficult to change them, because the construction of these beliefs allowed pupils effectively navigating their way through earlier cognitive hurdles.

To this end, studies conducted all across the world revealed that students often have beliefs or notions that are at odds with what scientists and researchers know about the world in which we live. Now that is known, these false beliefs are frequently referred to as misconceptions, preconceptions, naive beliefs, alternative beliefs, or alternative frameworks. As a result, misunderstandings can also be referred to as preconceived notions, unscientific views, simple theories, confused conceptions or false conceptions, and competing concepts. Students throughout their life have these naive notions. According to Thomson et al. (2019), children's perspectives and meanings can significantly differ from those of scientists. Their interpretation of science topics differs, which causes confusion in their thoughts. The literal definition of a misperception is a false belief. Misconceptions, inaccurate views, and incorrect and premature understanding exist in all age groups of students and people worldwide. Misconceptions are erroneous beliefs that students form that differs from scientifically recognised concepts (Rose et al., 2023). These beliefs, often known as naive or alternate perceptions, are particularly resistant to modification. According to Inuwa and Varo (2019), misinformation can have a

significant impact on someone's career. An example of a misperception is the belief that software engineers can troubleshoot personal computing difficulties. Furthermore, Qian et al. (2019) discovered a distinction between the thoughtless mistakes everybody is making and misconceptions regarding scientific principles and methods. Students absorb concepts and, on occasion, misconceptions. Rose et al. (2023) explored some computer science myths and misconceptions. Their research addressed and aimed to dispel these myths in order to give prospective computer science students and the general

public a more realistic understanding of the field. According to Firat (2017), developing students' conceptions of technology beginning in elementary school is a fundamental approach to promoting technology literacy in society. Identifying and correcting students' misunderstandings is an essential skill for a computer science teacher (Qian & James, 2017).

Theoretical frameworks

Two frameworks are offered in this study. They aim to explain misunderstandings, so these frameworks are selected based on their relevancies to how a learner interacts with naïve information, to also explain the reason and the way in which misconceptions emerge or hinder knowledge creation. A learning theory called constructivism places a strong emphasis on how learners actively construct their own ideas. Instead of merely taking in information, students actively reflect on their experiences, make mental images, and add new information to their schemas. The constructivism encourages in-depth learning and comprehension (McLeod, 2023) while Concept Formation (CF) is an inductive teaching strategy that helps students form a clear understanding of a concept (or idea) through studying a small set of examples of the concept (Parker, 2023) or Concept Formation can be seen as the process by which a person learns to sort specific experiences into general rules or classes (Hunt, n.d.).

Constructivism

According to the constructivism, which is concerned with viewing human knowledge as a process in which individuals attempt making sense of their environment, students do not learn from scratch, nor do they learn as a result of knowledge that is simply transferred to them via an external source. Since prior beliefs are crucial to the learning process, depending solely on rote learning may result in misconceptions. Incoherent knowledge construction can lead to misconceptions, which can impede further cognitive growth. Under this constructivist framework, in the paper examine both domain-generalist and domain-specific theories were examined. The constructivist theory argues that people acquire knowledge and form meaning based on their experiences and the need for learner autonomy in the classroom (Sarbah, 2020; Mandaar & Vijayakumar, 2020). The constructivism is an important learning theory that educators employ to help students acquire knowledge, which is based on the concept that individuals actively construct or create their own knowledge and that their learning experiences determine the nature of reality. Learners use their prior knowledge as a foundation and build upon it as they acquire new information. The teacher acts as a guide in the learning process; therefore, constructivism supports student-centred learning. In a constructivist classroom, learning is viewed as constructed, active, reflective, collaborative, inquiry-based, and evolving. The psychological theory of constructivism originates from the rapidly expanding field of cognitive science, primarily from the constructivist perspectives of Jean Piaget, the socio-historical work of Lev Vygotsky, and the constructivist account of discovery learning by Jerome Bruner (Chand, 2023). When new knowledge is integrated into the learner's pre-existing knowledge structures, meaningful learning takes place (Ausubel et al., 1968). If a learner can't incorporate new knowledge into their previous knowledge structures, it compartmentalises and can't be effectively utilised, which could lead to misconceptions. Ausubel defines this as "verbatim, arbitrary, non-substantive incorporation of new ideas into cognitive structure" (Cakir, 2008). The rote learning is frequently the cause of the discrepancy between new

information and existing knowledge structures. Piaget asserts that learners employ mental patterns to speed up learning and comprehension, which is similar to Ausubel's position. To interpret new information, these preexisting patterns are utilised. Students experience disequilibrium when their preexisting knowledge patterns are unable to account for new information, and the "mental balance" needs to be restored. Until equilibrium is established, the learner will either create a new pattern of thought or alter an existing one (Cakir, 2008). Therefore, assimilation refers to making slight adjustments to an established thought pattern, whereas accommodation refers to fundamentally reorganising established patterns. As a result, "incorrect" inculcation or housing usually leads to misunderstandings. To explain the above with an example, a novice may simply conclude that, based on their understanding of intake, exhalation must also be an active process involving muscles since they do not understand how air pressure inside the lungs interacts with atmospheric pressure. Alternately, individuals can create a new mental model to convince themselves that exhalation is the result of the diaphragm "forcing" air out of the lungs in their attempt to understand the role of "pressure" in breathing out. In both situations, the learner develops a misunderstanding as a result of their inability to put cohesive information together, possibly as a result of their past knowledge that breathing may be understood as an active process. On the other hand, domain-specific theorists (conceptual change) contend that misconceptions develop as a result of pupils, for whatever reason, failing to go through the essential conceptual change process to accept current scientific knowledge. When pupils are exposed to counter-intuitive concepts, conceptual change refers to the process of moving away from naive assumptions (Vosniadou & Verschaffel, 2004). It entails rearranging preexisting concepts to support current knowledge supported by evidence. Although this theory is founded on Kuhn's idea of a paradigm shift, it significantly differs from the domain generalist viewpoint. According to Kuhn's (2012) theory, scientists adhere to a set of common assumptions, commitments, and practices. Certain notions can no longer be used to explain anomalies as new information is known. A paradigm shift is a process whereby scientists may need to create new notions. This idea is used by theorists in this discipline to describe the procedure when a student must swap out and rearrange key ideas because the old ones are no longer sufficient to explain particular scientific findings. Unlike Piaget, this process is seen as the need to reorganise mental structures to place information based on controlled data, rather than a core cognitive communication of the learner seeking to achieve equilibrium based on prior knowledge (Larsson & Halldén, 2010).

There are several theories that explain why misconceptions develop in domain-specific fields using conceptual change theory. For instance, researchers claim that some scientific concepts are challenging for students to understand because their existing understanding may be based on antiquated paradigms or frameworks that conflict with more modern, scientifically accepted paradigms (Sarbah, 2020; Mandaar & Vijayakumar, 2020; Chand, 2023). These simplistic frameworks are hard to alter because they give students a somewhat cogent explanation for some scientific occurrences and are frequently reinforced by real-world events. Typically, students don't recognise these errors in reasoning and just add new information to their preexisting cognitive frameworks, which leads to erroneous conclusions. Therefore, a profound and ontological category shift is necessary for the acquisition of scientific conceptions (Vosniadou & Verschaffel, 2004). The lack of critical thinking, knowledge fragmentation, a lack of transfer, poor instruction, and, most importantly, misconceptions that contradict the most current scientific results are frequently to blame for the learning problems that many students encounter when learning scientific material. Because their first worldview provides a "relatively coherent system of explanation" that is based on actual experience and years of confirmation, students have a difficult time modifying this framework. Teachers who work with multicultural students should be aware that some students still follow traditions that may be at odds with current scientific knowledge.

Due to the ontological transformations, they must make in order to categorise things, students may end up with competing beliefs between their past and new knowledge (Miller, 2022). Students find it difficult to grasp several scientific and computing concepts because their initial classification of a subject and the new learning context don't match. The incompatibility hypothesis is the name given to this idea of mismatch (Miller, 2022). Consider "Flash drive" and "Hard disc" as examples. Based on textbook illustrations, students can classify these topics as "Memory" of a computer system. The student must constantly switch between two conceptual categories in order to understand them as long as prior knowledge and new information are incompatible. It can be challenging to overcome naive notions by education or confrontation if new concepts are incompatible with an underlying assumption. Hence, the constructivism can build individual and social knowledge, it contributes a positive impact on educational progress to improve students' abilities because constructivism opens the learner's curiosity about something new (Suhendi & Purwarno, 2018). These beliefs remain across age groups, educational levels, and individual pupils, resulting in consistent misconceptions among students across historical periods.

Concept formation

This theoretical framework, which is concerned with the concept development, is related to the negotiation of new knowledge. One can trace the origins of views on concept formation to the philosophers Kant, Locke, and Mill, who contended that a concept is a cognitive unit with meaning. The definition of a concept as a "unit of knowledge" so includes mental symbols as well as abstract ideas. A more modern perspective to examine the function of threshold ideas is that concepts are mental representations that can be interpreted as either mental images or word-like symbols in a "language of thought", it is also important to understand concepts not as mental and neutral representations but as different and related perspectives that unfold through specific ways of speaking and thinking in a horizon of positioned meanings (Guzmán et al., 2022; Bakanauskas et al., 2020). Languages are mirror images of one another, concepts can be thought of as actual objects that relate to and are comprehended by symbols or words. An act from teacher or students can be used to represent abstract concepts. As a result, an abstract notion is not always an image or mental representation in the mind, but rather an abstraction of a formal concept derived from the activity it performs. As a result, one could argue that if medical students experience issues during the concept formation process (for example, having their mental models simplified based on two-dimensional illustrations in textbooks or having difficulty creating abstract concepts from their mental models), they may be experiencing concept formation problems. The language may also be crucial in this sense (Brun et al., 2023). The student could get a misperception if they lack the scientific and computing vocabulary needed to establish the concept. Based on the above background, this study sheds light on the applicability and importance of clearing up misconceptions in computer science instruction (Munck, 2023).

Research Problem

From observations in past studies, students often enter post-secondary institutions having pre-instructional beliefs that are not always validated by current scientific theories. One might contend that during the tertiary-level teaching and learning activities, pre-instructional notions that conflict with modern scientific concepts can be easily eradicated. However, higher learning educators have the challenge to alter these pre-instructional notions in line with current and more acceptable concepts and meanings. A series of approaches have been tested in the past to resolve misconceptions in sciences most especially in computer science. Therefore, this study uses a practical approach, which is believed to actively involve students' participation, to correct any misconceptions in computer science.

Research Focus

Past studies have established that misconceptions are commonly observed among students in sciences, engineering, and social sciences. Therefore, this study focused on the use of a practical approach to correct students' misconceptions in computer science. It also found out whether the gender difference among students has any significant implication on students' misconceptions.

Research Aim

This study specifically aimed to investigate ways to get rid of misconceptions in the teaching and learning of sciences, notably computer science. It also considered how to address or dispel the observed myths using a pragmatic approach. In essence, it examines whether student gender differences can affect trends in misconceptions.

Research Questions

The following research questions guide the study:

1. Is there any statistically significant mean difference between the Pre- and Post-Test scores of students in correcting some misconceptions in computing concepts?
2. Is there any statistically significant mean difference between male and female students' scores after exposing students to practicals as an approach to correct some misconceptions in computing concepts?

Research Hypotheses

The research hypotheses to be tested in this study comprised:

H1) There is no statistically significant mean difference between the Pre- and Post-Test scores of students in correcting some misconceptions in computing concepts; and

H2) There is no statistically significant mean difference between male and female students' scores after exposing students to practicals as an approach to correct some misconceptions in computing concepts.

Research Methodology

General Background

In order to examine the effects of practical activities in correcting misconceptions relating to computing fields among students in two distinct contexts (Pre-Test and Post-Test), experimental design technique was used in the study. The study compared the students' scores on the Pre-Test and Post-Test. The Pre-Test was used to gauge the extent of the students' computing misunderstandings, and the Post-Test was used to gauge the impact of using a practical approach to address the misconceptions after exposing the students to appropriate practicals. The population of the study was made up of all undergraduate students in higher education institutions in Lagos State.

Sample / Participants / Group

The study used a random sampling technique to select 75 undergraduate students at Lagos State University of Education. The term "sampling technique" means the process of selecting a sample of observations from a population in order to draw conclusions about the population; additionally known as probability sampling. Therefore, 25 students each were sampled from the department of computer

science, department of Library and information science, and the department of technology education randomly to remove being biased.

Instrument and Procedures

The instrument - Achievement Practical Assessment Test called "APAT"- consisted of two stages: A and B. Students' personal data, including the gender, class, and age, was requested in section A, while questions about hardware and software were included in section B to clear up any misconceptions about the concept. Each question was designed to address a specific flaw in the errors that students have been making for years. The duplicates of the instrument were used on two separate occasions, one before and one after the intervention or treatment. The instrument's contents were evaluated by computer science specialists for construct validity and content validity, and then the same instrument underwent face validity validation with a subset of the targeted students. Before the test was given, the instrument's final version contained all the corrections and observations. The test-retest methodology was used to determine the instrument's reliability, and 20 copies of the instrument were given to students who were not part of the study's sample but nonetheless members of the population. The findings were split into two groups for statistical analysis to determine the reliability coefficient. A good and high dependability instrument was indicated by the reliability index of 0.887.

Data Analysis

The acquired data were compiled and analysed using the T-Test statistical analysis through the use of tables and charts for the student demographic data as well as to test the formulated hypotheses raised for the study using the statistical package for the social sciences (SPSS).

Research Results

The research results are presented below:

Table1

Participants College

	Frequency	Per cent	Cumulative Percent
College of Information and Technology Education	39	52.0	52.0
College of Science Education	36	48.0	100.0
Total	75	100.0	

Source: author's own development.

Table 1 lists the participants' colleges within the institution. As is evident, a total of 75 students participated in the study, including 39 from the College of Information and Technology Education and 36 from the College of Science Education.

Table2

Gender of the Participants

	Frequency	Per cent	Cumulative Percent
Male	40	53.3	53.3
Female	35	46.7	100.0
Total	75	100.0	

Source: author's own development.

The gender disparity among the participants is shown in Table 2. It discloses that a total of 75 students, including 35 female and 40 male students, participated in the study.

Table3

Educational Level of the Participants

	Frequency	Per cent	Cumulative Percent
100 Level Students	37	49.3	49.3
200 Level Students	38	50.7	100.0
Total	75	100.0	

Source: author's own development.

Table 3 shows that 38 students from the 200-level participated, while 37 students from the 100 level did not. This suggests that both levels should have an equal sample size to prevent bias.

Table4

Paired Samples Statistics

		Mean	N	Std. Deviation
Pair 1	Pre-Test Scores	30.6933	75	10.49321
	Post-Test Scores	88.1200	75	9.21215

Source: author's own development.

Table5

Paired Samples T-test

	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1 Pre-Test Scores - Post-Test Scores	-57.42667	14.49713	-34.305	74	.000

Source: author's own development.

A paired-sample t-test was conducted in order to evaluate the significant mean difference between the Pre-Test and Post-Test scores of students in correcting some misconceptions in computing concepts. There was a statistically significant increase in students' scores from the Pre-Test scores ($M=40.17$, $SD=10.49$) to Post-Test scores [$M=88.12$, $SD=9.21$, $t(74)= -34.305$, $p<.0005$] of students. The eta squared statistic (.94) indicated a large effect size.

Table6*Group Statistics*

	Gender Group	N	Mean	Std. Deviation
Post-Test Gender Scores	Male Post-Test Scores	40	87.0000	9.79272
	Female Post-Test Scores	35	89.4000	8.45820

Source: author's own development.

Table7*Independent Samples Test*

		F	Sig.	t	df	Sig. (2-tailed)
Post-Test Gender Scores	Equal variances assumed	2.648	.108	-1.128	73	.263

Source: author's own development.

An independent-samples t-test was conducted to compare the students' practical scores for males and females to correct some misconceptions in computing concepts. There was no significant difference in scores for males ($M=87.00$, $SD=9.79$) and females [$M=89.40$, $SD=8.46$; $t(73)=-1.128$, $p=.263$]. The magnitude of the differences in the means was very small ($\eta^2=.0169$).

Discussion

Trying to give the answer the first research question: "Is there any statistically significant mean difference between the Pre- and Post-Test scores of students in correcting some misconceptions in computing concepts? the results showed statistically significant mean difference between the pre-test and post-test scores. This means that the empirical method is good for correcting misconceptions in sciences. This assertion is buttressed by what Marsh and Eliseev (2019) said since students frequently make mistakes while learning, one essential objective of education research is to identify the best methods for correcting these mistakes. The author used empirical methods for studying error correction, describes data to show what is most effective, and provides guidance for teachers on how to correct students' mistakes. On the contrary, the second research question says "Is there any statistically significant mean difference between male and female students' scores after exposing students to practicals as an approach to correct some misconceptions in computing concepts?" Was not significant. It implies that gender issue is not a factor to measure misconceptions of students towards learning computing or sciences. The study of Ajai and Imoko (2015) in assessing gender differences in mathematics achievement and retention by using Problem-Based Learning (PBL). The study revealed that male and female students taught algebra using PBL did not significantly differ in achievement and retention scores, thereby revealing that male and female students are capable of competing and collaborating in mathematics. In addition, this finding showed that performance is a function of orientation, not gender. Oribhabor (2020) examined the influence of gender on academic achievement in Mathematics among senior secondary school students in Bayelsa State. The result of the analysis revealed that there is a significant difference in the Mathematics achievement of the male and female students in favour of the males. Also, Adigun et al. (2015) studied the relationship between student's

gender and academic performance in computer science in New Bussa, Borgu local government of Niger state. The results of the study showed that male students did not perform better than females' counterparts except with slight differences.

In testing the formulated hypotheses, and with a t-value of -34.305 and a p-value of .0005, the results from Tables 4 and 5 demonstrate that there was a statistically significant rise in students' scores from the Pre-Test scores ($M=40.17$, $SD=10.49$) to the Post-Test levels ($M=88.12$, $SD=9.21$). In order to determine the effects of the differences, the eta squared statistic was used; the value of .94 indicates a significant effect size; implying that in two cases there were significant differences between the pre-test and post-test results. This implies that students' misconceptions were corrected and their level of understanding improved, which was reflected in their performance in the post-test score - eta squared statistic of .94 proved this. The Pre-test scores were used to know the level of students' misconceptions in various areas of computer science. The results were in consonance with past studies using different approaches like interviews, focus groups and other methods. Their previous knowledge and the current knowledge gap may be responsible for the stark disparity. Because of this, Qian and Lehman (2019) recommended that computer science instructors be aware of their students' misconceptions and ready to assist them in developing a thorough understanding of computing principles. Okorochoa et al. (2010) added that if kids are not provided with accurate information, they would become grossly deformed. The phrase "Information is power" lends credence to this viewpoint since when people lack knowledge, they become distorted. Marsh and Eliseev (2019) used a similar approach to identify and correct the misconceptions.

With a t-value of -1.128 and a p-value $>.05$ indicating its non-significant level of scores, Tables 6 and 7 demonstrated that there was no significant difference in the scores for males ($M=87.00$, $SD=9.79$) and females ($M=89.40$, $SD=8.46$). In order to determine the effects of the differences, the eta squared statistic was used; the value of .0169 indicated a very modest effect size; implying that the scores of men and women were just marginally different. According to the results no statistically significant difference was found. It suggests that the preconceptions about computing that the teacher needs to dispel using realistic or other effective strategies are present in both male and female students (Adigun et al., 2015; Oribhabor, 2020).

Conclusions and Implications

The study provided important insights into how misconceptions in computer science can impede the creation of coherent knowledge and possibly provide obstacles when students are expected to complete challenging cognitive tasks like scientific reasoning. The study also explored and made an effort to debunk a number of widespread myths and misconceptions that people, including students, tend to believe. Because researchers can delve deeper during them, especially in an interview, interviews and other instruments may reveal more details regarding the nature and causes of each misunderstanding. Contrarily, a wider range of misunderstandings can be dispelled through practical work since it prompts students to question their previous knowledge beliefs when they conflict with new ones.

Research Limitations

The number of participants in the study and the number of computer systems available to correct misconceptions were insufficient, limiting the generalisability of the study's findings. Additionally, there was insufficient monitoring of the students to ensure that they carried out their assigned tasks. Hence, given that this study was carried out in a classroom setting, there were numerous instances of some students seeking to dominate their peers while receiving practical guidance.

Research Recommendations

It is therefore recommended that students need to get a deeper understanding free from the misconceptions from their prior experiences, they must be given the opportunity to investigate and test their own findings of the computer science pieces and software operations as well as their boundaries. Teachers should address common misunderstandings about various areas of computing by learning more about their history and preparing for when they come up in the lab or classroom and since conceptual change does not happen immediately, teachers should be encouraged to review prevalent misconceptions.

Suggestions for Future Research

This study suggests that other studies employ the hypothesis testing using alternative approaches and dig deeper into misconceptions outside of computing. Misconceptions cut across various fields of learning from sciences to engineering to social science and even languages, so it is suggested that similar studies should be extended to the aforementioned fields of study. This study concentrates on the use of a practical approach to correct misconceptions. It is also suggested that further studies should use an integrated approach to carry out similar studies, by combining two methods together to achieve better results. It is recommended in future research studies, that researchers should increase the number of participants for easy generalisation of the findings. Critical attention must be paid to where the practical will take place, the resources available for the practicals and human resources for effective and efficient conduction of the practicals. Hence, attention must be channeled to issues of some students trying to dominate other students while practical activities are going on in the laboratories. A week or two must be set aside to brainstorm with students and staff regarding the use and ethics of the use of laboratory gadgets and equipment. It is vital to investigate through research and hypothesis testing how misconceptions can be corrected using different approaches apart from the above-mentioned methods.

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