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TRANSFORMING THE LEARNING ENVIRONMENT THROUGH INTERACTIVE PEDAGOGIES

Lydia Mavuru
Department of Science and Technology Education, University of Johannesburg (South Africa)

Abstract

An interactive learning environment can be understood from diverse angles depending on the nature of the subject or concept taught. Interaction in the science classrooms creates an opportunity for the learner to engage meaningfully with the content. The study sought to explore how pre-service teachers conceptualise an interactive learning environment in the Life Sciences classrooms. Using a qualitative case study research design, 45 students enrolled for postgraduate certificate in education and specialising in Life Sciences, were selected to take part in the study. During the year these participants had been exposed to the teaching and learning of Life Sciences concepts using various interactive pedagogies. They were also engaged in analysing videos of lessons where previous pre-service teachers implemented interactive pedagogies in their classrooms. For data collection, each participant was tasked to critically explore how the use of a selected teaching strategy or approach could foster interactive learning in a Life Sciences classroom during work integrated learning. The work integrated learning period was seven weeks long hence the participants had adequate time to explore and select the strategy they wanted. Whilst the task sought the interactive pedagogies employed by the participants, it also assessed the participants' knowledge of the selected Life Sciences topic; knowledge of the teaching strategy; the suitability of the strategy; and affordances in making content accessible to learners. They then submitted their analysis which formed the data source. Habermas' critical social theory was used to analyse and interpret the participants' conceptions. The findings revealed a wide spectrum in pre-service teachers' conceptions about an interactive learning environment. Some based interactive pedagogies on learner inclusivity, use of what learners bring to the classroom, learner engagement, learner interest, ability to enable application of knowledge in real life, and use of modern learning technologies. The findings have implications for teacher professional development programmes.

Keywords: *Interactive learning, learning environment, life sciences, teaching strategies*.

1. Introduction

Life Sciences teaching requires the use of interactive pedagogies that involve learners in sharing knowledge and ideas meaningfully. The objective of using interactive teaching and learning is to promote the transfer of knowledge, skills, and values between teachers and learners and between learners and peers (Giorgdze & Dgebuadze, 2017).

The study sought to explore how pre-service teachers conceptualise an interactive learning environment in the Life Sciences classrooms. The study was guided by the research question: How do pre-service teachers conceptualise an interactive learning environment in the Life Sciences classrooms. This was meant to determine how much they have understood the interactive teaching strategies they had engaged in during lectures and the ones they utilised during work integrated learning. Work integrated learning provided them with an opportunity to work in schools under the mentorship of experienced Life Sciences teachers.

2. Literature review

According to Mendezel and Rick (2021) 4IR tools allow for personalised learning, creativity, and problem-solving skills development. In a study to infuse creativity and technology in 21st Century education, Henriksen, Mishra and Fisser (2016) indicated that, "creativity can be learned, but since it is a thinking skill it can only be "learned by doing" or as "learning in action." (p. 34). It therefore shows that technology should be used interactively for meaningful learning to be realised.

Practical work is important in affording learners the opportunity to learn and do science. According to Waite (2011), practical work gives learners an idea on how technicians or scientists work. It assists with enhancing their practical skills valuable in future career or academic routes. Demonstrations illustrates complex concepts and aids learners in the formulation of arguments based on the evidence gathered during the learning process (Strat et al., 2023; Subba et al., 2019).

Learning in social groups develops learners' conceptual understanding through social interaction. Social interaction in the classroom facilitates learners' understanding of the concepts learned (Senior & Howard, 2014). The form of social interaction might be verbal and nonverbal activities, such as experimenting together, conversation, dialogue, and presentation, which will stimulate learners and teacher to pose questions. From a pedagogical perspective, there is evidence from literature that learning is enhanced if it takes place in friendship groups. An example is of Barton et al. (2005) who found that learners working in groups scoring higher marks on an "openness to experience" scale that is significantly associated with a deep approach to learning (Zhang, 2003) compared to learners who studied alone. In another study, it was found that learners who completed a coursework task in a group significantly scored higher marks than those who completed a coursework task on their own (Senior et al., 2012).

Demonstration as a strategy provides visual display of the action and activities or practical work associated with the facts and principles of a lesson presented by the instructor in the classroom with the objective of facilitating the process of teaching and learning (Basheer, Hugerat, & Hofstein, 2017). When used effectively, demonstrations improve learners' performance and ability to handle any instruments or materials used during the demonstration. Earlier Giridharan and Raju (2006) indicated that demonstrations could play a significant role in helping learners develop comprehension skills and analytical skills during the learning process. Basheer, Hugerat, and Hofstein (2017) found in their study that demonstrations promote learner interest hence they are useful in facilitating and developing learning, promoting thinking skills and to enable learners to think more creatively.

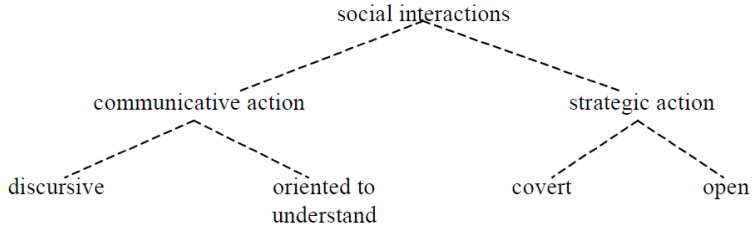
Lule (2022) explains illustrations as decoration, interpretation or visual explanation of a text, concept, or process, designed for integration in print and digital published media, such as posters, flyers, magazines, books, teaching materials, animations, video games and films. The author views the technique as useful in helping learners attain knowledge (Lule, 2022). Illustrations are more of a traditional way of teaching as the teacher talks more than learners, especially when they give the visual explanation of what is presented on the picture. This method requires the teacher to be creative by being able to align the illustrations with the content being taught to avoid confusion (Lule, 2022).

Teaching science topics in school can be very difficult, especially when the topic is of controversial nature. Certain abilities that are not given much emphasis in schools will be essential as the world becomes more varied and developing. Hence argumentation can engage learners in today's knowledge era which demand knowledge and abilities or skills, as well as moral sense and values (Ozdem et al., 2017). It can be an effective method for improving learners' knowledge retention and understanding of a topic with a focus on explanation, with learners aiming to create evidence that supports a certain account or claim (McNeill et al., 2006). To get a better understanding of science, learners of all ages must therefore engage in argumentation and enhance their argumentation and reasoning skills (Ozdem et al., 2017).

2.1. Theoretical framework

The study was underpinned by Habermas critical social theory. Habermas believes that scientific knowledge and its acquisition should be based on social interactions. This theory is captured by Hill (1972)'s interpretation that (scientific) knowledge is a social question, and is a social phenomenon; hence the way humans live is based on what they know and how they know. Figure 1 shows the four types of social interactions.

Figure 1. The four types of social interactions in Habermas typology of action.



Such a theory emphasizes the need to consider social interactions in the science classrooms, which can only be achieved using interactive teaching strategies.

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3. Methodology

The study was located within an interpretivist paradigm. According to Creswell (2014), an interpretivist paradigm enables the researcher to gain profound comprehension of the phenomenon in its unique context. This paradigm was appropriate for the study because the researcher obtained valuable insights about the conceptions of the Life Sciences pre-service teachers who had taught in diverse school contexts whilst enacting different interactive pedagogies in grade 10-11 classrooms. The study employed a qualitative case study design (Creswell, 2014), which involved a purposefully selected group of 45 students (Patton, 2001) herein referred to as pre-service teachers who were enrolled in a Post Graduate Certificate in Education programme specialising in Life Sciences. The unit of analysis was the pre-service teachers' conceptualisations.

Before data collection, these participants had been exposed to the teaching and learning of Life Sciences concepts using various interactive pedagogies. They were also engaged in analysing videos of lessons where previous pre-service teachers implemented interactive pedagogies in their classrooms. They had also been involved in seven weeks long work integrated learning hence the participants had adequate time to practise teaching whilst using the different teaching strategies. Due to this exposure in teaching, it can be assumed that the participants were knowledgeable and had experienced teaching using some of the interactive pedagogies learned during lectures.

To collect data, the researcher tasked the pre-service teachers to critically explore how the use of a selected teaching strategy or approach could foster interactive learning in a Life Sciences classroom during work integrated learning. Whilst the task sought the interactive pedagogies employed by the participants, it also assessed the participants' knowledge of the selected Life Sciences topic; knowledge of the teaching strategy/approach; the suitability of the strategy; and affordances in making content accessible to learners. Each participant made a submission which formed the data for the study. Each textual data was subjected to deductive and thematic analysis (Blum, Stenfors, & Palmgren, 2020).

4. Findings

Table 1 shows the analysis that was made from the participants' submissions. A clear depiction of the topics, reasons for identification of such topics, the selected teaching strategies, and their affordances in ensuring interactions amongst learners are presented.

Table 1. Results from the analysis of data from participants' submissions.

Life Sciences topic	**Reason for selection**	**Teaching strategy**	**Affordances**
The history of life on earth	-Complex topic -A lot of theoretical concepts -Historical events learners cannot relate to.	-Use of 4IR tools e.g., videos and animations. -Available on learners' gadgets.	-Allows for flipped classroom. -Can be watched anywhere: in class, at home, during break, in the bus when going home.
Nervous system: Reflex arc	Abstract concepts	Use of illustrations	Helps make the unseen visible and the complex simple. Can be traditional or digital.
Classifying microorganisms	Categorised based on different traits e.g., genetics, physiology, and morphology yet invisible with naked eye.	Use of practical work or investigations.	-Use of microscopes -Enlarges images on micro slides -Comparing images on slides with pictures in texts or micrographs. -Develops visual and manipulative skills.
Human reproduction	-A controversial topic to teach to learners from strong cultural and religious backgrounds. -Discussing human reproductive organs, menstruation or fertilisation is taboo in some cultures.	Using inquiry-based activities.	-Allowing learners to research concepts and share their cultural beliefs. -Promoting intense discussions and enhancing the quality of social interaction. -Engaging learners interactively. -Discussing cultural and religious issues to mitigate prejudices.
Nervous system: Reflex activities	-Need for practical demonstration before learners follow suite.	Use of demonstrations	-Provides interactive, hands-on learning opportunities. -Caters for various learning styles. -Attracts learners' attention.
Circulatory system in mammals	-Involves too many processes and terminologies. -Abstract concepts involved.	Use of an analogy	-Use of contextual cases familiar to learners. -Identifying analog and target.

	-Microscopic structures that learners cannot visualise using naked eye.		-Demystifies concepts and processes. -Mapping develops learners' understanding.
Genetics e.g. genetic disorders and diseases	-Controversial issues. -Evokes emotions in learners. -Can also be a source of stigma in affected learners in class and in communities.	Use of argumentation	-Allows learners to make informed decisions. -Creates awareness amongst normally shied away issues in society. -Helps to build rich information that may dispel misconceptions and stigmatisation.

From the analysis in Table 1, the participants identified topics that are either abstract or controversial in the sense of evoking mixed feelings in learners. Because of that complexity, the participants also identified teaching and learning strategies they considered suitable in engaging learners in meaningful interactions in the Life Sciences classrooms. In most of their choices, the use of 4IR tools were identified as useful when teachers employ most of the strategies for example demonstrations, practical investigations, and inquiry-based activities. Thus said, it means technology should always be used when teaching Life Sciences concepts in conjunction with the teaching strategy used.

Notably, the participants explained not only their reasons for choosing specific Life Sciences topics, but they also discussed the affordances of each of the identified teaching strategies in increasing interactivity during the teaching and learning process. An example is the use of demonstration as a teaching strategy which they considered suitable in catering for the different learning styles, thereby accommodating learners who have specific styles. One of the participants pointed the following:

Participant: Demonstrations provide for visual learning, auditory learning and those who learn through manipulation because the aim of it is to break down or bring theory into practice.

Another example is of illustrations, which participants considered as important in aiding memory. Picture illustration provides powerful visual tools that facilitate learning. According to the participants, illustrations help to develop learners' visual literacy, critical thinking skills and sharpen many more skills. The following are excerpts from participants' submissions:

Participant: Illustrations enhance many aspects of learning like comprehension, recall, problem solving, etc. Illustrations include diagrams and graphics which help learners understand a large amount of data using minimal and apt visual language.

Participant: Illustrations such as pictures capture the attention of the learners and make them want to know the story behind it. This is where most of the learners learn to interpret the illustrated pictures and improve their vocabulary by reading the stories that are written next to the illustrations.

The study shows that the use of illustration develops the cognitive behavior of learners by increasing their reasoning capacity.

5. Discussion

The use of 4IR tools together with other teaching strategies was found to be useful in developing creativity in learners as they engage and manipulate the technological tools in class. This finding is echoed in the findings by Henriksen, Mishra and Fisser (2016) and Mendezel and Rick (2021). The participants identified concepts they considered as controversial. These included genetic disorders and diseases, which can be a source of stigma in affected learners in class and in communities. As such the participants selected argumentation as a suitable strategy that allows learners to share, justify and oppose some beliefs and practices in an interactive learning environment. Ozdem et al. (2017) support the engagement of learners in argumentation to develop their reasoning skills.

The ability of the identified pedagogical strategies to enhance interactivity in the Life Sciences classrooms can be explained by Habermas critical social theory which emphasises the need to consider social interactions in the science classrooms. In this case, communication through discussions is of essence in enhancing learner understanding of Life Sciences concepts.

6. Conclusions and recommendations

The study sought to answer the research question: How do pre-service teachers conceptualise an interactive learning environment in the Life Sciences classrooms? The findings of the study showed the pre-service teachers conceptualised an interactive Life Sciences learning environment as that which enables learners to engage meaningfully when learning concepts that are abstract, difficult to understand, or those that evoke emotions due to them being controversial in challenging learners' belief systems or

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practices. The following teaching strategies were considered to be suitable to engage learners interactively: inquiry-based teaching, use of demonstrations, investigations, illustrations, and argumentation. Such findings inform both pre-service and in-service teacher development initiatives to consider development of teachers in the use of interactive pedagogies.

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