INVESTIGATING PRE-SERVICE STUDENT TEACHERS' PERCEPTIONS OF THEIR ACTUAL CONSTRUCTIVIST LIFE SCIENCES CLASSROOM ENVIRONMENT

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Abstract

With the development of research on learning environments, numerous instruments have been developed to measure various aspects of the classroom environment. This exploratory case study assessed student teachers' perceptions and their actual constructivist classroom environment in Life Sciences. The study is guided by Social Constructivism, Critical Theory and Self-reflection. The participants were 43 third year pre-service student teachers enrolled for the undergraduate degree in Natural Sciences. The Constructivist Learning Environment Survey (CLES) for Life Sciences was used to assess the degree to which Life Sciences classroom environment at this particular institution of higher learning is consistent with a constructivist epistemology. The CLES used in this study contains 30 items subdivided into five scales, namely, personal relevance, uncertainty about science, critical voice, shared control and student negotiation. The student's responses were measured on a five-point Likert type scale with response alternatives ranging from Never (1) to Always (5). The findings suggest that the students are generally positive about their constructivist classroom environment. However, there is a need for better participation with regard to shared control of the learning environment. This in turn assists lecturers responsible for Life Sciences to reflect on their epistemological assumptions and reshape their practice.

Keywords: constructivism, learning environment, life sciences

1. INTRODUCTION

Constructivism can be defined as either a view of learning or learning approach which posits that learners subjectively construct, interpret and reorganise their knowledge (Windschitl, 1999). Constructivism draws on the developmental work of Piaget (1977), Vygotsky (1978) and Kelly (1991) who emphasise that cognitive change only takes place when previous conceptions go through a process of disequilibration in the light of new information; and the social nature of learning and they suggest the use of mixed ability learning groups to promote conceptual change.

In defining constructivism, Fosnot (1989: 19) makes reference to four principles: learning depends on what we already know; new ideas occur as we adapt and change our old ideas; learning involves inventing ideas rather than mechanically accumulating facts; meaningful learning occurs through rethinking old ideas and coming to new conclusions about new ideas which conflict with our old ideas. A productive, constructivist classroom, then, consists of learner-centered, active instruction. In such a classroom, the teacher provides students with experiences that allow them to hypothesize, predict, manipulate objects, pose questions, research, investigate, imagine, and invent. The teacher's role is to facilitate this process. In other words, learning happens first on the social plane where, through interactions with more knowledgeable others, students come to understand new concepts and strategies. Individuals eventually use and extend these concepts and strategies to other contexts but meanings and interpretations have been initiated in social interaction rather than in solitary action.

Piaget (1977) asserts that learning occurs by an active construction of meaning, rather than by being passive recipients. He asserts that when learners encounter an experience or a situation that conflicts with their current way of thinking, a state of disequilibrium or imbalance is created. The learners are therefore forced to alter their thinking to restore equilibrium or balance. To be able to do that, learners make sense of the new information by associating it with what they already know, that is, by attempting to assimilate it into their existing knowledge. When they are unable to do this, they accommodate the new information to their old way of thinking by restructuring their present knowledge to a higher level of thinking. Similar to this is Kelly's theory of personal constructs (Kelly, 1991). Kelly proposes that people look at the world through mental constructs or patterns which they create. People develop ways of construing or understanding the world based on their experiences. When people encounter a new experience, they attempt to fit these patterns over the new experience. In other words people create their own ways of seeing the world in which they live.

2. HOW DOES CONSTRUCTIVISM MANIFEST ITSELF IN LEARNING ENVIRONMENTS?

In learning environments constructivism can take various forms such as encouraging students to discover, discuss and interpret knowledge; as organising learning environments for helping students construct and implement their own theories and as motivating reflection of gained knowledge and skills (Jonassen, 1999). Such a learning environment supports students to take responsibility for their own learning. To do able to do this, mental processes such as questioning, problem solving and researching in classroom settings extensively (Marlowe & Page, 2005). Research has shown that a learning environment which is designed according to constructivist principles, has positive effects on creativity (James, Gerard, & Vagt-Traore, 2010), metacognitive skills (Jager, Jansen & Reezigt, 2005; Lam, 2011), critical thinking (Maypole & Daies, (2001) and problem solving (Wilson, 2010).

Two main strategies have been identified to evaluate whether learning environments are in accordance with constructivist principles. The first one entails using instruments specifically designed to evaluate constructivist learning environments, and the second one is using students' learning approaches (Alt, 2014). Learning approaches focus on learning strategies and sources of motivation. Deep and surface learning are viewed as the two main learning approaches. Learners who use surface learning have difficulty in making connections between separate units of their work and employ mainly recall. Deep surface learners on the other hand, involves searching for evidence, making meaning and connections, and using higher order thinking skills (Entwistle, 2005). Deep learners unlike surface learners, who are passive recipients of knowledge, construct their own meanings by relating existing and new knowledge and can transfer their learning to other situations (Hermida, 2015). Deep learning falls within the constructivist view of learning.

Constructivism advocates theories that seek to show construction of knowledge by individuals and the society (Sanchez & Loredo, 2009) and redefines the role of students and teachers and their relationships. A nurturing as opposed to a competitive environment is created in a constructivist classroom. This epistemological declaration is founded on Vygotsky's (1978) view that more knowledgeable members of the society guide social interactions and provide gradual construction of knowledge by the less knowledgeable members of the community.

In a constructivist learning environment, learners are provided with authentic complex problems or projects supported by information resources, cognitive tools and learning-support strategies such as modelling, scaffolding and coaching (Jonassen, Marra & Palmer, 2003). Lecturers/ teachers in in constructivist learning environments give students enough time to think about tasks assigned and direct students to the appropriate resources to seek answers. Students are at the centre of instruction to ensure meaningful learning.

3. AIM OF THE STUDY

The aim of the study was to assess the extent to which students' perceptions of their classroom environments can be used to evaluate the use of constructivist principles in teaching and learning.

4. RESEARCH QUESTIONS

The study sought to answer the following research questions:

- How do third year student teachers' perceive their classroom learning environments in the Life Sciences?
- What are the implications of student teachers' perceptions of their classroom learning environment for teacher educators?

5. METHOD

Research design

This is an exploratory case study used to assess the third year student teachers' perceptions and their actual constructivist classroom environment in Life Sciences.

Participants

The sample comprised 43 third year Life Sciences pre-service teachers/ student teachers, 24 (58,81%) females and 19 (44,18%) males enrolled for an undergraduate degree in Life Sciences at an Institution of Higher Learning in South Africa.

Instrument

Data were collected using the original Constructivist Learning Environment Survey (CLES). The CLES comprising 30 items with six items for each scale was used to assess the degree to which Life Sciences classroom environment at this particular institution of higher learning is consistent with a constructivist epistemology. The five scales, namely, personal relevance, uncertainty about science, critical voice, shared control and student negotiation represented the key dimensions of critical constructivism (Taylor, Fraser & Fischer, 1997). The Personal Relevance scale is concerned with the students' perceived relevance of life Sciences to their out-of-school experiences, and how lecturers make use of students' everyday experiences as a meaningful context for the development of students' knowledge of Life Sciences. The shared control specifies how students share with lecturers the design and management of learning activities, assessment criteria and social norms of the classroom. The Student Negotiation scale focuses on whether teachers' pedagogical attention extends beyond the traditional social activity of students helping each other to work out the correct answer to a problem. The Critical Voice scale ascertains the extent to which a social climate has been established in which students feel that it is legitimate and beneficial to question the teacher's pedagogical plans and methods, and to express concerns about any impediments to their learning. The Shared Control scale is concerned with students being invited to share control of the total learning environment with the lecturer. Students' perceptions of their constructivist learning environments were measured on a 5 point Likert-type scale with response alternatives ranging from Never (1) to Always (5).

Data analysis

Descriptive and inferential statistics were generated from the data to measure the students' perceptions of their actual classroom environment according to the CLES.

6. RESULTS

Table 1 presents the students' perceptions of their actual classroom environment according to personal relevance, uncertainty about science, critical voice, shared control and student negotiation. Table 2 presents a summary of descriptive statistics.

Table 1: Students Perceptions of their classroom environments (N=43)

Personal Voice	**Mean**	**SD**
Statements In this Life Sciences class:		
1. I learn about the world outside of school.	3.82	0.91
2 New learning starts with problems about the world outside of school.	3.53	1.12

3. I learn how Life Sciences can be part of my out-of-school life.	4.42	0.70
4. I get a better understanding of the world outside of school.	3.97	0.86
5. I learn interesting things about the world outside of school.	3.94	0.93
6. What I learn has nothing to do with my out-of-school life.	1.85	0.98
Overall Mean	3.59	0.14
Uncertainty	Mean	SD
7 I learn that Life Sciences cannot provide perfect answers.	3.38	1.32
8 I learn how Science has changed over time	4.34	0.93
9. I learn how the rules of Life Sciences were invented.	3.84	1.01
10. I learn that science is influenced by people's values and opinions	3.72	0.86
11. I learn that today's Life Sciences is different from the Biology of long ago.	2.88	1.26
12. I learn that Life Sciences is about creating theories.	3.38	1.03
Overall Mean	3.59	0.18
Critical Voice	Mean	SD
13. It is acceptable/ OK to ask the lecturer "why do we have to learn this?"	3.63	1.08
14. It is OK for me to question the way I'm being taught.	3.70	1.04
15. It is OK for me to complain about activities that are confusing.	3.75	1.14
16. It is OK for me to complain about anything that prevents me from learning.	4.48	1.29
17. It is OK for me to express my opinion.	3.97	0.82
18. It is acceptable to speak up for your rights.	4.31	0.87
Overall Mean	**3.97**	0.17
Shared Control		
19. I help the lecturer to plan what I'm going to learn.	2.63	1.09
20. I help the lecturer decide how well I am learning.	2.84	1.24
21. I help the lecturer decide which activities are best for me.	3.19	1.22
22. I help the lecturer to decide how much time I spend on an activity.	3.16	1.20
23. I help the lecturer decide which activities I do.	3.44	1.12
24. I help the lecturer decide my learning	1.59	1.27
Overall Mean	2.74	0.07
Learning to communicate/ Student Negotiation		
25. I get the chance to talk to other students.	3.70	0.91
26. I talk with other students about how to solve problems.	4.53	0.87
27. I explain my understanding to other students	4.22	0.62

28. I ask other students to explain their thoughts.	3.59	0.95
29. Other students ask me to students explain my ideas.	3.75	1.06
30. Other students explain their ideas to me.	3.41	0.69
Overall Mean	3.97	0.17

Table 2: Summary descriptive Statistics

Categories	**Mean**	**SD**	**Min**	**Max**	**Range**
Personal Voice	3.59	0.14	1.84	3.84	2
Uncertainty	3.59	0.18	2.92	4.36	1.44
Critical Voice	3.97	0.17	2.44	4.45	2.1
Shared Control	2.74	0.07	1.59	3.44	1.85
Student Negotiation	3.97	0.17	2.13	4.53	2.4

7. DISCUSSION

As reflected on tables 1 and 2, the students perceived their classroom learning environment positively. Student negotiation and Critical voice had the highest means, 3.97 respectively. This implies that students are in agreement that in their Life Sciences class, a social climate in which students feel that it is legitimate and beneficial to question the teacher's pedagogical plans and methods, and to express concerns about any impediments to their learning is established. Negotiation and critical voice are very important aspects of a constructivist classroom because they unify the lecturer and students in a common purpose. Personal voice and uncertainty had a mean score of 3.59, which suggests that the learning environment in the Life Sciences class emphasises personal relevance to everyday life and inquiry centred learning.

In a constructivist classroom, students need to be engaged individuals who seek understanding of the world around them, largely through active learning and discovery (Van Merrie¨nboer & Paas, 2003; Driscoll, 2000). The lack of opportunity for students to ask their own questions is a very real concern in any learning environment. Shared control was rated the lowest by students, with a mean score of 2.74, which implies that students feel they need to be invited to share control of the total learning environment (that is, articulation of learning goals, design and management of learning activities etc.) with the lecturer. This includes the design and management of learning activities, determining and applying assessment criteria, and participating in the negotiation of the social norms of the classroom. A constructivist learning environment needs to be such that students control their own learning process, and they lead the way by reflecting on their experiences (Benudhar & Moumita, 2013; Roblyer, 2003; Van Merrie¨nboer & Paas, 2003). This process makes them experts of their own learning. Constructivists believe that knowledge is constructed I communities of practice through social interaction (Vygotsky, 1978). The lecturer has to help create situations where the students feel safe questioning and reflecting on their own processes, either privately or in group discussions. Also, talking about what was learned and how it was learned is really important. A constructivist classroom enables control from students' involvement in responsibility rather than external imposition and as a result, students become autonomous learners.

The learning environment is an important aspect in the education process and it impacts on the student achievement. It does not only influence the student's outcomes but the teacher's performance as well. The teacher/ lecturer, in such classrooms, has to take into cognisance what the students know, maximise social interactions between students so that they can negotiate meaning and provides a variety of sensory experiences from which learning is built. The results of this study indicate that using CLES assists a life sciences teacher or a lecturer to gain better picture and understanding of the current learning environment and perceived learning needs of their students. The life Sciences lecturer in this case could use the CLES information to improve on the teaching effectiveness in the Life Sciences constructivist classroom learning

environment.

8. CONCLUSION

Even though students are positive about their constructivist classroom environment, there is a need for better participation with regard to shared control of the learning environment is concerned. Life Sciences Lecturers, in their classes, need to afford opportunities for the students to participate in learning decisions such as activity planning in the classroom, evaluation of activities, timing of activities, defining problems in learning and so on. Life Sciences lecturers can use the information from this constructivist classroom learning environment assessment to improve on their educational practice and environments of their classrooms. Changing one's classroom to a constructivist one needs reflection on what is currently happening. It is therefore important for lecturers to constantly evaluate their learning environments to determine the extent to which they are in accordance with constructivist principles. This study should be followed by the preferred form of the CLES to find out what the students would like to see happening in their classes.

REFERENCE LIST

Benudhar, C., & Moumita, M. 2013. Epistemological and pedagogical implications of constructivism: A contemporary contemplation. *Indian Journal of Educational Research, 2*: 82-94.

Driscoll, M. P. 2000. *Psychology of learning for instruction.* Needham Heights, MA: Allyn & Bacon.

Entwistle, N. 2005. Contrasting perspectives on learning. In F. Marton, D. Hounsell & N. J. Entwistle (Eds.), *The experience of Learning: Implications for teaching and studying in higher education* (pp. 106-125). Edinburgh: University of Edinburgh.

Hermida, J. 2015. *Facilitating deep learning: Pathways to success for university and college teachers*. Boca Raton: CRC Press.

James, V., Gerard, R. L., & Vagt-Traore, B. 2010. Enhancing creativity in the classroom. In M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology*. Retrieved from http://www.textbookequity.org/oct/Textbooks/Orey_Emergin_Perspectives_Learning.pdf

Jager, B., Jansen, M., & Reezigt, G. 2005. The development of metacognition in primary school learning environments. *School Effectiveness and School Improvement, 16*(2): 179-196.

Jonassen, D. H. 1999. Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructionaldesign theories and models, a new paradigm of instructional theory* (pp. 215 -239). New Jersey: Lawrence Erlbaum Associates.

Jonassen, D.H., Marra, R.M. & Palmer, B. 2003. Epistemological development: An implicit entailment of constructivist learning environments. In N.N. Seel & S. Dijkstra (Eds), *Curriculum, plans and processes of instructional design: International perspectives* (pp. 75-88). Mahwah, NJ: Lawrence Erlbaum.

Kelly, G.A. 1991. The psychology of personal constructs: Volume one - A theory of personality. London: Routledge.

Lam, F. 2011. The socratic method as an approach to learning and its benefits (Senior Honors Dissertation). Retrieved fromhttp://repository.cmu.edu/cgi/viewcontent.cgi?article=1126vecontext=hsshonors

Marlowe, B. A., & Page, M. L. 2005. *Creating and sustaining the constructivist classroom*. ABD Corwin Press.

Merrill, M. D. 2002. First principles of instruction. Education Technology, Research and Development, 50(3): 43–59.

Maypole J., & Davies T. G. 2001. Students' perceptions of constructivist learning in a community college American history II survey course*. Community College Review, 29*(2): 54-69.

Piaget, J. 1977. *Equilibration of cognitive structures.* New York: Viking.

Roblyer, M. D. 2003. *Integrating educational technology into teaching.* Upper Saddle River, NJ: Merrill Prentice Hall.

Taylor, PC., Fraser, B.J. & Fischer, D.L. 1997. Monitoring the development of constructivist learning environments. International Journal of Educational Research, 27(4): 293-302.

Fosnot, C.T. 1989. Enquiring teachers, enquiring learners: A constructivist approach for teaching. New York: Teachers College Press.

Van Merrie¨nboer, J. J. G., & Paas, F. 2003. Powerful learning and the many faces of instructional design: Towards a framework for the design of powerful learning environments. In E. De Corte, L. Verschaffel, N. Entwistle & J. J. G. Van Merrie¨nboer (Eds.), Powerful learning environments: Unravelling basic components and dimensions (pp. 3–20). Oxford: Elsevier Science.

Vygotsky, L. 1978. *Mind and Society: The development of higher psychological processes*. Cambridge, MA: Havard University Press.

Windschitl, M. 1999. The challenges of sustaining a constructivist classroom culture. *Phi Delta Kappan*, *80*(10): 751-754.

Wilson, B. G. 2010. Constructivism in practical and historical context. In B. Reiser & J. Dempsey (Eds.), *Current trends in instructional design and technology (pp. 1-10)*. NJ: Pearson Prentice Hall.