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Using Working Models in the Teaching of Scientific Concepts at Early Childhood Education Level in Gokwe North Rural District Schools

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Abstract:
This research paper focuses on theuse of simple working scientific models made from inexpensive locally available materials in the teaching of scientific concepts at early childhood education level in Gokwe North Rural District primary schools of Zimbabwe. The study was necessitated by the need to improve the teaching and learning of scientific concepts at Early Childhood Education level through the use of models. The population for the study comprised of 128 primary schools, 515early childhood education teachers and 128 Teachers in Charge (TIC).A sample of 50 ECE teachers was selected through disproportional random sampling from purposively selected clusters of schools. Ten TIC's were purposively selected to participate in face-to-face interviews. Research findings revealed that ECE teachers in these cluster rarely use models when teaching scientific concepts. Instead there is over use of simple drawings and charts which are two dimensional in nature instead of working three dimensional models which are very important in concept formation. Teachers find it difficult to make working models because of lack of financial resources and lack of resourcefulness. Teachers are not really using locally available materials to make models because they do not possess the simple skills and tools to make such models. Most teachers believe that good models should be commercially made. The study recommends that short courses on how to make models should be designed for teachers by the concerned ministry. Teachers should enterprise in model making and use less of charts and drawings in the teaching of scientific concepts.

Keywords: *working, model, concepts, scientific, early childhood education.*

1. Background to the Study

This research paper focuses on the use of simple working scientific models made from locally available materials in the teaching of scientific concepts at ECE level.There is extensive theoretical support for the use of manipulatives through the work of numerous highly esteemed learning theorists. For instance, Jean Piaget's theory known as genetic epistemology emphasises construction of knowledge in the mind through the use of concrete objects when teaching young children. He emphasised stages of cognitive development in which he says at the preoperational and concrete operational stages there is need to provide object for manipulation (Morrison, 2007). Young children should be given the opportunity to act upon the environment and to acquire new knowledge, building upon old schemas through the process of assimilation and accommodation (French, 2007).Jerome Brunner theorised modes of representation in the teaching of new concepts in his constructivist approach (Mwamwenda, 2004; Child, 2007). He puts across the idea of the enactive mode which is action oriented and where learning should be concretized through the use of objects. Then there is the iconic mode where the educator goes on to build upon the learned concepts through the use of pictures, charts and drawings. When learners have mastered the concept well, the last mode is symbolic representations in different forms. There are two overarching ideas shared by these theorists: that using concrete tools is an important stage for learners as they develop an understanding of new concepts and that learners benefit from interacting with their environment in authentic ways.

According to Jannsasen cited in Bell (2010) models are part of educational technology which is an array of tools that might prove helpful in advancing children's learning. Teaching of scientific concepts using models make work easier for both the teacher and the pupils respectively. Gilbert, Osborne and Fenshama cited in Morrison (2007)indicate that the use of models in science teaching provides a solid foundation for subsequent development of scientific skills that pupils will use throughout their academic lives. This foundation helps pupils construct an understanding of key science concepts and also allow for future learning of abstract ideas.

Eshach and Fried (2005) purport that the use of models in early science experiences in India has helped pupils develop scientific reasoning, positive attitude towards science and a better foundation for scientific concepts to be studied later in their education. It is the intention of this paper to present what is obtaining in as far as the use of simple scientific models is concerned in Zimbabwe.

A research by Russell and Sorge at an American school in Virginia cited in Pitler, Hubbell, Kuhn and Kin (2007) indicates that the use of technologies such as models gives pupils control over their learning. The use of models in classroom instruction offers pupils the opportunity to manipulate at their convenience until they master the concept. Models bring the outside world into the classroom and make possible learning with visualisation and manipulation. In a survey to find out factors that facilitate teacher skills, teacher morale and perceived pupil learning in technology using classrooms. Baylor and Ritchie (2002) found that teachers valued the use of models in their classes because they had an impact on pupils' content acquisition and class performance.

Schacter and Fagnano cited in Pitler, Hubbell, Kuhn and Kin (2007) purports that models when applied effectively do not only increase pupil learning, understanding and achievement but also augment motivation to learn and supports the development of critical thinking and problem solving skills. A report by the Child Development Institute (2015) states that models when properly engaged become props for cooperative play and thus encouraging collaborative learning. Good models engage a child's senses, spark their imagination and encourage them to interact with others.

Spector (2012) asserts that models can provide learning experiences many real things cannot provide. The authority further argues that some models are assembled to provide interior views not possible with real objects and are the most recommended media when realism is essential for learning, especially with concepts that require identification by size, shape or colour and hands on. Models of complex devices or processes help to highlight essential elements and eliminate distracting details. A research by Heinich at a school in Nigeria cited in Spector (2012) shows that plastic model kits appeal to children of all ages and can stimulate inquiry and discovery.

Scientific ideas can be understood using physical models made from simple materials .These are external representations of cognition. As learners make use of these models, they also form mental pictures of what is in the real world and help students understand science ideas (Coll, France & Taylor, 2005 cited by Schwartz & Skjold (2012).There mental pictures are referred to as schemas by Piaget. Teachers need to have an understanding of how models are developed if children are to learn science in a way that reflects real-world scientific inquiry. Teachers therefore need an opportunity to learn about models during their training. Use of models as a part of scientific inquiry should be embedded into science content courses and teacher education courses drawing attention to relevant aspects of scientific models (e.g. Crawford & Cullin, 2004; Justi & van Driel, 2005 cited by Schwartz and Skjold,2012). Models are constructed and used as part of scientific inquiry by scientists. Thus, learners should be knowledgeable about what scientific models are, how they are developed, and how they are used by scientists

It is quite evident from preliminary research that teachers use more of charts, pictures and drawings which are two dimensional media. These lack the tangible and dynamic attributes of the physical manipulatives when teaching science concepts to young children. Informal talk also revealed that teachers feel that it is too early to be too serious with teaching scientific concept at early childhood level. They view this as a simple introductory stage. Most schools especially in rural areas do not have the capacity to buy commercially made teaching and learning media. Some teachers feel that it is too much to expect them to have models every time they are introducing a scientific concept in a struggling economy. Stakeholders within the Ministries of Education have expressed concerns on the teaching of science in early grades in that it is not accorded the seriousness that it deserves in terms of preparation and concept formation. Not much research has been carried out on the teaching of science concepts to young children in Zimbabwe. It is therefore prudent to carry out a study on the use of simple working models in the teaching of science concepts to young children in rural primary schools.

2. Research Design

The study employed e descriptive survey research design. Cohen, Manion and Morrison (2011) define a research design as a plan, structure or strategy of investigation concerned with obtaining answers to the research question. Punch (2009) refers to research design as all issues involved in planning and executing a research project. Therefore a research design is a strategy for planning and carrying out a research project. Ray and Mondal (1999) point out that the major strength of a descriptive survey is its wide scope. Chiromo (2009) posits that a descriptive survey involves drawing conclusions about a population basing on a sample.

3. Population and Sample

The population for this research study consisted of 128 primary schools, 515 ECE teachers and 128TICs. Punch (2009) defines a population as a target group usually large about whom we want to develop knowledge, but which we cannot study directly. A sample of 50 ECE teachers which is more than 10% of the population was selected through disproportional random sampling. Ten TIC's were purposively selected to participate in interviews because of their typicality. Franklin and Wallen (2009) define a sample as any subgroup from which information is obtained. Tuckman (1994) on the other hand defines it as a subset or a portion of a population that is selected for analysis.

4. Research Instruments

This study used questionnaires composed of closed and open ended items. Cohen, Manion and Morrison (2011) define a questionnaire as a useful instrument for collecting survey information, providing structured, often numerical data being able to be administered without the presence of the researcher and often being comparatively straight forward to analyse. These were administered in person to 50 ECE teachers to ensure a hundred percent return. Ten Teachers in Charge, purposively selected responded to face-to-face

interviews Aldridge and Levine (2001) define an interview as a social, interpersonal encounter, not merely a data collection exercise. The research focused on the benefits of using models in the teaching and learning of scientific concepts at ECE level.

5. Data Presentation and Discussion

The study sought to find out whether teachers were aware of the benefits of using models in the teaching of scientific concepts at ECE level. A questionnaire item required teachers to rate the identified benefits as very important or somewhat important. 'Somewhat' means to a lesser extent. Reference is made to Table1.

ITEM	Very important	%	Somewhat important	%
Provides a solid foundation for subsequent development of scientific skills	50	100	-	
Help in addressing achievement gaps in science performance	42	84	8	16
Gives pupils control over their learning.	33		17	44
Models bring the outside world into the classroom.	50	100	-	-
Provide motivation to learn and supports the development of critical thinking and problem solving skills.	50	100	_-	
Models can provide learning experiences many real things cannot provide.	40	80	10	20
Good models engage a child's senses, spark their imagination and encourage them to interact with others.	50	100	-_	-

Table 1: Teachers' responses on benefits of using models in the teaching of scientific concepts (N=50)

Data in Table 1 indicates that 100% of teacher respondents indicated that the following benefits were very important: Provides a solid foundation for subsequent development of scientific skills; Models bring the outside world into the classroom; Provide motivation to learn and supports the development of critical thinking and problem solving skills; Good models engage a child's senses, spark their imagination and encourage them to interact with others. Eighty four percent of the respondents rated as very important the statement which said that that the use of models helped in addressing achievement gaps in science performance while 16% indicated that the benefit is somewhat important. While80% indicated as very important the benefit that models can provide learning experiences which many real things cannot provide 20% indicated that it is somewhat important. Sixty- six percent of the respondents indicated that working models are very important in that they give pupils control over their learning whilst 44% indicated that the same benefit is somewhat important.

Responses made by teachers showed that most of the statements put across as benefits of models were regarded as very important followed by some who indicated that some of the statements were somewhat important.

Ten Teachers in Charge from 10 schools were interviewed on the benefits of using working models in the teaching of scientific concepts. The following are their responses:

- TIC 1: Models stimulate interest and motivation and help pupils understand more abstract scientific concepts
- TIC 2: Proper use of models promotes cooperative learning and facilitates the development of psychomotor skills among learners
- TIC3: Planned engagement of models make teaching and learning easier and enjoyable
- TIC4: I think models benefit learners in that they see and touch and also hear the sound.
- TIC5: With the use of models learners are actually learning through their senses.
- TIC6: Models are a benefit in the sense that children manipulate and construct understanding by using something functional.
- TIC7: Models help learners to understand things they may not have seen before. They help learners to understand the world around them.
- TIC8: Learning becomes more interesting when learners see things happening.
- TIC9: Children benefit because its hand-on approach.
- TIC10: Learners need to act on the environment and use of models is an important approach of providing a rich learning environment for learners.

All the ten Teachers in Charge(TIC) indicated that models assist pupils to understand more abstract scientific concepts and also stimulate pupils' interest and motivation to learn. TICs also added that models promote cooperative learning among learners. This could mean that TICs are in full support of the use of models in the teaching of scientific concepts. Vygotskian theory emphasises the importance of social interaction between the child and adults or peers in the environment, in the construction of knowledge. In line with the idea of cooperative learning in acquiring concepts, According toJohn-Steiner and Mahn (1996) as learners participate in a variety of activities jointly, they get opportunities to exploit their potentials they go through different modes of understanding and

within their zones of proximal development. Through social interaction and cooperative learning, learners acquire new learning strategies and useful knowledge which they can use independently. Emphasis is laid on learning through the senses, hands-on approach and rich learning environments in the teaching and learning process.

A report by the Child Development Institute (2015) states that models allow for hands-on experiences. They give pupils the opportunity to have fun while practising the things they will learn in later life. Research participants agreed that the use of models improves concept mastery. This is supported by Doering and Roblyer (2010) who purports that models as physical manipulations are a mainstay of early childhood classrooms because they help students bridge the conceptual difference between concrete and abstract scientific concepts. Interactive models have characteristics similar to key features of more complex systems in the real world. The use of models in classroom instruction offers pupils the opportunity to manipulate at their convenience until they master the concept. A report by the Child Development Institute (2015) states that models allow for hands on experiences. They give pupils opportunities to have fun while practising the things they are learning in school. This increases their retention of those things. Good models stimulate interest for continued play thereby reinforcing concepts learned. Spector (2012) asserts that models can provide learning experiences many real things cannot provide.

When asked to indicate whether they had the skills to make simple models for teaching scientific concepts, teachers gave varied responses. Reference is made to Table 2

Category	Number of teachers	%
Excellent	4	8
Very good	8	16
Good	6	12
Average	23	46
Not good	9	18
Total	50	100

Table 2: Teachers responses concerning their ability to make simple working models (n=50)

Data in Table 2 indicates that 8% of teacher respondents indicated that they could make excellent models .Sixteen percent of the teachers indicated that they were very good at making models while2% of them indicated that they were good at making simple scientific models. Forty-six percent indicated that they had average skills while 18 % indicated that they were not good at making models. This data could be interpreted to mean that most teachers were operating on average basis as far as making working models is concerned. This means that learners are also affected negatively by the teachers' inability to make simple models on their own. This could be true because teachers cannot afford to buy commercially made models for their classes. In depleted economy like ours in Zimbabwe, schools cannot afford to buy these media especially in rural areas. The fact that most teachers (46%) fell on the average category means that their lack of skills to make simple scientific models stems partly from their training which does not include purely hands-on modules like entrepreneurship so that they gain knowledge and skills in making these models.

Responding to the same question on whether teachers had the ability to make simple scientific models for teaching purposes, TICs responded to interviews as follows:

- TIC 1: Most teacher do not have the knowledge to make models. They pay someone to make a model for them and how often can they do that?
- TIC 2: When it comes to making models, it's something which is not taught practically at college so teachers have superficial skills of making these.
- TIC 3: Teachers lack the knowledge to make models. It is not part of their syllabus at college.
- TIC 4: Most lady teachers are not able to construct these models. They look for skilled people who charge them exorbitant prices .As a result using a model cannot be a daily matter. Most of the time they instruct abstractly.
- TIC 5: Teachers need in-service training on using locally available resources to make functional models.
- TIC 6: It is unfortunate that teachers teach without models most of the time.
- TIC 7: Teachers are capable of making models if they are taught how to do it .At the moment teachers are being deprived of entrepreneurship skills during their training.
- TIC 8: Teachers need real staff development on these things because most of them use charts and drawings instead of real objects for concept formation.
- TIC 9: Teachers study to much of theory at the expense of practicals.As a result, their entrepreneurship skills remain undeveloped.
- TIC 10: Teachers need training in making models. They lack the skills.

Responses made by teachers and TICs indicate that generally teachers lack the knowledge to make or to construct simple working models for the purposes of teaching scientific concepts effectively. The implication is that learners' understanding of these concepts is compromised. This is in line with Bers and Portsmore (2005:60) who say: "Most early childhood education programs do not prepare teachers in the area of technology nor do they offer a vision in which teachers see themselves as designers of technologically rich curricula, and not merely consumers." Generally, teachers lack support at the beginning of their teaching careers in terms of engaging in apprenticeship programmes and other kinds of opportunities to interact with more experienced teachers. Teachers need to have an understanding of how models are developed during their training. Use of models as a part of scientific inquiry should be embedded

into science content courses and teacher education courses drawing attention to relevant aspects of scientific models (e.g. Crawford & Cullin, 2004; Justi & van Driel, 2005 cited by Schwartz and Skjold,2012).Having noted that using models has so many benefits, it is imperative that teachers be equipped with both theory and practice in the form of hands-on activities which are commensurate with the scientific concepts to be taught at early childhood level.

6. Conclusions

The paper focused on the benefits of using working models in the teaching of science concepts at early childhood level. The paper concludes that teachers and Teachers in Charge are aware of the benefits of using models in the teaching of scientific concepts to young learners. However, teacher education has not put emphasis on the practical aspect of developing model making skills in teachers. As a result, most teachers as revealed by the findings cannot construct meaningful models because they lack the knowledge to do so.The implication is that they resort to instruction using charts and drawings to introduce some difficult concepts which in turn disadvantage learners.

7. Recommendations

The paper recommends that teachers who are undergoing training in teacher education institutions should be engaged in practical work where they learn to construct working scientific models for teaching purposes and for entrepreneurship.

- In-service teachers should be engaged in continuing professional development by forming partnerships with communities and industry so that they can also acquire some skills which will enable them to construct simple models using locally available materials.

8. References

i. Aldridge & Levine (2001).Surveying the Social world. McGraw-HillEducation http://www.mheducation.co.uk>chap
ii. Bers, M. U., & Portsmore, M. (2005). Teaching partnerships: Early childhood and engineering students teaching math and science through robotics. Journal of Science Education and Technology, 14(1), 59-73.
iii. Bell J. (2010). Doing Your Research Project. London Library of Congress Cataloguing.
iv. Baylor, A. L., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? Computers & Education, 39(4), 395-414.
v. Child .D (2007).Psychology and the Teacher. London: Holt, Rinehart and Winston
vi. Chiromo, A. S. (2009) Research Methods and Statistics A Student Guide Midlands State University. Gweru
vii. Cohen, L., Manion, L. & Morrison, K. (2011) Research Methods in Education London Routeledge
viii. Eshach & Fried (2005) Early Childhood Teachers' Views about science teaching practice.
ix. French. (2007).Children's early learning and development. NCCA. Dublin.
x. John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: A Vygotskian framework. Educational psychologist, 31(3-4), 191-206.
xi. Morrison, G.S (2007).Early Childhood Education Today. Carlisle Publishing Services. New York.
xii. Mwamwenda, T.S (2004).Educational Psychology an African perspective: Butterworths.
xiii. Pitler, H., Hubbell, R. E., Kuhn, M & Kin, M. (2007). Technology with Classroom Instruction. Virginia: ASCD.
xiv. Punch, K. (2009). Introduction to Research Methods in Education. Western Australia: SAGE
xv. Schwartz, R., & Skjold, B. A. (2012). Teaching about Scientific Models in a Science Content Course. Educación química, 23(4), 451-457.
xvi. Spector, M. J. (2012).Foundations of Educational Technology; New York Routeledge
xvii. Tuckman, B. W. (1994). Conducting Educational Research. Florida: Harcott Bruce and company
xviii. Wallen, N.E. & Fraenkel, J. R. (2009).Educational Research A Guide to Process book.google.com>education>research