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COLLOQUIUM

Conditions for Implementation of the Science Curriculum in Early Childhood Development and Education Centres in Kenya

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ABSTRACT Cognitive development and teaching have highlighted the importance of learning based on the relationship among individuals and the learning environment. Teaching and learning of science in early childhood development and education (ECDE) can only be effective if adequate facilities, materials, equipment and activities are put in place. Teaching of science in ECDE centres in Kenya is faced with numerous challenges, hence the negative influence on children's learning of the subject. This raised the question of whether we have appropriate conditions for implementation of the science curriculum in ECDE centres. This study investigated conditions for implementation of science in 115 ECDE centres managed by 230 teachers in Kakamega Municipality, Kenya. It used the ECDE facilities checklist, the ECDE classroom science materials/equipment checklist, the ECDE classroom science activities checklist, and the ECDE teacher classroom science questionnaire to analyse the availability of science materials, equipment, class size and activities for ECDE children in the classroom. Each teacher was videotaped for two consecutive days during science activities. Their attitude towards science curriculum was measured by the use of an attitude scale. The findings of the study indicated that three-quarters of the ECDE centres had appropriate general facilities. However, a majority (91.2%) of ECDE centres lacked adequate and quality classroom science materials/equipment. The activities that the ECDE teachers engaged in were mostly unrelated to science activities (85.7%), even though they had a favourable attitude towards the science curriculum. This study is significant because the resulting findings will influence practice in early childhood education by informing policy makers on prevailing conditions for implementation of the science curriculum. On the theoretical side, the findings will contribute to the development of teaching and learning science materials, science equipment and a children's science curriculum tool kit.

Introduction

Implementation of any curriculum can only be effective if adequate and appropriate facilities, materials, equipment, teaching and learning activities are put in place. Allocation of these conditions is necessary for achieving the specified learning goals. Therefore, effective teaching and learning in science in early childhood development and education (ECDE) centres cannot achieve the expected outcomes without availability of adequate and appropriate conditions. According to

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the National Research Council (1999) and Strozzi (2001), science knowledge emerges as a result of activities engaged and shared in an environment that connects individuals, materials, cultural tools, and symbol systems.

Teaching of science in Kenya's ECDE centres is faced with numerous challenges. In the first place, the majority (90%) of ECDE teachers end up in the ECDE teaching profession simply because there are no other alternative jobs (Nasibi, 2005). Once they land in the profession, they become more frustrated and demotivated due to the nature of the work, conditions under which they work and low payment in terms of salary. Others work in hardship areas in ECDE centres that do not have basic facilities (e.g. classrooms, toilets, kitchens, playgrounds). One of the basic issues of concern raised from this study was whether conditions for implementation of the science curriculum in ECDE centres were favourable.

Availability of adequate and appropriate conditions for the science curriculum in ECDE centres is an important strategy, as observed by Permberton (1999). Lack of appropriate conditions for implementation of ECDE science curriculum can result in teachers developing a negative attitude towards the subject. This may in turn have a negative impact on children's learning and interest in science. Given the crucial role that ECDE plays in the future development of scientists and technologists, it was important to assess the conditions for the implementation of science in ECDE centres in Kakamega Municipality, Kenya.

Related Literature

Science knowledge and understanding are constructed through social interactions (National Research Council, 1999). Classrooms are inherently social places where teachers and children negotiate the science curriculum together. The aim is to construct a teaching and learning science environment in which children and teachers are given opportunities to make decisions and pursue authentic questions and concerns. They attempt to connect what is known to the unknown, explore, test ideas and discover through play, informal learning science activities and projects. Guided participation in the activities of children is the primary role of the teacher, and play and the expression of ideas through interactions with adults and the environment are the primary business of children (Fu et al, 2002).

On the same point, Ginsburg et al (1999) are of the opinion that activities and projects based on children's interests in the world around them promote all domains of learning – mathematics, science, and literacy – develop metacognitive skills and enhance conceptual knowledge. Mathematics and science can be found in myriad activities that solve real problems in the classroom and on the playground as well as in stories, block building, dramatic play, animals in the classroom and outdoors, and so on. In many activities children learn about emerging mathematical and scientific concepts that encourage them to develop and use the tools of scientific thinking and testing: observation, recording, exploring changes, making predictions, asking questions, and finding ways to test out their hypotheses. Children learn about living things; physical changes in solids and liquids; motion, speed and balance; the needs and life cycles of living things; and quantity and measurement, for example.

According to the Exchange Every Day programme (Miller, 2008), a science centre in the classroom should have some activities that engage the children so that they will learn more effectively. A teacher can give children some specific challenges – by using balance scales, for example. First of all, they might let them play with the scale without direction, and then ask them some questions about it; for example, 'What makes this side of the scales go down?' 'Why doesn't it go down when I place this rock on the other side?' The young children's science centre should be made engaging for children. This may be equated to James Bryant saying, 'Behold the turtle. He makes progress only when he sticks his neck out' (Miller, 2008).

Kenya's ECDE policy framework (Republic of Kenya, 2006) elaborates on the need for a conducive, well-prepared classroom environment during implementation of the science curriculum. The ECDE classrooms are expected to be spacious and appealing. They should have appropriate, well-arranged furniture and mats on which children sit during science activities. Whatever furniture is used for sitting and writing should be of a proper size for children. The type of furniture (tables, chairs or desks) provided for the children's use has a far-reaching effect on their

physical development. This is because they affect posture and the degree of fatigue the children suffer. The type of furniture and equipment also influences children's performance in science activities. Therefore, chairs and tables provided for children's use should be of an ideal size and shape, and be colourful (appealing) in order to capture and sustain children's learning interest.

Another requirement is availability of centres of interest in ECDE classrooms. The centres of interest, or learning corners, facilitate and reinforce teaching and learning in each of the curricula areas. In ECDE centres, each of the curriculum areas has a centre of interest or learning corner. The Kenya Institute of Education (KIE) (1997) recommends the display in classrooms of assorted teaching and learning materials and equipment. They should be displayed in centres of interest according to the curriculum areas. If possible, most of the materials and equipment should be realia. In addition, they should be relevant, durable, safe, attractive, of good quality, and of an appropriate size and shape. The local environment should be explored fully so that some of the materials and equipment are improvised for cost effectiveness. When collecting and developing materials, age and developmental milestones should be taken into consideration.

During implementation of the science curriculum at ECDE level, the KIE (1997) has suggested the following as some of the materials and equipment that may be used:

1. Sand
2. Beam balances
3. Containers (plastic bottles, watering cans)
4. Painted (coloured) sticks
5. Water
6. Utensils (plastics spoons, cups, plates)
7. Light and heavy objects (stones, cotton, bamboo)
8. Coconut shells
9. Weather chart
10. Picture books, pieces of paper
11. Seeds, seedlings, leaves, roots, flowers, plants
12. Pictures and photographs of animals and plants
13. Nets, strings, sieves, boxes, crayons, pencils, plasticine
14. Animals
15. Models of the physical features

Martin (2000) perceives that class size serves as an economic indicator, with smaller classes signifying greater wealth of a particular country. Further, class size may reflect selective allocation of resources to, for example, special needs or practical classes. Whatever the reasons for the class size, there is little doubt that it affects how teachers can implement the curriculum.

Class size can affect the quality and effectiveness of teaching ECDE science. Siraj-Blatchford (2002) has described several ways in which class size could affect the quality and effectiveness of teaching. In smaller classes it can be easier for teachers to spot problems and give feedback, identify specific needs and gear teaching to meet them, and also to set individual targets for pupils and be flexible and adventurous in the use of different styles of teaching. On the other hand, Siraj-Blatchford (2002) suggests that teachers in large classes are more formal and less personalised in their style of teaching. They are forced to use different teaching methods to cope with pupils with different abilities. Pupil discipline is seen to be more difficult in large classes. Furthermore, relationships with some groups of pupils, particularly the shy ones, suffer in large classes. Finding time for marking, planning and assessment on the part of the teacher is more of a problem in large classes. Teachers see this as a direct threat to the quality of their teaching.

Baines & Kutnick (2001) have reported a study that was conducted on the effect of class size on quality of teaching. The resulting findings indicated that pupils in large classes were found to have a more passive role in contact with the teacher. A system observation study showed that two allied behaviours were common in large classes: at times when the child is simply listening to the teacher and at times when they are not singled out by the teacher, they are one of the crowd. Conversely, in smaller classes there was individualisation of teaching and an active role of pupils. Additionally, pupils were more likely to interact in an active way with teachers. This was seen in the greater likelihood of initiating and responding to the teachers and sustained contact with them.

In Kenya, the recommended teacher:pupil ratio in ECDE centres and lower primary classes is as follows (Republic of Kenya, 2006):

1. Below 2 years, 1:4
2. 2-3 years, 1:10
3. 3-4 years, 1:15
4. 4-5 years, 1:25
5. 5-6 years, 1:30
6. 6-8 years, 1:40

An assistant teacher is required for each of the above groups. Therefore, in the case of children with special needs, the recommended teacher:pupil ratio is as follows (Republic of Kenya, 2006):

1. Autism, 1:1
2. Deaf/blind, 1:1
3. Cerebral palsy, 1:1
4. Severe/multiple disabilities, 1:1
5. Visually impaired, 1:15
6. Physically handicapped, 1:15
7. Mild mental disability, 1:10
8. Deaf, 1:12

Teachers' attitude is another condition that acts as a filter through which teachers make instructional decisions in class. This takes place despite their reliance on their own pedagogical knowledge on curriculum guidelines. Teachers' attitudes have become a key issue in education. Handal et al (2001) have argued that attitudes have a strong impact on teaching and learning. Teachers' attitudes reflect personal theories of knowledge and knowing. They have been conceptualised as a set of predispositions that teachers hold on various educational processes, such as curriculum, schooling, students, teaching, learning, and knowledge.

According to Lovat & Smith (1995), attitudes also act as mental models driving teachers' behavior and the processing of new information. These attitudes seem to act as mediators between curriculum goals and their actual implementation. If the teachers' attitudes are more compatible with educational reform, it is probably the case that new ideas will be accepted and adopted in the classroom. Teachers can therefore be either obstacles or conveyors of change. It is very important that prior to any educational innovation, teachers' attitudes are explored, identified and dealt with as one of the conditions for implementation of the science curriculum. According to Prawat (1990, p. 256), the knowledge, beliefs and attitudes that teachers have shape what they choose to do in their classrooms and explain the core of instructional practices that have endured over time.

Purpose of the Study

The purpose of the study was to assess the conditions for implementation of the science curriculum in ECDE centres in Kenya.

Methodology

The study was conducted in ECDE centres in Kakamega Municipality, Kenya. It was based on a descriptive survey design because this design enabled the researcher to describe the conditions the way they were found. The design was also chosen because it enabled the researcher to gather data from a relatively large number of ECDE centres. The entire targeted population consisted of 123 ECDE centres, out of which 61 were public and 62 were private. The centres were manned by 238 teachers (115 teachers were in public centres, while 123 teachers were in private ones). A saturated sampling technique was used to select all the 123 centres and 238 teachers for the study. A pilot study was conducted in which 8 ECDE centres managed by 8 teachers were involved. Therefore, 115 centres and 230 teachers were included in the actual study. Out of the 115 centres, 57 were public and 58 were private. As for teachers, 111 teachers were in public centres and 119 were in private ones. Therefore, the sample size for the study comprised 115 ECDE centres managed by 230 teachers.

The study utilised the following instruments for data collection: ECDE facilities checklist; ECDE classroom science materials/equipment checklist; ECDE classroom science activities checklist; and the ECDE teacher classroom science questionnaire, to analyse the availability of science materials, equipment, class size and activities for ECDE children in the classroom. A videotape was used to capture data on teachers' implementation strategies during science activities and an attitude scale was used to measure their attitude towards the science curriculum. Before engaging in the actual exercise of data collection, the instruments were first piloted to confirm their reliability and validity. A pilot study was conducted in four public and four private ECDE centres in Kakamega Municipality, in which 8 teachers (4 from public centres and 4 from private centres) were involved. The 8 centres and 8 teachers were not involved in the actual study.

The content validity of the instruments was determined by giving the instruments to three experts in the area who advised the researcher accordingly. The experts scrutinised the instruments and gave independent opinions, which were incorporated in the final instruments used.

Data obtained from the study were analyzed by using the following techniques: tallying, frequencies, summation, means and percentages. Furthermore, data obtained from the study were analysed by combining notes taken and tape recordings into a meaningful flow. This was done by grouping together all the data that were similar in content. These were then organised by cross-referencing and establishing thematic categories in the data. This provided a way of including into the presentation the unquantifiable facts about the actual information that were observed and responses to the questionnaire.

Results and Discussion

Physical Facilities

The implementation of any curriculum can only be effective if adequate and appropriate facilities, materials, equipment, and teaching and learning activities are put in place. According to the research findings, all the ECDE centres under study had classrooms. However, 60% of the public centres and 30% of the private centres had classrooms with inadequate space. Learners in these particular centres did not have adequate space for working and movement. Due to inadequate space, teachers did not organise for group work activities in science. In addition, they had difficulties moving around the classrooms to attend to learners with scientific needs. Learning corners in all the ECDE curriculum areas had not been organised because of lack of space. There was congestion of furniture in the classrooms. In some situations, there were some classes that were overcrowded with learners. This kind of situation affected implementation of the science curriculum negatively.

At the other end, 40% of the public centres and 60% of the private centres had classrooms with adequate space. Learners in these centres had enough space for working and movement. Teachers could organise for group activities and conduct them effectively. Learners with scientific needs were attended to promptly. Learning corners had been arranged appropriately.

Learning corners or centres of interest were only found in ECDE centres that had spacious classrooms. The corners had been organised in all the ECDE curriculum areas, including science. However, the science centres of interest that were observed did not contain adequate science materials and equipment. Furthermore, the centres of interest in science did not cater for all the areas in the ECDE science curriculum. Most of the science learning centres in 90% of the classrooms had biologically based materials, such as seeds, fruits and plants. Materials and equipment in physical sciences were lacking in almost all ECDE classrooms. This implies that there is a lack of adequate science materials and equipment for teaching and learning in ECDE centres of Kakamega Municipality. Furthermore, the teachers are biased towards biological sciences in the development, collection and selection of science materials and equipment. During interview sessions, a larger percentage of teachers cited lack of security as an element of concern. Science materials and equipment were frequently stolen in cases where classroom doors were not lockable. This made some of the teachers reluctant to develop science materials and equipment. Accordingly, it was thought that ensuring that security is put in place and lockable doors are installed in ECDE centres should be a major priority for all administrators.

The study also sought to establish availability, adequacy and appropriateness of furniture in Kakamega Municipality ECDE centres. The items observed under furniture included teachers' and learners' tables, chairs, shelves, cupboards and desks. They all serve an important role for the implementation of a science curriculum. During the research, it was observed that the best and most modern furniture was found in a few (15%) of the high-cost private ECDE centres. Items such as cupboards were only found in the high-cost centres. The management in such high-cost private ECDE centres understood the importance of ideal furniture in the teaching and learning of science, and had directed their funding to support such activities.

However, all the ECDE centres (100%) in the study had teachers' tables in classrooms. In addition, most of the centres had enough tables and chairs of the right size for learners. A few of the centres had desks instead of small-sized tables and chairs for the young learners. The realisation that furniture was important for effective learning was evident, but it was also apparent that funding did not allow for adequate purchases in some of the centres.

The availability of adequate furniture of the right size and shape facilitated the implementation of science activities. For example, furniture, in the form of cupboards was used to store some of the science materials and equipment. The cupboards guaranteed safety of the materials and equipment because they were lockable. Teachers without cupboards in their classrooms took the trouble to transport the science materials to head teachers' offices. This was meant to ensure that the materials and equipment were safe.

During the observations, it was noted that learners who worked while using tables, chairs or mats had an interest in science activities. The opposite happened to learners who worked while seated at desks or benches or on the floor. They felt uneasy and lost interest in activities after a very short time. They often switched to other negative behaviours, such as bullying one another and making a lot of noise. Teachers were able to vary teaching methods with learners who worked on science activities while seated comfortably than with those who were uncomfortable on the floor, for instance. This implies that the type of furniture availed in ECDE centres can have a far-reaching effect on implementation of the science curriculum.

Materials and Equipment

Teaching and learning materials and equipment are an important part of the implementation process of any curriculum. A survey of the ECDE centres under study revealed that the most dominant reference document was the guidelines provided by KIE (1997). The researcher perused the guidelines for content analysis. It was established that the document was quite general and merely guided teachers on what to teach in science. It did not detail what could be taught and how to implement ECDE science in a practical way. Thus, ECDE teachers in Kakamega Municipality were not conversant with the scope of the ECDE science curriculum. This is especially so since they do not have a syllabus for ECDE science.

Further investigation established that there were only three types of ECDE textbooks that were used by teachers. They were *Activity Book One*, *Activity Book Two*, and *Activity Book Three*. All of them were authored by the KIE. The science curriculum topics were found in one of the three textbooks, *Activity Book Two*. The topics were merely listed without many details. The same book also contained listed topics for the ECDE language curriculum. According to most of the teachers, the mentioned textbook was the main reference material provided by the KIE. All the teachers in public centres relied on it during implementation of science activities. A few teachers in private centres had other reference materials from elsewhere.

The implication here is that ECDE teachers in the area of study do not have access to adequate and relevant science books and materials for reference. They lacked diversified knowledge, skills and techniques for teaching ECDE science, despite their positive attitude. During the interviews, 99% of the teachers admitted that they had never visited any academic resource centre such as a library. This, together with the fact that they had not been exposed to scientific forums such as meetings, workshops, seminars and conferences, was regarded as problematic. As a result, science teaching and learning was done in a routine manner that became a tradition.

Observation of availability and adequacy of materials and equipment was carried out since they play a crucial role during implementation of the science curriculum. The only real science

materials that were seen in most classrooms were seeds, plants, stones, utensils and sticks. This kind of picture was mostly witnessed in public ECDE centres. A number of private ECDE centres had assorted collections of science materials and equipment. They comprised collections of shells, beam balances, feathers, cotton wool, wires, batteries, stones, tins and beads. During teaching and learning, most of the teachers made use of the materials and equipment. They allowed learners to manipulate the materials and equipment. This suggests that some of the ECDE teachers in Kakamega Municipality understand the role played by materials and equipment during the teaching and learning of science. They consider the fact that young children learn better by using the five senses through manipulation of materials and objects.

In terms of resources, all the classrooms under study had charts. Most of the charts had been prepared by using long-lasting (durable) materials. The charts were prepared in all the ECDE curriculum areas. When interviewed, the teachers maintained that the charts reinforced whatever was taught and learnt in science and other areas. However, a majority of the charts had drawings of animals and plants. This is another area that indicates that ECDE teachers in Kakamega Municipality have the most positive attitude towards biological sciences. On the other hand, they have the least positive attitude towards physical sciences.

Preparation for Teaching

Preparation and maintenance of essential and professional records is another important condition in the implementation of a science curriculum. For effective curriculum implementation, prior and adequate preparations are a must. It was important for the study to establish some information in this area. Based on research findings, all the teachers under study had prepared schemes of work for the entire term. They were based on the thematic and integrated approach of teaching and learning. The teaching of science was done by integrating science topics with those in other curriculum areas. Analysis of the documents revealed some kind of confusion in the way teachers stated the science objectives to be achieved. A similar problem was witnessed in writing of learning experiences, teaching methods and evaluation procedures. A small percentage of the teachers seemed to have understood what a thematic and integrated approach entailed. The teachers reported that they were confused and frustrated as far as the approach was concerned. This implies that teachers have not conceptualised and internalised the application of a thematic and integrated approach to teaching science and that ECDE science in Kakamega Municipality is not taught optimally despite the teachers' positive attitude.

Just like the schemes of work, all the teachers under study had prepared lesson plans. Each teacher had prepared lessons that covered a whole week or in some cases two weeks. The lesson plans were based on particular themes which were to be taught in all the curriculum areas by using a thematic and integrated approach. In the lesson plans, the teachers indicated the objectives to be achieved in each of the curriculum areas. Very few teachers had an idea on how to state achievable and timely objectives. The majority of them had problems stating achievable objectives that were learner centred, and this indicates that the training provided to ECDE teachers does not address their professional needs adequately.

Methods of Teaching

Regarding methods of teaching, most of the teachers indicated that they incorporated poems, rhymes drama, story-telling, nature walks and singing into lesson plans. They also used discussion and experimentation methods. The study also revealed that teachers had not been trained on how to prepare records of work in science. In this case, all the teachers (100%) did not have records of work in science. They all maintained that they had a slight idea on how to prepare records of work, not only in science but even in other areas of the ECDE curriculum. This implies that the training component in ECDE still has a number of issues to address – for example, training teachers on how to prepare and use professional records.

All the 230 teachers (100%) under study had prepared progress records on how pupils progressed in learning. The science column of the progress records was a checklist (tick) against stated target behaviours. The records did not have keys for interpretation of the ticks into

meaningful information. Accordingly, there was no correlation between the teachers' most positive attitude towards evaluation procedures and practical evaluation of learners' progress in science activities. This means that ECDE teachers in Kakamega Municipality fully understand what they are supposed to do in the science curriculum, and yet they do not put it into practice. It seems that the teachers undergo training programmes which do not offer practical grounding in each element of the science curriculum.

Administrative Support

There were few teachers in private centres who revealed the fact that they were denied opportunities by managers to implement the science curriculum. Management in these particular entities emphasised teaching of the three Rs (reading, arithmetic and writing). This was meant to be used as a strategy for attracting parents to enroll their children in private ECDE centres. Hence, ECDE centres were used as income-generating programmes. Therefore, teachers in these particular centres were supposed to prepare and keep professional records as a cover-up in case of any eventualities. This means that the ticks observed in progress records were not a sincere reflection of pupils' learning progress in science. It then reflected that the science curriculum is not fully implemented in all the ECDE centres in Kakamega Municipality.

Management of Learners' Discipline

An organised and disciplined class is regarded as a mandatory condition in the implementation of a curriculum such as a science curriculum. A teacher can only achieve objectives stated in a curriculum if there is effective management of learners in a learning environment. At an ECDE level, class management can only be possible when pupils work in groups with a variety of adequate materials. Based on this background, the researcher sought to establish modes of grouping pupils in ECDE centres of the area of study. Research findings revealed that teachers had grouped pupils according to developmental needs. Most of the teachers had also grouped learners according to abilities. The teachers said that this kind of grouping enabled learners to perform activities and move as per the group pace. During science activities, the teachers went round each group and provided learners with individualised assistance.

There were few other teachers who had grouped learners according to age bracket. Here, science activities, materials and equipment were provided to children with regard to their developmental milestones. However, the teachers still considered individual differences even when the learners worked in groups. This suggests that teachers in the area of study regard individual differences of children as a factor in the teaching and learning of science. They also understand the role played by group work in teaching and learning.

In a few classes, teachers managed classes as entire groups. This kind of situation was observed in classes with over 50 learners. Class control in these classes was seen to be a challenge to teachers during science activities. The teachers were compelled to resort to lecture methods, reciting of poems, story telling, singing and dancing as strategies for class control and management. This implies that class management is an important factor to be considered in implementation of the science curriculum. Class management can also result in formation of an attitude towards ECDE science curriculum by a teacher.

Attitude formation is another condition that affects the implementation of science and other subjects. The research findings established that teachers' attitude towards the four elements of the science curriculum was positive. In addition, their overall attitude towards the science curriculum was also positive. It is also clear that the teachers were more positive towards evaluation procedures and objectives than towards other aspects. They were averagely positive towards teaching methods and least positive towards learning experiences. The teachers' positive attitude towards the science curriculum had a number of reasons in support of it. Most of the reasons mentioned by teachers for liking teaching of ECDE science reflected the objectives of the teaching and learning of ECDE science. The reasons indicate behaviour change that was supposed to occur in learners as a result of being exposed to science experiences. This result suggests that ECDE teachers in Kakamega Municipality understand the role of science for young children. However,

this does not mean that teachers were effective in implementation of the science curriculum. Lack of adequate and appropriate conditions influenced implementation of the science curriculum negatively.

Conclusions and Implications

The study was designed to assess conditions for implementation of a science curriculum in ECDE centres in a particular region of Kenya. Availability of adequate and appropriate conditions is mandatory for implementation of a curriculum.

Data regarding implementation of the ECDE science curriculum was obtained by using observation checklists. There is a need for facilities such as adequate classrooms, centres of interest (learning corners) and adequate furniture for effective implementation of the science curriculum. According to the research findings, all the ECDE centres under study had classrooms. However, 60% of the public centres and 30% of the private centres had classrooms with inadequate space. Learning corners in all the ECDE curriculum areas had not been organised due to lack of space. This kind of situation affected the implementation of the science curriculum negatively. It also negated the positive attitude held by ECDE teachers towards the science curriculum.

Learning corners or centres of interest were only found in ECDE centres that had spacious classrooms. The corners had been organised in all the ECDE curriculum areas, including science. However, the science centres of interest that were observed did not have adequate science materials and equipment. Further more, the centres of interest in science did not cater for all the areas of the ECDE science curriculum. Most of the learning centres in 90% of the classrooms had biologically based materials, such as seeds, fruits and plants. Materials and equipment in physical sciences lacked in almost all the ECDE classrooms in the area of study. This implies that there is a lack of adequate science materials and equipment for teaching and learning in ECDE centres of Kakamega Municipality. Also, teachers lack knowledge, skills and techniques for acquiring science materials and equipment. Furthermore, the teachers are biased towards biological sciences in the development, collection and selection of ECDE science materials and equipment.

The study also sought to establish the availability, adequacy and appropriateness of furniture in Kakamega Municipality ECDE centres. It was realised that the best and most modern ECDE furniture was found in a few (15%) of the high-cost ECDE centres. This means that management in high-cost private ECDE centres has understood the importance of ideal furniture in teaching and learning of ECDE curriculum areas including science. All the ECDE centres (100%) under study had teachers' tables in classrooms. In addition, most of the centres had adequate tables and chairs of the right size for learners. A few of the centres had desks instead of tables and chairs for the young learners. This implies that availability, adequacy and appropriateness of furniture as a condition for implementation of the ECDE science curriculum has not been fulfilled fully. It means that administrators in ECDE centres lack appropriate knowledge and awareness of the effect of furniture on the physical development and learning of young children. They also lack knowledge on the importance of ideal furniture during young children's science activities.

Teaching and learning materials and equipment are part and parcel of the implementation process of the science curriculum. A survey of the ECDE centres under study revealed that the most dominant reference document was the guidelines produced by the KIE (1997). It was established that the document was quite general and merely guided teachers on what to teach in science. The implication here is that ECDE teachers in the area of study have no access to adequate and relevant ECDE science books and materials for reference. This means that ECDE teachers in Kakamega Municipality do not have diversified knowledge, skills and techniques for teaching ECDE science, despite their positive attitude. It implies that availability of teaching and learning materials and equipment as a condition of implementing the science curriculum has not been addressed in Kakamega Municipality ECDE centres. This situation has been made worse by lack of science resources and refresher courses.

Preparation and maintenance of essential and professional records is one important condition in implementation of the science curriculum. Based on research findings, all the teachers under study had prepared schemes of work for the entire term. They were based on the thematic and integrated approach to teaching and learning. The teachers had also prepared lesson plans. Analysis

of the documents revealed some kind of confusion in the way teachers stated the science objectives to be achieved. A similar problem was witnessed in learning experiences, teaching methods, evaluation procedures, preparation of progress reports and records of science work.

A small percentage of the teachers seemed to have understood what the thematic and integrated approach was all about. The majority of the teachers complained that they were confused and frustrated as far as the approach was concerned. Therefore, preparation and maintenance of essential and professional records as a condition for implementation of the ECDE science curriculum in Kakamega Municipality is not satisfactory. This means that ECDE science in Kakamega Municipality is not effectively implemented due to limitations in the preparation and maintenance of professional documents.

The study also sought information on class management as one of the conditions for implementation of the ECDE science curriculum. At an ECDE level, class management becomes effective when pupils work in groups with a variety of adequate materials and equipment. The researcher attempted to establish modes of grouping pupils in ECDE centres of the area of study. Research findings revealed that teachers had grouped pupils according to developmental needs, abilities and age brackets. This implies that teachers in the area of study have understood the role played by group work in class management – an important condition in implementation of the ECDE science curriculum.

In a few classes, teachers managed classes as entire groups. This kind of situation was observed in classes with over 50 learners. Class control in these classes was seen to be a challenge to teachers during science activities. It implies that class management as a condition for implementation of the ECDE science curriculum in the affected centres is unsatisfactory. This kind of situation can result in teachers developing a negative attitude towards the science curriculum.

Attitude formation is one of the conditions that affect implementation of the science curriculum. Research findings indicated that teachers' attitude towards the four elements of the science curriculum was positive. Also, their overall attitude towards the science curriculum was positive. The teachers' positive attitude towards the science curriculum had a number of reasons in support of it. Most of the reasons mentioned by teachers for liking teaching ECDE science reflected the objectives of the teaching and learning of ECDE science. The fact that teachers had a positive attitude towards the science curriculum does not imply that they were effective in its implementation. Lack of adequate and appropriate conditions negatively influenced implementation of the science curriculum.

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