Practising Inquiry-Based Instruction (IBI) in Tanzanian Early Years Education: An Assessment of Teachers' Views and Curriculum Contexts

Subilaga Mwakyusa Kejo[1] (Ph.D.), Maregesi Manyonyi Machumu[2] (Ph.D.) & Mjege Kinyota[3] (Ph.D.)
[1,2&3]Dar es Salaam University College of Education, University of Dar es Salaam, Dar es Salaam, Tanzania

Corresponding author[1]: subilaga.kejo@duce.ac.tz

Abstract

This study explored teachers' conceptions and practices of practising inquiry-based instruction (IBI) in early years education and how the curriculum supports IBI integration. Employing a qualitative approach, this study generated data from 37 purposively selected early years teachers from ten schools in Dar es Salaam using interviews and document analysis. It was found that teachers have a narrow conception of IBI. Moreover, teachers rarely integrate IBI in their classrooms due to large classes, unsupportive curriculum contexts, and limited understanding of IBI. Furthermore, the findings revealed that though the curricula objectives and content permit integration of IBI, overemphasis on academic skills such as literacy and numeracy skills limits the integration of IBI.

Keywords: *early years, inquiry-based learning, in-service teachers, Tanzania*

DOI: *https://dx.doi.org/10.56279/ped.v42i1.3*

Introduction

The need to expose young children to scientific inquiry is well justified in the literature (Schiefer, Golle, Tibus, & Oschatz, 2019). Inquiry-Based Instruction (IBI) is widely acknowledged as one of the best approaches for promoting scientific inquiry (Areepattamannil, 2012; Cairns & Areepattamannil, 2019; Fitzgerald, Danaia, & McKinnon, 2019). In other world countries such as the USA and South Africa (Dudu & Vhurumuku, 2012b), IBI is recognised as a formal approach to science teaching. The fascination with IBI is partly explained by the very nature of science as a question-driven endeavour (Edelson, Gordin, & Pea, 1999). In other words, inquiring is an essential element of all scientific activities. Research shows that IBI is generally associated with enhanced science self-efficacy (Cairns & Areepattamannil, 2019; Fitzgerald et al., 2019), self-regulation skills (Moote, 2019), development of higher-

order thinking skills (Moote, 2019), and interest and achievement in science (Cairns, 2019). Furthermore, exposing pupils to IBI can enable them to have informed views of the nature of science (Das, Faikhamta, & Punsuvon, 2019).

In early years classes, including pre-primary and Standard One and Two, IBI is normally associated with children's development of a foundation for scientific reasoning (Fang, 2020). It has been established that exposing young children to scientific inquiry maximises their chances of succeeding in science in their later years (Hansson, Lotta, & Thulin, 2020). Despite the justification for exposing young children to IBI, some researchers have raised concerns regarding children's cognitive ability to engage in sophisticated scientific endeavours (Byrne, Rietdijk, & Cheek, 2016; Marian & Jackson, 2016). Marian and Jackson (2016), for instance, argue that there is a risk of exposing young children to misconceptions once they are exposed to science-domain-specific knowledge during their early years. Nonetheless, many experts agree that young children can engage in IBI (Tunnicliffe, 2016; Byrne et al., 2016). Tunnicliffe (2016), for example, states that at the kindergarten level, children are capable of carrying out their own investigation if teachers can carefully guide them.

Similarly, Byrne et al. (2016) argue that children should be encouraged to develop skills in questioning, observation, recording, and communicating results. However, unlike older children, Byrne et al. (2016) warn that young children need more teacher guidance and enough time for them to successfully engage in inquiry-based science. In this case, scaffolding (Vygotsky, 1962) would be necessary for young children. In a study that investigated how an infant schoolteacher helped children to engage in inquiry science, Marian and Jackson (2016) found that children were capable of gaining domain-general knowledge skills, such as measuring, questioning, developing conclusions, observation and making inferences. The teacher achieved this through engaging a young child in play. In addition, according to Wang et al. (2010), educational technology platforms, such as games and software packages that are widely used in Early Childhood Education (ECE), can be used to foster inquiry during the early years as they support problem structuring, enhance the metacognitive process, and facilitate the utilisation of resources.

Moreover, IBI has been used in young children's learning at home under parental guidance. Nonetheless, IBI is rarely practised in early years classrooms partly due to concerns that many teachers lack pedagogical content knowledge and other necessary skills needed to practise it (Byrne et al., 2016; Marian & Jackson, 2016; Siry & Kremer, 2011). For instance, many teachers are unable to link children's inquisitive and curious tendencies with early years curriculum content such as communication and language (Siry & Kremer, 2011). Moreover, many teachers hold beliefs that children are incapable of engaging in IBI due to their limited cognitive abilities (Byrne et al.,

2016; Samarapungavan et al., 2018).

In Tanzania, early years education comprises pre-primary classes as well as Standards One and Two classes, which lay a foundation for later learning (MoEST, 2019). Indeed, the early years of education are recognised as an important stage in development and learning. Although IBI is not officially stated in documents as an approach to teaching in early years classes in Tanzania, there is evidence that teachers and children engage in some activities, such as exploration and discovery, which are characteristic features of IBI (Mkimbili, 2019; Mkimbili et al., 2017). The pre-primary education curriculum also emphasises active learning and the use of child-centred approaches and ICT in the teaching-learning process (MoEST, 2016b). Likewise, the curricula for Standard One and Two emphasise learner-centred approaches.

While IBI is implicitly emphasised in early years education in Tanzania, very few studies have been conducted on IBI integration at this level. However, studies on IBI in secondary schools (e.g. Mkimbili et al., 2017) show that teachers find it difficult to practise IBI due to challenges associated with the availability of resources, medium of instruction, and teachers' preparedness to use IBI. Other studies show that teachers in Tanzania use teacher-centred pedagogy even though the curriculum emphasises learner-centred approaches (Kafyulilo & Tilya, 2019; Vavrus & Bartlett, 2012). This indicates a mismatch among curriculum objectives, suggested teaching and assessment activities, and the teaching and learning environments, to mention a few. In curriculum theory, such a mismatch is commonly referred to as a lack of curriculum coherence or 'alignment and continuity in learning goals, content, assessment and instruction' (Sullanmaa, Pyhältö, Pietarinen, & Soini, 2019, pp. 244-245).

Essentially, good coherence among the curriculum's elements has been associated with the successful implementation of educational reforms (Mhlolo & Venkat, 2009; Sullanmaa et al., 2019). Meanwhile, the lack of coherence among curriculum documents has been associated with difficulty in practising learner-centred teaching (Mhlolo & Venkat, 2009). According to Edelson et al. (1999), coherence problems in the curriculum are an obstacle to IBI integration. This clearly signifies the need to investigate how teachers' integration of IBI in early years education is influenced by coherence among the elements of the curriculum. Therefore, the present study explored the extent to which early years curriculum contexts support the integration of IBI. Specifically, the study addressed the following questions:

i. How do early years education teachers conceptualise IBI?
ii. To what extent do teachers integrate IBI during the teaching and learning process?
iii. To what extent do early years curricula support the integration of IBI?

Early years education in Tanzania

The first years of life are considered critical for laying a foundation for children's later learning and development (Melhuish et al., 2015). While young children start learning even before joining formal schooling, early years education in formal settings is critical for their learning. In the present study, early years education is conceptualised as the education of children at pre-primary, Standard One and Standard Two levels. The 1995 Education and Training Policy (ETP) formalised Pre-Primary Education (PPE) as part of formal education in Tanzania, stipulating that each primary school shall have a pre-primary class (United Republic of Tanzania [URT], 1995). The 2014 ETP made PPE compulsory and free for every Tanzanian child and reduced its duration from two years to one year (URT, 2014).

One of the objectives of PPE is to prepare children for primary school. To ensure that pre-primary school children learn and develop the competencies. The reviewed curricula emphasised competence development as opposed to the content-based curricula that emphasised knowledge acquisition through memorisation. This implies that the reviewed curricula emphasised competence development through activity-oriented learning, with the child being the key player in the teaching and learning processes (MoEST, 2016a, 2016b). This suggests that the reviewed curricula acknowledge the integration of IBI in early years education.

Effective implementation of the early education curricula requires well-trained and competent teachers (Marian & Jackson, 2016; Siry & Kremer, 2011). Studies on early years education in Tanzania reveal that the majority of early years education teachers lack specialised training in teaching young children (Mligo, 2015; Mghasse & Francis, 2016). Although the Basic Statistics in Education (BEST) show that 9,592 (77.8%) out of the total 12,333 pre-primary schoolteachers were qualified teachers in 2019 (URT, 2019), most of them lacked specialised training in early years education. In fact, research shows that most of them were trained as primary school teachers, which meant to teach older children (Mabagala & Shukia, 2019). Since primary school teachers are largely trained using teacher-centred pedagogy, the extent to which they integrate IBI in early-year education remains questionable.

Theoretical framework: IBI

In science education, IBI is termed differently. For example, researchers term it as 'inquiry-based science instruction' (Areepattamannil, 2012, p. 134), 'inquiry-based learning' (Moote, 2019, p. 265), 'inquiry-based science teaching' (Fitzgerald et al., 2019, p. 543), 'inquiry-teaching' (Jiang & McComas, 2015, p. 554), 'science through inquiry' (Dudu & Vhurumuku, 2012b, p. 581), and 'classroom inquiry' (Dudu & Vhurumuku, 2012a, p. 150). Despite these variations, there is an agreement among

researchers that IBI involves teaching and learning science in a way similar to how it is done by professional scientists (Cairns, 2019; Cairns & Areepattamannil, 2019; Dudu & Vhurumuku, 2012a; Jiang & McComas, 2015; Vhurumuku, 2011). Thus, school science should reflect the tenets of 'scientific inquiry' (Capps, Crawford, & Constas 2012, p. 292).

However, this view of IBI is widely criticised for its perceived failure to provide sufficient guidance to teachers and students. As a result, researchers in science education have recently defined IBI in terms of implementable classroom practices. Previously, researchers like Fitzgerald et al. (2019, p. 544) defined IBI based on the levels of inquiry involved. While open inquiry was considered the highest level of IBI, closed inquiry was viewed as the lowest level of inquiry, often characterising many science classes in which students engage in manual-guided, highly structured laboratory experiments (Fitzgerald et al., 2019). To avoid confusing IBI with other student-centred approaches, other researchers have defined IBI based on what takes place in the classroom. Thus, IBI is generally defined as involving:

> … situations where students are required to observe and question phenomena, suggest explanations for the observations they have made, design and carry out experiments that provide evidence that support or contradict hypotheses, and analyse data and draw conclusions from data (Cairns & Areepattamannil, 2019, p. 3).

In summary, IBI researchers envision science classrooms where students engage in hands-on activities, generating questions, designing investigations, carrying out investigations, providing alternative explanations and communicating the results.

In this work, the researchers adopted the five facets of IBI from the Principles of Scientific Inquiry-Student (PSI-S) and the Principles of Scientific Inquiry-Teacher (PSI-T) (Campbell, Abd-Hamid, & Chapman, 2010, p. 15). These two principles are among the most reliable and frequently used instruments that were designed to measure the extent to which students and teachers engage in IBI (Byrne et al., 2016). Although the instruments were developed for secondary science education, they emphasise specific activities that constitute classroom inquiry relevant to early years education. Five facets, including framing questions, designing investigations, conducting investigations, collecting data and drawing conclusions, have been adapted to suit the context of early years education (Byrne et al., 2016; Marian & Jackson, 2016; Siry & Kremer, 2011).

Table 1

The Five Facets of IBI

Aspect of scientific inquiry	Description
Framing research questions (FQ)	focuses on the extent to which students are responsible for framing their own research questions during investigations
Designing investigations (DI)	focuses on the extent to which students are responsible for designing their own procedures for conducting investigations
Conducting investigations (CI)	focuses on the extent to which students are responsible for conducting or carrying out the procedures
Collecting data (CD)	focuses on the extent to which students are responsible for making decisions about data collection during investigations
Drawing conclusion (DC)	focuses on the extent to which students are responsible for drawing conclusions during investigations

Source: Text modified from Campbell et al. (2010, p. 17)

According to Campbell, Abd-Hamid and Chapman (2010), IBI is conceptualised using five facets (See Table 1), all of which were used to assess the extent to which early years curriculum supports IBI. Specifically, the five aspects were used to guide the preparation of the interview guide, and they provided a framework for analysing curriculum documents and interview data.

Methodology

This study employed a qualitative research approach with a phenomenological design. This approach permitted researchers to gain an in-depth understanding of teachers' conception of IBI and their views on how the curriculum and teaching contexts support IBI. Epistemologically, the study was based on the assumption that knowledge is culturally and socially co-constructed by active participants. This is why semi-structured interviews and document analysis were chosen as methods of data collection.

Participants

The sample for this study comprised 37 teachers who were purposefully selected from 10 schools in Dar es Salaam, Tanzania. They were selected based on the criterion of being teachers in early years classes. In terms of demographics, the

average age, total working experiences, and working experiences in the current classes were 43.5, 19.5 and 6.1, respectively, implying that many teachers are assigned to teach lower classes when they get older. In terms of class level, the sample comprised 13, 14 and 10 pre-primary, standard one and standard two teachers.

Data collection

The researchers employed face-to-face interviews with the teachers in order to explore their views on the subject. The interview guide consisted of thirteen (13) questions distributed across three themes: teachers' conceptions of IBI, the five facets of IBI, and curriculum contexts. Sample questions included: What strategies do you use to nurture children's curiosity? How do you help children to frame questions that can be answered through investigation? In which ways does the current curriculum support the integration of IBI? The interview sessions ranged between 43 and 68 minutes and were conducted using Swahili, which is the language of instruction at this level of education.

This study also employed document analysis in order to respond promptly to the research questions (Bowen, 2009). Curriculum documents and syllabi for pre-primary and early primary education (Standard One and Two) were analysed. These documents were retrieved from the Tanzania Institute of Education (TIE) website (http://www.tie.go.tz/). The aims of education in Tanzania, class-level objectives, learning areas and competencies for each level are stated in these documents. In addition, the teaching /learning and assessment strategies and the resources to be used in guiding the development of competencies are recommended in the documents.

Data analysis

Analysis of documents

Guided by the five tenets of IBI, content analysis, as suggested by Bowen (2009), was employed. Relevant phrases such as 'inquir (y/ing)', 'investigat (e/ion)' 'experiment', 'question', 'practical', 'creativ (e/ity)' were used in searching the statements related to IBI. Some of the phrases, such as inquiry, question and investigation, were synonymous, making the search more comprehensive. Furthermore, the researchers used other synonymous phrases such as examination, testing, design, testing, and research so that relevant themes are captured. In order to account for the number of occurrences of the phrases, word frequency count was performed using MAXDQA 20. Correspondingly, a lexical search was carried out to reveal all the segments containing the searched phrase. The researchers also remained open throughout the analysis so

that themes that were outside the pre-determined codes could be captured.

Analysis of interview data

The interview data were transcribed and sent to two language experts for translation into English. The next stage of analysis involved reading and re-reading the transcripts to familiarise ourselves with them. Later, the tenets of IBI were used to establish the initial codes. Phrases such as 'inquir (y/ing)', 'investigat (e/ion)', 'experiment', 'question', 'practical', 'creativ (e/ity)' 'inquisitive' were used to look for the segments related to IBI. As in document analysis, the researchers remained open throughout so that the codes that were not expressed using the pre-determined codes could be captured. For instance, line-by-line coding was performed for selected segments from each participant so as to broaden the scope of the analysis. Meanwhile, constant comparison and contrast (Strauss & Corbin, 1990) were made so that similarities and variations across age, school and working experience could be captured. This technique helped the researchers to place the codes into respective categories and themes.

Trustworthiness of the Study

To maximise the trustworthiness of the study, selected segments from one curriculum document and each participant's transcripts were assigned to each of the three researchers for them to code separately. Initial coding was guided by the research questions and the five facets of IBI. The purpose was to create an agreed codebook that was used for coding the remaining documents and interview segments. We were able to determine the reliability by computing the number of codes that all the researchers agreed on divided by the total number of codes. Initially, the agreements were 57.6 and 53.3 per cent for documents and interview transcripts, respectively. Later, each researcher was requested to clarify the disagreed codes, followed by continuous discussions among the researchers. Only codes that resonated with all researchers in terms of how they relate to the research questions were refined and thus retained. In this case, the reliability improved to 67.1 and 65.3 for documents and interviews, respectively. Furthermore, nineteen (19) out of the thirty-seven (37) respondents were able to read the findings sections as a means of cross-checking. Although their understanding of the findings seemed limited, their comments, especially on the direct quotes, helped the researchers to refine the findings.

Results and Discussion

Early years teachers' conceptualisation of IBI

The first objective of this study sought to explore early years education teachers' conceptualisation of IBI. When asked to explain what they considered to be IBI, the participants had different responses, as summarised in Table 2.

Table 2

Teachers' Conceptions of IBI

S/n	Response	Frequency	%
1	I have no idea	3	8.1
2	IBI involves the application of question-and-answer teaching method	8	21.6
3	IBI involves children working on their own to find a solution to a problem	2	5.4
4	IBI involves giving children the freedom to express themselves during the teaching and learning process	3	8.1
5	IBI is a teaching approach that builds children's curiosity	10	27
6	IBI is a teaching method that engages the child in learning through different activities	11	29.7
Total		37	100

As shown in Table 2, almost all teachers had a limited view of IBI. Nearly one-third of the teachers considered IBI as a teaching approach that actively engages children in the teaching-learning process and thus builds skills that enable them to make exploration. The quotations below reflect teachers' conception of IBI:

> …is the teaching approach that builds curiosity in the learners. With this approach, I can use questions and give children some activities to make exploration. When you ask questions, you induce them to explore and, thus, find the solution to the problem (Teacher E, interview).

As the excerpt above suggests, many teachers (24/37) associate IBI with specific teaching methods, such as the question-and-answer method, individual or group assignment and discussion method, which give children an opportunity to discuss the problem freely and arrive at a solution freely.

Nonetheless, there were variations among teachers, whereby few teachers were able to articulate enough when it comes to conceptualising IBI. An example is Teacher_K, a Standard Two teacher who asserted:

> IBI is the teaching approach that engages the child in the teaching and learning process by performing different activities. The child can perform

> such activities physically and make some observations and experimentation. In this way, the child develops curiosity (Teacher K, interview).

Teacher K's definition implies that she understands IBI as a methodology that encompasses engaging students in activities such as observation and experimentation. In addition, she believes that IBI leads to the development of curiosity among students. Yet, some teachers did not have any idea of what IBI is (See Table 2).

Teachers' naïve conceptions of IBI can be explained differently. Firstly, despite the average total teaching experience of 19.5 years, teachers' average teaching experience in early years classes was only 6.1 years, implying that most teachers are moved to early years classes after teaching in higher classes. In the same sense, the average age of the teachers was found to be above 43 years. While teachers of that age are assumed to be well experienced in handling children and taking care of them, in the context of Tanzania, this age group comprises teachers with limited specialised training in teaching young children and who have not received in-service training for so long (Anangisye, 2011). Secondly, most of them were educated when a learner-centred pedagogy was not strongly advocated. Their obsession with teacher-centred approaches might have shaped their conception and practice of IBI.

Finally, according to the demographics, most of them have a low level of education, that is, a two-year certificate course in teaching that they took after finishing lower secondary education. In other words, these teachers were trained as primary or elementary school teachers at the certificate level. Thus, technically, they are not qualified to teach in the early years, though they are preferred over the younger generation of teachers who have recently received specialised training in ECE. It was also learnt that all teachers in the sample were female, implying that the population of teachers in early years in the country is mainly female, likely because of the belief that they have a caring nature essential for young children. This is not surprising given that globally, females are considered to be possessing such traits as compassion, empathy and sympathy (Weisgram et al., 2011).

Teachers' integration of IBI in the teaching and learning process

This study also intended to find out the extent to which teachers in early years classrooms integrate IBI during the teaching and learning process. To address this objective, the results are organised in terms of the main tenets of IBI while remaining open to other emerging themes, as highlighted in the sub-sections that follow.

Framing research questions (FQ)

This tenet focuses on the extent to which students are responsible for framing their own research questions during investigations. Although in the early years, science

was not taught as a separate subject, the researchers focused on understanding teachers' intentions to nurture inquiry by encouraging children to frame questions that can be answered through investigation. From the findings, many teachers (28/37) generally acknowledged that young children are curious in nature. Nonetheless, there was a feeling among the majority of teachers that most of the pupils' questions tend to be irrelevant and out of what the children are supposed to learn. More often, irrelevant questions would come from the youngest children, as Teacher_C says:

> I notice the mistakes, and when they ask me back, I clarify, but because I teach the youngest of them, mostly, they do not ask questions. If I allow them to ask, they will only ask irrelevant questions. One may tell you that s/he feels hungry (Teacher C).

On the other hand, a few teachers (6/37) believed that children ask good questions. Thus, they (children) should be encouraged to ask such questions as pointed out by a Standard Two teacher:

> A few students may ask authentic questions that are relevant to the lesson. However, we do not encourage them to ask irrelevant questions about imaginary things, even though they sometimes do (Teacher BB).

The quotes above suggest that teachers regarded any question not related to the ongoing session as irrelevant and, hence, destructive. Furthermore, it was noted that teachers perceived some of the questions asked by students as morally unacceptable, as highlighted in the following quotations:

> Sometimes, a child may ask about private parts of the body. I find it very difficult to respond. You know it is against our moral values (Teacher_GG, interview).

> They [children] may ask, my mom has a big stomach, I don't know why! And the child insists that I provide a reason. But you can't answer that question in public…they are too young (Teacher_J, interview).

Overall, while most teachers (25/37) believed that children could frame questions that can be answered through investigation, these questions are normally perceived by the teachers as irrelevant and/or not fit for investigation. This suggests that some cultural beliefs held by teachers can limit what they think about children overall. Therefore, policy intervention must be informed by the social and classroom culture embedded in teachers' contexts.

Designing investigations (DI)

Theoretically, designing investigations means the extent to which children are responsible for developing their own procedures for conducting investigations. The findings indicated that children are not given the opportunity to design procedures

for investigation. Specifically, it was found that most of the teachers (23/37) do not guide children to design investigation, as one teacher illustrated:

> I do not allow children to design investigations because they are too young, and it was not part of the lesson. You know, at that age, they cannot reason well like us. (Teacher II, interview).

As Teacher II demonstrated, a significant number of teachers (17/37) believed that designing investigations is beyond children's ability. When asked about how the curriculum supports the integration of IBI, most of the teachers (31/37) reported that the emphasis of the curriculum is on the 3Rs (reading, writing and arithmetic). For instance, one Standard One teacher illustrated:

> …but another problem with our curriculum is that other competencies that would require some investigations are not given much emphasis compared to that given to the 3Rs. The curriculum focuses more on the 3Rs (Teacher V, interview).

Furthermore, some of the teachers (11/37) believed that designing investigations is only for science. As Teacher L said:

> Perhaps the teacher would like to teach that child other things like science, arts, and sports, but the curriculum does not contain those enabling skills…. I suggest science could be given emphasis by the lower classes (Teacher L, interview).

Some teachers (9/37) viewed early years curricula as lacking continuity when it comes to encouraging students' curiosity as related to conducting investigations as one Standard Two teacher expressed:

> The problem is that in a pre-primary class, a child might be taught about inquiry, but as s/he goes to higher classes, the emphasis shifts to the 3Rs. Standard 1 does not emphasise inquiries. However, if this child could proceed with learning through an inquiry approach in Standard 1 as in pre-primary class, teachers could be able to tell whether this child fits better in Science, Mathematics or Arts (Teacher O).

It is apparent from the excerpts above that teachers perceive early years curriculum as putting more emphasis on numeracy and literacy than inquiry skills.

Conducting investigation (CI)

Conducting an investigation focuses on the extent to which children are responsible for carrying out their own investigations. The findings revealed a general trend in which many teachers (30/37) do not provide opportunities for children to conduct even simple investigations. The interview data indicated that teachers do not trust children when it comes to conducting investigations. For instance, a teacher

was found to be hesitant to allow children to investigate light as a condition for photosynthesis, considering them too young for the task, as described here below:

> I did not do it this way because they were too young, and it was not part of the subject. I only told them that they would know this idea better when they joined a secondary school (Teacher FF, interview).

Furthermore, some teachers reported the learning environment to be a barrier to engaging in activities related to conducting investigations.

> The learning process is affected. The number of classrooms does not match the number of learners.… so, when Standard One children leave school at 11:00 AM, Standard Two children occupy the classrooms. There is limited time and space to conduct investigations (Teacher R, interview).

Generally, the teacher's decision not to engage children in conducting investigations was influenced by a combination of factors such as learners' age, learning environment, and teacher's perceptions of investigation as 'not part of the subject'.

Collecting data (CD)

This tenet focuses on the extent to which children are responsible for collecting data and making decisions about data collection. Most teachers (21/37) reported that they do not engage students in data collection for questions that demand investigation. Instead, some engage children in bringing teaching and learning materials (such as items for counting) to the classroom.

> …they [children] do not collect data honestly…we cannot engage them in collecting the data because of their age. After all, we [teachers] don't have much time …we have to teach the 3Rs (Teacher W, interview).

> …collecting data…no no… maybe sometimes we ask them [children] to bring in the learning materials such as counting items (Teacher T, interview).

The above excerpts indicate that teachers do not engage children in activities related to collecting data.

Drawing conclusions (DC)

Drawing conclusions focuses on the extent to which children are responsible for drawing conclusions during investigations. Findings indicated that teachers do not guide children in drawing conclusions. They engage them in limited activities only. Teachers felt that children are too young to engage in IBI activities, as one pre-primary teacher asserted:

> My learners are too young; they cannot provide conclusions. So, I am the one to make the final conclusions (Teacher N, interview).

There was also a tendency for the majority of teachers to assume the monopoly of 'correct' conclusions. In other words, teachers would make sure that the right answers are communicated to the children and that wrong answers are not left unchallenged by the teachers:

> After making the research conclusion, I will take all the data, and then we will start going through them together in the classroom. Where necessary, I will correct that… we were supposed to do so, and so we will cooperate by asking clarification questions… why is your picture this way? It had to be that way, why did you do this, you had to do that … (Teacher BB, interview).

Although the conclusions being referred to by many teachers did not match the definition of a conclusion being referred to in the theoretical framework, the teachers believed that students could make conclusions with the help of their teachers. These findings suggest that teachers rarely practise IBI mainly due to their naïve conceptions of IBI as well as the mistrust in children's ability to engage in IBI. There is a need to change teachers' views and understanding of IBI. As Ssempla & Masangila (2019) found, teachers who had no clear knowledge of IBI did not effectively integrate IBI and were reluctant to change their teaching practice. Large class sizes also make it difficult for teachers to integrate IBI. In this study, for example, the average class size was 72 pupils.

Meanwhile, IBI demands that pupils are given an opportunity to pose and argue about researchable questions (Cairns, 2019; Cairns & Areepattamannil, 2019; Moote, 2019). As such, large class size may be a barrier to integrating IBI. Although research on the effectiveness of class size is inconsistent (Pedder, 2006), there is enough evidence suggesting that smaller classes have positive effects on teaching and learning (Ayeni & Olowo, 2016). For example, smaller class sizes are associated with enhanced academic achievement and enjoyment (Shen & Konstantopoulos, 2019), as well as enhanced student attention and activeness (Blatchford et al., 2007). Thus, class size is a matter that requires immediate intervention for successful IBI integration.

IBI in early years curricula in Tanzania

This study, among other things, investigated the extent to which the early education curriculum contexts support IBI integration. Curriculum documents for PPE, Standard One and Standard Two were analysed to determine the extent to which they support IBI. Specifically, the main documents analysed were:

i. Curriculum and Syllabus for Pre-primary Education (MoEST, 2016a)
ii. Curriculum for Basic Education Standard One and Two (MoEST, 2016b)
iii. Basic Education Syllabus for Standard One (MoEST, 2016c)
iv. Basic Education Syllabus for Standard Two (MoEST, 2016d)

The main areas of focus during the analysis included aims and objectives, as well as the curriculum. Generally, the findings produced mixed results, with only some of the aspects supporting IBI integration.

Curriculum objectives

Objectives constitute an important aspect of the curriculum. The pre -primary curriculum highlights nine educational objectives, the general aim of which is consistent with IBI. According to the curriculum, the main objective of PPE is to 'promote the overall development of the child, that is, their mental, physical, social and emotional characteristics and capabilities' (MoEST, 2016c p.4). This is in line with the IBI framework as it intends to promote thinking skills, which are mental capabilities. The development of thinking skills is further emphasised in another objective, which is to 'develop creative and logical thinking skills' (MoEST, 2016c p.4). Two other objectives were identified as supportive of IBI. These are: 'to promote the child's early learning skills and lifelong appreciation of learning' and 'to develop in a child self-consciousness, self-confidence, self-esteem and respect for others' (MoEST, 2016c p.4). In their broad sense, the objectives respectively focus on developing 'learning skills' and 'self-confidence', all of which are related to IBI. These may promote or provide room for the integration of IBI in enhancing young children's thinking and related skills.

With regard to the Standard One and Two curricula, findings indicate some aspects that relate to or are likely to be promoted through IBI. The findings suggest that IBI is featured in three of the curriculum's objectives, specifically those whose intent is to help the child in practising simple communication, maintain health and hygiene, and care for the environment (MoEST, 2016d p.2). It is these three objectives that demonstrate an emphasis on IBI and the framework activities that may be used to realise them.

The objectives that were identified in the two curriculum documents are presented below:

Table 3

Curriculum Components That Support IBI Integration

Level	Objectives	Content
Pre-primary	• promote the overall development of the child (i.e. their mental, physical, social and emotional characteristics and capabilities; • promote the child's early learning skills and lifelong appreciation of learning; • develop in a child self-consciousness, self-confidence, self-esteem and respect for others; • develop creative and logical thinking skills;	Learning areas: • Language, communication and literacy development • Creative, aesthetic and expressive development • Mathematical and logical thinking development
Standard One & Two	• practise simple communication. • maintain health and hygiene. • care for the environment.	Competences: • Communicating • Recognising ways to protect against diseases • Recognising living things found in the environment

Teaching and learning approaches

The teaching and learning approaches constitute another key aspect of any curriculum. The curricula for early years education are organised in a competence-based approach, with a particular focus on developing literacy and numeracy skills (MoEST 2016c & MoEST 2016d). In both the pre-primary and standard Ones and two curricula, teachers are encouraged to use participatory methods and ensure that children learn by interacting with relevant materials both indoors and outdoors. Specifically, the pre-primary curriculum 'places the child at the centre of the learning process …' (MoEST, 2016c, p.5). That is to say, the curriculum emphasises the use of child-centred approaches, a necessary aspect for integrating IBI. Generally, the pre-primary curriculum emphasises 'teaching methods that encourage children's active participation in performing different activities' (2016c, p. 12).

Although some features of IBI are highlighted in the general aspects of the curriculum, they are featured in broad intentions that can be hard to perceive at the implementation level. These findings have implications for the inclusion of explicit statements about IBI integration during the curriculum design and review processes.

Curriculum competencies and teaching/learning activities

Regarding the competencies to be developed, the pre-primary curriculum identifies competencies in six learning areas. These are (i) the ability to relate to each other, (ii) the ability to communicate, (iii) the ability to care for their health, (iv) the ability to care for the environment, (v) Mastering artistic skills and (vi) Applying mathematical concepts (MoEST, 2016c, p. 4). Although IBI is not directly featured in the curriculum, the development of competencies under the three areas indicated in Table 3 can be linked with the integration of IBI. The three areas highlight the development of communication, creativity, and mathematical and logical thinking. With regard to classroom activities prescribed in the syllabus (2016c), none of them seemed to be linked with IBI. One would expect IBI elements to feature at least under competencies related to the three areas mentioned. However, the activities under those competencies mainly focus on performing an activity after the teacher's demonstration and not on thinking and formulating questions that can be answered through investigation. This has implications for curriculum review as well as training of teachers to deal with an inquiry-friendly curriculum.

For the Standard One – Two curriculum, the competencies are divided into two major areas: 3Rs competencies (Literacy and numeracy skills: Reading, Writing, and Arithmetic) and supportive skills (aimed at the child development in other areas) (MoEST, 2016d). Generally, the main focus of this curriculum is to strengthen pupils' competencies in the 3Rs. This implies that an overemphasis on the 3Rs may limit the integration of IBI, hence a need to reconsider curriculum priorities.

Conclusion and Recommendations

Generally, the findings imply that early years teachers need specific in-service training opportunities to equip them with the pedagogical content knowledge necessary for integrating IBI teaching. Likewise, there is also a need to incorporate proper pedagogical skills into pre-service programmes. There is also the need to review the curriculum for the early years classes. For instance, although the present curriculum emphasises teachers' use of child-centred approaches, it overemphasises mastering literacy and numeracy skills, with little guidance on how teachers can use child-centred approaches to enable children to acquire those skills.

Although this study highlights important findings on a subject upon which little research has been conducted in Tanzania, it is not without limitations. Firstly, it is based merely on interviews and analysis of curriculum materials, but, in essence, classroom observation would provide a detailed understanding of how teachers integrate IBI in Tanzania. For instance, through observations, future studies might investigate how teachers can enable children to engage in IBI while teaching and/or guiding children's play. Secondly, to better understand the perspective of students

themselves, future research might be needed to investigate young Tanzanian children's perceptions of/about inquiry and their capability to engage in it. This is important, given that the norm in most societies of Tanzania is to discourage kids from asking critical questions. Finally, our review of the literature has revealed that there are several versions of activities constituting IBI. Given that the present study was limited to one version of IBI by Cairns (2019), future research can investigate other versions of IBI that are more compatible with the Tanzanian context.

References

Areepattamannil, S. (2012). Effects of inquiry-based science instruction on science achievement and interest in science: Evidence from Qatar. *The Journal of Education Research,* 105(2), 134-146.

Ayeni, O.G., & Olowe, M.O. (2016). The implication of large class size in the teaching and learning of business education in tertiary institutions in Ekiti state. *Journal of Education and Practice, 7*(34), 65-69.

Blatchford, P., Russell, A., Bassett, P., Brown, P., & Martin, C. (2007). The effect of class size on the teaching of pupils aged 7 – 11 years. *School Effectiveness and School Improvement: An International Journal of Research, Policy and Practice, 18* (2), 147-172.

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal, 9*(2), 27–40.

Byrne, J., Rietdijk, W., & Cheek, S. (2016). *Enquiry-based science in the infant classroom: "letting go." International Journal of Early Years Education, 24(2), 206–223.* https://doi.org/10.1080/09669760.2015.1135105.

Cairns, D. (2019). Investigating the relationship between instructional practices and science achievement in an inquiry-based learning environment. *International Journal of Science Education, 41*(15), 2113-2135.

Cairns, D., & Areepattamannil, S. (2019). Exploring the relations of inquiry-based teaching to science achievement and dispositions in 54 countries. *Research in Science Education, 49*: 1-23.

Campbell, T., Abd-Hamid, N. H., & Chapman, H. (2010). Development of Instruments to Assess Teacher and Student Perceptions of Inquiry Experiences in Science Classrooms. *Journal of Science Teacher Education, 21,* 13-31.

Capps, D.K., Crawford, B.A., & Constas, M.A. (2012). A review of empirical literature on inquiry professional development: Alignment with best practices and a critique of the findings. *Journal of Science Teacher Education, 23* (3), 291-318.

Das, P. M., & Faikhamta, C., & Punsuvon, V. (2019). Bhutanese students' views of nature of science: A case study of a culturally rich country. *Research in Science Education, 49*:391–412.

Dudu, W.T., & Vhurumuku, E. (2012a). Exploring South African Grade 11 learners' perception of classroom inquiry: validation of a research instrument, *Science Education International,* 23(2), 150-165.

Dudu, W.T., & Vhurumuku, E. (2012b). Teachers' practices of inquiry when teaching investigations: A case study. *Journal of Science Teacher Education, 23* (6), 579-600.

Edelson, D. C., Gordin, D. N., & Pea, R. D. (1999). Addressing the challenges of inquiry-based learning through technology and curriculum design. *Journal of the Learning Sciences, 8*, 3-4, 391-450.

Fang, S.-C. (2020). Towards scientific inquiry in secondary earth science classrooms: Opportunities and realities. *International Journal of Science and Mathematics Education*. https://doi.org/10.1007/s10763-020-10086-6.

Fitzgerald, M., Danaia L., & McKinnon, D.H. (2019). Barriers inhibiting inquiry-based science teaching and potential solutions: Perceptions of positively inclined early adopters. *Research in Science Education, 49*, 543-566.

Hansson, L., Lotta, L., & Thulin, S. (2020). Book talks as an approach to nature of science teaching in early childhood education. *International Journal of Science Education, 42*(12), 2095-2111. https://doi.org/10.1080/09500693.2020.1812011.

Jiang, F., & McComas, W.F. (2015). The effects of inquiry teaching on student science achievement and attitudes: evidence from propensity score analysis of PISA data. *International Journal of Science Education, 37*(3), 554–576.

Kafyulilo, A.C., & Tilya, F. (2019). Learning Technology by design: Experiences from In-service science and mathematics teachers in Tanzania. *Journal of Education, Humanities and Sciences, 8* (1), 16-29.

Marian, H., & Jackson, C. (2016). Inquiry-based learning: a framework for assessing science in the early years. *Early Child Development and Care, 187(2), 221–232*. https://doi.org/10.1080/03004430.2016.1237563.

Ministry of Education, Science and Technology [MoEST] (2016a). *Basic Education Syllabus for Standard I*. Tanzania Institute of Education.

MoEST (2016b). *Basic education syllabus for standard II*. Tanzania Institute of Education.

MoEST (2016c). *Curriculum and syllabus for pre-primary education.* Tanzania Institute of Education.

MoEST (2016d). *Curriculum for basic education Standard I and II*. Tanzania Institute of Education.

MoEST (2019). *National Basic Education Statistics in Tanzania (BEST).* Government Press.

Mhlolo, M. K., & Venkat, H. (2009). Curriculum coherence: An analysis of the National Curriculum Statement for Mathematics (NCSM) and the exemplar papers at Further Education and Training (FET) level in South Africa. *African Journal of Research in Mathematics, Science and Technology Education, 13* (1), 33-49.

Mkimbili, S. T. (2019). Meaningful Science Learning by the Use of an Additional Language: A Tanzanian Perspective. *African Journal of Research in Mathematics, Science and Technology Education*, *23*(3), 265–275. https://doi.org/10.1080/18117295.2019.1654212.

Mkimbili, S.T., Tiplic, D., & Ødegaard, M. (2017). The role played by contextual challenges in practising inquiry-based science teaching in Tanzania secondary schools. *African Journal of Research in Mathematics, Science and Technology Education*, *21*(2), 1-11. https://doi.org/10.1080/18117295.2017.1333752.

Moote, J. (2019). Investigating the longer-term impact of the CREST inquiry-based learning programme on student self-regulated processes and related motivations: Views of Students and Teachers. *Research in Science Education 49*: 265–294.

Pedder, D. (2006). Are small classes better? Understanding relationships between class size, classroom processes and pupils' learning. *Oxford Review of Education, 32* (2), 213-234.

Samarapungavan, A., Mantzicopoulos, P., & Patrick, H. (2008). Learning science through inquiry in kindergarten. *Science Education, 92*(5), 868–908. *https:// doi.org/10.1002/sce.20275.*

Schiefer, J., Golle, J., Tibus, M., & Oschatz, K. (2019). Scientific reasoning in elementary school children: Assessment of the inquiry cycle. *Journal of Advanced Academics, 30*(2), 144–177. *https://doi.org/10.1177/1932202X18825152*.

Shen, T., & Konstantopoulos, S. (2019). Estimating causal effects of class size in secondary education: evidence from TIMSS. *Research Papers in Education, 36*(5), 507–541. *https://doi.org/10.1080/02671522.2019.1697733*.

Siry, C., & Kremer, I. (2011). Children explain the rainbow: Using children's ideas to guide science curricula. *Journal of Science Education and Technology*, 20(5), 643–655.

Ssempala, F., & Masangila, J. O. (2019). Effects of professional development on chemistry teachers' understanding and practice of IBI in Kampala, Uganda. *International Journal of Scientific Research and Education, 7* (2), 8085-8105.

Strauss, A. L., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Sage Publications.

Sullanmaa, J., Pyhältö, K., Pietarinen, J., & Soini, T. (2019). Curriculum coherence as perceived by district-level stakeholders in large-scale national curriculum reform in Finland. *The Curriculum Journal, 30* (3), 244-263.

Tunnicliffe, S. D. (2016). *Starting Inquiry-based Science in the Early Years: Look, talk, think and do.* Routledge.

United Republic of Tanzania [URT]. (1995). *Education and Training Policy*. Government Press.

United Republic of Tanzania [URT]. (2014). *Education and Training Policy*. Government Press.

United Republic of Tanzania (2019). *Basic statistics in education (BEST)*. Ministry of Education, Science and Technology.

Vavrus, F., & Bartlett, L. (2012). Comparative pedagogies and epistemological diversity: Social and material contexts of teaching in Tanzania. *Comparative Education Review, 56* (4), 634-658.

Vhurumuku, E. (2011). High school chemistry students' scientific epistemologies and perceptions of laboratory inquiry. *Chemistry Education, Research and Practice*, 12, 47-56.

Vygotsky, L. S. 1962. *Thought and language*. MIT Press.

Wang, F., Kinzie, M., McGuire, P., & Pan, E. (2010). Applying technology to inquiry-based learning in early childhood education. *Early Childhood Education Journal*, 37, 381-389.

Weisgram, E. S., Dinella, L. M., & Fulcher, M. (2011). The role of masculinity/ femininity, values, and occupational value affordances in shaping young men's and women's occupational choices. *Sex Roles, 65*, 243–258.