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Early Childhood Education and Care Towards Sustainable Academic Performance in Accounting[1]

Makeresemese Qhosola
ORCID: https://orcid/0000-0002-0543-1948
University of KwaZulu-Natal
QhosolaM@ukzn.ac.za

Abstract
This study aimed to design a strategy to improve the academic performance of early childhood education and care (ECEC) learners in mathematics, and thence accounting, in a sustainable manner. Accounting is not taught as a separate subject to mathematics at the ECEC level, therefore we focused on those aspects of mathematics that link directly with central learning areas in accounting. We used participatory action research, and posthuman theory framed the study. Multistakeholder participation was used to encourage five key skills of the 21st century (collaboration, communication, compassion, critical thinking, and creativity) in the learners as co-researchers in order to promote sustainability in their learning of mathematics in ECEC as basis for accounting in the future.

Keywords: sustainable academic performance in accounting, participatory action research, critical discourse analysis, Bloom's taxonomies of learning, posthumanism

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Introduction and Background

This study aimed to design a strategy to improve the academic performance of early childhood education and care (ECEC) learners in mathematics, and thence accounting, in a sustainable manner. In terms of formal school curriculum documents in South Africa, learners are only introduced to the study of accounting in the senior (Grades 9–12) grades (Maddock & Maroun, 2018). Only the bases of accounting are laid at the ECEC level (Fouché, 2013). However, current thinking, buttressed by research, points to significant advantages (in terms of sustainable academic performance at ECEC level and later) when children are exposed to an early start, prior to formal school education (King & Pringle, 2019). Therefore, although accounting is not formally taught separately from mathematics at the ECEC level, in this study we focused on magnifying and capitalising on those aspects of mathematics that link

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directly with some of the crucial and central learning areas and topics in accounting. Furthermore, accounting requires numerical and analytical skills that are also integral elements of mathematics (Mkhize, 2019). Thus, in this study, the focus was on number operations (addition, subtraction, multiplication, and division) and on shapes and colours as forms of categorisation and classification of information. Moreover, we added further topics (elements of environmental and green accounting/sustainability accounting) to enlighten and heighten the awareness of learners, even at this level, of the deleterious effects on our lives and livelihoods of not caring for our planet and the universe (King & Pringle, 2019). These topics included making the young children aware of the heavy costs of environmental pollution and how these lead directly to the social ills of unemployment, poverty, and deepened levels of inequality.

Accounting and mathematics seem to be difficult subjects to gain good marks in for many learners throughout their entire academic careers (Baten et al., 2020). This is even more so with those from poor and marginalised communities such as a township in the Free State (Mkhize, 2019). The challenge as we see it is that mathematics, which is the corner stone of accounting, requires learners to have the ability to manipulate ideas and conceptions of size and shape (Silva et al., 2019). They also need to be able to see differentials and similarities among relationships; to solve problems alone and, more importantly, with peers; to be collaborative in approach; to be compassionate with their tasks and others; to be able to communicate the intentions and outcomes of their actions; and to evince high levels of critical thinking and creativity (Margot & Kettler, 2019). In short, this is about understanding number operations. It is about understanding how addition and division differ, how they function differently from subtraction and multiplication, and vice versa. The challenges for learners can be anywhere (Mkhize, 2019), and many studies indicate that challenges are based on issues of misrecognition leading to misconceptualisation, where learners see things other than what a figure represents. Misrecognition or misconception can reside in the learning child's intellectual abilities, or their sense of perception, or how in how they process signals from the object-world through their erroneous schema and strata that shift or falsify the initial stimulus and interpretation (Margot & Kettler, 2019).

Thus, the abovementioned challenges are innate and are inside the child's cognitive functioning as they struggle with the calculation and manipulation of number operations (Gilligan et al., 2019). However, in this paper, the argument is that to locate the challenges of calculating subtraction, multiplication, division, and addition that are fundamental to the study of accounting solely and exclusively intrapsychically, misses the point—albeit understandably so. Those conceptions are residue of Jean Piaget's genetic epistemology, which left the entire world burdened with a rigid classroom system in which children born on a particular day, month, and year are supposed to be at a predefined stage of cognitive development—and at a particular grade level (Burman, 2021). The hold of Piaget's theory has been all-pervasive given that this classroom stratification also pays homage to the disgraced notion of intelligence quotient—a calculation based on the ratio between one's chronological age and mental age (Burman, 2021). The assumption of all these is that children at the same chronological age are supposed to know certain similar things, in almost equal measure (Zajda, 2021). This lie saw Sir Cyril Burt being de-knighted for fabricating evidence about the similarity and equality of identical twins' performance in mathematical tests despite their being raised in very separate and far-off homes. He had wanted to prove that intrapsychic moments were more powerful in determining performance, but he tampered with the data and lost all respect and esteem when he was found out. Thus, while the jury is still out on which of hereditary and environmentally acquired competencies has the greater impact on an individual's academic performance in mathematics, the answer conclusively, is *not* heredity abilities only (Zajda, 2021). The perennial question that this study therefore investigates is*:* "How can the academic performance of ECEC learners be enhanced in mathematics, thence accounting—such that it is sustainable?"

Genetic epistemology could thus not be used as either the conceptual or the theoretical framework for this study because of the reasons discussed above, and especially because it valorises the value and power of the isolated genius (Marwaha et al., 2017). Even when Piaget became uncomfortable about the concepts of accommodation and assimilation that emerged from his theory, he did not revise it. Those two principles have contested the power of the isolated genius who matured through age into skill and competencies. They reinforced the importance of others in defining and enhancing one's skill, identity, or performance. Lev Vygotsky emphasised that we need other people and other things to assist us in defining who we are and what our strengths and prowesses are (Zajda, 2019). His concepts of socio-historicism and zone of proximal development capture his views accurately—that our identities, our academic performance, our everything, are always created in those small spaces between ourselves and others. These African adages amplify this view: "I am because we are" and "It takes a village to raise a child."

Posthumanism as the Theoretical Framework

The above view finds full expression in the posthuman theoretical framework. That is why this paper uses posthumanism to reinforce the notions that Vygotsky lay on the table, and which Urie Bronfenbrenner (1974) ably clarified. Posthumanism recognises that even learners of mathematics and accounting basics at the ECEC level are already entangled with others, with theories, and with nonhuman ways of doing. Thus, it is not only through cognition that the child learns accounting or mathematics—they learn through their entire being. This realisation posits that we learn better when we recognise the impacts and influences of the animate and the inanimate in our environments on our learning and performance of accounting and mathematics (Houston, 2017). Our interactions with the animals and objects in our world define us and impact our direct and indirect learning of mathematics and accounting. They create who we are and our performance. They determine the heights we can fly to. In short, our learning of accounting and mathematics, for example, is shaped by our relational experiences, and ultimately, we become a product of these interactions. (Blyth & Aslanian, 2022). The entities that we are, and come to know as ourselves, do not have an independent existence. In fact, what counts is the relationships that we have with others—with animals, resources, plants, other human beings, ideas, and so forth. Posthumanism teaches us about the highest level of knowing mathematics, accounting or any other subject, for that matter (Weldemariam, 2022). This is the level that is democratic and decentred and does not belong to anyone because it is collaborative and mutually co-constituted. Posthumanism advances the agenda for social justice in the learning of mathematics and accounting even in terms of how research is formulated—where all learners, irrespective of age, are regarded as fully fledged human beings who can feel, know, argue, and debate. Hasina Ebrahim's (2018) studies in South African ECEC centres show that all children have a way of knowing and sharing their ideas with others, albeit in different ways that may require us to listen—and to listen very carefully and acutely. The materiality of the posthuman is how knowledge of accounting and mathematics (and its production) become decentred among all, irrespective of gender, race, and so forth, and do not remain the preserve of only a few privileged individuals. Rules for conducting research become human rules that recognise the multiplicity of understandings and interpretation and are not hierarchised (Ebrahim, 2018).

Conceptualising Teaching and Learning in ECEC

Theories of learning and teaching have come almost full cycle in that the role of rote memorisation, although recognised where lower forms of learning are involved, is no longer the ultimate goal of learning (Yadav, 2022). A cursory look at theories of learning affirms the hierarchisation of learning as espoused by Bloom and his taxonomy (Abalkheel, 2022). More advanced and more cognitively demanding modes of learning tend to rely on the development of skills of thinking and not on the memorisation of content (Yadav, 2022). A learner who functions at the highest cognitive level is the one who is creative and can solve a problem based on its challenges rather than on what they

remember about solving such problems previously. This advanced form of learning implies seeing connections and similarities that become new hooks upon which new and novel ways of resolving a problem can be anchored (Abalkheel, 2022). This new mode is about being able to experience a cognitive jump from what looks simple and normal to a novel solution that has little to do with that which is known. Some theorists of this new mode of learning emphasise the need to be sensitive to problems and the development of a propensity to solve them. It is about understanding that learning is always about confronting new challenges and new contexts and trying to make new meanings and understandings under all circumstances (Arievitch, 2020). This mode of learning involves the use of a special eye that can see the connections between the various components of a situation, sift through, and focus on the new patterns that may emerge.

Fortunately for young children, this mode proceeds from what they like best—which is play. It also involves the use of as many senses of perception as possible. Abstraction to the higher levels is possible when initiated from all the senses to enhance understanding (Retno et al., 2019). The senses of one child when capitalised on, are effective; but when more than one child come together to learn and support one another, learning increases exponentially as each of these learners is forced to see the problem and the solution from at least two perspectives (Romano & Woods, 2017. Two perspectives are always better than one, and they encourage the learner to always try to explain their position to the other, thus improving on their own understanding—as in the case of a teacher who tends to understand subject content more when they explain it to others. Interaction among more than one learner fosters communication because each one has to explain to the others the intention of their actions and the outcomes thereof (Retno et al., 2019). It is about learning to present a convincing argument, accompanied by evidence and facts. This mode of presentation requires the presenter to be passionate and focused when making a point in order to ensure that all in the audience can follow their line of argument. It is in convincing others and sticking to one's line of thought that critical thinking is engendered. Every fact is thus subjected to thorough scrutiny with the focus of the argument clearly upheld and emphasised through coherent and logical argumentation. From such discourse, creativity and new learnings emerge as result of the dialogic scrutiny.

Although the preceding discussion may seem to pertain to youth and mature adults only, it is particularly prevalent among young children (Goldstein et al., 2019). Hasina Ebrahim (2018) has demonstrated that young children operate and function in the same manner as adults and youth—they lobby, they marshal arguments, they club together against ideas as well as for ideas, and so forth. In engaging in all the above, young people are supported by everything in their universe. Young learners are ideal to demonstrate how the mind operates—even a brick can be mentally converted into a bus with the child experiencing no dissonance or conceptual gaps (Ebrahim, 2018). The things in their universes include inanimate objects, the animate, human, and nonhuman beings as well as the more-than-human such as computers with artificial intelligence using sensors and algorithmic reasoning capabilities (Osgood & Mohandas, 2022).

Methodology and Design

Based on the above, this paper reports on how participatory action research was conducted with and among ECEC learners aged 2 to 5 years old as co-researchers. The study also included their parents, their learning centre practitioners and supervisors, as well as willing significant members of the entire community at a township in the Free State (see Table 1). Officials of both the Department of Basic Education and Department of Social Development in the Free State, as well as researchers from University of Mpumalanga, University of the Free State, and University of KwaZulu-Natal were invited to participate although, due to their hectic schedules, they could not always be there. All came together to assist the ECEC centre to formulate a strategy to ensure that early learning was robust and sustainable in preparation for the study of accounting and mathematics in later life.

Table 1: Co-Researchers as Participants: A List of Credentials

Co-Researchers	Total
Learners in the ECEC centre	80
Church and ECEC leaders	4
Matron and practitioners	5
Parents	14
Community members and Department	5
Universities	4

The aim of this study, namely, to enhance the academic performance of ECEC learners in mathematics, and thence accounting such that it remained sustainable, implies that the study is an intervention and not merely an exploratory or extractive treatise intended to gather or collect information. As an intervention study, it therefore lent itself readily to the use of participatory action research, which leads to change in society. When using participatory action research, the participants of a study (who initially come in as the observer or the observed) come out of the study as co-researchers, owning the study and giving it direction in a democratic way. What drives such a study is the formulation of a real-life solution to a real-life problem by people who are directly affected.

I became involved in this study because people in the community had requested my mother to look after their children when they went to work. Having a doctorate in accounting education, I saw an opportunity to give back to this community, which had supported me and my mother, by being involved in the ECEC centre and converting it into a place of learning mathematics robustly yet in a way that was friendly and take every child by the hand. As part of a bigger consortium of universities, we applied to one of the three abovementioned universities for ethical clearance in which we had to demonstrate that there was no way that the study would harm the young children or adults physically, emotionally, cognitively, or in any other way. All participants signed assent forms granting us permission to work with them to develop new and more appropriate ways of teaching and learning mathematics for accounting. The mathematics we taught was ordinary mathematics, but all the examples and activities were from appropriate accounting learning areas. There were 80 children between the ages of 2 and 5 years old, and all spoke seSotho. Every child was supported by their respective parent or guardian who also signed consent forms to ensure that the safety and interests of the children came first at all times. They were advised that they could withdraw from the project at any stage of the project.

We held a meeting with all learners, their parents, church leaders and other stakeholders who support the centre such as local business people, teachers, taxi owners, and shop owners to mention some. The practitioners at the centre and the administration staff including the matron gave us permission and also signed the consent form. We established that their vision and mission were in line with the research aim of the project, which was to find ways to improve learning in the teaching of mathematics so as to create more possibilities for these learners to choose to study accounting in the future. We conducted a strategic planning session in which we began with a SWOT analysis of the challenges of teaching and learning mathematics at this level of education. We also reflected on our strengths individually and collectively as well as our weaknesses, and the opportunities and threats that had to be taken into consideration as we crafted a winning strategy. Based on the SWOT, we prioritised points to try to implement. These were to highlight the effective teaching and learning of number operations like addition, subtraction, multiplication, and division, as well as shapes and colours as forms of categorisation and classification of information. All these were to be from the perspective that environmental pollution was a cost to everyone. A lot of data were generated throughout the study. Some of the data were transcribed and some have been kept safely in audio and video formats. Data were analysed using Teun Van Dijk's (2015) critical discourse analysis, focusing on the text as the first

level of analysis; the second level was discursive practice then finally, the socio-structural level. Table 2 shows our action plan with the priorities and an exemplary lesson from each priority.

Table 2: Action Plan

Priority	Activity	Responsible	Resources	Time Frame
Number operations: Addition and subtraction	Steps to schools and from home per child	Team Leader A	Measuring tape	Thrice weekly for a month
Number operations: Multiplication Subtraction	Groups of children	Team Leader B	Balloons	Thrice weekly for a month
Shapes	Circles, triangles, square	Team Leader C	Videos	Thrice weekly for a month
Colours	Sky, ocean, blood	Team Leader D	Videos	Thrice weekly for a month
Pollution	Noise, smoke, plastics	Team Leader C	Videos	Thrice weekly for a month

Every three weeks the team came together to reflect and evaluate progress made. This was evaluated as the achievement of each of the priorities, and each team had to present a report to the meeting. The reports were analysed regarding progress or lack thereof. New plans were formulated where necessary, incorporating the achievements at the first level and this followed a spiral for each objective respectively.

Data From Some Lessons

> ***Team:*** *how many steps did you walk from home today Sello, Maki, dipuo, Dipoleloe? From tomorrow each of you must make sure you show and tell how many steps you walked from home to school. Count them and show how you counted them.*
>
> ***Dipolelo:*** *I walked 300 steps.*
>
> ***Team:*** *Show how.*
>
> ***Dipolelo****: I started with the first foot to count and the second foot counted for step one and then the right foot just like that.*
>
> ***Dipuo:*** *I started with the left foot as one and then the second foot.*
>
> ***Team:*** *If you drove a car, would pollution be more or less than when walking and why? When will it be more cheap between the two—why? When you calculate cost what will you include****?***
>
> ***Sello:*** *Walking.*
>
> ***Dipuo:*** *No, driving. I saw TV say so about carbon.*
>
> ***Dipulelo:*** *But you take long, it should be walking when you throw rubbish and tin around because you walk too slow****.***
>
> ***Team:*** *Correct, even though you take long to walk, it is good for your health to walk. When you walk you also reduce on pollution as fewer gases are released compared to those released from carbon fuel.*

Morabane: *What is carbon?*

Dipuo: *What is fossil fuel?*

Dipolelo: *How can it be cheaper when a car drives compared to when one person walks?*

Team: *Walking is cheaper because what is left behind when walking as carbon emission is non-existent but when you drive the fossil fuel burns and it emits some which is costly to remove from the air and it goes into the lungs of people who get sick and have to pay money to the doctor. Walking is cheaper also because it remove unwanted air from the lungs as a [person] walks.*

Dipuo: *I know that going to the hospital is expensive because my dad goes there a lot and every time he comes from there he cannot buy us big M.*

These data were subjected to critical discourse analysis, which means that to come to the findings and meaning of the data as presented, we looked at the spoken words of the participants as co-researchers. We also tried to glean meaning from their written words as well as from their actions when teaching and learning the basics of mathematics and accounting at the ECEC. But we went deeper in search of more meanings of the words at the discursive practice level. This is the level at which meaning is not simply overt, but where we had to read between the lines in the contexts of the known behaviours of the participants as co-researchers. This meant bringing to the analysis process our own knowing of the habits of the minds of the co-researchers in those circumstances. These included understanding what made them tick and say certain things. In our view, and as asserted by Van Dijk (2015), the fullest meaning was gleaned at the social structural level where we went beyond the habit of the mind to understanding how the social context was structured to enable co-researchers to produce particular understandings as evidenced in their utterances and actions during the study. Applying critical discourse analysis is a comprehensive approach in which all three levels are brought to bear on text at the same time—in a manner similar to how theologians conduct exegesis of text, or how archaeologists date stones as bones of animals that lived billions of years ago. The meanings gleaned from data in this way may not be readily discernible by the untrained eye. It involves a special "seeing" that traverses three different and deeper levels at the same time.

Discussion of Findings

This study aimed to enhance the academic performance of ECEC learners in mathematics and thence, accounting. Unfortunately, we are not able to say whether the knowledge acquired will be used to progress to accounting as a preferred area of learning. The learners have however been exposed sufficiently to some of the basic concepts of sustainable and environmental accounting. If they do want to make this subject choice in future, they are likely not to experience problems. However, the choice cannot be guaranteed at this stage.

Collaboration

One of the principal skills identified in the literature for meaningful and successful participation in accounting in the 21st century, is collaboration. Learners in this study were exposed to various forms of collaboration, for example, among their parents as individuals; between parents and the school; among learners, parents and teachers; among the learners at school with community members; and so forth. As the extract above indicates, they learnt from one another how to calculate the distance from home to school. Each learner came up with their own particular way of calculating the distance and, from their peers and the teaching team, they learnt what the correct way was. This mode of

learning is sustainable because the learners actually experienced the distance through walking, and the final calculation was used for purposes of clarification after that learning had happened.

Communication

The extract also shows how actively communicative the learners were, despite their young age. These learners made their inputs freely and without being encouraged or coerced. They seemed to understand their story and how sustainability in accounting was determined. Even though the teaching team may have emphasised certain themes and issues, the learners chose to substantiate what sustainability meant from their self-chosen positions that emphasised respect for the universe, which in turn, extended to those of the teaching team. The learners were able to weave a convincing, coherent, and focused analysis of a meaningful mathematics-related activity.

Compassion

The learners and all the co-researchers demonstrated great levels of compassion for what they were learning. They experimented with different strategies to express their ideas. Their self-chosen positions seemed to be inspiring to them because they consistently came up with alternative methods of describing sustainability through how they calculated the costs thereof. They were familiar with the fact that sustainability went beyond mere support from many quarters, to including sustainability as a cost to the environment and livelihood of the planet. Even though they were not verbalising it, there was realisation that sustainability included respect for the environment and all that occurs within it**.**

Critical Thinking

The learners, as young as they were, evidenced multiple perspectives in their responses. They looked at all possible signs as they responded to questions that required deep thinking even in instances where they had not been exposed to the ideas before. They were able to summarise and make informed guesses based on logical thinking that was also critical. They seemed to not be making their responses easily or without applying their minds deeply—and seemed able to classify, compare, and synthesise as they did so. Most of the time, they operated at the highest levels of Bloom's taxonomy. Without assuming a strong causal relationship, it is possible to propose that participating in this study led to more open minds as well as more critical thinking among all, especially the learners.

Creativity

There was also an emergence of creativity among the learners about the use and understanding of mathematics and, most importantly, of sustainability in accounting. They seemed to be weaving into their understanding, complex issues of carbon footprint, which has become a bone of contention in the world today with regard to the use of fossil fuel. Some of the learners, albeit not fully informed about the matter, already had an idea that calculating cost in modern-day accounting includes costs to the environment such as in the impact of carbon footprint.

Conclusion

The perspective adopted in this study is based on posthumanism, which includes allowing young learners to have a say in how they learn and how their knowledge is generated—a perspective born out of frustration with the Anthropocene, which has destroyed the planet. The posthuman response is for restoration and organic interactions that do not lead to the destruction of the plant, animals, objects, and more, through whatever means of disrespect (Dudley, 2021).

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