Bukti Reviewer Pada South Afrika South African Journal of Education

South African Journal of Education
Official publication of the Education Association of SA

Executive Editor: Prof. Ronél Ferreira

2023–05–09

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Re: SAJE 2296

To whom it may concern

This letter serves as confirmation that Dr Samsul Maarif acted as reviewer for the ***South African Journal of Education***.

Kind regards

Ronél Ferreira
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South African Journal of Education

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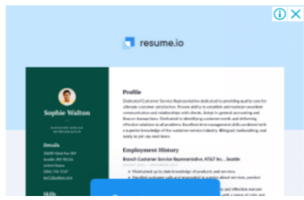

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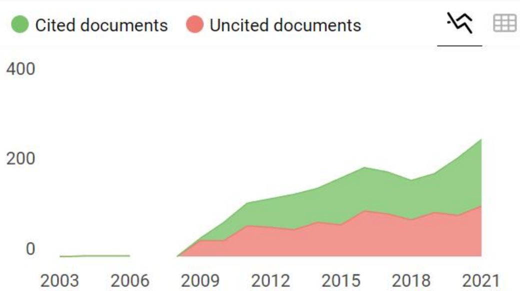

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Estelle Botha <estelle.botha@up.ac.za>

to Samsul_maarif

Thu, Oct 6, 2022, 3:31 PM

Dear Dr Samsul Ma'arif

Prof. Ferreira, Executive Editor, kindly requested me to send you this e-mail.

We believe that you would serve as an excellent reviewer of the manuscript, "Exploring Interactive Whiteboard Pedagogical Practices in Grade 11 Mathematics: A Case Study of Two Gauteng Township Secondary Schools" which has been submitted to ***SA Journal of Education***. The submission's extract is inserted below, and we hope that you will consider undertaking this important task for us.

Kindly confirm your availability to act as reviewer by 13 October 2022.

The review itself is due 2022-10-31.

There has been considerable investment in interactive whiteboards (IWBs) and their use in the Gauteng province in South Africa to enhance teaching and learning. IWBs could transform the culture of teaching and learning in the education system and have been accepted by many schools as a game changer in the classroom. However, there has been little research on IWB integration, especially in the teaching of Mathematics in Grade 11. We used the interaction equivalency theorem to investigate the pedagogical affordances of IWBs and develop an understanding of their ability to enhance the quality of interaction, and consequently, improve pedagogic practices of teaching Mathematics in Grade 11. This study is framed within the social structuralism and

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constructivist approaches. Data was generated using questionnaires, interviews and observations, and the data analysis was guided by the interaction equivalency theorem, which consists of three types of interactions, namely learner-content, learner-teacher, and learner-learner. This research adds empirical validity to the interaction equivalency theorem by confirming IWBs' pedagogical affordances and how IWBs positively influence the way Mathematics content is delivered. In addition, the IWBs engaged learners with varied representations and virtual manipulatives that can aid conceptual understanding.
Keywords: Interactive Whiteboards; Interaction Equivalency Theorem; IWB Pedagogical Practices; Virtual Manipulatives

Yours sincerely

Estelle Botha

Due to the high number of e-mails received, please allow 7 working days for a response.

--

Ms Estelle Botha
Administrative Editor: *South African Journal of Education*
Faculty of Education
University of Pretoria
Pretoria
0001

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Estelle Botha

Due to the high number of e-mails received, please allow 7 working days for a response.

Samsul Maarif <samsul_maarif@uhamka.ac.id> Nov 3, 2022, 10:58 PM

to Estelle

Thank you for the opportunity. I am very happy to be a reviewer at SAJE. This is the best opportunity for me

Reply Forward

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Estelle Botha <estelle.botha@up.ac.za> Mon, Nov 14, 2022, 3:04 PM

to me

Dear Dr Samsul Ma'arif

Thank you for informing us opportunely! We appreciate your time and effort.

Kindly note that the review itself is only due on 11 December.

Find hereto attached the relevant documentation.

Kindly note that the editorial office only reopened on 15 September,
please expect a delay in response.

Yours sincerely

Estelle Botha

On 03/11/2022, Samsul Maarif <samsul_maarif@uhamka.ac.id> wrote:
> Thank you for the opportunity. I am very happy to be a reviewer at SAJE.

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This message and attachments are subject to a disclaimer.

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Samsul Maarif <samsul_maarif@uhamka.ac.id>
to Estelle

Mar 13, 2023, 8:29 PM

Dear Estelle Botha

Here we present the results of a review of an article entitled "Exploring Interactive Whiteboard Pedagogical Practices in Grade 11 Mathematics: A Case Study of Two Gauteng Township Secondary Schools". Thank You

Kind Regard

Dr. Samsul Maarif, M.Pd.
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Faculty of Teacher Training and Education
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Estelle Botha
to me

Mar 23, 2023, 2:49 PM (9 days ago)

Dear Dr Samsul Ma'arif

We have noticed that you made comments in terms of Article 2296. However, we would like you to help us in making a final decision by indicating your recommendation:

a) Acceptable without revision
b) Acceptable with revision not requiring reconsideration by referee
c) Acceptable with revision requiring reconsideration by referee
d) Resubmit Elsewhere

Kind regards

Estelle Botha

---------- Forwarded message ----------
From: Samsul Maarif <samsul_maarif@uhamka.ac.id>
Date: Mon, 13 Mar 2023 20:29:07 +0700
Subject: Re: SAJE 2296

Samsul Maarif <samsul_maarif@uhamka.ac.id>
to Estelle

Mar 25, 2023, 12:51 AM (7 days ago)

Dear Estelle Botha

After considering the results of the review of the article entitled "Exploring Interactive hiteboard Pedagogical Practices in Grade 11 Mathematics: A Case Study of Two Gauteng ownship Secondary Schools", so I as a reviewer give a recommendation: Acceptable with evision not requiring reconsideration by referees. Thus I give this recommendation for the enefit of the publication process in the SAJE journal.

Thank You

Kind Regard

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Bukti Artikel Yang Di Reviu

Exploring Interactive Whiteboard Pedagogical Practices in Grade 11 Mathematics: A Case Study of Two Gauteng Township Secondary Schools

Abstract

There has been considerable investment in interactive whiteboards (IWBs) and their use in the Gauteng province in South Africa to enhance teaching and learning. IWBs could transform the culture of teaching and learning in the education system and have been accepted by many schools as a game changer in the classroom. However, there has been little research on IWB integration, especially in the teaching of Mathematics in Grade 11. We used the interaction equivalency theorem to investigate the pedagogical affordances of IWBs and develop an understanding of their ability to enhance the quality of interaction, and consequently, improve pedagogic practices of teaching Mathematics in Grade 11. This study is framed within the social structuralism and constructivist approaches. Data was generated using questionnaires, interviews and observations, and the data analysis was guided by the interaction equivalency theorem, which consists of three types of interactions, namely learner-content, learner-teacher, and learner-learner. This research adds empirical validity to the interaction equivalency theorem by confirming IWBs' pedagogical affordances and how IWBs positively influence the way Mathematics content is delivered. In addition, the IWBs engaged learners with varied representations and virtual manipulatives that can aid conceptual understanding.

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Commented [A2]: It is important to know that the abstract contains an introduction, method, result and conclusion

Keywords: Interactive Whiteboards; Interaction Equivalency Theorem; IWB Pedagogical Practices; Virtual Manipulatives

Introduction

The South African education system has an obligation to enable the society to deal with ever changing social and economic trends by ensuring that it delivers quality education that makes citizens more accountable and equipped with higher-order skills to be able to solve problems. The education system faces the challenge of correctly implementing the new National Curriculum Statement to ensure there is effective teaching that improves the quality of the learning experiences in schools (Bagarukayo & Kalema, 2015). The National Curriculum Statement operates on the principles of outcomes-based education and aims to empower learners with skills and knowledge that can be used in a global world by encouraging an active, learner-centred approach (Bagarukayo & Kalema, 2015). This has necessitated government, especially provincial governments, to invest in various digital technologies to enhance teaching and learning.

The Gauteng Department of Education (GDE) invested in interactive whiteboards (IWBs) to revolutionise instructional delivery and practices in the classroom. Beauchamp and Kennewell (2010) developed an information and communication technologies (ICTs) interactivity model between teacher and student. The model suggests the following five levels of ICT interactivity: No interactivity; authoritative interactivity; dialectic interactivity; dialogic interactivity; and synergistic interactivity. Vissa (2016) insisted that teachers should strive to reach the synergistic interactivity level to ensure that learners develop higher-order thinking and good communication skills. According to Beauchamp and Kennewell (2010), interactivity happens in various forms and may be technical, physical, or conceptual in nature. Technical interactivity has the rapid and dynamic feedback and response functions of the IWB, such as drag-and-drop and hide-and-reveal (Beauchamp & Kennewell, 2010). On the other hand, the physical manipulation on the IWB best describes the physical interactivity of the IWB. Conceptual interactivity actively engages both learners and teachers to generate and evaluate ideas and construct new knowledge (Beauchamp & Kennewell, 2010). These three forms of interactivity can only be experienced once learners and teachers have access to ICT.

Gillen, Staarman, Littleton, Mercer and Twiner (2007:256) found that “the IWB can serve as an effective tool to encourage interaction between the students and the learning material, using teaching methods that include presentation of material in various ways”. Based on whether IWBs bring change to the pedagogical practices of educators, this study aligns itself with Manny-Ikhan, Dagan, Tikochinski and Zorman’s (2011) view that technology (IWB) can assist with classroom interaction but that the instructional method still lies in the hands of the educator. Despite well-documented international research on IWBs’ pedagogical affordances (Angeli & Valanides, 2009; Warwick & Mercer, 2011) and its “potential as a tool for collaboration, improving student learning outcomes and streamlining lesson planning” (Shi, Yang, Yang & Liu, 2012:213), there was a need to explore the bigger picture within the South African context. Therefore, the research question this paper seeks to answer is “How do the pedagogical affordances of IWBs support learner-content, learner-teacher and learner-learner interactions in the teaching of Mathematics in Grade 11?"

Context of this Study

The schools in Gauteng provide a rich environment in which to conduct research about interactive technology adoption and practices. The GDE has invested heavily in the installation of IWBs in an effort to create equitable access to technology in schools and to enhance teaching and learning, particularly in Mathematics. The GDE equipped Grade 11 classrooms with IWBs in most non-fee paying township schools in 2016 in an effort to create smart classrooms and do away with books, pens and chalkboards. These schools are located in previously disadvantaged areas, such as townships and squatter camps. In light of IWBs' affordances, the GDE regarded IWBs as enabling tools with features that can act as affordances for learning. The GDE insisted that the audio, visual and kinaesthetic nature of IWBs makes learning more diverse, leading learners to become problem solvers through discovery learning. These ICT affordances allow teachers to facilitate learning and help learners reach their highest learning potential. IWBs are not meant to replace teachers but to enable teachers to innovatively deliver content in more diverse and structured ways. In light of these significant IWB affordances and the provincial policy on digitising classrooms, this study provides timely insights on IWBs as a pedagogical tool to revolutionise instructional delivery and practices in the classroom.

Literature Review

The purpose of this study was to investigate the extent to which pedagogical affordances of IWBs support interactivity in the classroom beyond content delivery. Multimodal representation of subject content knowledge in the classroom supports instructional equity and inclusion, enabling learners to "move beyond linear pathways of learning, characteristic of, but not exclusive to, behaviourist approaches, and to adopt more individualised strategies and pathways" (Conole & Dyke, 2004:119). Glover and Miller (2001) suggested that such teachers find it difficult to use a pedagogical approach and IWBs' interactivity to impact teaching and learning, and the inability to fully use IWBs as pedagogic tools that enhance teaching and learning leads to classrooms with clashing pedagogic practices. Kennewell and Morgan

(2003) confirmed that IWBs' pedagogic affordances have turned Mathematics classrooms into active learning spaces, collaborative environments and information hub centres in schools.

The Mathematics pass rate in the Further Education and Training band has been below 90% for the past four years according to the National Senior Certificate Technical Report (2015). The report showed that learner performance in Mathematics is low compared to other subjects, and it also showed the various intervention strategies, such as the Secondary School Improvement Plan, that the Department of Basic Education has adopted to improve priority subjects. Even after the many strategies that have been developed and implemented, the 100% pass rate in Mathematics seems unachievable. The traditional chalkboard is not giving teachers sufficiently interactive ballast. The provision of IWBs in Grade 11 classrooms coupled with the poor performance in Mathematics prompted this study, which is designed to establish whether the pedagogical affordances of IWBs support interaction and give teachers pedagogic affordances to enhance teaching and learning.

The affordances of IWB has been proven to offer "the opportunity for pupils to be allowed to explore their own ideas and share them with the class in a reflective discourse", and these affordances are "mediated by teachers" (Tanner, Jones, Kennewell & Beauchamp, 2005:726). John and Sutherland (2005:409) believed that "in order to understand the development and consequences" of pedagogic opportunities of ICTs such as IWBs, teachers need to "interpret the tool itself (its material and structural elements) more in terms of the assumptions it makes about the user, the activities it encourages, and the way it constrains and enables particular activities". This suggests that teachers who excel in ICT integration have necessary subject content knowledge and good pedagogy and digital skills to select relevant technology that suits the teaching and learning space. The interactivity of IWBs can help learners to be critical thinkers because they learn from observation and by questioning their own knowledge. The multimodal features of the IWBs enable users to manipulate objects to achieve interactivity. The use of ICTs in teaching and learning causes teachers and learners to socially interact with one other and their environment. The social interaction encourages knowledge sharing and bridges the digital divide that may exist between teachers. Bakhtin (1981) regarded dialogic talk as a process of creating a space for multiple voices and classroom discourse that challenge the power relations constructed by monologic practices. According to Alexander (2006), IWBs' affordances encourage classroom dialogue, which influences how learners construct new knowledge and understanding. The new knowledge, according to Piaget, is "not simply given to children when they learn. Rather children create knowledge when they learn" (Moll, 2001:1). The interactivity of IWBs provides teachers and learners with scaffolding mechanisms; hence, most activities or concepts are built to have practical and kinematic features.

Theoretical Framework

Considering the well-documented potential benefits of IWBs to change interactions and practices in the classroom, we used Anderson's (2003) interactivity equivalency theorem to investigate the pedagogical affordances of IWBs. According to the interactivity equivalency theorem, "deep and meaningful formal learning is supported as long as one of the three forms of interaction (student-teacher, student-student, and student-content) is at a high level" (Anderson, 2003:5). The interactivity equivalency theorem provides a versatile tool to develop a deeper understanding of IWBs' affordances in the smart classroom. Figure 1 presents the nature of interactions (learner-content, learner-learner, and teacher-learner) that enable learners to construct knowledge (Wang, Woo & Zhao, 2009). The aim of the study was to investigate the pedagogical affordances of IWBs and how they support interactions in classrooms.

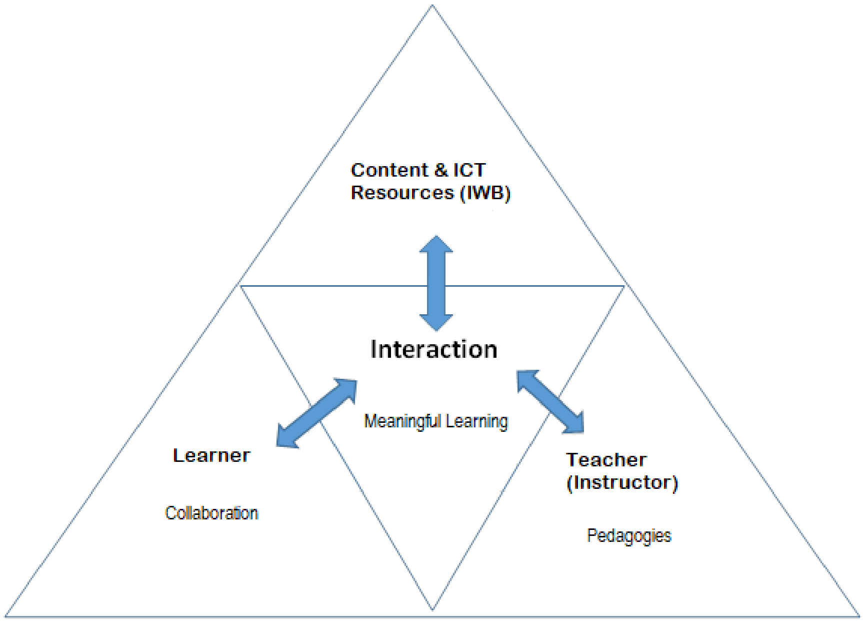

Figure 1 The nature of interaction between learner, teacher and content

From the constructivist perspective, learners do not passively receive information but construct meaningful knowledge through interacting with the environment. Teachers ought to help learners exceed the boundaries of what they are capable of achieving on their own and provide new areas for exploration about the subject matter that the learner may not have previously considered on their own. Theorists like Moore (1993) explained interactivity by drawing from pedagogical concepts where learners interact with other leaners (learner-learner), content (learner-content), and instructors (learner-instructor). IWBs can create interaction among teachers, learners and content. These resources offer teachers the opportunity to design instructions that are learner-centred (Erbaggio, 2012). During knowledge construction, learners personally internalise, negotiate, and share information meaningfully (Wang et al., 2009). The theory of interactivity is assumed to enable learners to actively build and modify knowledge as well as become problem solvers and critical thinkers.

Methodology

This study used a case study approach drawing on the phenomenological perspectives of Mathematics practitioners and used qualitative data collection methods. A series of semi-structured interviews were conducted over 3 months, and the participants freely responded with specific details of their application of IWBs in their teaching. The researchers probed the participants on their overall use and their practices to enhance teaching and learning in the classroom. Lesson observations involved one researcher attending Grade 11 Mathematics classes where IWBs were used. The study used a complete observation technique, which ensured that the researcher did not participate in the situation. The observation technique provided evidence of teachers' practices in the classrooms and allowed the researcher to provide a balanced interpretation instead of relying on the perceptions of the teachers.

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Study Design

This study followed a qualitative approach to gain deeper knowledge about the participants by using interviews and observation.

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Context and Participants

The setting of this study was two Gauteng secondary schools in Ekurhuleni North District. These schools were selected because they were some of the first to receive IWBs in the district. These are previously disadvantaged schools without ICT resources and infrastructure. Currently, the schools have IWBs in Grade 11 and 12 classrooms and the teachers were provided with laptops loaded with personalised content for their subject. The study used purposive sampling to select one Maths head of department (HoD) and two Grade 11 Maths teachers from each school, totalling six participants.

Data Analysis

The schools were named School A and School B to make the data analysis and description easier. The data collected in both schools were transcribed verbatim and organised using direct phrases to maintain authenticity and to refine the generated data accordingly to avoid data overloading (Cohen, Manion & Morrison, 2011).

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Findings

This section presents a summary of the classroom IWB integration practices of each of the six participants. The participants described how IWBs have changed their teaching approach. Although a few teachers were still using IWBs as chalkboards, they also used other features to display objects, figures, and video and audio files. It is evident where their lesson planning and presentation have changed to suit the capabilities of IWBs.

Limpopo

Limpopo is classified as a moderate IWB user. She has less than five years of teaching experience, has been teaching Mathematics for two years and has been using an IWB for one year. She can access e-books and other education programs installed on the board and use interactive gallery contents, shapes and videos. However, linking other devices such as cell phones, tablets and laptops to the IWB appeared to be a challenge to her. She has limited skills with IWB interactive tools and cannot develop a lesson using IWB interactive tools. Limpopo indicated that she used the IWB to prepare and teach Mathematics. She stated that the IWB influences learner participation "*through pictures and diagrams that are displayed on the board, learners' focus tends to increase since they see variety of things. Learners started to conceptualise content in a more structured manner*". Limpopo emphasised that, "*IWB encourages learners to brainstorm ideas and work together to solve problems and answer questions and the availability of extra content that consist of visuals and audio encourages learners to interact with content*". There is evidence that IWB features enable multimodal representation of information, especially abstract concepts. Limpopo cited the different tools with animations on the IWB as important because it benefitted learners by offering different learning approaches. Limpopo said, "*The availability of internet-based videos, pictures and multimedia files enable me to teach in a manner I can bring visuals, sound clips and row content to the classroom".* During the lesson observations it was clear that the IWB enabled more learner-learner, learner-content and learner-teacher interactions and that participation was high. Overall it was clear that the multimodal representation of content played a role in the interactivity of the classroom and provided Limpopo with a wide variety of teaching objects.

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Tugela

Tugela is a novice IWB user and has been using the IWB for less than a year. She has 14 years of teaching experience and has been teaching Mathematics for 10 years. She has little experience with ICT and struggled to manipulate the tools on the IWB to suit her lesson. She could access the IWB daily, e-books, a few programs pinned on the taskbar, and the gallery contents and shapes. She had limited knowledge of creating animations using objects' properties, linking the IWB with other ICT tools was a challenge, and she hardly used the internet. She described the IWB's influence on learner participation as follows:

> *The use of visual and text help learners to conceptualise Maths content differently as compared to when they are taught using textbooks only. IWB can give clear colours that correctly give the representation of a diagram, picture or object. The fact that users can bring objects closer gives users advantages.*

She used the IWB to display PowerPoint slides, but her lack of technological knowledge was clear when she asked learners to copy handwritten notes from the board. She also used the IWB as a chalkboard by using free-hand writing to emphasise concepts. No multimedia was used to teach but she successfully pinned e-Book pages with diagrams for the learners to answer questions based on the pages. Learner-content interaction was encouraged and achieved by exposing learners to more comprehensive word problems from previous question papers. She was clear about the benefits of IWBs and said IWBs have "*rich and extended material … accessible from external devices*", but she was unable to pedagogically integrate the IWB in her teaching. Tugela mostly used the IWB as a basic display tool and made no attempts to use it to creatively expand teaching and learning opportunities.

Pongola

Pongola has 15 years of teaching experience and has been a HoD for more than 5 years. He has taught Grade 11 Mathematics for more than six years and has used an IWB for 2 years. He is classified as an advanced IWB user. Pongola can present various learning content on the board and navigate through the board without any difficulty. He indicated that the IWB has helped him teach Mathematics concepts in a more practical way. The participant used GeoGebra (a mathematics program) to plot

Commented [A8]: When writing the name of the respondent, has permission been obtained from the respondent? Is it necessary to disguise it with initials?

Commented [A9]: Writing the results of the interviews will be better equipped with the context of what is being asked, what you want to explore so that keywords appear as part of the findings different graphs, which made his teaching more graphic and practical. He said that the IWB influences learner participation because the "*use of media has made teaching to be more meaningful and practical. Presenting through IWB has made teachers to prepare beyond textbook scope*". He could use the IWB to rotate, flip, and shift diagrams to suit his lesson objective, which improved learner participation. Pongola highlighted that learners' attention in the classroom has improved since they are engaged with interactive activities. There is evidence that the use of GeoGebra encourages teacher-learner, learner-learner and learner-content interaction. Pongola asserted that "*teaching through IWB is interesting and beneficial since assessment was administered through linking the board with tablets. Access to a variety of extra audio-visuals and other material on the internet enabled all learners to be accommodated in terms of their competence level and diversity*". He stated that the multimodality of the IWB has made teaching Mathematics exciting as it includes more visuals, audio and interactive activities.

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Mogalakwena

Mogalakwena is the most experienced teacher in this study with more than 25 years of teaching experience. He has been a HoD for 10 years, has been teaching Mathematics for more than 15 years, and has been using the IWB for 2 years. He is classified as a novice IWB user. He can access and use few of the IWB's teaching and learning tools. The learners help Mogalakwena to use the teaching and learning tools and applications on the IWB. When he was asked how the IWB influences learner participation, he responded that "*all learner activities are saved on the IWB for future use; these activities are easily modified and corrected to suit the lesson of the day*". He is using the IWB as a repository tool instead of taking advantage of the different learning resources or objects available. With the learners' help he managed to allow them to discuss and respond to questions on the IWB using tablets. The lesson activity tools were used to support active learning. There was evidence of teacher-learner, learner-learner and learner-content interaction. Mogalakwena said that learner concentration improves when they see images and hear sounds. He explained that "*through moving objects around the board, learners are able to view Maths concepts in different forms. Learners become aware that objects can be rotated and reflected to form a new shape".* Mogalakwena used few tools on the IWB to support subject content presentation.

Letaba

Letaba has 10 years of teaching experience, has been teaching Mathematics for eight years, and has been using the IWB for two years. He is classified as a moderate IWB user. He has been using various ICTs and software applications to enhance teaching and learning. He can successfully link other ICTs, such as learners' tablets and a laptop, with the IWB. Letaba used IWB tools such as shapes and gallery pictures to teach. This made his lessons more meaningful because leaners could differentiate features of various geometric shapes. He said that he used the IWB promote learner-content by "*connecting tablets with the IWB*". He further said that the IWB influences learner participation "*with the addition of videos, animations and graphics, many lessons have 21st century based skills which are more relevant to the learners of today*". There was evidence of experience using different software and interactive features in the tool. Learners' attention was maintained throughout by giving them individual tasks to complete in a short time. Letaba indicated that teaching with IWBs is interesting because it uses colour and motion. He highlighted that his lesson objectives were achieved because he used presentations rather than writing on the chalkboard. He emphasised the importance of using IWBs and argued that IWBs provide many ways to present information. It was clear that the IWB enhanced collaboration among the learners and the teacher. Letaba took advantage of the multimedia affordances of the IWB to present visuals and content in various formats. There was evidence of a smart classroom as the IWB was synced with learners' tablets and he used his laptop to display extra content.

Indwe

Indwe is classified as an advanced IWB user. He has four years of teaching experience, has been teaching Mathematics for three years, and has been using an IWB for more than a year. He can navigate through educational programs installed on the IWB and easily link the IWB with a laptop and the learners' tablets. He said that the IWB influences learner participation by making *"teaching easy because it has applications that support enquiry learner and learner independence*" and confirmed that learners are "*highly focused on learning materials that shows 2D and 3D diagrams and that the use of the IWB retains learners' attention because they become problem solvers rather than simply being passive learners*". He also stated that collaborative activities such projects forced learners to interact among themselves as well with the content and teacher. Indwe said the IWB and the internet allow both learners and the teacher to interact with a variety of sources while teaching and learning. He said that the IWB helps him deliver content differently from the traditional teaching approach because he uses "*innovative methods of teaching and learning by effectively using ICT, demonstrating experiments and drawing of graphs by means of GeoGebra*". The use of various applications with features such as sound, three-dimensional images and videos help him accommodate diverse learners. The installed e-books help him focus on the scope of the subject, and his lesson objectives are always met.

Discussion

The level of IWB integration varied for all six participants, and there was evidence that professional development and support opportunities are needed. However, the study shows that using IWBs in the classroom can transform teaching and learning. The multimedia affordances, such as digital learning objects, sound, images, animations, e-books and colours, enable the creation of smart classrooms. It was clear that teachers' pedagogical inclinations also plays an important role in the adoption and integration of IWBs as pedagogical tools. Across the Grade 11 classrooms in the two schools, the IWBs' effect on student behaviour was the same. The replication of classroom activities on the IWBs seemed to enhance interactivity and allow learners to participate on the IWB. All the teachers agreed that one of the IWB's pedagogical affordances is supporting interactivity in the classroom.

Mogalakwena's ability to use the IWB to support learner interaction was limited, but he demonstrated its affordance to support interactivity by allowing learners to discuss and respond to questions on the IWB using tablets. Indwe and Letaba agreed that an affordance of IWBs is retaining learners' attention. Indwe stated the IWB allows learners to become problem solvers rather than remain passive learners. Letaba said that IWBs can only support interactivity if learners are given tasks that retain their attention, and that this enables learners to become problem solvers. He also stated that project-based activities forced learners to seek help from their colleagues and teachers. The responses from the teachers seem to suggest that when IWBs are used in the classroom, there is evidence of learner-learner, learner-content and learner-teacher interaction. Teachers are becoming aware that they should not dominate the lessons as this will lead to less interactivity. High classroom interaction is realised when teachers have less control over the lesson (McGee, 2003). In interactive classrooms learners become independent and self-driven and their thinking skills are improved. This confirms Soo and Bonk's (1998) idea that interaction among learners encourages collaboration and discovery during learning. The participants demonstrated how the affordances of IWBs can support interaction in the classroom.

The data presentation showed how IWBs facilitated interaction among learners, content, and teachers, which relate to Carmean and Haefner's (2002) theory of knowledge construction through interaction. Regardless of the participants' ICT skills, using IWBs made learner-centred lessons rather than teacher-centred lessons possible. IWBs' ability to accommodate various teaching approaches is seen as one of its most powerful features, and it could be seen in how it influenced the way the teachers delivered their lessons. Limpopo and Pongola explained that the interactive nature of IWBs helped them plan, prepare and deliver lessons in a more concrete and expressive manner. Programs such as GeoGebra allow the participants to teach Mathematics using graphics. GeoGebra forced the participants to link the learners' textbooks with what is drawn and manipulated on the IWB. Tugela's and Mogalakwena's teaching approaches have been influenced by the IWBs to a certain degree, although they still use it as a chalkboard. They have not taken advantage of the pedagogic affordances of IWBs. However, the use of different colours to highlight and emphasise concepts has surely made an impact on their lessons.

Letaba and Indwe spoke at length about how their teaching has been influenced by the IWB. They were both adamant that the traditional teaching method denies learners the opportunity to interact with subject content in different formats (visuals, audio, 2D and 3D dimensions). Letaba highlighted that the IWB can be linked with learners' devices to share content, which means that learners do not have to spend time copying notes. Teachers can address learning barriers and preferences by using videos, animations, and graphics. Indwe explained that the availability of the internet on the IWB benefits both learners and teachers since they can interact with a variety of sources. Letaba and Indwe emphasised that the IWB influenced their teaching approaches because they became facilitators of knowledge rather than knowledge givers. Learners are now exposed to many forms of content because of the innovative nature of IWBs. Hence, the multimodality of IWBs enables learners to conceptualise content in a more ergonomic way, and their focus tend to increase when visuals are used. Tugela recommended the use of IWBs because it promotes innovative thinking. Pongola creatively used the IWB to expand teaching and learning opportunities by accessing a variety of extra audio-visuals and other material on the internet to accommodate all learners' competence level and diversity.

The internet makes extra material accessible, helping learners become critical thinkers when they are challenged by new content. Mathematics is an abstract subject, and teachers find it difficult to relate it to learners' life experiences. However, Indwe demonstrated how he leverages the multimodality of IWB to bring real life experiences into the classroom through videos, audio and animations. All the participants' classroom practices showed that they have adopted a modern teaching approach that encourages active participation as well as enquiry-based and self-regulated learning through IWBs. This is in line with the findings of Hammond (2010), who advocated for cognitive affordances that serve as learning interactions between cognition and technology. Angeli and Valanides (2009) regarded cognitive affordance as a concept associated with pedagogic ICT affordances because they both relate to the interaction between the cognition and technology. There is evidence that the affordances of IWBs give Maths teachers the opportunity to transform their teaching and enhance the learning of mathematical concepts.

Learners have been challenged to think and interact with each other using a variety of stimuli, such as verbal, visual and kinaesthetic (Wong, 2013). There is evidence that IWBs can transform pedagogies in the classroom and act as a catalyst for change in education. The pedagogically diverse activities among the six teachers showed that the critical aspect of adoption is the level of technological knowledge, which enables learner-learner and learner-content interaction. However, Mogalakwena was not limited by the level of his technological knowledge, and he developed a reciprocal relationship with the learners to help him use the IWB. The learners were of great assistance, and it enabled teacher-learner interaction. The multiple representations of mathematical figures on IWBs enable learners to develop a distinctive mathematical knowledge, which is different to general everyday knowledge (Smith, Higgins, Wall & Miller, 2005). Through colouring, highlighting and shading figures, the participants in this study managed to emphasise and explain mathematics concepts in a simpler way. This is in line with De Vita, Verschaffel and

Elen’s (2014) notion of multiple visualisations, which suggests that IWBs have the affordance of multiple visualisations that helps reinforce conceptual learning. The use of different colours and shading brings more clarity to the figures and they become distinct from ordinary figures. However, for teachers to achieve high interactivity in the classroom, they are advised to construct activities that encourage active participation and collaboration. The affordances of IWBs coupled with proper pedagogic practices are known to influence learner-learner, learner-teacher and learner-content interaction (Manny-Ikhan et al., 2011).

Conclusion

The primary research question the study aimed to answer is ‘How do the pedagogical affordances of IWBs support learner-content, learner-teacher and learner-learner interactions in the teaching of Mathematics in Grade 11?’. The research study showed that the participants pedagogically used IWBs to support a dialogic classroom. This supports Alexander’s (2006) argument for a dialogic classroom that supports social interaction among teachers and learners. Beauchamp and Kennewell (2010) argued that IWBs allow a whole class of students to share, create and explore subject content. The differences in the integration of IWBs is attributed to access to professional development opportunities and support based on the teachers’ level of technological knowledge. Thus, professional development opportunities must be differentiated as lack of “information regarding IWB’s pedagogy and pedagogical practices could lead to teachers” delivering knowledge that is insufficient and ineffective (Wong, 2013:2). De Vita et al. (2014) insisted that IWBs affect classroom interaction since it can enhance demonstration and modelling. Teaching with IWBs differs from traditional teaching since rich, blended learning and teaching materials can be accessed and presented with ease. This requires teachers to plan and prepare lessons with more content knowledge. The teachers in this study acknowledged that IWBs enabled them to store and retrieve content for future use, and their planning and lesson presentations revolved around linking previous content stored in the IWBs in the form of e-books or e-content.

The ability to link content from e-books with what is written on the board has encouraged teachers to teach with multiple screens. This captures learners’ attention since they can relate what is explained with what is on the e-book. Sharing Mathematics content from IWBs to learners’ tablets enabled teachers to focus more on explaining mathematics concepts and be less worried about the time it takes learners to copy notes. The ability to share content instantly within the classroom created collaborative and collective learning based on team work and social cohesion. Hence, IWBs’ multimodality enables teachers to teach using different learning objects. Wong (2013:4) asserted that the versatility of the “IWB supports several different learning styles such as visual-spatial, auditory and kinaesthetic”. Hence, IWBs afford teachers a pedagogic teaching approach that encourages learners to learn through watching, listening, touching and moving objects around. However, in order to maintain an innovative teaching level in the IWB classrooms, teachers must constantly research and become lifetime learners.

The pedagogical practices of Mathematics teachers in the IWB-enabled classrooms showed a gradual adoption of contemporary digital pedagogies. The IWBs’ pedagogical affordances continue to create social and active interaction among teachers and learners. The secondary township schools in Gauteng province are in their first decade of exploring teaching using IWBs, and challenges ranging from adoption to adaption of these ICTs are inevitable. The positive impact of IWBs’ pedagogical affordances in the delivery of Mathematics content is evident in this study. Moreover, Mathematics teachers were exposed to new pedagogical opportunities with which learning was mediated and without which dynamic interaction could not be realised. The study also illustrated the interaction process that happens in many forms, such as demonstration, modelling, dialogue and scaffolding, and this encourages meaningful and active learning. An important outcome of the analysis of the findings is the provisioning of differentiated professional development opportunities for all teachers. The teachers in this study showed that IWBs provided them with scaffolding mechanisms that enable them to practically teach and interact with mathematics concepts in a modern and meaningful manner.

Note

The Ethics Committee in Education of the Faculty of Humanities, acting on behalf of the Senate, granted ethical clearance with Protocol Number: 2017ECE045M.

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Review

Article ID: 2296

Review Guidelines

(Indicate your answer by highlighting the relevant word)

1. Importance of article/Relevance and appeal to national / international scholars	Excellent	Good	Moderate	Poor
2. Original and independent research	Excellent	Good	Moderate	Poor
3. Presentation and readability	Excellent	Good	Moderate	Poor
4. Statement of problem(s)/aim(s)/objective(s)	Excellent	Good	Moderate	Poor
5. Theoretical basis/Theoretical framework/Literature review/Clarification of concepts	Excellent	Good	Moderate	Poor
6. Appropriateness of (if applicable)				
6.1. Research plan and design	Excellent	Good	Moderate	Poor
6.2. Data-collection and procedure	Excellent	Good	Moderate	Poor
6.3. Data analysis	Excellent	Good	Moderate	Poor
6.4. Data presentation/Discussion	Excellent	Good	Moderate	Poor
6.5. Conclusion/Recommendations	Excellent	Good	Moderate	Poor
7. To what extent is the line of argumentation in the article clear, cohesive and logical?	Excellent	Good	Moderate	Poor
8. Contribution to theory	Excellent	Good	Moderate	Poor
9. Contribution to practice	Excellent	Good	Moderate	Poor

Comments for the editor’s attention

Here are some things that need fixing:

Abstrack

1. It is important to know that the abstract contains an introduction, method, result and conclusion
2. The methodology is not clear, the research methodology that has been used is not written down

Method

1. In the methodology section: Is it enough just to observe? No triangulation process?
2. For research design, it would be better equipped with coding that refers to what keywords will be explored
3. Data analysis is not enough just a description, but it is necessary to explain what keywords you want to analyze

Finding

1. In the results or findings section, it is necessary to explain what keywords are the findings in the form of coding so that the findings will be more clearly read
2. Writing the results of the interviews will be better equipped with the context of what is being asked, what you want to explore so that keywords appear as part of the findings
3. When writing the name of the respondent, has permission been obtained from the respondent? Is it necessary to disguise it with initials?

Discussion

1. The discussion section is tailored to the findings that involve important outcome keywords

Comments for the editor’s and author’s attention

Final decision

(Please choose only 1 answer by highlighting the relevant choice)

a) Acceptable without revision
b) Acceptable with revision not requiring reconsideration by referee
c) Acceptable with revision requiring reconsideration by referee
d) Resubmit elsewhere