



SANDBOX RESEARCH COMPENDIUM 2021



EMERGING INSIGHTS FROM THE SANDBOX SCHOOLS PROJECT

The Sandbox Schools Project is a multi-year research project that seeks to explore what 'education for a fast-changing world' could look like in South African public schools



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Acronyms and Abbreviations

4IR	Fourth Industrial Revolution
CAPS	Curriculum and Assessment Policy Statement
CLP	Competency-based Learning Programme
DBE	Department of Basic Education
ERQ-CA	Emotion Regulation Questionnaire for Children and Adolescents
GEC	General Education Certificate
ICT	ICT Information and Communications Technology
LMS	Learning Management System
LoLT	Language of Learning and Teaching
MiSP	Mindfulness in Schools Project
NECT	National Education Collaboration Trust
PSRIP	Primary School Reading Improvement Programme
R&C	Robotics and Coding
R&D	Research & Development
SCC	Scratch Coding Club
SEL	Social Emotional Learning
SGB	School Governing Body
SLP	Structured Learning Programme
SMTs	School Management Teams
STEM	Science, Technology, Engineering and Mathematics
SWOT	Strengths, Weaknesses, Opportunities and Threats
UJ	University of Johannesburg

Executive Summary



Executive Summary

There is growing evidence and acknowledgement that education systems around the world need to evolve to better equip young learners with relevant skills and competencies for a fast-changing world to enable them to succeed in an uncertain and complex future. The NECT's innovation unit, known as the Edhub, works to better understand and contribute to the local evidence base on this topic. The Sandbox Schools Project is the Research and Development (R&D) mechanism within the Edhub where primary research is conducted in 11 local schools in order to prototype, iterate and learn from approaches to developing skills and competencies in South African learners.

In 2021, as the Sandbox Schools Project commenced its second year of research, the COVID-19 pandemic continued to accentuate the volatility of the fast-changing world and foregrounded the urgent need for education systems to better prepare teachers and learners for this reality. The impact of the COVID-19 pandemic on the education system also highlighted the importance of the ability of all components of the education ecosystem to work collaboratively together in support of a shared vision.

This research compendium is a collection of learnings emerging from the Sandbox Schools Project in 2021. Despite the disruptions and challenges experienced due to the COVID-19 pandemic, the Edhub team implemented and conducted research on several interventions in the Sandbox Schools. The key findings and lessons from the research are highlighted below, with more detailed articles on each intervention accompanying this summary.

Key Insights from the Sandbox Schools Project Interventions 2021



COMPETENCY-BASED LEARNING PROGRAMME (CLP)

Timeframe: Jan 2020 to date

A competency-infused structured learning programme in Grade 1 Home Language, consisting of daily lesson plans, classroom resources, quarterly training, light-touch coaching and ongoing support.

Key insights:

- o The CLP programme is well-designed and delivered
- o Teachers' pedagogical content knowledge (related to literacy) has improved
- o Teachers need time and practice to master the literacy methodologies and to grasp an understanding of the competencies





MINDFUL CLASSROOM

Timeframe: Sep – Nov 2021

A daily mindfulness-based routine at the Grade 5 level designed to equip teachers with 5-10 minutes of mindfulness activities and practices they can do in the classroom.

Key insights:

- o Teachers observed benefits of facilitating mindfulness in the classroom
- o There is a need to increase the teacher training duration
- o Challenging to implement mindfulness in large classrooms



ROBOTICS AND CODING (R&C)

Timeframe: Aug – Nov 2021

A series of teacher training workshops, provision of lesson plans of the curriculum-prescribed practical tasks, teacher support throughout the implementation process and the provision of R&C kits which learners used in Natural Science and Technology group projects.

Key insights:

- o Inadequate digital literacy a bottleneck to effective teacher training
- o Teachers struggled to grasp the fundamental content concepts
- o WhatsApp is the most effective channel for providing teacher support
- o Learners expressed positive sentiments towards the R&C group project and perceived positive educational impact



SCHOOL CULTURE FOR A FAST-CHANGING WORLD

Timeframe: March 2020 to date

Series of participatory workshops with school leaders to co-create an environment conducive to learning in a fast-changing world.

Key insights:

- o Technology and digitisation are essential tools in creating future-fit schools
- o Strengthening school-community partnerships is essential for successful teaching and learning in rural primary schools
- o A neuroleader is the future-fit leader
- o Focusing on social-emotional learning for school leaders, teachers and students, is key to the effective management of schools during a global pandemic





INITIAL TEACHER EDUCATION FOR A FAST-CHANGING WORLD

Timeframe: Jan 2020 to date

Sandbox-aligned studies conducted by postgraduate students at the University of Johannesburg (UJ) focused on teacher preparation for the fast-changing world.

Key insights:

- o Learning to design competency infused lessons should intentionally invoke deliberate practice
- o Pre-service teacher education must be geared towards the development of adaptive expertise because of the complex and evolving nature of teaching
- o Designing play activities that challenge student teachers to think innovatively and enhances their creativity
- o Creating a context conducive to creative learning through a scratch coding club helps pre-service teachers to develop transversal skills



① Introduction to the EdHub



1 Introduction to the EdHub

The Edhub is the innovation unit of the National Education Collaboration Trust (NECT). We design and drive education innovation to assist the South African basic education system in preparing for the demands of a fast-changing world. We learn on behalf of the system about education practices that are relevant to the changing world, and we explore how these practices could impact, at scale, the South African education system. We do this through iterative Research and Development (R&D) within the Sandbox schools and Advocacy within the broader education sector. Learnings emerging from the Edhub are used to inform shifts in both policy and practice.

This research compendium is a collection of emerging learnings in 2021 from the R&D unit within the Edhub, the Sandbox Schools Project. Also known as the Sandbox, this is a multi-year research project that explores approaches to competency-embedded education in South African public schools. The Sandbox schools are a group of 11 quintile 1-3 schools based in Limpopo and Soweto. The aim of the Sandbox is to prototype teaching and learning practices for a fast-changing world within the context of a typical public school in order to gather evidence on practices and models that could be considered for use in South Africa. These learnings are shared with the Department of Basic Education (DBE) and education sector stakeholders to inform dialogue and system transformation. Emerging learnings are shared with education stakeholders, providing both practical tools for programming and contributions to the advancement of theoretical understandings in the field; this is achieved via formal and informal channels such as dialogues, research papers, book chapters and policy briefs.



② 2021 Sandbox Intervention Mix

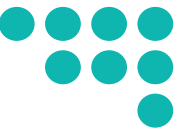


2 2021 Sandbox Intervention Mix

The Sandbox has selected a handful of niches to research within the broader theme of 'skills and competencies for a changing world'. A rigorous selection process is undertaken to determine which interventions to include in the Sandbox Schools Project. On average, an intervention is prototyped for a 3-year period, and in some cases, shorter interventions are included to respond to a changing external context such as the COVID-19 pandemic.

Intervention	Description
Competency-based Learning Programme (CLP)	A structured learning programme that deliberately and systematically incorporates skills and competencies for a fast - changing world into the teaching of Curriculum and Assessment Policy Statement (CAPS) subject content. Core to the intervention is a lesson plan guide for teachers, which illustrates where and how to incorporate competencies into their daily teaching.
School Culture for a Fast-changing World	The School Culture for a fast - changing world intervention works with school principals to establish the leadership principles and practices necessary to cultivate an environment conducive to teaching and learning in the fast-changing world.
Mindful Classroom	A daily mindfulness-based routine at the Grade 5 level designed to equip teachers with 5-10 minutes of mindfulness activities to do in the classroom with their learners.
Robotics and Coding (R&C)	A short intervention with Grade 6 Natural Science and Technology teachers and learners using robotics and coding to understand how learners enact collaboration in small groups.
Playful Project-Based Learning	A playful project-based learning intervention with Grade 5 learners in Life Skills in Term 3. <i>(This was a collaboration with the DBE E3 initiative).</i>
Initial Teacher Education for a Fast-Changing World	A series of interventions in initial teacher education at UJ. <i>(This was a collaboration with the Education faculty at UJ).</i>





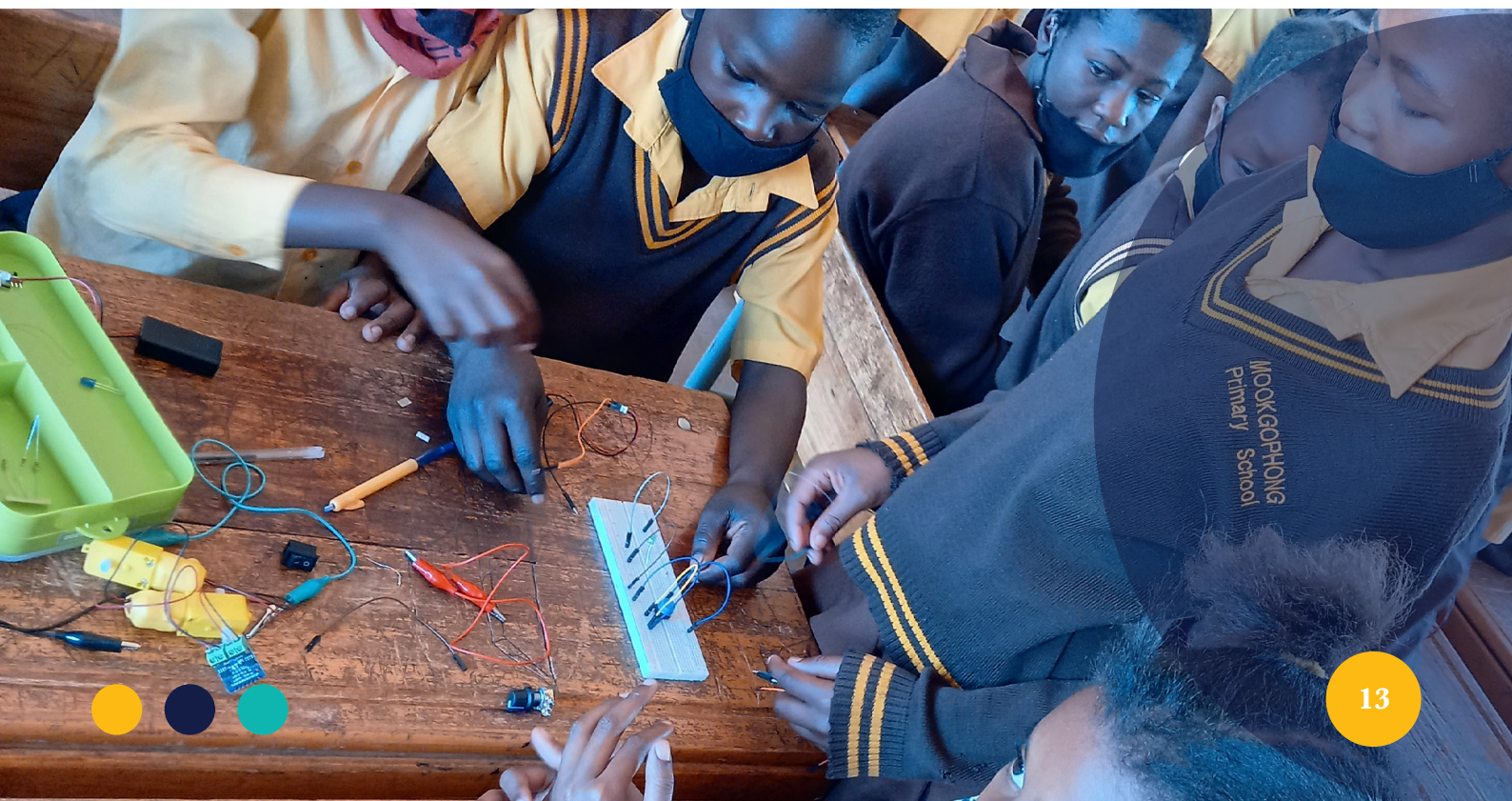
2021 Reflection

Towards the end of the relatively complex year of 2020, the Edhub evaluated the shifting demands of the education sector alongside notable shifts in the global education landscape. Reflections focused on the value the Edhub might add to the sector within the emergency COVID response measures, relative to maintaining a focus on reimagining education in the medium to long term.

Key learnings from this process influenced the Sandbox Schools Project focus for 2021:

- **Anchoring on building back better** – Whilst the Edhub made appropriate adjustments to programming within the Sandbox Schools Project to ensure the relevance of interventions to schools during the pandemic, the strategic orientation of the Edhub remained rooted in making contributions to rebuilding the system over the medium to long term, with relevance to the fast-changing world.
- **Leveraging opportunities presented by COVID-19** – The pandemic played a role in shaping educators' perceptions and attitudes towards the need for education in a fast-changing world. The Edhub saw an uptick in the appetite for approaches to education that equip our learners, teachers and principals with the skills they need to thrive in a changing world.
- **Skill and competency framework development** – The feedback from Sandbox schools educators emphasised the need for a common language and shared definitions of the terminology used. This feedback made it clear that developing an underlying competency framework would benefit not only educators, but all stakeholders.

Despite the challenges and disruptions experienced due to the COVID-19 pandemic, the Sandbox team implemented and conducted research on several interventions in 2021. The key insights from each intervention are shared via the articles in this compendium.



3 Infusing Competencies into Daily Lessons: Key Insights from the Competency-based Learning Programme



3 Infusing Competencies into Daily Lessons: Key Insights from the Competency-based Learning Programme

In our complex and fast-changing world, there is increasing acknowledgement that formal education systems globally are not adequately preparing young people for life after school (Fadel, Bialik & Trilling 2015), and that schools need to foster a breadth of competencies that will enable young people to better navigate an uncertain future (Winthrop, 2018). While the Brookings Institution found that the current South African curriculum contains many of these social, emotional and cognitive competencies, it highlighted a number of challenges regarding the deliberate and systematic implementation of the competencies in practice (Care, Kim, Vista & Anderson 2017). In this context, the NECT EdHub seeks to explore how we can better equip learners and teachers in South African public schools with the skills and competencies needed for success in the 21st century and beyond.

3.1 Explicit Competency Development

As part of the ongoing work to understand how to deliberately infuse skills and competencies into the CAPS curriculum, the Edhub designed and launched the Competency-based Learning Programme (CLP) in Grade 1 Home Language in 2020. The CLP is a structured learning programme (SLP) that seeks to support teachers in developing both foundational literacy skills and competencies for a fast-changing world through content and pedagogy. The programme embeds specific competencies into a structured, CAPS-aligned tool that many public school teachers are familiar with (structured learning programmes), thereby providing teachers with the necessary scaffolding to deliberately infuse these competencies into their teaching.

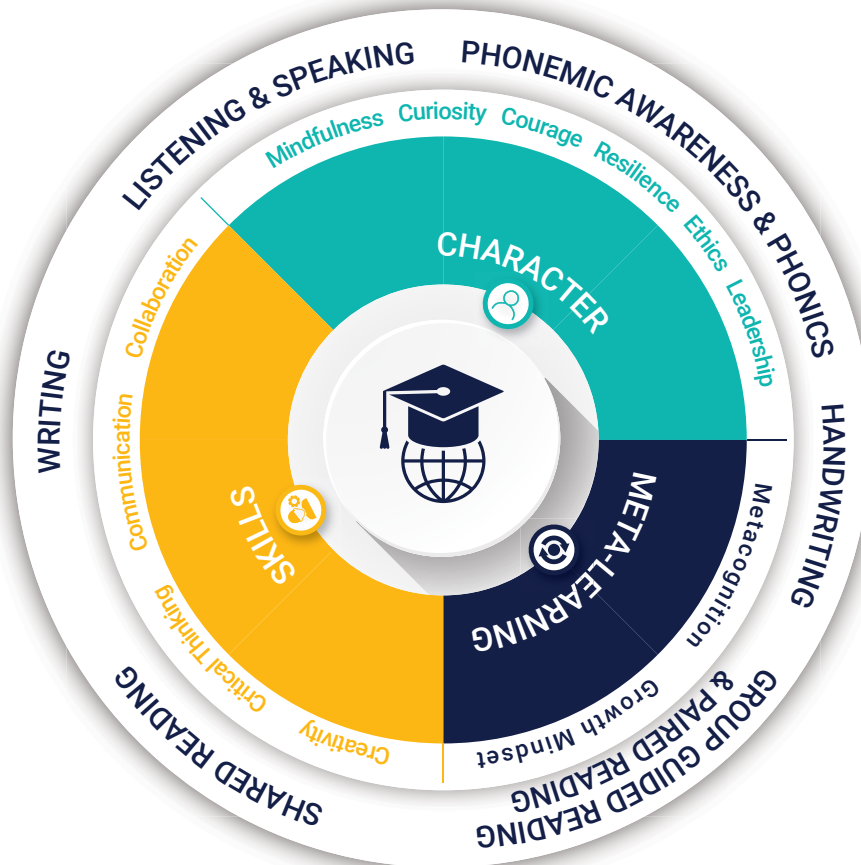
The underlying premise for this intervention is that the approach may be applied to any subject, in any grade. For the purposes of learning, and to improve the design of the intervention, we have chosen to prototype the CLP in Grade 1 Home Language lessons.

The programme consists of materials for teachers – including a detailed lesson guide, Big Book of themed stories per term, supporting classroom resources, light touch coaching and quarterly training on how to implement the methodologies. The programme revolves around a structured weekly routine, which is designed to develop a set of prioritised competencies while teaching the literacy skills outlined in the curriculum. This is visualised in the competency framework in Figure 1.





Figure 1: Competency-based Learning Programme framework (CLP)



3.2 2021 EXPERIENCES

It is important to acknowledge the role that the ongoing COVID-19 pandemic has played in shaping experiences in the classroom over the past year and a half. While the CLP was designed and launched in Term 1 2020, the pandemic and lockdown measures severely disrupted the first year of research and implementation, so that many of the planned training and data collection activities could not take place. In addition, the prolonged implementation of rotational timetabling to comply with social distancing requirements has had an adverse effect on teachers' abilities to deliver the curriculum. Studies from other provinces suggest that Foundation and Intermediate Phase learners in resource-constrained schools may have lost 50-75% of a year of learning in 2020 (Mohohlwane & Shepherd, 2021).

The impact of this disrupted learning was a recurring theme in feedback provided by the CLP teachers in 2021, many of whom highlighted the challenges they faced in trying to ensure that learners grasped curricular content despite only attending school on alternate days or weeks. The additional psychosocial burden of the pandemic on teachers and learners should also be taken into account when contextualising these experiences and insights from the classroom.





3.3

Emerging Themes and Insights from Educators' Experiences

The insights are drawn from research conducted with Grade 1 teachers at the Sandbox schools in 2020 and 2021. The CLP research included the following:

- Pre- and post-training assessments of teachers' knowledge related to the CAPS Home Language curriculum and the CLP training content in Term 1 2021;
- Post-training feedback surveys in 2020 and 2021 which focused on teachers' experiences of the programme;
- Informal verbal feedback collected by school-based project coordinators in 2021, based on a standardised set of questions.

The primary objective of the CLP intervention is to learn from the design and implementation of an intervention that deliberately develops competencies in learners, via CAPS subject content, so that (1) these learnings may contribute to the evidence on competency-based learning approaches in Global South contexts; and (2) this intervention may be considered for scale, if considered effective and feasible. The findings and insights presented below have guided revisions to the CLP and the development of recommendations regarding its evolution and adoption at a wider scale:

The programme is well-designed and delivered

Feedback from teachers in both 2020 and 2021 indicates that they appreciated the quality and design of the materials and training they received. This can be seen in responses to open-ended questions in the 2020 surveys and in verbal feedback to school coordinators in 2021, for example:

"The CLP materials are easy to understand and to use in lesson preparation and in using in class." (Foundation Phase teacher, Limpopo, 2021)

While teachers also provided feedback on specific errors in the materials, such as spelling errors or missing elements, the overarching sentiment expressed was appreciation for the programme.

Teacher's pedagogical content knowledge (related to literacy) has improved

The pre- and post-training test results indicate an improvement in teachers' knowledge of CLP methodologies and CAPS curriculum content, which is comparable to results from the Primary School Reading Improvement Programme (PSRIP) (NECT, 2020). However, as with other SLPs, the improvements are off a relatively low base of knowledge. In general, the CLP teachers' test scores are over 10 percentage points higher than the pre- and post-test scores of Foundation Phase teachers in the PSRIP. This is an indication that the teachers at the Sandbox schools displayed slightly better pedagogical content knowledge than the national average, both before and after training – shown in Figure 2 below.



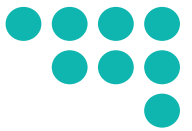
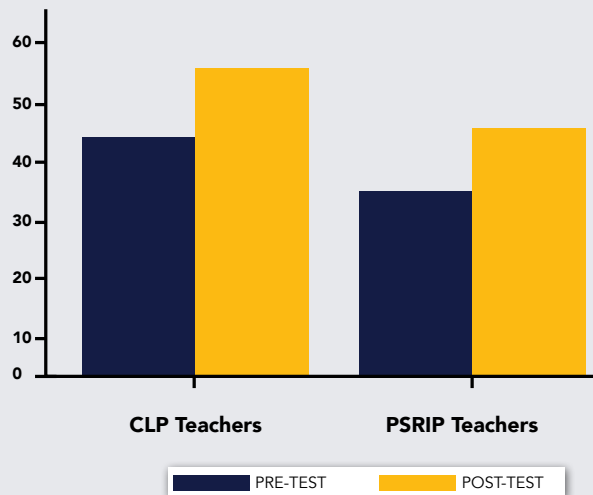


Figure 2: Programme content test scores of teachers in the PSRIP and CLP



Notes: 1. Programme content test score is the total score on teachers' knowledge of CLP or PSRIP training content.
2. Pre-test and post-test refer to results before and after the training programme, respectively.

Teachers need time and practice to master the literacy methodologies and to grasp an understanding of the competencies

The feedback from teachers suggests that they understood and appreciated the guidance relating to the implementation of literacy routines and methodologies to a greater extent than the competency-infusion aspects of the programme. For example, when asked what they found most helpful about the training, the majority of teachers in Limpopo mentioned guidance around reading (both shared and group guided reading).

Teachers also seemed to have a limited understanding of what the CLP aims to achieve; when asked what they understood the CLP to be, teachers' answers did not point to a distinct theme. For example some teachers defined CLP as: 'Programme to improve reading and writing skills'.

In contrast, both teachers at the research school in Soweto displayed a deeper grasp of the CLP, and one explicitly mentioned 21st century skills (a term often used interchangeably with 'competencies for a changing world').

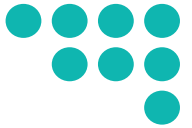


The materials systematically incorporate competencies – this could be made more explicit

Feedback from numerous critical reviews confirmed that competencies for a changing world have been deliberately and systematically incorporated into the programme. However, there were also recommendations that the programme's competency-infusion aspects should be made more explicit to support teachers' understanding of this key aspect. The feedback has led to the following revisions and additions to the programme:

1. Explicit tagging of competencies and sub-competencies in revised lesson plan materials;
2. Development of dual framework, outlining how literacy methodologies and competencies work together, for use in training and coaching;
3. Development of competency-focused training videos, explaining each competency in more depth and modelling how it can be developed in a Foundation Phase classroom.






Core Methodologies

Below are extracts from the CLP Lesson Plan materials which show how competencies and sub-competencies are explicitly tagged in the lesson plan:




Activity: Start-of-Week Goal Setting

Rationale	<ul style="list-style-type: none"> The aim of this activity is to help learners understand that they can take responsibility for some of their own growth and learning. They can do this by choosing what they want to improve or develop, and by planning how to do this. This is done in a routine way every week to teach learners a procedure for goal setting, that they can internalise and use on an ongoing basis.
Focus Competency	Sub-competency <i>How does this look in action?</i>
 Metacognition	Determining goals, plans to achieve those goals, and monitoring one's progress <ul style="list-style-type: none"> What is your goal? What strategies can get you there?
	Monitoring comprehension and managing information accordingly <ul style="list-style-type: none"> Are you on the right track? Do you understand what you are doing and why?
	Practising awareness and regulation of internal state <ul style="list-style-type: none"> How are you feeling right now? Why do you think you feel this way?



Activity: Oral Activities – Theme Vocabulary

Rationale	<ul style="list-style-type: none"> The aim of this activity is to extend learners' cognitive, conceptual and academic vocabulary, in order to improve reading comprehension and general knowledge. Another aim is to better equip learners with the language required to name and describe their feelings, which helps them to better understand and process these feelings.
Focus Competency	Sub-competency <i>How does this look in action?</i>
 Critical Thinking	Identifying, clarifying, and organising information <ul style="list-style-type: none"> Keep your ideas organised Draw or write your ideas in a way that you can share with others





Competency Development



Focus Competency CURIOSITY

Sub-competency	How does this look in the story?
Seeking to understand deeply	The teacher encourages her learners to think deeply about how people in other countries learn.
Seeking out novelty and trying new things	For the learners, the Chinese way of life is new. By communicating with Chinese pen pals, they will experience new things. Kagiso even tries to use chopsticks, something he has never done before!
Seeking different perspectives to broaden understanding	The learners gain new perspectives about what Chinese learners do at school. They compare this to what they do in a South African school. They broaden their understanding of schools around the world.



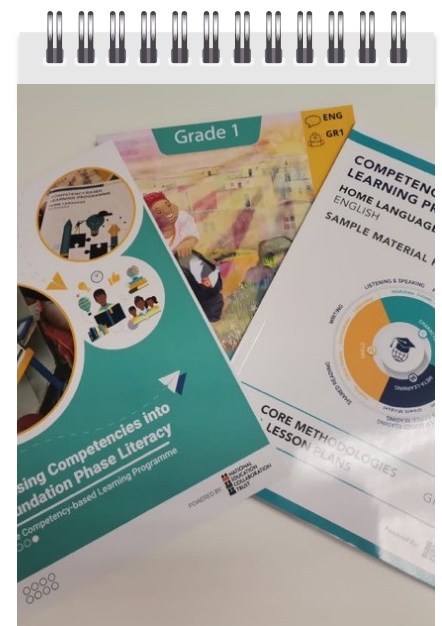
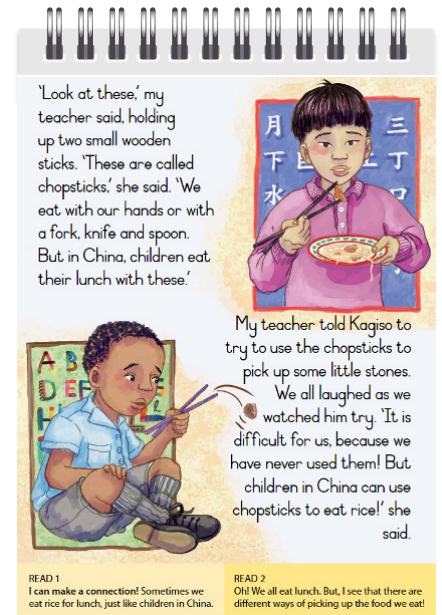
Focus Competency COLLABORATION

Sub-competency	How does this look in the story?
Taking and sharing responsibility with others	Bongi helps her dad get the backyard ready for the braai, by taking on the responsibility of watering the grass.
Utilising each individual's unique skills and perspectives	Each family member uses their skills to prepare for the family event: Bongi and her dad prepare the backyard; Anna keeps the younger children entertained.
Navigating and resolving interpersonal conflict	Even though Anna wants Bongi to play with her, Bongi cannot because she has to help her dad. Bongi has to learn how to say no to her friend without creating a conflict situation.





The Big Book is part of the materials that are provided to teachers under the CLP programme. The Big Book is made up of themed stories for each term. Below are some extracts from the Big Book:





Pacing is a challenge

Many teachers have found that it is difficult to keep up with the programme – a challenge commonly experienced by teachers across SLPs when first implemented (Piper & Dubeck, 2021). The teachers suggested solutions like shortening the Big Book stories or reducing the number of activities and new sounds introduced – for example:

“Teachers feel that doing two phonics per week is burdensome for the learners. The CLP doesn’t allow for repetition to emphasise the phonics concept for better grasping. One phonics per week should work better.”

(Limpopo school coordinator field notes)

Teachers may be experiencing this challenge for a range of reasons including mastering the routines and methodologies, understanding the cyclical nature of the programme, managing time, and managing classroom dynamics in large classes. These factors have also been exacerbated by the COVID-19 pandemic and rotational timetabling, which has drastically reduced the amount of teaching time available to cover the curriculum – even though it has been revised to focus on essential content.

Mindfulness has been successfully implemented and appreciated by teachers

Feedback from teachers in the programme, as well as insights from a school-wide Mindfulness intervention implemented in 2020, indicate that mindfulness exercises are relatively simple to incorporate into a classroom routine and are enjoyed by both learners and teachers. For example, when asked by school coordinators to identify what was working well about the CLP, many teachers mentioned mindfulness:

“Mindfulness – The learners enjoy doing the exercises. Mindfulness activities are helping a lot in preparing the learners mentally for class. Mindfulness activities help the learners to relax and concentrate. It relieves stress from the learners. Mindfulness has also improved communication between the teachers and the learners. The learners find it easier to open up to the teachers now.” (School coordinators)

This feedback suggests that although teachers may not necessarily demonstrate a deep understanding of how the competencies for a changing world are infused into the CLP, they are indeed practicing and appreciating some of the methodologies designed to develop these competencies, an example being Morning Mindfulness.





3.4 Conclusion and Recommendations

Insights from research conducted in 2020 and 2021 indicate that teachers are making progress regarding their pedagogical content knowledge related to literacy. Furthermore, the teachers' implementation of the routines and methodologies in the CLP is improving. However, they are also experiencing challenges covering the curriculum at the prescribed pace – a systemic challenge that has been exacerbated by the COVID-19 pandemic and rotational timetabling. The teachers also seem to have a limited understanding of how and why the CLP infuses competencies for a changing world into teaching practice. In response to the research findings, the EdHub is in the process of developing a series of competency-focused training videos in local languages for the Foundation Phase, designed to help the teachers understand how and why the CLP infuses competencies into teaching practice. Based on the research insights, we propose the following recommendations for the CLP going forward:

- Add assessment to the CLP – incorporate assessment of competencies into the prototyping process to better understand how we might integrate these adaptations into school-based assessment in the Foundation Phase.
- Consider aligning CLP with the General Education Certificate (GEC) – given the overlap between the GEC's intentions of assessing General Capabilities (aka competencies), there is opportunity to pilot the CLP in selected subjects in Grade 9 to align with these assessment outputs.
- Expand the CLP prototype to selected grades – consider rolling the CLP out to all Foundation Phase grades for Home Language to build on the competencies being developed in Grade 1.
- Expand the CLP prototype to selected subjects – consider prototyping the CLP in other subjects.
- Evolve the competency framework – adapt and strengthen the competency framework based on feedback from local teachers and prototyping experiences.
- Localise terminology – develop shared terminology for the competencies in local languages.
- Programme name change – consider changing the name of the intervention from 'Competency-based Learning Programme' to 'Competency-embedded Learning Programme' - a more accurate description of how competencies are infused into existing subjects.

There is a need to continue to learn about the CLP in practice, and this can be achieved by expanding the prototype into a larger pilot. The piloting could perhaps be done with schools that have experienced success in implementing traditional structured learning programmes in order to get a deeper understanding of implementation and outcomes at a larger scale and in a variety of contexts.





3.5 References

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Well-Being Matters: Exploring a Culture of Mindfulness in the Classrooms



4 Well-Being Matters: Exploring a Culture of Mindfulness in the Classrooms

There is a broad agreement among different education stakeholders that educational systems should support children to develop emotional and social skills in order to nurture meaningful relationships and become emotionally and socially responsible individuals. Research suggests that education systems that cultivate social-emotional competencies and mindful presence in learners through mindfulness practices may be what the world needs to prepare children to withstand adversity and positively respond to challenges in a fast-changing world (Lantieri, Nambiar, Harnett, & Kyse, 2016). With this in mind, the Sandbox team decided to introduce the Mindful Classroom intervention in the Sandbox schools in order to explore how to cultivate learners' social emotional competencies and mindful presence through daily mindfulness practice. Insights from this exploration will guide the design of more long-term future interventions related to mindfulness practice; while mindfulness is not a designated subject like History or Maths, it can easily be woven into the fabric of classroom learning.

The Mindful Classroom intervention focuses on the socio-emotional learning that needs to take place for children to regulate their own emotions and build a network of cognitive and social skills. The ability to regulate emotions is constructed over a lifetime, but explicitly learning the skill earlier is advantageous. Children with better emotional self-regulation are calmer in class, interact reasonably with peers and respond to teachers with more focused attention (Bailey & Jones, 2019).

4.1 Mindfulness Practice as the Facilitator of Emotional Regulation

Mindfulness practice is a process of purposefully cultivating self-regulated attention towards present-moment experiences compassionately and without judgment, attachment to any point of view or the need to change those experiences. The benefits of mindfulness practice in school contexts have been extensively documented. For example, the Mindfulness in Schools Project in the UK found that integrating mindfulness practice into the school day trains learners' brains to be better equipped to learn and enhances emotional regulation (MiSP, 2021).

Important to the South African context, there is evidence that implementing social and emotional activities, including mindfulness, in schools benefits all children; however, it disproportionately benefits children from low-income communities because the majority of these children experience higher levels of adversity and trauma resulting from insecure access to housing, food, health care and safety (Franke, 2014). Teaching children the skills they need to identify and manage emotions and to self-regulate, along with addressing their physical, mental and emotional needs, can guard against the negative effects associated with anxiety and stress (Center on the Developing Child at Harvard University, 2016).





4.2 The Mindful Classroom Intervention

The Mindful Classroom is a 12-week structured intervention that introduced a daily 5-10 minute mindfulness-based routine at the Grade 5 level in five of the Sandbox Schools. The goals of the intervention are to: (1) investigate the feasibility of implementing mindfulness activities in South African primary schools; and (2) assess the effectiveness of the data collection instruments. Although, designed as a 12-week structured programme; however, COVID-19 restrictions resulted in the start date being delayed, and the programme was implemented over six weeks. The mindfulness activities were 5-10 ten minutes long, and included a range of exercises such as:

1. Body scan exercises: These exercises draw attention to feelings and sensations in all parts of the body, bringing awareness to how each part feels.
2. Seated meditation exercises: Learners sit in an upright position with their eyes closed, and direct attention to their breathing.

Of the 10 Sandbox Schools in the Waterberg District, five schools were identified as control schools and the other five as treatment schools. Control schools were aware of the mindfulness practice intervention, but were excluded from the training and did not receive any mindfulness practice support. Thirteen teachers from the five treatment schools were virtually trained by the Sandbox team during a 2.5 hour workshop. In addition, teacher support was provided during implementation of the Mindful Classroom intervention; the support included light-touch coaching and a WhatsApp group.

4.3 Situating the Intervention: The first questionnaire

We conducted a pre-exposure survey to get an idea of how teachers defined mindfulness and also to assess the degree to which teachers reported endorsing mindfulness practice. In total, 23 teachers from both the control and treatment schools responded to the online pre-exposure questionnaire. Teachers were either in an older grouping (45-55 years old) or in a younger grouping (25-35 years old).

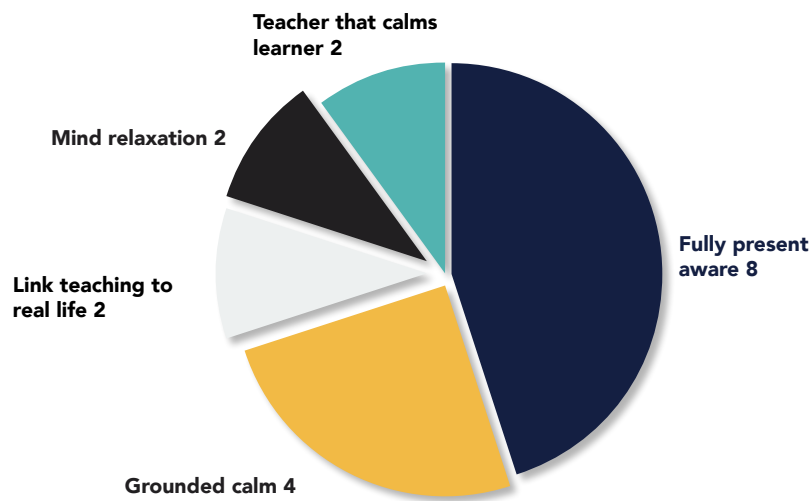




Teachers' definitions of mindfulness

When asked, an open-ended question, how they define the concept of mindfulness practice, eight out of the 23 teachers defined it as being fully present or aware (see Figure 1). Four teachers defined mindfulness as being grounded and calm.

Figure 1: Definition of mindfulness



Teachers' endorsement of the mindfulness practice

Teachers mainly endorsed the mindfulness concept, answering 'maybe' or 'yes' to all the questions (see Figure 2). Most teachers said they would recommend mindfulness practice as a classroom tool. However, only a few perceived mindfulness as a realistic way to improve their lives outside the classroom: only seven out of the 23 respondents said 'maybe' mindfulness practice is a realistic way to improve their lives.

Figure 2: Endorsement of Mindfulness





Learners' emotional regulation

Before implementing the intervention, we administered an Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA), which was designed to assess two aspects of emotional regulation: reappraisal and suppression, where reappraisal is classified as an adaptive strategy and suppression of emotion as a maladaptive strategy for long-term emotional management. A total of 383 learners from the Sandbox Schools answered the ERQ-CA, and there were slightly more boys (52%) in the sample. The sampled learners attended schools in which the Language of Learning and Teaching (LoLT) is an African language until the end of Grade 3, with the language of instruction changing to English in Grade 4.

While the ERQ-CA should have been read verbatim as per the administration guidelines, there were schools where the children struggled to understand the English version, resulting in the need for code-switching. Although code-switching is considered in the data analysis, the linguistic problems (not understanding the items) caused noise and error to the extent that no valid or reliable inferences can be drawn from the ERQ-CA data analysis results.

4.4 Findings after Implementation

At the end of November, post implementation of the intervention, we interviewed five out of 13 teachers from the treatment schools. The interview questions included a section about the training, for example: 'What were your experiences of the training received for the mindfulness classroom?' The interview guide also contained a section on implementing the mindfulness practices, with questions such as: 'What has been your experience thus far with facilitating mindfulness in class?'



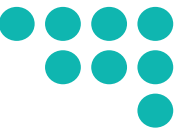


Table 1: Insights emerging from end-line teacher interviews

Themes	Description
1. Training experiences and challenges	<ul style="list-style-type: none"> a. Some teachers highlighted that they needed more training time (at least 1 week) and interaction with other groups/participants b. The majority of the teachers found the training challenging – some felt alone and found the new material difficult to comprehend
2. Applications in classrooms and favourite mindfulness exercises	<ul style="list-style-type: none"> a. Applying mindfulness exercises with other staff members before meetings b. Mindfulness exercises are calming and relaxing for both learners and teachers c. Favourite exercises: breathing and smelling the flowers; blowing out the candle; a place you have been
3. Benefits observed by teachers	<ul style="list-style-type: none"> a. Reduced fighting and conflict b. Improved learners' focus as they paid more attention after mindfulness activity c. Increased awareness of their surroundings d. Learners were calmer and could face their emotions
4. Personal views and perceptions	<ul style="list-style-type: none"> a. Change in teacher behaviour: teachers will feel more positive towards mindfulness if they continue to use the practice b. It starts with the individual, requires buy-in and time c. Teachers feel strained due to teaching in COVID times, which makes implementing a new practice difficult
5. Challenges observed by teachers	<ul style="list-style-type: none"> a. Mindfulness exercises are not practiced outside the classroom by learners b. Learners want to play during mindfulness activities – they don't take mindfulness seriously c. In large classrooms, it is challenging to implement mindfulness – working with small groups is best (approximately 15 learners) d. Most teachers feel uncertain about the value e. Learners need practical demonstration – instructions alone are not useful f. Requires discipline from the teacher, have to use it continuously to see the benefit
6. Suggestions for the future	<ul style="list-style-type: none"> a. The teachers suggested expanding the programme to more classes, subjects, schools and teachers b. Include learners in training – learners need more input to understand mindfulness and its value c. Training improvement: face to face rather than online





4.5 Conclusion and Recommendations

The Sandbox team gathered several learnings and insights from designing and implementing the Mindful Classroom intervention. The research findings highlight that it is feasible for teachers to implement the mindfulness practice in classrooms, but some factors such as large classes make it more challenging (working with small groups of approximately 15 learners is best). Encouragingly, the majority of the teachers endorsed the use of mindfulness activities in the classroom.

However, we also observed that at the beginning of the implementation, some teachers struggled to understand the value of practicing mindfulness; although the long-term use of the mindfulness practice may reveal its usefulness, in the short-term, rewards or awards could be offered to teachers and learners to motivate them to continue with the practice. The research findings also suggest that teachers' training experiences and the eventual implementation of the intervention could be enhanced by providing in-person training, increasing the training duration and allowing the teacher to build networks and form peer relationships. Some studies suggest training the teachers for 15 to 45 minutes per week over a period of 8 to 12 weeks.

With regards to insights on learners, the linguistic problems (not understanding the items) caused noise and error to the extent that no valid or reliable inferences can be drawn from the ERQ-CA results. We recommend the development of a contextualised (South African) Emotional Regulation Questionnaire (ERQ) for African language learners. During interviews, teachers reported observing the benefits of conducting mindfulness activities with their learners in the classrooms; this highlights the importance of providing teachers with tools such as mindfulness practice to aid in classroom management and also enhance the socio-emotional learning of children.

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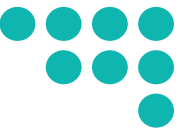
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**5 Evolving School Culture to
Respond to the Fast-changing
World**



5 Evolving School Culture to Respond to the Fast-changing World

5.1 Reflections on Sandbox School Culture Stream

By: Professor Kat Yassim, University of Johannesburg, Dept of Education Leadership and Management, Faculty of Education

We began 2021 with 'making sense of an upside-down world' (see Found Poem). This poem, created by the Sandbox school principals, set the tone for deliberations for the year. Based on a SWOT analysis during the first engagement, and after consultation with their respective school management teams (SMTs), the Sandbox school principals selected, the projects that would lead the research direction of the school culture stream. Each project cluster created a plan of action that suited their individual context, while at the same time providing an opportunity to collectively learn from each other. The three projects were:

1. **Leading digital readiness** (Dikubu Primary School, Lekkerbreek Primary School, Mmamakwa Full Service School & Albert Luthuli Primary School)
2. **Leading teacher well-being** (Dagbreek Primary School and Mmampatile Primary School)
3. **Leading the strengthening of school-community partnerships** (Hector Peterson Primary School, Mookgophong Primary School, and BB. Matlaila Primary School)

This reflection focuses on each of the projects and how they developed throughout 2021.



LEADING DIGITAL READINESS

Enabling school digital readiness

The COVID-19 pandemic catalysed a need for school leaders to focus on the digital readiness of their schools, given the full closures and rotational timetables put in place. In this regard, four of the Sandbox schools led the digital leadership project. Each school had a different orientation to the project because resource differences meant that priorities differed. Mmamakwa Primary School offered every teacher a laptop using funding received towards their focus of being a full-service school. Dikubu, Lekkerbreek and Albert Luthuli were securing laptops for their staff; however, resources still had to be shared. The schools aim was to reach the point of one teacher, one laptop, and one student, one tablet. All the Sandbox schools worked ardently at securing the dream mentioned above. In addition, Lekkerbreek Primary School realised that there was a





need for a generator, modem and data allocations outside of school. Through intervention by and support from the school governing board (SGB), the Lekkerbreek Primary School secured a generator and 20 modems with a monthly data allocation; the resources were shared amongst staff members as needed. Together with the DBE's support of providing digital resources, each school worked actively to secure as many digital gadgets as they could. Increasingly, priority was given towards developing a fully-fledged digital school. In this regard, at Lekkerbreek, many administrative functions and meetings with staff and others transitioned online.

Tiered digital professional development

In tandem with resources, staff development took priority. Formal training through workshops and other online webinars and opportunities were encouraged. Staff categorised into those with beginner, intermediate and advanced technology skills assisted in developing in-house programs that support teachers at schools. All schools noted that younger teachers seemed to be leading technology expertise; as a result, the information and communications technology (ICT) committees at all of the schools involved were chaired by younger teachers who created a program to empower older colleagues. These younger teachers were nominated to participate in the DBE and UJ's coding and robotics offerings. In many instances, school principals volunteered to learn from more technologically advanced staff. Parents were also involved, for example, at Lekkerbreek, a parent volunteer took the lead towards teacher and learner ICT development. Every staff member and learner was timetabled into regular ICT workshop sessions in the computer lab.

FUTURE PLANS

Future plans entail continued development of teachers towards teaching, learning and pedagogical development using technology as a teaching resource. The inclination is to further equip learners with resources that would enable them to learn at home with technology. The desire to develop tools and expertise for online learning has become a reality. Many strategic decisions focused on digital development and meeting the need for the development of 21st century skills. Certainly, COVID-19 created the perfect storm for such aspirations in schools that had been labelled or conceptualised as deficient. The story changed from 'we do not have' to 'what can we do with what we have?' The seeds were sown for an interest in digital development as school principals also engaged with their own self-development.

At the Principals' Conference held on 1-2 September 2021 (see Principals Conference Blog), Principal Andries Makgoba represented the group in a presentation that yielded much praise. Members of the audience commended the Sandbox school principals by labelling them 'can-do leaders'. Their work as digital leaders was captured in two UJ MEd research projects and is described in the section School Culture Research Studies below. The principals' digital stories can be accessed through (Digital Stories).





LEADING TEACHER (AND LEARNER) WELL-BEING

A customized approach to healing

Two of the Sandbox schools, Dagbreek Primary School and Mmampatile Primary School led the teacher (and learner) well-being project. The need for such interventions emerged due to the COVID-19 related stigmatisation that a few staff members and learners experienced after recovering from COVID-19. For example, a staff member, upon returning to school, was isolated by colleagues, and parents refused to send learners to her classroom, Principal Manne took the first steps towards addressing well-being issues at Dagbreek Primary School. Together with her SMT member, Ms Sithole, they attended the Africa Voices Dialogue online engagement and several workshops on well-being. Their first point of departure was distributing an online survey; teachers were asked about their fears, their well-being concerns and the details of the stresses they were experiencing. In addition, teachers were asked about what they thought would be useful interventions that would help them embark on managing well-being at this school. The results of this survey resulted in several interventions:

- More time was devoted by the principal and SMT to teacher and learner well-being. Principal Manne called this 'an open-door policy' where a deliberate effort is made to observe teachers and visit their classrooms to enquire about well-being;
- A talk was given by a COVIDd-19 expert who assisted with information sharing, responding to questions and correcting misconceptions; and
- A team of psychologists from the local hospital was brought in to support individual teachers and learners who were experiencing trauma.

Investing in healing circles

In the case of Mmampatile Primary School, Deputy Principal Pilane saw a need to focus on well-being because of the trauma experienced by learners and staff members. This school collectively decided to invest in 'healing circles (see Yassim & Pilani, 2021)'. These healing circles were created through an authentic inclusion of safe spaces for courageous conversations and the inclusion of the local pastor who led the prayer and spiritual health activities needed for these circles.

The next steps for the school are centred around the work of 'life righting', where healing is supported through writing. In the coming months, it is anticipated that the SMT, selected Life Orientation Teachers and some health professionals from the parent body will be trained in the writing for healing initiative. The concept of writing could be transferred to voice-noting as another alternative for audio journaling.





These innovations are extensions of making access to healing possible. Art as therapy would be another avenue of exploration for this school. It must be noted that these schools did not adopt an Eastern or Western notion of well-being; they crafted an African orientated approach that taps into the familiarity and life-world of the communities that they serve.

The work of well-being leaders was captured in research conducted by one UJ MEd research project, an extended abstract of the research and key findings is provided in sections below.

LEADING THE STRENGTHENING SCHOOL-COMMUNITY PARTNERSHIPS

The last project cluster comprises of three Sandbox schools: Hector Peterson Primary School, BB Matlaila and Mookgophong Primary School. These schools focused on developing a 'Maslow before Bloom' approach based on values-based leadership (see Yassim, 2021). Serving some of the poorest communities, these schools prioritised the inclusion of all stakeholders in addressing the challenges that COVID-19 brought to the schools. Below are some of the interventions that were implemented:

- **Community partnerships:** Hector Peterson Primary school Principal Mahapa partnered with various spaza shops in the farm labourer community that the school serves; as parents do not have access to technology, communication from the school was posted on the spaza shop walls and learner materials were dropped off and collected from the spaza shops.
- **Corporate involvement:** Tiger Brands, a company present in this farming community, was contacted by all three schools to provide a breakfast programme. These schools supplemented DBE food programmes with their food garden produce as well as the inclusion of breakfast from Tiger Brands.
- **Home visits:** Learner absenteeism was addressed through home visits. During home visits, the teachers sometimes found homes where learner neglect and abuse seemed to be prevalent. In this regard, the schools invited the police, social services and the health department to create an action plan that facilitated learner safety and well-being.
- **Community volunteers:** Support for home-schooling was addressed by seeking out educated (matric and beyond) but unemployed youth in the community. Learners whose homes did not have support were allocated tutor groups that were run by various community members.

A podcast (<https://podlink.to/fspA>) further describes some of these developments in terms of school-community partnerships over 2021. At the principals' conference, Hector Peterson Primary School's Rebecca Mahapa presented the developments in this group project.





CONCLUDING THOUGHTS

A lot was achieved amidst a pandemic that brought with it both crises and opportunity. Through this forced opportunity, the Sandbox school principals were able to develop a learning community commensurate with a fast-changing world. Their commitment to leading their schools towards imperatives that support a digital world and one in which human beings are central to the academic project means that they have moved beyond the Rubicon – the move towards the (Im)possible. The general leadership conversations have eclipsed the deficit notion of ‘we don’t have’ to “what can we do with what we have?” As we project into the future, the main question we ask is: How do we extract the learning from the transformation of cultures of learning and make it available for all leaders leading South African schools? We believe that exposure to the praxis of the theoretical orientations of the transformation processes employed in this pilot of ten schools offers others a pathway towards authentic and sustainable change. We plan on developing a self-study short learning programme, inviting other leaders to learn about an approach to leading sustainable change that is not a one-size-fits-all nor a recipe-book best practice approach, but is rather a call to reading the context, working with a school community and building a co-created participatory culture of a learning process that is constantly evolving – for a fast-changing world. The following sections will provide the key insights from the various school culture research studies that were conducted by students and faculty members at the University of Johannesburg for each of the three school culture projects that were discussed above.

5.2

Future-fit Leaders for Future-fit Schools: Principal narratives of leading rural primary schools for 4IR imperatives

By Frenchesca June Clark, University of Johannesburg, Faculty of Education

The research project aimed to understand the kind of future-fit leadership strategies employed by school leaders that result in future-fit schools. The focus was on rural primary schools in Limpopo. Through a literature review, we were able to define: future-fit education; the fourth industrial revolution (4IR) and the opportunities and challenges it brings for education; leadership styles and the leadership of rural primary schools; and the challenges faced by rural school leaders. A qualitative research approach was used in the study. Ten principals of rural primary schools in Limpopo responded to the research questions using WhatsApp voice notes. Their responses were converted into narratives from which digital stories (see Digital Stories) were created.



EMERGING THEMES AND INSIGHTS

After data collection, the responses were thematically analysed and coded in order to find the emerging themes and insights:





The importance of a neuroleader as a future-fit leader

The four key competencies of a neuroleader are performance, collaboration, innovation and agility. The leaders should also be resilient and creative and stay up to date with the latest innovations and changes in education.

Future-fit education

Technology and digitisation are essential tools in creating future-fit schools. Infrastructure also needs to be improved to help with the digitisation of schools.

The fourth industrial revolution

The educators should ensure that they have the necessary skills to maximise the use of digital equipment in their schools to equip their learners adequately for a 4IR world.

Rural school leadership in a time of crisis

Collaboration, innovation and agility are contributing factors in managing the challenges of leading rural primary schools, especially during a crisis such as the COVID-19 pandemic. The study revealed that the pandemic re-emphasised the need for the various stakeholders such as the education department, SGB, SMT, parents, teachers and learners to work together. The various stakeholders are dependent on each other for successful teaching and learning in rural primary schools; they need to network and collaborate.

Supplementing learners' nutrition

The research findings revealed that due to poverty, learners in these schools are dependent on the National Schools Nutrition Programme (NSNP); therefore, it helps if schools can supplement the learners' nutrition by planting and maintaining vegetable gardens.

Diversified communication channels

The study highlighted the importance of creating and using a school Facebook page and WhatsApp groups to communicate with parents because communication is vital in the successful leadership of any school. Spaza shops also played a role in passing messages from the schools to caregivers/parents and learners in their communities.



CONCLUSION AND RECOMMENDATIONS

Since the study included ten rural primary school principals in Limpopo, the findings can be generalised to other rural primary schools in Limpopo. The principals and educators need to stay up to date with the latest changes in education and continually improve their digital skills so that online teaching and learning can become standard practice so that in case of a future crisis, learning need not be interrupted. Finally, more research is needed to explore the possibility of having fully digital rural schools with a rotational timetable that includes days of online lessons and some days in school.





5.3

Digital Leadership: Towards developing an innovative technology-led culture of learning in rural Limpopo schools

By Thangeni Fulufhelo, University of Johannesburg, Faculty of Education

The research study was designed to explore the kind of digital leadership required to develop an innovative technology-led culture of learning in rural Limpopo schools. The literature reviewed emphasised that digital leadership in schools is one of the solutions for the educational challenges arising from the COVID-19 pandemic. Pre-COVID-19, educational leaders were leading face-to-face, but during the COVID-19 lockdown, leaders were forced to use a new online approach. In this study, a qualitative research approach was used in which semi-structured interviews and focus group discussions were conducted for data collection. Three school principals participated in one-on-one interviews and one focus group discussion.



EMERGING THEMES AND INSIGHTS

The main results from the data analysis and key insights are presented below:

Digital leadership in schools

The research findings highlight that digital leadership plays a crucial role in the changing world of technology. Digital leadership must be implemented to prepare learners for the 4IR, for online teaching and learning and for communicating with stakeholders.

Factors leading to digital leadership in schools

The study revealed factors that lead to digital leadership in schools, namely: accessibility of digital tools; involvement of stakeholders; using young newly-qualified teachers from universities; and verbal motivation.

Lessons for implementing digital leadership in schools

Leaders must manage resistance to change by involving all staff members or informing them about the digital change. To ensure effective digital leadership implementation, leaders must inform the staff members about the plans and consider their ideas to avoid resistance to change. To facilitate effective digital leadership in schools, digital leaders must make sure that all the digital tools in the schools are functional and encourage all staff members to use the tools.

Moreover, leaders must not lock the digital devices in storerooms when they go to meetings; staff members must be able to access the devices and familiarise themselves with the digital tools. To ensure a technology-led learning culture, leaders must continuously engage in professional development programmes to enable them to operate emerging digital tools. Professional development can be done through personal development, professional learning communities or departmental training.





CONCLUSION AND RECOMMENDATIONS

The qualitative research study revealed how school leaders can develop an innovative technology-led culture of learning in Limpopo schools. Steps include the leaders' continuous use of digital tools which helped them lead digitally during the pandemic and can help them to lead in the fast-changing world. Effective digital leadership is essential because we live in the era of the 4IR, which has changed the way we live and work. It is recommended that principals, as digital leaders, must ensure that staff members and learners have access to digital tools so that they can become familiar with them. It is recommended that digital leaders use different strategies when approaching their staff members as staff are less likely to resist digital leadership if leaders approach them appropriately. Therefore, there is a need for the SGB, SMT and teachers to discuss the matter of digital tools before implementation to avoid resistance to change. More research studies are needed to assess the socioeconomic challenges of digital leadership as most of the existing studies do not consider this aspect.

5.4

Leading with the Head, Heart and Hands: Social Emotional Learning in Rural Primary Schools

By Mariska van Reenen, University of Johannesburg, Faculty of Education

Several studies have found that social emotional learning (SEL) leadership has been effective in maintaining a positive learning culture during the COVID-19 pandemic. This study examined whether an SEL leadership approach positively impacted the learning culture in low quintile Limpopo schools. The study was underpinned by the Head, Heart and Hands Transformational Leadership Model. In addition, three other relevant leadership theories, namely transformational leadership, distributive leadership and vision setting leadership, were considered.

This study explored the different leadership approaches of school leaders in the Limpopo schools and their influence on the culture of learning at their schools during the COVID-19 pandemic. Moreover, the study explored the challenges that contributed to the lack of positive and effective learning environments.

A qualitative research approach based on phenomenological thinking was adopted. As part of the study, the school leaders explored the implications of leading their schools during and after a crisis such as a global pandemic using the Head, Heart and Hands Transformational Leadership Model. The key learnings and insights from the research are highlighted below:





EMERGING THEMES AND INSIGHTS

Distributive leadership

Focusing on SEL for school leaders, teachers and students was key to managing schools during the COVID-19 pandemic. The study also revealed that some schools were initially unfamiliar with SEL and its importance. School leaders stated that they had little knowledge of stigmatisation and staff well-being in general and emphasised the importance of ongoing training in order to understand these concepts better.

Open and effective communication

In order to cultivate and sustain a positive culture of learning, open communication between school leaders, teachers, learners and parents is essential. This study revealed that it was easier to provide support for all staff and learners when SEL was understood better through a transformational model such as the Head, Heart and Hands Transformational Leadership Model. The findings suggest that when school leaders and teachers are involved through consultation and training, unity and trust are developed, directly impacting how teachers manage students.



CONCLUSION AND RECOMMENDATIONS

Considering that the research only involved two schools, the study's findings cannot be generalised to all primary schools in Limpopo. Nonetheless, the impact of a better understanding of SEL leadership approaches is evident in the effective management of the two schools. Notably, the research findings indicate that education leaders and teachers should be compassionate, communicative and empathic in order to build good relationships with learners and maintain a positive and effective learning culture. It is recommended that school leaders participate in ongoing training on SEL, distributive leadership and staff well-being based on the Head, Heart and Hands Transformational Leadership Model. Principals who receive professional development would be better equipped to deal with multiple aspects of change and their confidence in instructional leadership would be enhanced (Miller, Goddard, & Schroeder, 2016).



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⑥ Cultivating Competencies for a Fast-changing World through Robotics and Coding



6 Cultivating Competencies for a Fast-changing World through Robotics and Coding

6.1

An Exposure to Robotics and Coding Kits: Providing opportunities for group work

In South Africa, socio-economic challenges faced by some learners directly impact their ability to access educational resources such as Robotics and Coding (R&C) kits. In 2021, as part of our work to understand how the education system can deliberately develop competencies for a fast-changing world in learners, the EdHub worked closely with CRSP dsgn to implement the R&C intervention in four primary schools that are part of the Sandbox Schools project.

The goal of the intervention was to contribute to the growing body of knowledge on how educators and learners relate to R&C in South African classrooms and how to prepare educators for using R&C in teaching and learning. For this intervention, we chose to locate the R&C treatment within an existing CAPS subject that requires group project-based learning. The intervention addressed the following two key research questions:

1. What are the opportunities for project work using R&C in Grade 6 Natural Science and Technology?
2. What is the nature of the collaboration within an R&C intervention for Grade 6 Natural Science and Technology projects?

In other words, the Edhub used the R&C intervention as a vehicle to: (1) understand the nature of collaboration among learners in project-based learning; (2) determine if learners' working with robotics kits facilitates the development of competencies for a fast-changing world such as critical thinking, communication, curiosity and problem-solving techniques; (3) observe teachers' uptake of and experience with the R&C kits we provided them.



THE SANDBOX R&C INTERVENTION

R&C facilitates learning that focuses on designing, building and doing programming, thus encouraging learners to be creative and think critically when they face challenges in solving problems. Furthermore, with R&C group projects, the learning activity changes the role of teachers and learners: traditionally, teachers transfer knowledge (lecture method) to passive audiences, while in R&C, practical tasks give learners a more active role in learning.





The intervention was initially designed as a teacher-facilitated, opt-in extracurricular club for Grade 4-7 learners, focusing during 2020 on project-based 4IR-themed activities. However, due to the COVID-19 pandemic, the extracurricular activities in schools were wholly stopped by the DBE; this necessitated a different approach to giving learners access to R&C kits. The intervention design was reviewed and updated into an in-curriculum, project-based application in the Grade 6 subject of Natural Science and Technology. The R&C kits were utilised in curriculum-based group science projects prescribed for learners during Terms 3 and 4.

The intervention consisted of: training teachers in R&C applications and the in-lesson integration of this knowledge and technology; providing lesson plans for the curriculum-prescribed practical tasks that the teachers selected to do with the learners; supporting teachers throughout the implementation process; providing Grade 6 learners with R&C kits to use in Natural Science & Technology small group projects in class.

Figure 1: CRSP ROBO Micro:bit V2.0 Coding Kit (with 20 boards, battery packs, USB cables & guides)





The initial plan was to conduct 6 x 1,5 hours teacher training sessions; however, after assessing the effectiveness of the initial training sessions, the number of sessions was increased to 13. A total of eight teachers were trained. The teacher training was conducted before learners' exposure to and application of the R&C kits and included the following key aspects:

- Introduction to R&C;
- Integration of R&C into Natural Science and Technology teaching and learning;
- Provision of lesson plans for the curriculum-prescribed practical tasks the teachers selected to do with the learners.

In addition to the synchronous training sessions, the teachers were given access to a course on the CRSP ROBO Learning Management System (LMS) to foster asynchronous teacher development. Teacher training content such as the presentations and Zoom recordings of teacher training sessions, quizzes, additional information and guided tutorials were hosted on the platform. All the teacher training sessions were uploaded onto CRSP dsgn's YouTube channel and Google Drive for the teachers to access. Throughout the project, teachers were provided with remote support, namely: hosting one-on-one school meetings; personalised support calls and messages; short-form videos with step-by-step instructions; and communication through a WhatsApp group.



EMERGING INSIGHTS FROM TEACHER TRAINING AND REMOTE SUPPORT

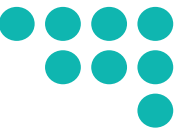
Inadequate digital literacy a bottleneck in effective teacher training

The lack of adequate digital literacy amongst most of the teachers was a bottleneck in effective teacher training as it hindered the ability of the teachers to complete the prerequisite tasks for coding tutorials - this essentially limited the pace of the training programme. For example, during the initial visual and block-based coding tutorials, some teachers were not familiar with the technique of dragging and dropping visual elements in a graphical user interface (GUI) using a mouse. Therefore, training facilitators had to provide remote guidance on the correct use of a mouse and keyboard to navigate, control and input data on a computer; this assistance was challenging to provide over a video conferencing platform.

Poor and limited internet access hindered effective teacher training and support

Poor internet connectivity resulted in a bulk of the training sessions being performed with the teachers' video feeds off, and this affected the ability of the facilitator to visually interact with the teachers during most parts of the training sessions. The poor levels of usage of the CRSP ROBO LMS, which was developed to foster asynchronous teacher development, could potentially be attributed to the teachers' limited internet access.





Teachers struggled to grasp the fundamental concepts behind building electric circuits

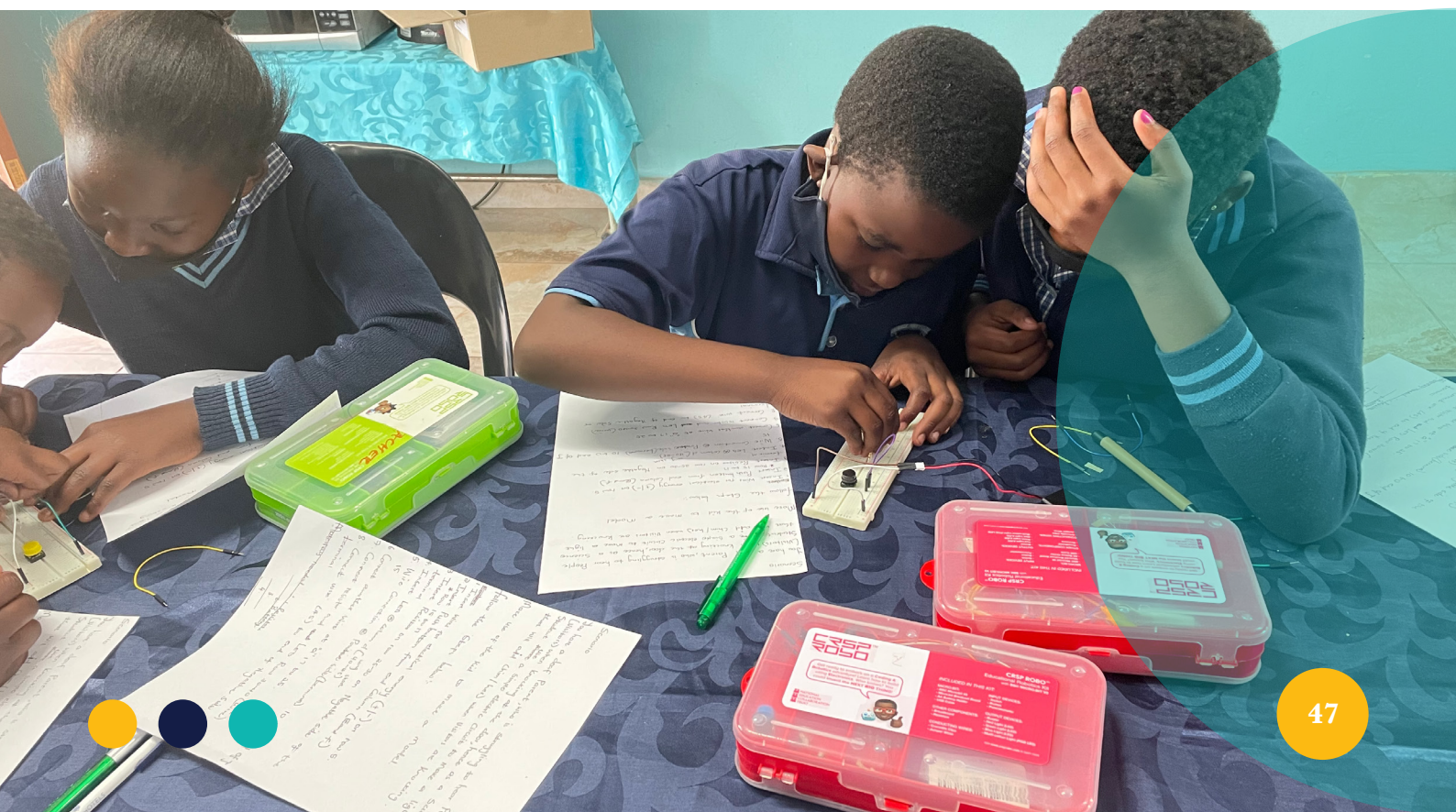
While teachers did not experience too much trouble building simple electric circuits using conducting wires, the majority of them experienced difficulty with grasping the fundamental concepts behind building circuits using breadboards. Despite a number of training sessions and tutorials spent on this topic, it proved challenging to reach an adequate level of competency. We decided to provide short-form video tutorials which proved to be effective in enabling the teachers to build electric circuits using breadboards in time for the planned classroom implementation and data collection.

Practical tutorials were more effective teacher development tools

Shifting the focus of training sessions to practical tutorials instead of theoretical lectures proved to be a more effective teacher development strategy since it facilitated the identification of troublesome areas and the provision of assistance to address them.

WhatsApp is the most effective channel for providing ongoing teacher support

WhatsApp was the only effective means to distribute learning content and communicate with the teachers. Email, YouTube, the LMS platform and Google Drive simply did not work well: this could potentially be due to the teachers' limited access to internet. At various stages of the intervention, teachers requested that most of the content (i.e., lesson plans, worksheets, website links and videos) be shared via WhatsApp. Shorter videos shared via WhatsApp yielded greater engagement and positive sentiments from teachers; these videos were most effective when shared right before the teachers needed to implement the specific content that the videos covered (i.e., Just-in-Time training).





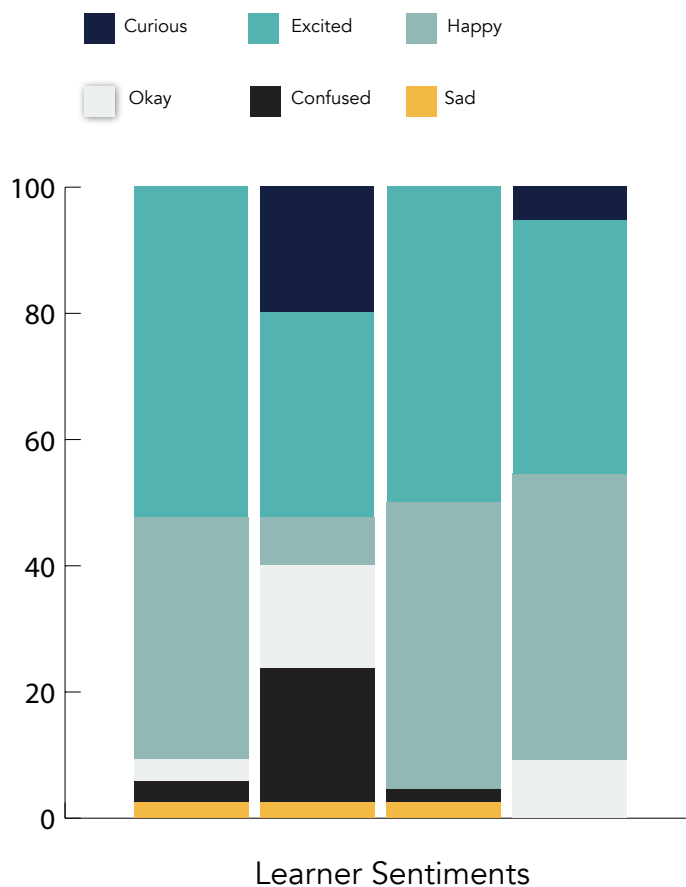
EMERGING INSIGHTS FROM LEARNERS' EXPERIENCES

Data on learners' experiences was collected through in-class observations and learners' lesson feedback slips. The findings and insights are presented below:

The majority of learners expressed positive sentiments towards the R&C group project

Most learners expressed that using R&C kits during the group project elevated their curiosity, excitement and happiness. However, some learners, predominantly from one school, expressed negative sentiments; this may be attributed to the strict teaching style that was implemented to facilitate the R&C group project at this specific school. In addition, the negative sentiments could be associated with the difficulty of using the kits: across the four schools, a few learners highlighted that they found it difficult to use the robotics kits.

Figure 2: Learner Sentiments towards R&C (Comparison by School)





Teaching style influences learner motivation/interest

The majority of learners across the four schools expressed interest and motivation in building projects using the robotics kits. A small percentage of learners in two of the schools expressed disinterest in working with the robotics kits in the future. This may be attributed to what we observed to be a strict and non-playful teaching style in School B, where about 20% of learners expressed disinterest, and the under-preparedness for the lesson by the teacher at School C, where only 5% of learners expressed disinterest.

Learners perceived positive educational impact

Edhub implemented two R&C interventions in schools in Gauteng before the 2021 intervention. Due to the insights gained from the previous prototypes and after reviewing the draft R&C curriculum, the EdHub chose to provide a robotics kit that would contain distinct electronic components instead of the modular electronic blocks that were developed and deployed in the previous R&C interventions in 2018 and 2019. Teacher training was in-person in 2019; however, due to the COVID-19 pandemic, training was virtual in 2021. Nonetheless, the data collected during the 2021 R&C intervention correlates with that collected in the 2019 R&C intervention. In general, there were very low levels of negative sentiment expressed towards the robotics projects in both 2019 and 2021. However, the negative sentiment was greater in 2021, as indicated by the number of learners who expressed being confused: in 2019, the percentage of learners who expressed that they were confused was about 6%, increasing to 13% in 2021. The increase in negative sentiment may be attributed to the 2021 robotics kits being more difficult to use than those used in 2019. In 2019 and 2020, a nearly identical percentage of learners expressed that they had learnt something new after the robotics intervention. This finding demonstrates that, in general, the perceived educational impact amongst the learners was not substantially influenced by the differences between the 2019 and 2021 R&C interventions and resources.



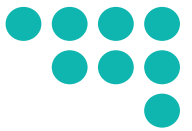
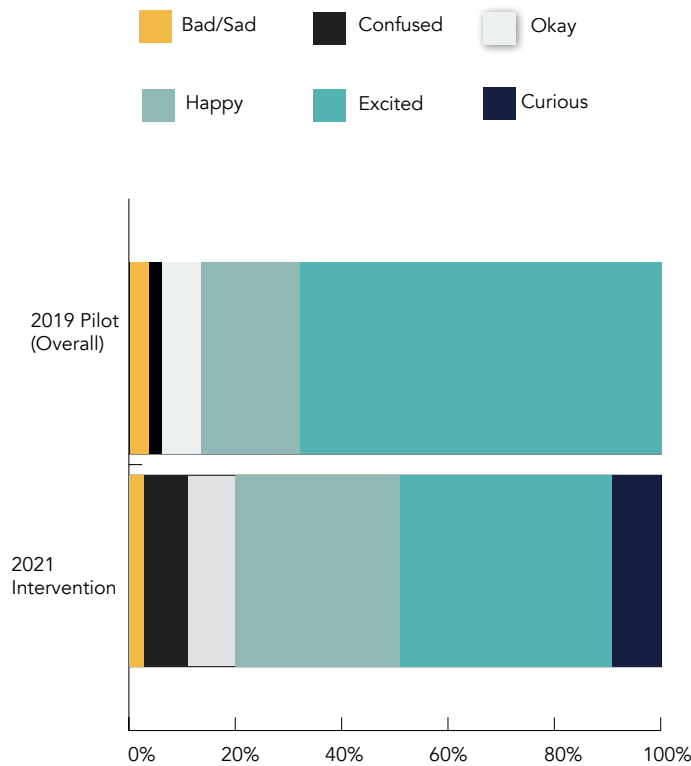


Figure 3: Comparison of Learner Sentiment (2019 vs. 2021 interventions)



CONCLUSION

Insights from this study highlight that it is essential to provide sufficient time and resources to enable teachers to adopt the use of R&C kits in their classes, bridge existing skills gaps and incorporate the relevant pedagogical methodologies into teaching. During the teacher training workshops, we observed that the majority of teachers experienced difficulty with grasping the fundamental concepts behind building circuits using breadboards and the general in-lesson use of the R&C kits. Therefore, prior to the implementation of R&C interventions, teachers should be provided with: training in R&C applications; training on the in-lesson integration of the R&C knowledge and technology; lesson plans for the curriculum-prescribed practical tasks; and short-form content videos with step-by-step instructions. In general, learners' feedback was predominantly positive, with the majority expressing high levels of excitement, curiosity and motivation towards using the R&C kits for project-based learning. A large proportion of learners expressed that they had learnt something new after using the R&C kits in group projects.

The next section will provide the key learnings and insights from another research study that was conducted as part of the Sandbox R&C intervention by a student from the University of Johannesburg. The study attempts to identify the various patterns of collaboration that typify projects where learners use robotics kits to learn about complex science constructs in the Grade 6 Natural Science and Technology class. Collaboration is one of the competencies that learners require to thrive in a fast-changing world.





6.2

The Nature of Collaboration in Grade 6 Natural Sciences and Technology Robotics and Coding Learner Group Projects

By Patrick Makhubalo, Jacqueline Batchelor and Sarah Gravett, University of Johannesburg, Faculty of Education

When learners use robotics kits as mediating tools to learn about science and technology, they invariably end up working on group projects. Through such projects, learners develop good attitudes toward scientific inquiry as they design and make various workable learning artefacts. Project-based learning is an active, learner-centred learning approach that emphasises learners' autonomy, stimulates proactive investigations, promotes goal setting, advances teamwork, and allows for reflection in real-world situations. In such project-based learning groups, learners tend to take on various responsibilities in a collaborative effort to solve problems, assuming real-world roles such as programmer, builder or analyst. There is usually a high level of coordination and division of tasks among learners as they share ideas and manage their duties.

When learners work together to solve problems using robotics kits, they often explore beyond the task itself, evoking multiple possible solutions before settling on the most viable option. Robotics can thus enhance teamwork and enable learners to develop various skills as they engage in the learning experience, generating new ideas whilst supporting other learners that lack knowledge in using robotics kits.

What is of interest in this study is the various patterns of collaboration that typify projects where learners use robotics kits to learn about complex science constructs in the Grade 6 Natural Science and Technology class. These patterns of collaboration can vary, given that participants might have different ideologies, propose contrasting ideas, have various ways of expressing themselves, possess different skills and display divergent approaches when learning and solving problems. To fully understand what the patterns of collaboration tell us about learning Grade 6 Natural Science and Technology using robotics kits, we rely on the Computer-Supportive Collaborative Learning (CSCL) framework in the analysis of observations.



IMPLEMENTATION AND RESEARCH

Four Sandbox schools participated in this research: three in the Waterberg district of Limpopo and one affiliated with UJ. Seven teachers were trained in four online workshops focusing on how to use the robotics kits and how to integrate robotics and coding using various strategies including setting project-based learning group tasks. Data collection comprised of eight video observations of project-based activities involving eight groups of five learners each, as well as four individual teacher interviews.

In the analysis of these project-based learning group activities in which learners used robotics kits, learners' attitudes and behaviour were closely observed, verbal and non-verbal communication categorised, the way learners co-constructed knowledge noted, the roles they assumed classified, and any barriers to participation documented. In their semi-structured interviews, teachers reflected on the design of the project-based group activities and their observations of learner collaboration.





EMERGING INITIAL INSIGHTS

Extended period of familiarisation required

Initially, learners were very reserved and hesitant to participate in group activities using the robotics kits that were very new to them. Observing COVID-19 protocols meant that learners were masked for the duration of the activities, impeding their verbal and non-verbal communication. At times they had difficulty hearing each other, resulting in many hands reaching for very small parts of the robotics kits simultaneously. Learners were more focused on the kits than on each other. They spent a considerable amount of time simply touching, moving and fitting parts together without any real objective apart from familiarising themselves with contents of the kits. This was an important phase of exploration, even though it became evident that boys were initially more active in handling the kits and less hesitant than the girls to get involved. The girls made up for the initial lag in participation with encouragement from teachers.

Freely sharing ideas without fear of failure

One of the teachers made a point of encouraging learners to put their ideas together and to give each other a chance. She reinforced the message that it was good to try different things, even if they did not work. Another teacher commented:

“Engagement was good simply because they were free and wanted to be seen to be working together and not to just dismiss an idea before trying it. Let us not tell each other that it will not work, try it first. If it does not work, let us start afresh. There is nothing wrong with getting it wrong as long as in the end it works.”

Learners increasingly became invested

As the task became more serious and artefacts started to be constructed, learners' interest intensified. One of the teachers stated: “They were so creative and invested. They even asked for more time to keep going at the end of the lesson.” A teacher observed some competition between groups and within groups:

“If you are telling them what to do, they do not have a view for themselves. You need to tell them what you want in the end, not how to do it. They need to figure it out for themselves and say to each other that when my idea is not working, someone else must get a chance to try as they compete with each other. If all subjects were as practical as the robotics kits, our learners will go far. They touch, they put things in practice, and they get so happy when they get a result.”





Leaners gained their teacher's respect

A teacher was surprised by her learners and said:

"Some of these learners have talents and can go very far using these robotics materials. They showed me as their teacher more that I knew what was possible. They were more knowledgeable than myself and I learnt something new from them. Because of this, I started to respect them more."

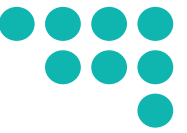
In subsequent data collection phases, we will delve deeper into the nature of collaboration and will focus more on the opportunities for project work using R&C in Grade 6 Natural Science and Technology. Learnings from this project can help initial teacher education institutions, researchers and practicing teachers understand the patterns of collaboration when learners use robotics kits in project-based tasks and thus strengthen the design of such activities.

"Patrick Makhubalo is a Master's student in ICT in Education at the University of Johannesburg Jacqueline Batchelor is an Associate Professor in the Faculty of Education, specialising in Digital Learning and Sarah Gravett is a Professor of Teacher Education and Development at the University of Johannesburg."





Initial Teacher Education and Competencies for a Changing World



7 Initial Teacher Education and Competencies for a Changing World

This section of the compendium provides key learnings and insights from several research studies on initial teacher education that were conducted by students and faculty members at the University of Johannesburg. All the studies explore approaches to deliberately embedding competencies for a fast-changing world into various aspects of initial teacher education, to ensure that pre-service teacher training remains current, relevant and enables future educators to be prepared for the demands of the fast-changing world.

7.1 Designing for Learning: A course on lesson design for pre-service teachers

By Sarah Gravett and Dean van der Merwe, University of Johannesburg, Faculty of Education

In 2020, we piloted a course for final year Bachelor of Education student teachers at UJ's Soweto campus on how to design lessons that place pupil learning at the centre and that integrate transversal skills/competencies into the teaching of learning content. The implementation of the course was researched using a comprehensive set of data, including analysis of the lessons that students designed, analysis of assignments submitted by students and interviews with students. The 2020 research informed the second iteration of the course, which was implemented in 2021. More research was conducted in 2021, resulting in further enhancement of the course. Based on the research conducted over the two years and the refinements that resulted, what are we teaching final year pre-service teachers about lesson design and why? Here we provide a snapshot of the course.

- **Lesson design approach:** The lesson design approach requires student teachers to show in the lessons they design how they plan to use specific teaching practices and why they plan to use these. The why relates to a core point of departure in the course: teaching is first and foremost about enabling learning. Good teaching thus presupposes a thorough understanding of the nature of learning and the learning process. The approach to lesson design requires that the reasoning underlying teaching practices be made explicit, drawing on core ideas (principles) derived from the science of learning literature. To enable student teachers to do this, a comprehensive document was developed for them to guide them. This document combined insights from cognitive psychology, developmental psychology, education and cognitive neuroscience literature that sheds light on the learning process and, by implication, how to teach in order to guide and support the learning of others. This document articulates the rationale of the course approach, the principles, classroom implications and suggested teaching practices.





- **Inclusion of competencies for a fast-changing world:** The document mentioned above also explains the why and how of including competencies for a fast-changing world/transversal skills, particularly communication, collaboration, critical thinking, creativity (the 4Cs), and metacognitive skills. The 4Cs and metacognitive skills are widely touted as essential in a fast-changing world. We make the case that these are not add-ons when teaching, but must be developed in tandem with teaching learning content. This is done through appropriate teaching practices. For example, critical thinking will be cultivated if teaching practices invoke critical thinking through using higher-order questions that elicit this type of thinking.
- **Deliberate practice:** Another point of departure is that learning to design lessons should intentionally invoke deliberate practice. This involves purposeful and mindful rehearsal to refine teaching practice. Part of the refinement includes making the thinking that underlies teaching practices/actions explicit.
- **Development of adaptive expertise:** Connected to deliberate practice is our assertion that pre-service teacher education must be geared towards the development of adaptive expertise because of the complex nature of teaching. Teachers who are adaptive experts make teaching decisions and execute teaching practices based on a deep conceptual understanding of why and under which conditions these teaching practices are suitable. We believe that the lesson design approach that we teach is contributing to the development of adaptive expertise. We saw evidence of this in the lessons that we analysed, and it was confirmed in the interviews conducted with the student teachers.

The course required student teachers to design lessons in a cyclic (iterative) fashion. During the first cycle, the student teachers designed the introduction phase of the lesson. During the second cycle, they designed the body of the lesson. They also had to include a revised version of the introduction phase based on feedback they received from teacher educators and peers. In the third cycle, the student teachers submitted a modified version of the lesson's introduction and body (again based on feedback received), and they designed the consolidation phase. In the fourth (final) cycle, the student teachers revised all three phases and submitted a final version of their designed lesson. This iterative approach supports deliberate practice and the development of adaptive expertise.

One of the changes that we made to the course to be implemented in 2022 is a more intentional focus on inquiry in teaching. Even though using open/higher-order questions to facilitate classroom dialogue and deeper learning was present before, we realised that students need more guidance on how to use questions as the core of learning tasks for learners, how to engage all learners through questions and how to deal productively with learner responses.

In addition, we link the notion of inquiry to the principles that undergird the lesson design approach. For example – one of the principles is that learning requires attention and cognitive engagement. We guide student teachers to explore why questions are relevant concerning this principle. We want them to understand that teachers must persistently capture and direct learners' attention because learning is primarily a question of what we pay attention to and think about. If teachers do not explicitly draw learners' attention to what it is to be learned, there is a risk they will be distracted by other things. Using thought-provoking questions to focus learners' attention and thinking works well. Also, curiosity concentrates attention. Humans are naturally curious and





look for opportunities to engage in thought and problem solving related to the curiosity that they encounter. Teaching should harness this via questions that direct learners' attention to the puzzle inherent in the curiosity.

The renowned educational psychologist and former president of the Carnegie Foundation, Lee Shulman, after 30 years of studying teaching, concluded that:

“Classroom teaching is perhaps the most complex, most challenging, and most demanding, subtle, nuanced, and frightening activity that our species has ever invented.”

In this course on lesson design, we aim to prepare final-year pre-service teachers optimally for the complexity of teaching, exacerbated by a fast-changing world, in as much as this is possible in pre-service teacher education.

“Sarah Gravett is a Professor of Teacher Education and Dean van der Merwe is a lecturer in the Department of Childhood Education at the University of Johannesburg.”

The following sections will provide key learnings and insights from several research studies on initial teacher education that were conducted by students and faculty members at the University of Johannesburg. These research projects explore how to integrate transversal skills/competencies into the teaching of learning content.

7.2

A Course for First-Year Pre-service Teachers on Guided Play

By Lerato Ndabezitha and Sarah Gravett, University of Johannesburg, Faculty of Education

In 2021, the Faculty of Education at UJ piloted a course on play and playful learning as part of the Bachelor of Education in Foundation Phase Teaching. The rationale for introducing this course was the mounting body of evidence suggesting that children's cognitive, emotional and physical development is enhanced through play. Play in the Foundation Phase of schooling, and particularly in Grade R, could also be harnessed to prepare children for the demands of the higher grades. For example, executive functions and self-regulation are crucial for school success, and these could be developed through play. In addition, much has been written about how playfulness and play activities can prepare children for the future. Through play, children can, for example, practise the 4Cs – communication, collaboration, critical thinking and creativity. These transversal skills are widely touted as crucial to functioning well in a fast-changing world.

We researched the design and implementation of this course, which was offered to first year students in the first semester. The aim of the course was to guide the students in developing an understanding of guided play for teaching in Grade R and to provide them with practice opportunities to develop play-based teaching skills for the Grade R classroom. An informal inquiry at the onset of the course revealed that the student teachers had not considered the potential value of play for teaching and learning before. The course addressed the following themes:





- The rationale for using guided play as a central pedagogy in Grade R;
- The characteristics of play;
- Different types of play;
- The use of guided play to foster the holistic development of children, specifically executive functions, language and literacy, and number awareness.



IMPACT OF COVID-19

The course was planned in 2020, assuming that the COVID-19 restrictions would ease and that contact classes at the university would resume in 2021. However, in the first semester of the 2021 academic year, there were no contact classes because of the continued COVID-19 restrictions.

The course thus had to be offered fully online; this posed a challenge because the students were in their first year of the first semester at a university. They had not adjusted to the university environment yet, and many had not been involved in online learning before. Also, even though the university supported students with data (many students could not afford to buy their own), the data was not sufficient to allow for implementation of online learning using all the affordances of the LMS (Blackboard) in use. This course attempted to address the limited data issue through regularly using short, pre-recorded videos to communicate with students. These, together with course content, learning tasks and slides were uploaded on Blackboard. Blackboard collaborative live sessions were also used, but had to be limited due to the data issue. In addition, WhatsApp sessions were conducted fortnightly to support students and to engage them in interaction with each other.

Research data was collected via interviews and through analysis of the videos and portfolios that the students submitted. Here we report on what student teachers learned about guided play and how they applied their learning in designing guided play activities that can be used in Grade R:

Understanding of uses of guided play

The essence of the findings is that students developed an adequate understanding of how guided play could be used for teaching in Grade R, although there were gaps in their understanding.

Planning and designing curriculum-related guided play activities

Students gained a functional understanding of how to plan and design curriculum-related guided play activities for Grade R learners. They understood the importance of incorporating the learning and developmental needs of the children in tandem with the purpose of the activities derived from curriculum requirements.

It was evident that the actionable and constructive feedback that the students received on formative assessment tasks throughout the course helped them to rethink play activities and deepen their learning. The final assessment opportunity, namely a portfolio, also supported deeper learning. One of the portfolio tasks was that the students had to rethink and redesign





one of the play activities on which they had received feedback. They also had to explain how the play activity was changed and adapted and why. This allowed them to reconsider the play activity based on course learnings and to articulate the thinking underlying the improved activity. Another task in the portfolio that elicited deeper learning required students to reflect on their learning trajectories.



EMERGING INSIGHTS AND RECOMMENDATIONS

The task response showed that students were able to identify and articulate areas of improvement and development. Such meta-cognitive self-awareness is important for deepening learning. An unexpected finding is students highlighting the notion of creativity in relation to play. The finding is unexpected because development of creativity was not communicated to student teachers as a goal of the course, even though the notion of developing communication, collaboration, critical thinking and creativity is implicit in the way the course was constructed. Nevertheless, student teachers highlighted that having to design play activities challenged them to think innovatively and enhanced their creativity; this was indicated as a positive learning. The link between play, playfulness and creativity is widely acknowledged in the literature on play.

A gap in students' understanding is that they often conflated giving instructions with providing guidance. We have reflected on the possible reasons for this gap. We realised that the course did not pay adequate attention to what guiding implies in relation to guided play, versus giving instructions. In the future, the course must explore guiding practices more intentionally. Students need to be introduced to the notion of scaffolding that supports learners' cognitive, affective and behavioural engagement by using open-ended prompting, encouraging learners to question and confirming learners' persistence and effort. Students should also be afforded opportunities to rehearse these practices, coupled with actionable, supportive and explanatory feedback. Guiding practices must also be modelled more purposefully to student teachers.

Deeper learning was somewhat impeded due to us having had to offer the course fully online in a situation where student teachers had limited data at their disposal. We learned that it would be possible to present a course such as this one successfully online, even for novices, such as first year students, if all the affordances of online teaching are available. A prerequisite would be a stable internet connection and sufficient data to allow the students to view longer demonstration videos, engage in synchronous discussions and produce longer videos of their play activities that could be uploaded for assessment. However, we are of the view that presenting this course using a blended teaching and learning approach would be an ideal way to combine the best affordances of online and contact teaching.

Aspects that could be dealt with online are guidance around learning tasks related to readings and analysis of guided play activities, scenarios and case studies. The contact sessions could then be used for deepening collaborative inquiry on coursework, enacting coursework learnings and undertaking core guided learning practices.





The implementation that took place in 2021 will inform a second iteration of the course, which will be implemented in 2022. This iteration will also be researched.

“Lerato Ndabezitha is a Lecturer in the Department of Childhood Education at the University of Johannesburg (UJ) and Sarah Gravett is a Professor of Teacher Education and Development at UJ.”

7.3

Creating a Context Conducive to Creative Learning for Pre-service Teachers: A scratch coding club at the University of Johannesburg (UJ)

By Linford Molaodi, Sarah Gravett and Jacqueline Batchelor, University of Johannesburg, Faculty of Education

We conducted research in 2021, using semi-structured interviews, on how pre-service teachers who were learning to code through participation in an online Scratch Coding Club (SCC) experienced the facilitation strategies and processes employed in the club. The purpose of the SCC was to create an additional opportunity, outside the formal teacher education curriculum, for pre-service teachers to learn coding for teaching and to develop transversal skills which will serve them well in a fast-changing world.

The main research goal was to ascertain whether the facilitation strategies and processes used in the SCC created an environment conducive to creative learning from the students' perspectives and whether they considered what they experienced as relevant to their professional development as teachers. We use the term creative learning here in line with how Mitchel Resnick (the “father” of Scratch) conceptualises it: he associates creative learning with the type of learning that is required to develop and support creative thinking and creative expression.

We chose Scratch as a coding language due to its features that resonate with our quest to develop pre-service teachers' proficiency in relation to collaboration, communication, critical thinking, creativity and computational thinking. Learning to code using Scratch allows for developing these skills. Also, Scratch is widely used as a teaching tool in various contexts: this was important to us because our focus in initiating the SCC was to contribute to the professional development of pre-service teachers. The project leaders and facilitators jointly articulated four principles to guide the implementation of the SCC, namely:

■ **Creating a family-like environment:**

UJ education students come predominantly from rural and township (peri-urban) communities characterised by African family relations. These communities place strong emphasis on inter-connectedness and togetherness based on respect, caring, sharing and mutual success. The principle of creating a family-like environment was included to recognise the importance of student teachers' backgrounds and to create an environment that supports inter-connectedness and togetherness.





■ **Supporting students to create projects about which they are passionate:**

The principle that pertains to creating projects which students are passionate about is derived from one of the four Ps (projects, passion, peers and play) that Mitchel Resnick articulates in his book *Lifelong Kindergarten*. It was included to encourage students to build projects based on their interests because when people work on projects which they are passionate about, their willingness to learn is enhanced and they also develop deeper understandings and richer connections in their knowledge.

■ **Creating a fun-filled, playful environment:**

We decided on creating a fun-filled, playful environment for students as a principle because we wanted to engage students in play during the learning process – thus invoking another one of the four Ps. We also wanted students to enjoy the sessions, therefore we purposefully wanted to bring in fun elements. Through this we aimed to engage students emotionally. This is important because positive emotions foster engagement and learning. Such emotions include feeling cared for and respected and experiencing interest, joy and curiosity.

■ **Enhancing students' understanding of teaching and learning:**

We aimed to create learning experiences for student teachers that would enhance their understanding of teaching and learning practices that create an environment conducive to learning. Such practices engage learners cognitively and emotionally. In other words, we wanted them to experience these practices themselves and modelled the practices for them.

The coding club sessions took place online via Microsoft Teams. Each SCC session comprised three components:

Social component: intended to enhance social relations between 'buddies'. The term buddies was used to denote participants, with a view to invoking playfulness and supporting a collaborative spirit. During the social component, buddies introduced themselves and responded to one of the week's questions/prompts, e.g.:

"What was your highlight of the week?"
"What did you appreciate this past week?"
"Share something with buddies to motivate them."
"State your question of the day."

SiyaScratcher: refers to the hands-on component in which buddies were divided into different channels using Microsoft Teams to create projects together under the guidance of a facilitator. One of the rules of engagement included that anyone with a question had to first ask fellow buddies for support or advice before involving the facilitators.

Sharing and Reflecting: Projects were uploaded to the online Scratch platform and shared in the UJ Scratch studio. Buddies reflected live on the learning process: their struggles, likes and dislikes and overall experiences.





KEY FINDINGS AND INSIGHTS

- The research findings show that student teachers experienced the learning environment as structured, collaborative, supportive and joyful. The findings confirm the appropriateness of the principles that guided the design and implementation of the SCC.
- The facilitation strategies and processes employed during the SCC sessions had a substantial positive impact on the students' learning experiences. Students experienced the balance between the structure provided through consistent facilitation routines and organisation of sessions, coupled with the caring and spirited demeanour of the facilitators and the freedom to explore in collaboration with peers in a joyful learning environment as contributing significantly to their personal well-being and professional growth.
- While student teachers experienced joy and fun, the SCC was simultaneously structured in a way to engage them cognitively through challenging tasks that required them to explore, take risks, figure-out and experiment. They were supported in this through scaffolding, which often involved consulting and collaborating with peers and facilitators employing open questions to guide their learning for creating projects. Thus, inquiry (questioning) and a solution-seeking orientation was fostered, instead of providing ready-made answers that might inadvertently inhibit creative exploration.

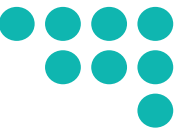


CONCLUDING REMARKS

We concluded that from the students' perspectives, the facilitation strategies and processes used in the SCC created an environment conducive to creative learning. The students also considered what they experienced as contributing positively to their professional development as teachers. Though the SCC was not a formal course, we argue that the core processes and structures employed in the SCC are largely applicable to formal learning environments. Having experienced first-hand a balance between structure and free exploration in collaboration with peers, scaffolding practices that guide and deepen learning, and facilitator demeanour that creates a safe and joyful learning environment, it is our hope that the students will draw on these experiences when they enter the teaching profession, despite the challenging environment in many schools in South Africa.

"Linford Molaodi is a lecturer in ICT-enhanced learning in the Department of Childhood Education at the University of Johannesburg, Sarah Gravett is a Professor of Teacher Education and Development at the University of Johannesburg and Jacqueline Batchelor is an Associate Professor in the Faculty of Education, specialising in digital learning."





By Kenneth Baloyi, Jacqueline Batchelor and Sarah Gravett, University of Johannesburg, Faculty of Education

In the previous Sandbox research Compendium of 2020, we outlined a study to derive design principles for integrating robotics into competency-infused science, technology, engineering and mathematics (STEM) lessons, with a focus on Natural Sciences and Technology lessons. Six initial design principles were presented as derived from literature and grouped under the Technological Pedagogical Content Knowledge (TPACK) Framework clusters. These principles were further refined in collaboration with preservice teachers in a design-based research study conducted over a two-month period.

Initially planned for 20 pre-service teachers, the study was eventually conducted with twelve final year Intermediate Phase pre-service teachers at UJ. The drop in numbers was due to the constant COVID-19 challenges posed by the national lockdowns. Participants did not have prior knowledge or exposure to robotics in education. Furthermore, a decision was made to conduct the study in a hybrid mode with a mix of face-to-face and online workshops. There were two face-to-face and two online workshops. Participants were grouped, and after each workshop, semi-structured interviews were conducted to gather participants' reflections and learn about their experiences during the workshop. The experiences and engagements were also recorded and observed. In total, six lesson plans were designed for Grades 5 and 6.

Data was analysed and six principles were derived and refined. These principles represent the key considerations for integrating robotics into the already existing curriculum. We distinguished between Robotics as a curriculum and robotics in the curriculum. Our study is based on robotics in the curriculum. The first five principles all culminate in principle six, which would therefore not exist without the other principles. Principles are presented according to four clusters. All of the principles were confirmed in the study.

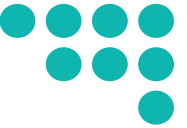
Robotics and STEM

Teaching STEM using robotics starts with a thorough knowledge of the robotics kits. The study found that it was essential to have a sound understanding of robotics technology for teaching and learning. Before participating in the research, pre-service teachers did not have any knowledge of robotics and coding, but this changed after they participated in the workshops. In the end, they understood the interplay between robotics and coding, how these technologies can be applied in the curriculum and, importantly, how robotics can be used with other already existing tools in the classroom.

Pedagogies to develop competencies for a changing world

This cluster contains two principles that relate to the use of pedagogical strategies. Firstly, pre-service teachers used collaborative learning as the primary strategy for teaching through robotics. Their lesson plans provided evidence that they thought carefully about developing learner competencies through collaboration. Secondly, they created lessons that allowed learners to experiment and reflect on their artefacts.





The activities they created were based on real-life problems that needed to be solved such as creating a hydropower station as a solution to the national crisis of power shortages and load-shedding.

Developing knowledge and competencies in teachers

Participants' lesson plans were intentional about teaching Natural Science and Technology and participants were already thinking about using the same robotics technologies to teach other STEM subjects through robotics. The selection of lesson content was premised on the teaching opportunities offered by robotics. Before selecting what content to teach, participants explored the type of activities the robotics kits could accommodate. The aim was to develop lesson plans that developed learners' competencies for a changing world; achieving this aim was made possible after participants had worked in groups and experienced some struggles. The competencies participants developed were the ones they wanted to develop in their learners and they were able to model the competencies for the learners.

Supporting the development of teachers' knowledge of integration

It is vital to set up conditions that allow for the development of the technological, pedagogical and content knowledge and competency necessary to integrate robotics into teaching. If preservice teachers do not experience robotics in action, they will not have the expertise required to integrate it effectively. Thus, training should incorporate experiential learning. As one participant recollected: "You know when you made us actually play with the low-cost educational robotics toy....a lot of ideas came."



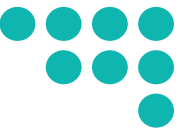
CONCLUSION

The study does not claim to have found the formula for integrating robotics into education. However, these findings can be used to create awareness among pre-service and in-service teachers of the potential of robotics to supplement learning. Secondly, those seeking to train teachers to teach through educational robotics are advised to provide rich hands-on experiences for the teachers and pre-service teachers they are training. After all, if they do not gain experiential knowledge, they will be less likely to integrate robotics into their lessons.

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**8 Broader Contributions to
Education for a Fast-changing
World**



8 Broader Contributions to Education for a Fast-changing World

In addition to the interventions being prototyped and researched in the Sandbox Schools, the Edhub contributes to the growing conversation about education for a changing world by convening a variety of discussions among education stakeholders, hosting dialogues and publishing outputs in the public sphere. In 2021, this work included hosting dialogues and conferences, strengthening local and international partnerships, contributing to book chapters and journal articles, and being mentioned in a number of opinion pieces written by members of UJ's Faculty of Education.



DIALOGUES AND SEMINARS

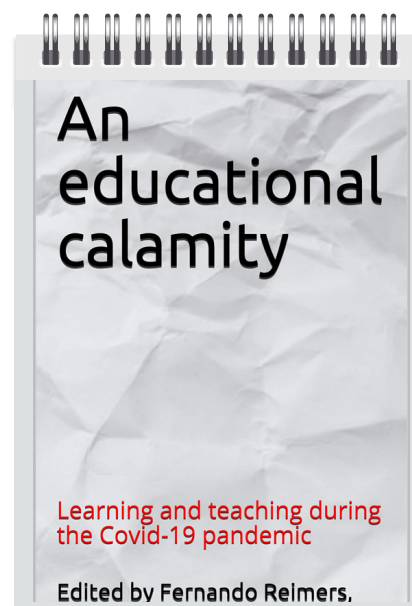
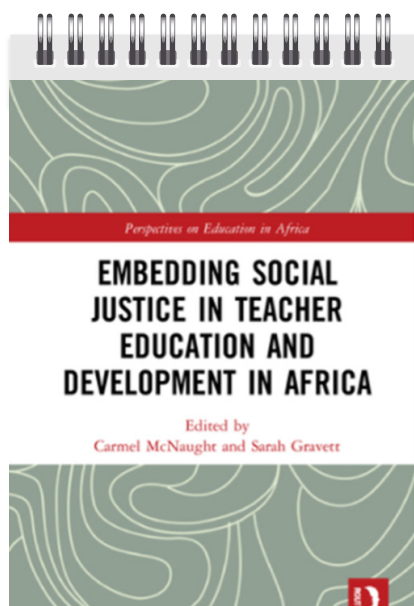
- In collaboration with Kagiso Trust, we hosted the inaugural annual 'School Leadership in a Fast-Changing World' Conference
- Presented Competency-based Learning Programme policy analysis at Harvard University's Global Education Conference
- Presented at the Human Resource and Development Education Sector Consultative Conference – Skills for the 21st Century
- Presented 2020 Sandbox findings at the DBE Teacher Development and Curriculum Management (TDCM) forum
- Shared Sandbox 2020 findings at the Education Management Association of South Africa (EMASA) Conference
- Presented at the DBE multi-stakeholder reference group on the General Education Certificate (GEC) on Assessment Practices for 21st Century Competencies
- Presented on the Competency-based Learning Programme at the Standard Bank's annual CSI conference
- Presented Competency-based Learning Programme policy analysis at the DBE Teacher Development and Curriculum Management (TDCM) forum





PUBLICATIONS AND RESEARCH OUTPUTS

- Publication of chapter 'The Sandbox project: Developing competencies for a changing world in South African schools' in *Embedding Social Justice in Teacher Education and Development in Africa*, edited by Carmel McNaught and Sarah Gravett, published by Routledge
- Publication of chapter 'South African Curriculum: Infusing Competencies for a Changing World' in *An Educational Calamity, Learning and teaching during the COVID-19 pandemic*. Edited by Reimers, F., Amaechi, U., Banerji, A., Wang, M., & Giannini, S
- Authored and disseminated a policy brief on 'Assessing skills and competencies for a changing world'
- Journal article published: Moodley, C., Seerane, T., & Gravett, S. (2022). Learning at home for Grade 1 learners in disadvantaged communities: Insights from the Sandbox@ Home COVID-19-response intervention. *South African Journal of Childhood Education*, 12(1), 8
- 2020 Sandbox Schools Research Compendium – A compendium of research articles sharing emerging learnings from interventions in the Sandbox Schools Project
- 4 articles published in the Mail & Guardian
- 13 blog posts sharing emerging learnings from the Sandbox Schools Projects





Thank you

The Sandbox Schools Project would not be possible without the collaboration of many individuals and organisations who share a vision for the future of education in South Africa. Thank you for your time, effort, enthusiasm and active engagement in this project. We appreciate your continued partnership and applaud the role you are playing in pioneering the future of the South African education system.

We would especially like to thank:

- The Sandbox Schools, including principals, SMTs, SGBs, teachers, support staff, care givers, and learners
- Waterberg District Education Department
- Limpopo Provincial Department of Education
- Department of Basic Education
- The University of Johannesburg Faculty of Education, including academic staff and postgraduate students
- Students focusing their studies on the Sandbox
- Colleagues from the University of South Africa (UNISA)
- The Center for Curriculum Redesign
- Class Act Educational Services
- CRSP dsgn
- E3
- NECT colleagues who contribute to the Edhub's thinking and provide continuous support