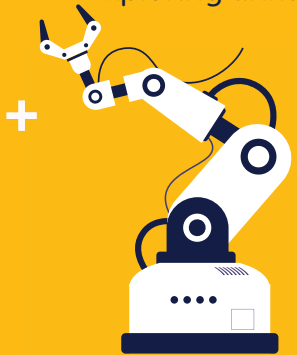
edhub

SANDBOX

TINKERING INTERVENTION

Exploring tinkering as a tool for teaching & learning in the classrooms



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Executive Summary

There is increasing acknowledgement, due to growing inequality and increased uncertainty in the fast-changing world, that there is a need for children to develop a more holistic set of skills and competencies for them to thrive in the present and future. For children to thrive in this fast-changing world and be equipped to create a better world, learning needs to be more than just a matter of memorising facts. Evidence from research suggests that play is a fundamental mechanism for children to develop, and it is increasingly being perceived among caregivers and educators as critical for engagement, positive relationships and learning (The LEGO Foundation, 2022). Similarly, according to UNICEF (2018) learning through play can enhance learners' mastery of academic concepts and build motivation to learn.

In this report we provide an overview of the research insights gathered during the implementation of a mini-Tinkering intervention in the Sandbox schools. The Sandbox Schools Project is the Edhub's flagship research project, that trials approaches to competency-embedded education in South African public schools. The aim of the Sandbox is to test these teaching and learning practices within the context of a 'typical' public school in order to gather evidence on which practices and models are best suited to the South African schooling system.

Tinkering is a sensory-filled experience in the classroom that encourages learners to interact with, be hands-on with and manipulate building blocks and various other materials. The NECT Edhub implemented the Tinkering intervention at two primary schools, which are part of the Sandbox Schools Project, in Limpopo.

The LEGO Foundation donated the tinkering kits, and 16 teachers were trained on how to use them in the classroom. Teachers were then given full autonomy to decide on when and how they chose to introduce tinkering into their lessons. The primary objective of the intervention was to obtain an understanding of how teachers perceive and experience the use of tinkering kits in South African public school classrooms. After two months of implementing tinkering in the classrooms, semi-structured interviews were conducted with the teachers to gather data on their perspectives and in-class experiences using tinkering kits in grades 1, 3, 4, 6 and 7 lessons.

The main findings from the thematic analysis of the qualitative data are as follows:

- Tinkering kits can be used across different grades and subjects
- Tinkering was described by the majority of teachers as a fun, creative, hands-on way of learning that promotes self-learning, creativity, collaboration and deeper learning through play
- Tinkering benefits learners with learning difficulties by enhancing their engagement and creativity
- Tinkering is not a one-size-fits-all approach to teaching and learning
- Tinkering can be further improved in the classroom

The intervention is referred to as a mini-intervention because it was implemented over a short period of time (ran over a period of 2 months) and the sample size was small (16 teachers in 2 schools).

Tinkering Explorations in Sandbox Schools

The mission of the LEGO Foundation is to elevate and implement the growing evidence base to empower children to learn through play. The Sandbox Tinkering Intervention is part of the LEGO Foundation's tinkering pilots being conducted in several schools in South Africa. Two primary schools located in the Bela Bela circuit were selected from 10 Limpopo Sandbox Project schools to participate in the intervention. The choice of schools was based on their willingness to participate and proximity to each other. Initially, the intervention was meant to focus on grade 3 and 6 teachers; however, during the planning phase the teachers teaching other grades (1, 4, and 7) showed interest and were also given the opportunity to opt-in. Grades 3 and 6 were initially chosen because the research findings would provide rich insights for both the foundation and intermediate phases, instead of focusing on just one phase. The research insights will give a clear profile for decision-makers to articulate how playful learning through tinkering in the classroom can potentially look like and the challenges faced across the different primary school phases.

As part of the intervention, at a two-day workshop, 16 teachers were given an introductory training on tinkering. The training included a breakdown of tinkering terminologies, description of components of the tinkering kits and demonstrations of potential ways to use tinkering as a pedagogy in the classroom. The training was practical and experimental in nature, in that the teachers spent most of the training time using the tinkering kits to build different objects. The tinkering kit includes LEGO technic pins, beams, axle, gear, connectors, wheels and pegboard. After the training, the teachers were given tinkering kits so that they could use the kits with their learners while teaching in the classroom. They were also given a training manual and tinkering lesson samples for different subjects pitched at different grades (1 to 7). The teachers were given full autonomy to use tinkering as an alternative pedagogy in their classrooms.

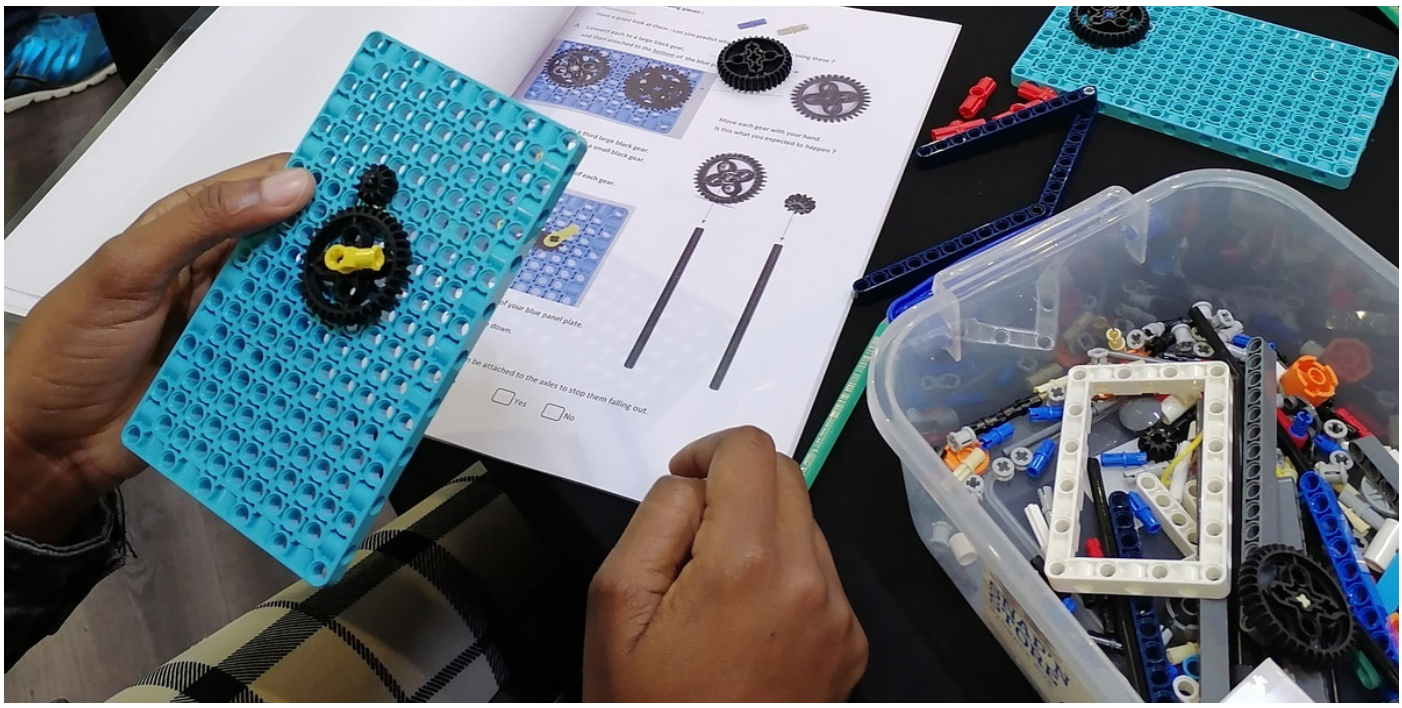


Figure 1: LEGO tinkering kit

After two months of implementing tinkering in the classroom, the 16 teachers from the Sandbox schools were asked to participate in semi-structured interviews. The interview questions focused on their experiences and thoughts on the use of the tinkering kits in the classroom. For example, teachers were asked how they felt about the tinkering process, how they used the tinkering kits in the classroom, what worked well and what was hard about it, how they would describe tinkering to other teachers, and what they would change about the tinkering kits. The research questions that guided the interview questions were the following:

1. What are teachers' experiences of the training they received on Tinkering?
2. What are teacher's experiences with trying out tinkering in the classroom?
   - 2.1 In which subjects did they choose to use the tinkering kits and why?
   - 2.2 Example of use cases?
   - 2.3 What worked well and what challenges did they face during implementation?

The Tinkering intervention was divided into two phases. The first phase, which is reported in this document, focused on the implementation of the intervention - teachers' in-class tinkering experiences. The next phase of the intervention will attempt to address the following research questions:

1. If teachers were given an opportunity, during workshops, to co-design lessons which incorporate tinkering:
   - 1.1 What ideas would they come up with, which subjects, and lessons would they choose?
   - 1.2 Would their participation in co-designing lessons influence the frequency of implementing tinkering activities in their classrooms?
2. What is the potential of tinkering as a model for scalability and replicability in the classroom?
3. How does the use of tinkering affect learning in learners? Does learning change when tinkering is in the learning mix?
4. Does tinkering help them with curriculum pacing/covering?

The research insights derived from analysing the interview data for phase 1, are discussed in the following section.

Figure 2: A one of a kind easel with a LEGO mat used in a tinkering classroom

Key Research Findings and Insights

Teachers' tinkering experiences were explored through the analysis of qualitative data gathered through interviews. The method used to analyse the qualitative data was deductive thematic analysis, where close attention was paid to the data relative to the research questions. Thematic analysis is a way to make sense of interviews by looking for themes or similar experiences. The following observations and insights came through when the interview data, from the 16 teachers, was analysed.

01. Teachers' Perspective on the Tinkering Intervention

Need for more training sessions and support materials

Training was inadequate in terms of the number of training sessions. It was suggested that teachers could further benefit from refresher training workshops, videos with practical examples and manuals with more examples. The teachers' views with regards to training include the following:

> *"The workshop must not just be once off but sometimes there must be a refresher course. It could have been that when Tinkering is introduced, it gets introduced with its manuals for us to be able to see that this thing, like this lesson, like it is proud and can fit in all subjects, yeah, it could be used this way and this way and that way in all the lessons." [Teacher 5]*
>
> *"Yes, I think we can be workshopped not once, I don't know how often but yeah, more often I think it will at least assist us." [Teacher 2]*
>
> *"Rather give us videos of practical things that learners can see because visual is also important for our learners. So if they can see, if we can put on some video and then we say, do that. Then, it is a challenge. We are trying to put in and incorporate all these things as a form of learning. So, anything to help learning." [Teacher 10]*

Figure 3: Teachers tinkering in groups during training

Tinkering involves the use of toys to make learning fun

During the interviews, teachers were asked how they would describe tinkering to another teacher. The teachers' definitions varied but a common theme came through in their definitions: tinkering is a pedagogical approach that uses toys and gives learners the chance to learn in a fun and hands-on way. Playing is a great way to help learners develop their ability to think creatively, solve problems, and explore their curiosity (Zosh et al, 2017). Six of the teachers described tinkering as learning through play. Below are some of the teachers' description of tinkering.

"To me tinkering is only a learning through play. Since when the learners were working on the tools that were provided, they are expressing their thoughts while touching or playing with the material, the tools." [Teacher 5]

"It is about learners using their hands and brains and toys to create things that they think will be useful to them." [Teacher 8]

"I would say it is learning and teaching in a fun manner. Letting the learners think out of the box, also bringing out an element of creativity from them." [Teacher 7]

Tinkering was highly recommended as a useful teaching method

Majority of the teachers (81%), across grades and subjects, recommend tinkering as a way to teach in the classroom. The reason that mostly accompanied the recommendation was that tinkering helps students learn in different ways - it caters for different types of learners. Teachers' responses when asked whether or not they would recommend tinkering to other teachers, included the following.

"There are different methods of learning. Tinkering is another method of learning that a child can learn. So, I would recommend it, I would tell the teacher, Use this, because not all kids are the same." [Teacher 9]

"So, what I will actually advice to other educators about tinkering is that tinkering is the method which enhances your teaching and learning. I think with tinkering we can actually introduce certain skills to learners." [Teacher 5]

"I would recommend tinkering to other teachers, to English teachers in that part of presenting, building, and then in group discussions, and then I believe in other subjects it could be useful." [Teacher 2]

"I recommend tinkering. The reason is that when most of these learners use tinker's tools, it brings their mind back into the class. When you teach sometimes, you can see that the learners are absent minded, but should you bring the tool in front of them, their whole attention gets concentrated onto that tool. Tinkering enables them to think for themselves and work with their hands." [Teacher 12]

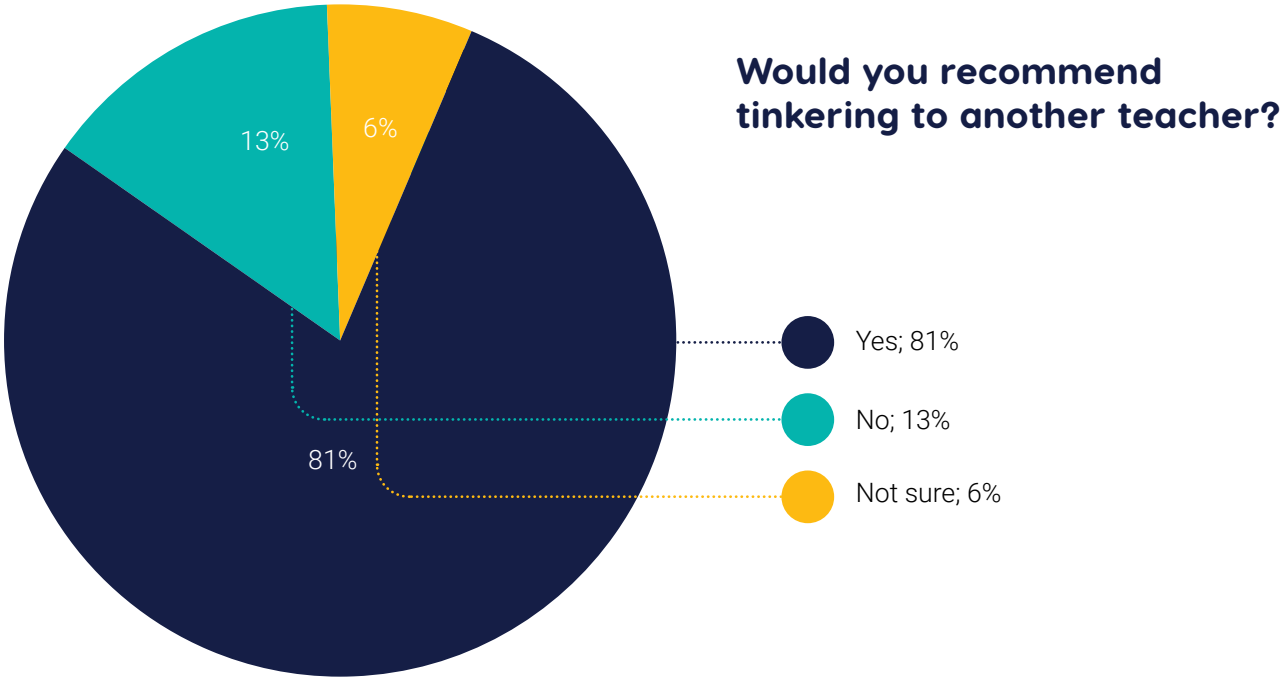


Figure 4: Teachers' responses when asked if they would recommend tinkering

02. Implementation of Tinkering in the Classroom

The majority of teachers used tinkering kits in the classroom

Most teachers, 14 out of the 16, used the tinkering kits in their classrooms. Interestingly, some teachers used tinkering not with just one group of learners but across grades and subjects. However, two teachers did not engage much in tinkering in the classroom, the reasons provided were that they were sick or the learners misbehaved during tinkering.

> *"Honestly, I have not used it. We used it when we were teachers only, so I did not get an opportunity to use it because I was not all right. I was not feeling well." [Teacher 5]*
>
> *"What happens is that I don't want to lie. I only use it for fun because our learners, or my learners are not disciplined. I thought when I introduced it. They would be fully focused on what they are doing, but then the more they enjoy it, they start misbehaving, and then they dwell much, and then they do whatever they want to do." [Teacher 10].*

Tinkering kits were used by the teachers across grades & subjects

After two months of tinkering in the classroom, teachers were asked to share the grade level and subjects in which they used tinkering. Several teachers used the tinkering kits in different grades while others used the kits in multiple subjects within the same grade. Teachers mentioned using tinkering in grades 1, 3, 4, 6 and 7. The grade in which tinkering was most frequently implemented was grade 6. Figure 4 below gives a summary of the grades in which the tinkering kits were used by the 16 teachers to promote deeper learning in the classroom.

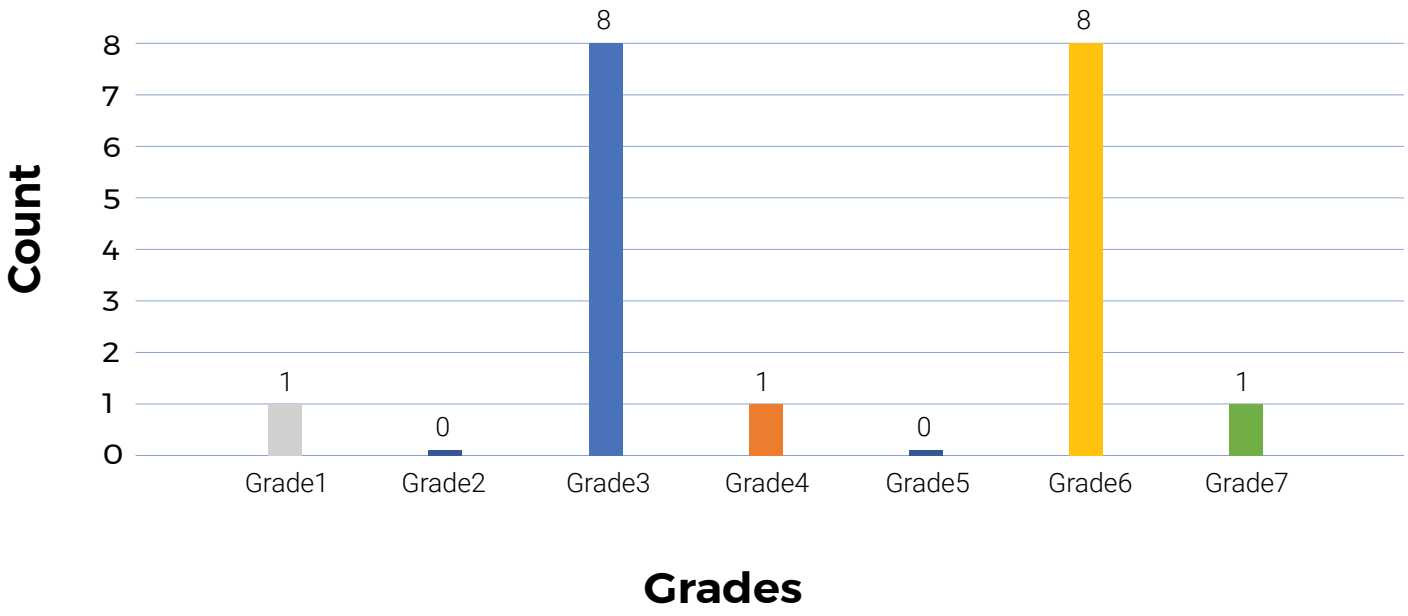


Figure 5: Grades in which tinkering kits were used

The subjects within which tinkering kits were used include: Languages, Life skills, Mathematics, economic and management sciences (EMS), Natural Science & Technology and Social Sciences. However, the majority of the teachers mentioned using tinkering in language classes such as English lessons and in Mathematics.

The figure above highlights that tinkering kits were used across a range of subjects. The teachers' responses when asked to mention the subject in which they used tinkering include the following:

> *"I used them right here in my very class, during the English lesson and did it in Sepedi and during Maths class." [Teacher 3]*
>
> *"I can apply in mathematics and in Life Skills." [Teacher 5]*
>
> *"I used tinkering in Mathematics and I used tinkering in EMS." [Teacher 7]*
>
> *"I used it in Natural Sciences and Technology." [Teacher 12]*

Therefore, based on teachers' responses, tinkering kits can be used across different grades and subjects within primary schools.

Free construction using tinkering kits

Three teachers mentioned that they used tinkering not formally but in a casual, fun, freestyle way. Free construction involved learners choosing the projects they want to work on using tinkering kits. Allowing learners to playfully investigate what they can create using tinkering kits can potentially enhance learners' curiosity and creativity. Therefore, in addition to the kits being used in a formal structured and guided way, teachers can also allow learners to engage with tinkering kits freely.

" What we are doing is not based on a certain lesson. We are freestyling. It means that a learner will make a shape of anything that comes to his or her mind." [Teacher 16]

"I can't say I really enjoy it because I have never used it. I used it once, and honestly speaking, I have never integrated it. I only used it for fun." [Teacher 10]

"Yeah, I tried using it a couple of times. For example, I just gave them the toys and told them to build anything that they could think of. I told them to be innovative, so, ja they tried, they tried their best." [Teacher 11]

"Honestly, I have used tinkering in my classroom but not formally so, in a freestyling mood." [Teacher 6]

03. Teaching and Learning with Tinkering Kits

Tinkering facilitates hands-on and engaging ways of learning

Tinkering is a hands-on and learner-centred approach to teaching that moves the focus from the teacher towards the learners. Most teachers highlighted that using tinkering as a pedagogy approach enables learners to be hands-on during lessons, and this stimulates learners' critical thinking and also gives them more exposure to problem solving. Moreover, the use of tinkering kits also enhanced learner engagement during the lessons. Teachers' description of some of their observations during tinkering in the classroom include:

"Somewhere, somehow, it teaches the learners to do what? To think because when they are building something, they are busy thinking that they can build something, not this but that, and be able to build just that." [Teacher 8]

"Tinkering is a new method of teaching in which the learners learn through doing and seeing. It is the method which involves all learners, encouraging all of them to be part of the lesson. They are colourful, and then each child will want to learn. It is sort of like they learn through play, using tinker tools." [Teacher 3]

"Tinkering encouraging learners to develop thinking ability in the world in which we live today." [Teacher 9]

"When you teach, sometimes, you can see that the learners are absent-minded, but should you bring the tool in front of them, their whole attention gets concentrated on that tool. Tinkering enables them to think for themselves and work with their hands" [Teacher 9]

"Tinkering allows the learners to learn themselves, and it is a practical thing unlike talking about something you don't see." [Teacher 14]

Teachers also observed that tinkering benefits rebellious, slow and practical learners. During tinkering these learners become more engaged, focused and tend to understand the concepts better. These learners are interested in building things with their hands, emphasising a kinaesthetic learning approach (Physical learning activities). The following are a few examples of teachers' comments:

"It really involves the learners, even learners who don't normally pay attention who are a bit handful, all of them became very focused when tinkering." [Teacher 3]

"Now as I said, some learners are slow of mind, and if you give them things to do with their hands, you will see how smart they are. That is why they say that we should not give up and throw in a towel if the learner is struggling in class." [Teacher 5]

"Some learners are not gifted in writing, they can be gifted in creating something, so she can see the potential that this one is not good in writing but when I ask him to build something, he can build up something on his own." [Teacher 4]

"Tinkering keeps learners who are noisy in class very quiet. Their mind concentrates on what they are doing. And the way I observed these young ones on WhatsApp, it was very quiet in the class." [Teacher 1]

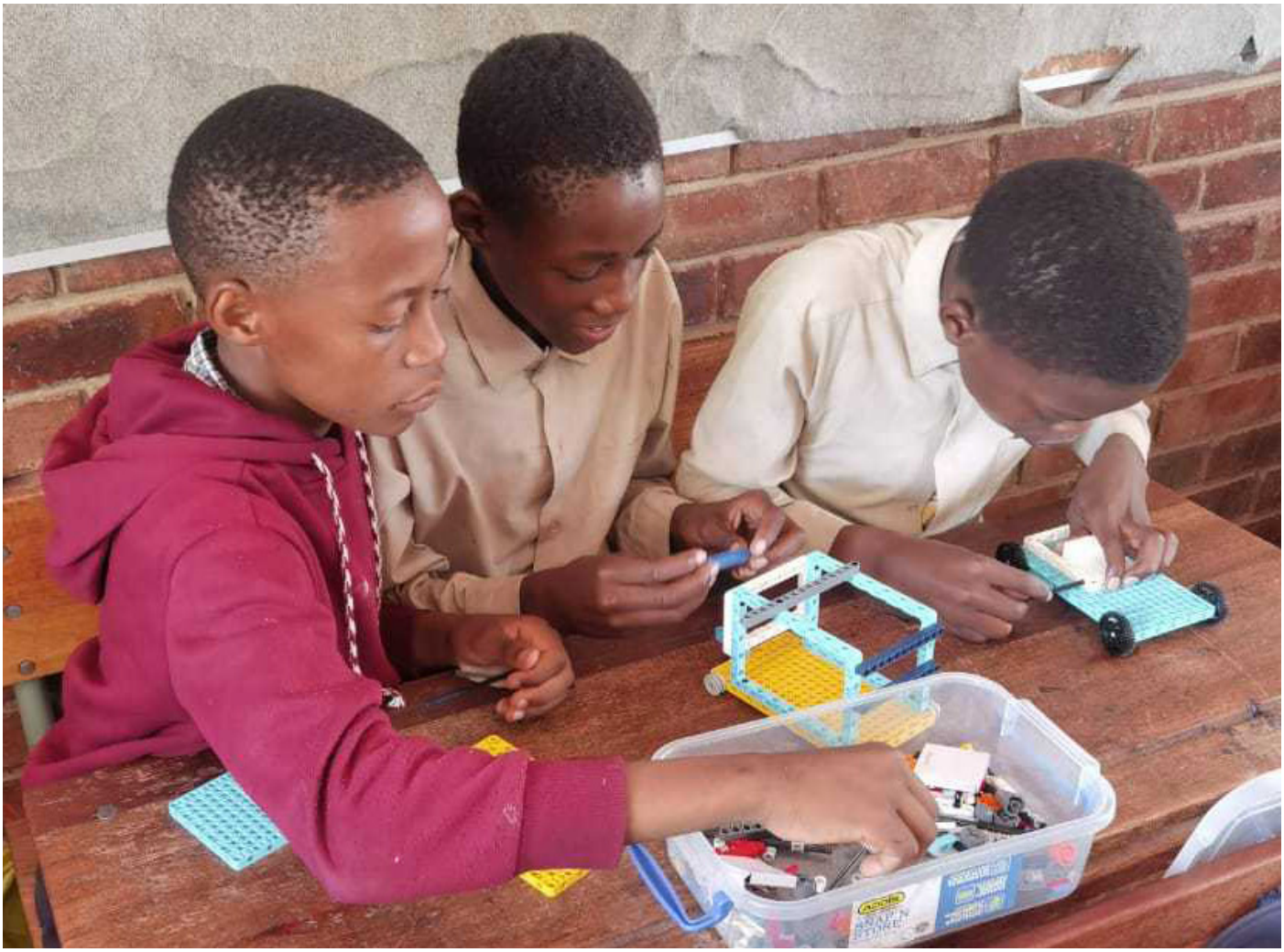


Figure 7: Grade 6 learners tinkering in the classroom

Tinkering promotes creativity & deeper learning through play

Several teachers reported that using tinkering kits in the classroom promoted creativity and deeper learning. Play-based learning promotes active learning, which involves using different parts of the brain and various ways of thinking thus facilitating deeper learning and development of other critical skills (Barblett et al., 2016; UNICEF, 2018). According to the teachers, due to the hands-on nature of tinkering, the learners' creativity was enhanced. Below are some of the teachers' comments on how they incorporated tinkering into their lessons.

"When I introduced it, I only explained to the learners the different parts of the tools and how they work. And just advise them to create anything from their mind that can move or anything that they think they can create." [Teacher 10]

"In Grade 7, we had an entrepreneur topic where they would build any object, and they would say how much they would sell it for." [Teacher 7]

"Yes, in Sepedi, and I saw that when we read about Maleleme, reading about that story or about that narration, the learners start to relate to it. Maleleme was a hardworking man. They started to make the shapes of cars to show that we, too, can do something. The story described him as a diligent man… I saw them getting involved saying that they wanted to be like this man because this man was working hard for his family. So, if we work, we also can do the same. It encourages learners to see the importance of working." [Teacher 15]

"Uhm, I used it when we were working with three-dimensional shapes, and So I asked the learners to use those tools to build these three-dimensional shapes. They did build them, and we did the prepositions using tinker's tools." [Teacher 3]

"So, when they are tinkering, they use different resources which are different. So, they can see that if I join this one to that, it will give me a 2-D shape, 3-D Shape, a triangle or whatever." [Teacher 4]

Feedback from the teachers also suggests that limiting guidance can promote learners' creativity when using tinkering kits. Six teachers mentioned that they frequently engage in "free construction", in which the learners get to choose the projects they work on and build whatever they feel like freely and this enabled learners to further develop their creative skills.

Tinkering benefits learners with learning difficulties

Learners have various approaches to the learning process and are introduced to the education system with different ways of processing information. Some teachers highlighted that tinkering especially benefits learners with some learning difficulties:

"The fact that I have been able to include even the learners that have learning barriers to be involved in the work because now they were not left behind, but now they were more involved. So being involved encourages the learner to participate in terms of the lesson." [Teacher 7]

"So, I think with tinkering we can actually introduce certain skills to learners that which they can [unintelligible] even though they are not good academically, but there are certain things they actually can embrace themselves." [Teacher 13]

"He or she is not able to grasp, not able to understand. There are some learners who are slow catchers. But tinkering and its tools help the learner to say to himself, "with this in my hands, I can do this or that." His mind is being applied." [Teacher 5]

"It also helps learners with learning barriers to be more involved. Learners with learning barriers can get more involved during tinkering." [Teacher 8]

Tinkering can be used to facilitate collaboration

Tinkering can promote collaboration among learners when they are asked to do a task as a group. It improves learners' ability to work as a team and learn valuable skills like problem-solving, cooperation, communication, experimentation, and persistence as they complete these tinkering group tasks. Majority of the teachers reported that through tinkering group tasks, the learners were able to develop their collaboration and communication skills.

> *"They are working in pairs, meaning they learn to work as a team, and they communicate with one another." [Teacher 1]*
>
> *"Our learners just need to have discipline. All about discipline. Some of these learners do not want to share. It also helps us to teach our learners to learn to share." [Teacher 4]*
>
> *"It is for two learners. Pairs, they are working in pairs, meaning that they learn to work as a team and communicate with each other." [Teacher 11]*
>
> *"They team up together and advance their potential as a group." [Teacher 15]*

Figure 8: A grade 3 learner using tinkering in a Life skills class

04. Challenges faced by Teachers during Tinkering in the Classroom

As tinkering is a new approach to teaching and learning, it presented several challenges for some teachers. This section gives a brief description of the main challenges faced by the teachers when they used or attempted to tinkering kits during lessons.

Tinkering is not a one-size fits all teaching approach

It is not possible to incorporate tinkering kits in all lessons. Ten teachers expressed that it is difficult to integrate tinkering into some specific parts of their lessons. For example, the teachers who used tinkering in their English lessons, reported that they found it difficult to use tinkering when covering topics such as tenses or parts of speech.

> *"But some other stuff, like teaching the tenses, is very difficult to link it with tinkering." [Teacher 1]*
>
> *"Also, I don't know how to incorporate it in most of the lessons. For example, if I am teaching adjectives, it doesn't, for me, it doesn't cater for that topic." [Teacher 6]*
>
> *"I feel like for me as an English teacher, I am a bit, I don't want to say lost, but it's not easy for me to incorporate it in my lessons." [Teacher 6]*
>
> *"It is difficult, only for parts of speech. For other things like teaching them maybe, Uhm, what, reading. You cannot just get reading via tinkering." [Teacher 11]*

Time constraints hinder use of tinkering kits

Time allocated to each lesson is limited and was not designed to include tinkering activities. According to the teachers, the time constraint therefore hinder learners from fully engaging with tinkering kits, as a significant amount of lesson time is spent unpacking and tidying up the kits. Fourteen teachers highlighted that limited lesson time is an issue. The concerns raised by teachers include the following:

> *"The issue is that the learners will use them, and thereafter, they must collect and pack them away. Doing so takes them a bit longer. It eats into the time of the next period because we follow the timetable." [Teacher 3]*
>
> *"My challenges were time and how this consumes the time. We don't have enough time. We just squeeze things in because we are always rushing for time! We don't have time." [Teacher 8]*
>
> *"Most of our lessons in which we use tinkering tools take 15 minutes. And others 30, like in Maths. I think time is wasted when they pack these away." [Teacher 3]*
>
> *"But to me i don't know whether the problem was me. It was time-consuming. And then, I couldn't discipline the learners because they were so attached to it, they never wanted to move." [Teacher 10]*

Pieces of the tinkering kits easily get lost

Some pieces of the tinkering kit are very tiny; therefore, learners often lose the small parts when they use the tinkering kits. Consequently, the next group of learners will not have the full opportunity to engage with the tinkering kits as the parts will be missing. Ten teachers mentioned that since these learners are young (in primary school), the size of some of the tinkering kit pieces makes it hard for the learners not to lose them.

"The challenges which I could say I saw were among the Grade ones. These Grade 1 young learners drop the tools. They go missing. Some small parts used for building do go missing because they are small tools." [Teacher 3]

"Kit. Ja, those pieces are too small. So it is difficult not to lose some of the small pieces." [Teacher 1]

"The small pieces get lost easily. And with the number of learners we have, it becomes a bit of a challenge, but they can be made bigger, so yes." [Teacher 6]

Insufficient tinkering kits can disrupt learning during group projects

Collaboration between learners can be improved by asking them to create things, as a group, using tinkering kits. However, some teachers mentioned that asking learners to tinker as a group can disrupt the learning environment. Due to large class sizes, the kits are sometimes insufficient, which can lead to unnecessary fighting or conflicts between learners.

"One is building something, and the tools he or she needs are used by the other learner, and there will be fights and commotion if he or she tries to take those tools from them. So, if each child could have their own box and build whatever he or she wishes to build, it would be fine." [Teacher 8]

"We have, some classes, we have like 50 members in the class, and we only have like 19 boxes. So most of the time kids have to share those kits, and stuff like that, and most kids have different ideas." [Teacher 13]

"So sometimes when you group them like that, some of them feel overpowered during their group. You find that there is one of them who suggests that he wants to build a certain thing and prevent others from coming up with their ideas, shooting down everything they come up with, you see?." [Teacher 16]

05. Teachers' Ideas and Recommendations

Most teachers had some suggestions on how the tinkering experience can be improved. However, four of the teachers mentioned that they had no recommendations for improvement or concerns with regards to implementing tinkering in the classroom. This group of teachers outlined that they have not yet encountered any challenges and that their experience with tinkering has been positive. The ideas on how the tinkering experience can be improved are discussed below.

Improving the tinkering kits

Teachers suggest that the implementation of tinkering in class can be improved by increasing the size of the small pieces in the tinkering kits; this will minimize the chances of learners losing them. Alternatively, tinkering kits could come with extra pieces which can be used to replace the lost ones. Teachers also recommend that tinkering kits be organised according to their size this will improve time management issues in the classroom and also will reduce time spent trying to identify the exact missing pieces. Some examples of the teachers' recommendations are as follows:

"If we could pack the little buttons and everything into packages. But I would guess that is something that I have to do." [Teacher 7

"I wish the small ones had their container in which to put them." [Teacher 4]

"So, it is difficult not to lose some of the small pieces so meaning that they should also give us an extra boxes in order for us if there is any other part missing in another box, we can go and replace." [Teacher 1]

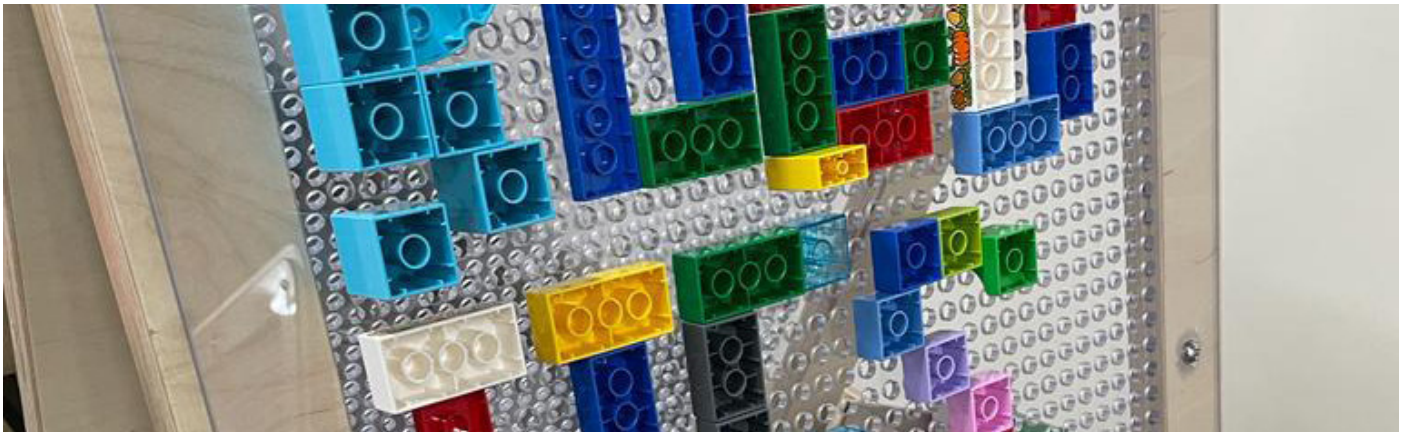


Figure 9: A 3 dimensional image created on an easel during a tinkering class.

A tinkering kit for each learner

Teachers suggested that the learning process would be more enriching if a tinkering kit could be made available for each learner. When each learner has their own kit, they are able to fully engage with the kits and conflict amongst learners will be minimised during a tinkering exercise in the classroom. Below are some of the suggestions from the teachers:

> *"My suggestion is the one I mentioned, saying that I wish each child could have his or her box for them to be able to build whatever they want." [Teacher 8]*
>
> *"The learner must have their own kit and must know how many they are and must know how to use them. What must they do, you see?. We must increase the kits so that the learners can be able to tinker because we find ourselves having to teach many of them using one thing. So, if it were possible, it would be individual boxes." [Teacher 16]*
>
> *"The only suggestion that I have is for us to have enough kits for the learners because the challenge that we have is that, our classes are overpopulated." [Teacher 13]*
>
> *"If there is any other part missing in another box, we can go and replace it because they are so small that even when they fall to the ground, some of them they may look for it and not find them, meaning that we are missing a part, and when we go and create next time, something is missing meaning that we cannot complete whatever we want to build." [Teacher 11]*

Community of practice or Support network

Tinkering is a new pedagogy approach for the teachers, thus a network to support and learn from can benefit teachers and improve their implementation of tinkering in the classroom. Seven teachers expressed that tinkering is a new teaching approach for them, so they are still trying to figure out how to effectively use it in their classrooms. They highlighted the need for spaces or a platform where they could learn, reflect and enhance their tinkering teaching approach. This is evident in the following teacher's responses:

> *"But should you find us rushing, it is sometimes because we are not able to do this thing that we want to do. But we should start step by step and interact with other teachers." [Teacher 16]*

"I will want to ask about this, but I do not know who to ask. Sometimes you find that you yourself can form a shape which then makes me see that this is possible. The workshop must not just be a once-off, but sometimes there must be a refresher course." [Teacher 9]

"I might invite the teacher to my class and observe what happens when I use Tinkering to observe for myself. And in that way, maybe he may be able to see whether tinkering is useful or not useful. But I will make sure gore if these are the positives which I want him to see, I will make it in such a way that it attracts him." [Teacher 12]

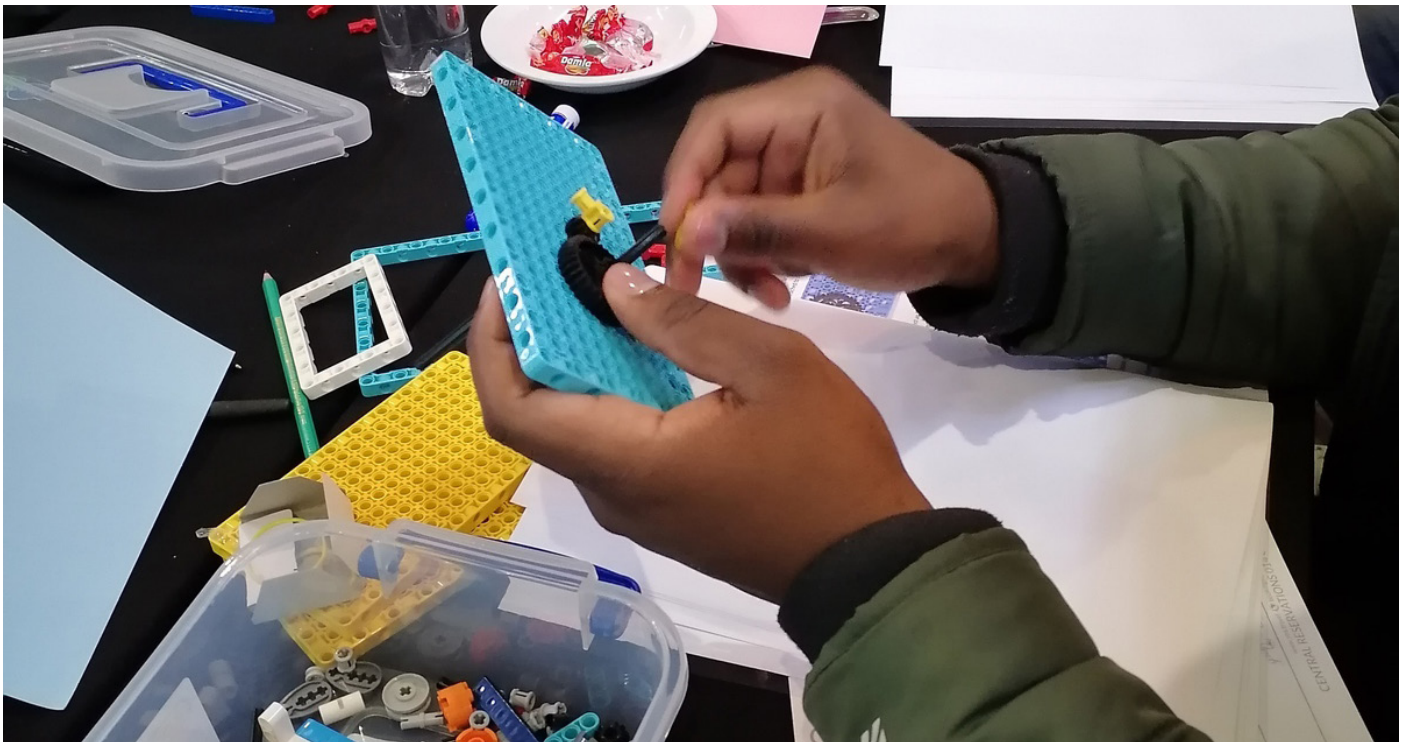
Officially allocating time for tinkering on the timetable

Time allocated to each lesson is short and limited, this makes it challenging to incorporate tinkering into the lessons. Six teachers strongly felt that tinkering should be used more to facilitate learning. They suggested that this can be achieved through allocating time after lessons to do tinkering and adding more time for tinkering within the curriculum.

"I would suggest that the schools must find the time into which tinkering time can be squeezed in." [Teacher 2]

"They are more suitable for use towards the end of the day where you know that after using and packing them, you will be doing something else maybe outside the contact time." [Teacher 3]

"Maybe I don't know if they could work from home or somewhere because, to be honest, time is very little here at school and especially at the time during which we [unintelligible] face those challenges." [Teacher 8]



Intentions and Limitations of the Study

The intention of the Sandbox mini-Tinkering intervention was to gather insights on teachers' perceptions and experiences with tinkering during training and implementation in their classrooms. The intention of the study was not to determine the impact of tinkering on learner outcomes, but to work with a small sample of teachers to gain insights into what worked well and what proved to be challenging when they used or attempted to use tinkering in the South African public school classrooms.

The research insights from this study can be used to inform the design of larger tinkering interventions, including the design of the kits and application thereof. While the intention was not to provide a nationally representative sample, a limitation of the approach includes the size of the sample (2 schools and 16 teachers) and the short period of implementation. In phase 2 of the Tinkering intervention which is going to be led by a masters student at the University of Johannesburg, a larger sample will be used and more research questions will be addressed.

Conclusion

Tinkering is a new method of teaching that utilises tinkering kits, allowing learners to be actively engaged with the learning process by following certain instructions from the teacher. Tinkering kits involve a kinaesthetic learning approach which seems to hold learners' attention to the instructions given by teachers. Not only is this an effective approach in keeping the learner's attention, but it also involves a creative and fun approach to learning. Tinkering introduces teachers and learners to a more learner-centred teaching approach that can be used across various subject areas and age groups.

Tinkering allowed the learners to engage with more practical thinking and deeper learning and it also enhanced learners' creativity and independence. Some pitfalls noted by teachers are the difficulty in incorporating tinkering within specific lessons, such as teaching sentence structuring as an example. The majority of teachers agreed that the packaging of the tinkering kits could be reformulated as small parts present challenges when packing away and keeping the tinkering kits complete.

The teachers recommend that the kits be organised by size and that the LEGO Foundation should consider putting additional pieces in the kit so that they can be used as replacements when parts get misplaced or damaged. Lastly, teachers have recommended that an internal networking group be made available so that teachers would be able to communicate their successes and shortfalls within the tinkering teaching process and will also be able to support and advice each other.

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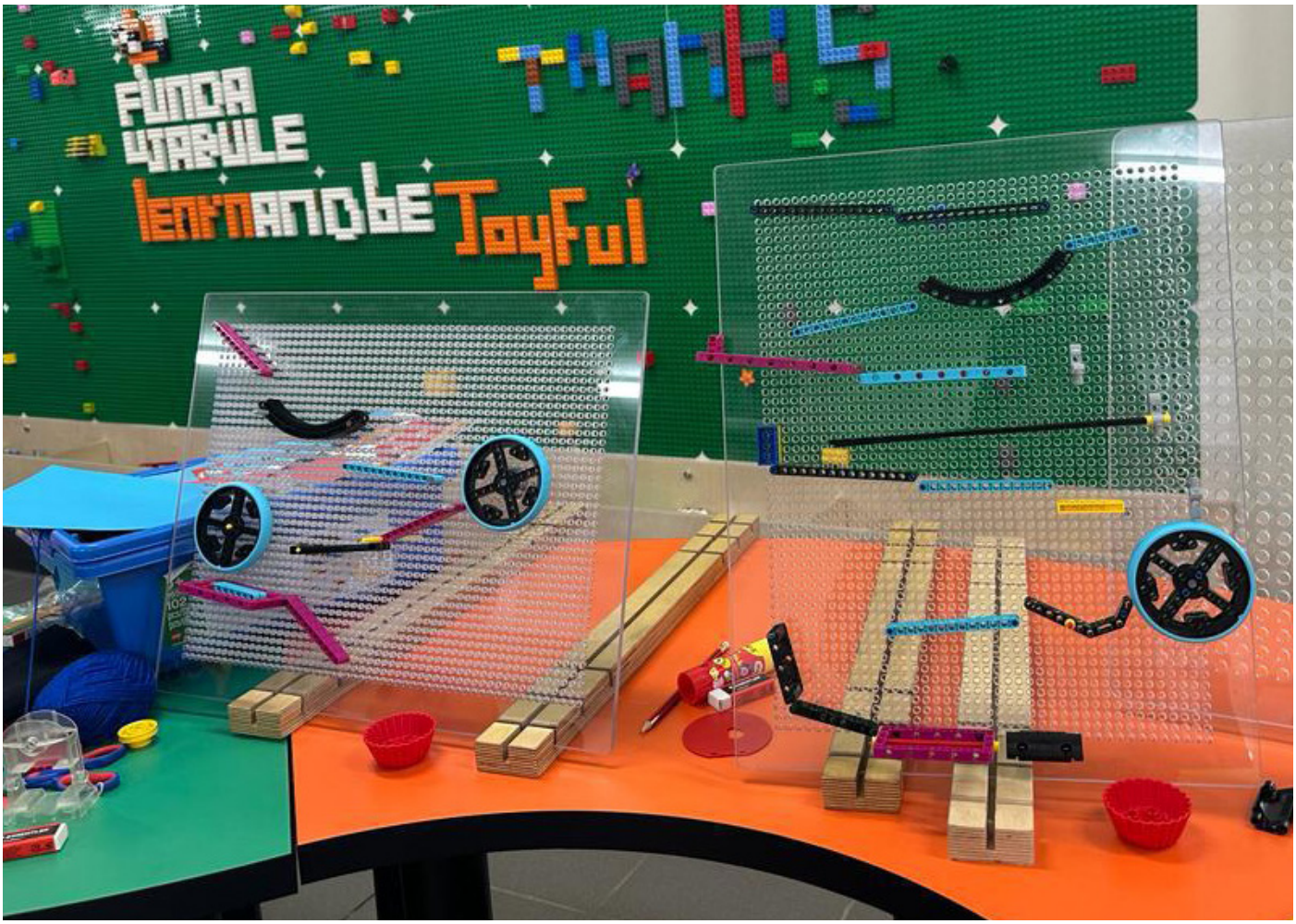

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