Pots and Pans, Books and Stories, Apps and Tablets - The Power of Digital in Young Children's Pre-school Settings

Megan G Baxter*

Child Computer Interaction Group, University of Central Lancashire, marcher2@uclan.ac.uk

Matthew Horton

Child Computer Interaction Group, University of Central Lancashire, mplhorton@uclan.ac.uk

Janet C Read

Child Computer Interaction Group, University of Central Lancashire, jcread@uclan.ac.uk

Julie Allen

Child Computer Interaction Group, University of Central Lancashire, jallen17@uclan.ac.uk

Rhona Anne Dick

Lingokids, rhona.anne.dick@lingokids.com

This work in progress builds on the work on 'Small CCI' working with children below the age of 5. The purpose of this study was to compare children's engagement and experience with three classroom activities over a three-week period. Eight children aged three and four years old took part in each activity (learning on tablet devices, free play in the home corner, and story time with their teacher) each week and were asked to complete a pre and post-test Smileyometer to rate each activity for fun, followed by a 'This or That' at the end of each session. The children's engagement was also measured by the research team using the Leuven scale. The results indicate that children of this age range can complete these evaluation tools. The children indicated that for all weeks they found the learning on the tablet devices the most fun and every child ranked the tablet activity as the best each week using the 'This or That' method. The researchers marked engagement the highest on the tablet devices for two of the three weeks. We note these results as unsurprising but suggest that they help us to understand the power of digital when considered in such settings and propose that researchers need to adjust for this when evaluating digital products with children of this age.

CCS CONCEPTS • Human-centered computing • Human computer interaction (HCI) • HCI Design and Evaluation methods • User studies

Additional Keywords and Phrases: Pre-school, Kindergarten, Evaluation, Ethics, Commercial, Case-study

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1   Introduction

In IDC, a common approach to evaluating technology is to measure engagement and to use this to validate a new tool, software solution or design experience. When seeking to compare the usability, experience, or fun of one product or service over another, the competing products given to the children need to ideally be equally motivating to sustain their attention and deliver a 'fair trial' [4]. It is easy for a designer of a product for children to report high engagement when their product is compared with, say, a dull video of sheep grazing. Indeed, many studies in IDC evidence that technology is generally considered fun and that it can be hard to take away the 'digital' attraction from studies when evaluating software and tech imbued apps. In Read et al. [5], an evaluation of learning using an app, a worksheet, and a teacher at the smartboard, clearly showed children giving high ratings for engagement with the app and showed observed engagement as high for this activity when compared to the other two.

Engagement is context deep and manifests in ways that are identifiable through observations such as expressing contextual engagement or involvement within an activity [8]. Studies that focus on the 3-6 age bracket appear to choose observational methods as a base for their work which they then supplement with other approaches such as questionnaires and scales. A study by Sánchez-Morales et al. [9], conducted in Mexican public schools with 4-6 year olds, evaluated usability of a game through observation in the school environment, system usability scoring adapted to the appropriate age range and eye tracking. Kandlhofer [1] used observational methods to evaluate children's learning through upcoming technology. They created 10 units using AI and computer science technology to introduce the new technology at an age-appropriate level to kindergarten pupils with the hope of developing AI literacy technology. The children were observed during each unit, and then asked, several days later, to draw a picture of one of the units from memory to assess learning.

For the IDC community, this work continues that done by Read et al. [5]. That earlier study contained three conditions: Lingokids App, teaching slides and worksheets. The study focused on evaluation of fun, learning and engagement via smiley faces from the Fun toolkit, the Leuven scale and assessment of 'momentary' learning. The results revealed that the children had the most enjoyment out of the app and engagement was scored highest between the app and the worksheets. As the results focused on engagement in work-style activities, where the objection is to learn, the focus for this current study moved to engagement in play activities to observe if the app would still have the highest engagement levels. There is also a benefit to understanding how observation and self-report can be used to identify how engaging a product is. It is also, as shown by the literature, an important benefit to IDC to be able to unpick the 'mesmerizing' effect of digital tech on children's preferences and on observed engagement. In this study we therefore explore three play instances in a pre-school setting with eight children who were observed over three weeks. One play instance was a digital play activity on tablets with a commercial product, another was a listening to story activity with a teacher and the third was free play in the pre-school home corner. Triangulating different self-report and observation scores we seek to quantify and discuss the power of digital to help researchers understand the distance that may be inherent in all evaluations of digital tech.

2   METHOD

2.1 Participants

Eight children aged three and four years old, participated in this study over a three-week period. The children were based in a local pre-school center. Due to the nature of working with children of this age, not all children were present for all of the sessions. There were four researchers over the three sessions; they observed a

different activity each week, this was done to minimize researcher effects where, for example, one might consistently score engagement higher than another.

2.2 Apparatus

Fun and engagement were measured through researcher observation (4 in total) and completion of the Leuven scale, and child self-reported pre and post test Smileyometers and the 'This or That' method. The Leuven scale [2] is a popular and a preferred method for evaluation with childcare practitioners in western countries; it assesses children's engagement levels; extremely low, low, moderate, high, and very high. The scale has its own code book for formulating results. An advantage of the Leuven scale is that it is a child centered approach, limiting adult interaction in the child's world. One limitation is that it is not suitable for all non-Western cultures due to them presenting engagement and wellbeing behaviours differently [3]. Rintakorpi and Reunamo [7] used the Leuven scale to assess and support children's learning.and found that using the scale helped staff to plan and deliver more targeted activities to the children which increased their excitement, curiosity, and contentedness. In our study, the Smileyometer [6] was used before and after children did each activity and then once a week children expressed their preferences using the 'This or That' method [10]. The home corner was set up as part of the pre-schools' continuous provision, no extra resources were required. The story was provided by the school and agreed with the research team ahead of the study. The third condition required an app, for which we used the Lingokids App, available on Android tablets. Assessing materials were provided through the Fun Toolkit (Smileyometer and the 'This or That').

2.3 Procedure

Before the study began, parents were sent consent forms, along with a cover letter, parent information and a withdrawal form. The pre-school kept all the consent information, the researchers only referred to the children by their first names and no personal data was collected. At the start of each week the participating children were split into three groups by their class teachers. The children were then able to choose a sticker to attach to themselves and this same sticker was then attached to the child's Smileyometer sheet to ensure sheets and children could be reunited if the sheets were misplaced during the study. Following this the children were then sent to their first activity. At the start of each activity the children filled in a pre-test Smileyometer to indicate how much they expected to enjoy that specific activity. They were then given approximately 15 minutes to experience the activity before completing a post-test Smileyometer. During each activity the researchers would complete the Leuven scale for each child. The four researchers moved around each condition per week to eliminate any researcher effect. Once the children had completed their post-test Smileyometer they would move to the next activity and the process would be repeated until all three activities had been completed. At the end of the final activity the children would then be presented with the three 'This or That' combinations (app vs. story, story vs. home corner, home corner vs. app) and choose their preference for each. Once completed the children were thanked for their help that week.

2.4 Study Design

The study design was 'within subjects' with the dependent variable being 'activity' (app, home corner, story) and the independent variables being 'engagement', and 'fun'. The independent variables were measured using the Leuven scale of engagement, children's self-report using pre and post-test Smileyometers, where children choose the level at which they enjoyed the condition, and the 'This or That' post activity where the children chose which activity they preferred.

3   RESULTS

Over the three days, with each child doing three activities per day, we could maximally anticipate having 24 sets of scores from children had all eight attended every session and always handed in their data. In the event we gathered in 22 sets of scores. Due to the decision to not track children from one week to the next – each 'score' is necessarily treated as an individual instance – we cannot look at longitudinal effects from one week to the next.

Table 1: Means of the Smileyometer

Condition	Week 1 - before	Week 1 - after	Week 2 - before	Week 2 - after	Week 3 - before	Week 3 -after
App	5	4.8	4.1	4.9	4.8	4.5
Home corner	4.5	4.3	4.8	4.1	4.8	4
Story	3.8	4.6	4.1	3.9	3	4

   Table 1 shows the children's mean Smileyometer scores before and after each condition. The app was rated highest after play each week. Week 1 (after scores) the app scored M=4.8, followed by the story at M=4.6 and the home corner M=4.3. Week 2 (after scores) the app was graded highest by the children at M=4.9, the home corner came second at M=4.1 and the story was placed last at M=3.9. The final week (after scores) demonstrates a similar pattern of the highest scored was the app by M=4.5, the home corner and the story was evaluated at the same fun level (M=4).

Table 2: Results of the 'This or That' showing preferred activities

Week	App vs Story		Home corner vs App		Story vs Home corner	
1	7	0	0	7	3	4
2	8	0	3	5	3	5
3	7	0	1	6	4	3

   Table 2 displays the children's opinions on which activity they liked the most through the 'This or That' questions. All children chose the app over the story across all weeks. The app was chosen over the home corner in 18 out of 22 instances 18 however, when children were asked to choose between the story and the home corner, the home corner was rated higher (12) than the Story (10). This suggests the children liked working on the app generally but given the choice between the home corner and a teacher led story they would prefer to work in the home corner again.

Table 3: Engagement means using the Leuven Scale

Week	App	Home corner	Story
1	4.7	4	3.1
2	3.8	4.8	3.3
3	4.7	3.9	3.9

   Table 3 suggests that on week 1 and 3 the children were most engaged in the app but not on week 2. The App had the highest levels of engagement noted by the researcher (M=4.7) on week 1, the home corner (M=4) was second and the story had the lowest engagement levels (M=3.1). Week 2 ranked the home corner to have the highest engagement levels (M=4.8) over the app (M=3.8) and the story (M=3.3) Week 3 had engagement with the app highest (M=4.7), followed by the same (M=3.9) for both the home corner and the story. The data proposes that children engage more with the app and with peers than with a teacher led story. However, week 3 encountered Wi-Fi issues as the app would not load on some of the tablets provided. Children had to share the

tablets one between two for their games. The data showed that this had no effect on the children's engagement as it was the same as week 1 and it is the highest ranked in engagement overall for that week by a significant amount. This suggests that even when things go wrong children enjoy and prefer working with technology.

4   DISCUSSION

The data collected from the Smileyometers revealed that the children enjoyed working on the app on tablet devices most. This is in spite of there being issues around connectivity in week 3 and with children playing games with relatively low completion levels (as indicated by the company who supplied the apps) in week 2. This consistent high rating speaks to the mesmerizing effect of tablet devices.

The findings from the 'This or That' that the children completed at the end of every week tell a similar story. The app was chosen by every child in preference to the story every week and was also chosen by the majority over the home corner. The results with the Smileyometers combined with the 'This or That' show that children are able to discriminate what they thought they would find fun and what they actually enjoyed. This discrimination is evident in Table 1 where children's Smileyometer scores before and after play change based on their experience. Week 2 they scored the home corner a 4.8 before play but decreased it to a 4 after play, this is the same score as the Story (4) for after play but in Table 2 the children ratio was (5:3) children would prefer to play in the home corner again over the story. Although children related the home corner and story the same on the Smileyometers after play, a greater number of children still chose the home corner in the 'This or That'.

The Leuven scale scores showed the app on week 1 and 3 scored the highest mean for engagement. This suggests that on these weeks the children were highly engaged.

The data collected from the study largely implies that children find working with apps the most fun and have higher levels of engagement whilst using them. That said it was clear that children enjoyed playing in the home corner either alone or with peers in child-led play. Children were able to use this time as 'free play' and engaged with the environment. The teacher led story was ranked least fun by the children on most weeks and this was reflected in their engagement levels recorded by researchers. A potential reason for children's engagement being higher with the app and home corner could be observers' bias on the wriggle factor. Traditionally children are to sit still and listen to stories and not take their eyes off the pictures in the book or the static teacher; this 'behavior' is seen as highly engrossed and therefore engaged with the story. However, with conditions such as an app or the home corner, this isn't the case. The screen is constantly changing and moving, reengaging children's eye to screen contact and they can sit, move and wriggle as much as they like provided they don't take their eyes off the screen. The home corner is different again, children can move, walk, and physically play and chat, this is seen as highly engaged. If children were to sit still and stare at one thing, this would be seen as disengaged and potentially bored. While children at preschool age can sit still and listen, they do get distracted easily and are still learning this 'school readiness' behavior. Perhaps the wriggle factor was an unconscious bias in the researcher's mindset. This could be addressed with multiple observers, conversations about how engagement should be scored in the different environments of the playschool and / or different positionings of where an observer is sat.

What was apparent in the study was that children enjoyed all their activities and it is certainly the case that children benefit from a range of play activities in the classroom. It would be entirely wrong to suggest that adding more digital into such classrooms would immediately improve engagement for all children. Looking at the differences in reported means and in the observational data we can suggest that the power of digital is in the region of 0.5 on a five-point scale. The Small CCI paper by Read et al. [5] noted that children's engagement was highest with the app, even when the focus has shifted from learning objective activities to play objected activities. This current study correlates with those results even when comparing digital with free-play and story listening and even with connectivity and connection issues with the app. We note this as a factor that might be further studied in order to provide a more level comparison between digital and non-digital with this age group.

5 CONCLUSION

A combination of surveys and observations were employed within this study. The Leuven scale, Smileyometer and This or That method were used with the children to generate fun and engagement levels. The results found that the app overall scored the highest fun and engagement across the majority of the weeks. Whereas the home corner and the story scored lower. When issues occurred that researchers predicted might have negative effects on children's scores and engagement, the children still chose the technology as their favorite. Comparing with earlier work, we posit that the power of digital is considerable and can immediately suggest a 10% higher score for both observed and reported engagement with this age group. Future research will examine the technology phenomenon in more detail in an attempt to disassociate the technology effect from fun and engagement.

6 Selection and Participation of Children

For this study the researchers approached the university pre-school on campus. They agreed dates and times that worked best with the pre-school and the children. The school sent out information sheets about the study and consent forms should the parents wish to allow their child to participate. The children who had consent to take part were brought into a separate area to talk to the researchers, a conversation about consent, participation and how to withdraw took place with the children. If the children, no longer wanted to take part they could just walk away from an activity. The children were split into 3 groups, not all of them were present every week therefore the groups varied in size. The participants moved from activity to activity in a carousel with 15 minutes at each activity.

REFERENCES

<bib id="bib1"><number>[1]</number>Martin Kandlhofer, Gerald Steinbauer, Sabine Hirschmugl-Gaisch, and Petra Huber, 2016. "Artificial intelligence and computer science in education: From kindergarten to university." In *2016 IEEE frontiers in education conference (FIE)*, pp. 1-9. IEEE, https://doi.org/10.1109/FIE.2016.7757570.</bib>

<bib id="bib2"><number>[2]</number>Ferre Laevers, 1999. The project Experiential Education: Concepts and experiences at the level of context, process and outcome. In *Keynote Papers, Proceedings of the Seventh Early Childhood Convention* (Vol. 1, pp. 17-26).</bib>

<bib id="bib3"><number>[3]</number>Learning Journals (n.d.). *The Leuven Scale for Emotional Well-Being*. https://learningjournals.co.uk/what-is-the-leuven-scale-and-how-to-use-it/ Date sited: 01/12/2023</bib>

<bib id="bib4"><number>[4]</number>Anthony. D Pellegrini, 2001. "The role of direct observation in the assessment of young children." *The Journal of Child Psychology and Psychiatry and Allied Disciplines* 42, no. 7 https://doi.org/10.1017/S002196300100765X</bib>

<bib id="bib5"><number>[5]</number>Janet C Read, Matthew Horton, Dan Fitton, Gavin Sim, Rhona Anne Dick, Emanuela Mazzone, and Rachel Forbes, 2023. "Small CCI–Exploring App Evaluation with Pre-schoolers." In *Proceedings of the 22nd Annual ACM Interaction Design and Children Conference*, pp. 94-99. https://doi.org/10.1145/3585088.3589362 </bib>

<bib id="bib6"><number>[6]</number>Janet C Read and Stuart MacFarlane. 2006. "Using the fun toolkit and other survey methods to gather opinions in child computer interaction." In *Proceedings of the 2006 conference on Interaction Design and Children*, pp. 81-88. https://doi.org/10.1145/1139073.1139096 </bib>

<bib id="bib7"><number>[7]</number>Kati Rintakorpi, and Jyrki Reunamo, 2017. "Pedagogical documentation and its relation to everyday activities in early years." *Early child development and care*. https://doi.org/10.1080/03004430.2016.1178637 </bib>

<bib id="bib8"><number>[8]</number>Andrea Ritoša, Frida Åström, Eva Björck, Lisa Borglund, Elin Karlsson, Elaine McHugh, and Elisabeth Nylander, 2023. "Measuring children's engagement in early childhood education and care settings: A scoping literature review." *Educational psychology review*.. https://doi.org/10.1007/s10648-023-09815-4 </bib>

<bib id="bib9"><number>[9]</number>A Sánchez-Morales, JA Durand-Rivera, and Claudia Lizbeth Martínez-González, 2020. "Usability evaluation of a tangible user interface and serious game for identification of cognitive deficiencies in pre-school children." *International Journal of Advanced Computer Science and Applications* 11.6.https://doi.org/10.14569/ijacsa.2020.0110661 </bib>

<bib id="bib10"><number>[10]</number>Bieke Zaman, 2009. "Introducing a pairwise comparison scale for UX evaluations with preschoolers." In Human-Computer Interaction–INTERACT 2009: 12th IFIP TC 13 International Conference, Uppsala, Sweden, August 24-28, 2009, Proceedings, Part II 12, pp. 634-637. https://doi.org/10.1007/9783642.03658368 </bib>