Digital and Traditional Games in Kindergarten Classroom

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Abstract

Game-based instruction offers diverse learning opportunities, especially for young learners. This study investigated the effectiveness of game-based learning in early childhood education and identified whether digital or traditional play enhances numeracy more effectively among kindergarten pupils. Thirty children aged 5–6 were divided into two groups: one used traditional games, the other digital games, during math lessons. Using a quasi-experimental design with pre- and post-tests, the study first assessed pupils' numeracy skills, followed by a one-month intervention. Afterward, a post-test was administered, and results were analysed. Findings revealed improvements in numeracy performance in both groups, shifting from "Did not meet expectations" to "Outstanding." Both the mean difference and mean gain difference were significant for each group. The study concludes that both digital and traditional games, when guided appropriately by adults, are effective tools for improving numeracy among kindergarten learners. Given the growing body of literature supporting play-based strategies in education, the study recommends integrating a variety of game-based activities in early childhood classrooms to enhance engagement and learning outcomes.

Keywords: game-based learning; kindergarten numeracy; traditional games; digital games

Resum. *Jocs digitals i tradicionals en l'aula d'educació infantil*

L'ensenyament basat en jocs ofereix múltiples oportunitats d'aprenentatge, especialment per als infants. Aquest estudi va analitzar l'eficàcia de l'aprenentatge basat en jocs en l'educació infantil i va determinar si el joc digital o el joc tradicional millora més eficaçment la numeració en alumnes d'educació infantil. Trenta infants de cinc a sis anys es van dividir en dos grups: un utilitzava jocs tradicionals i l'altre jocs digitals durant les classes de matemàtiques. Mitjançant un disseny quasi-experimental amb proves abans i després de la intervenció, es va avaluar primer el nivell de numeració dels alumnes. Després d'un mes d'intervenció, es va administrar una prova final i es van analitzar les dades. Els resultats van mostrar millores en el rendiment de numeració en ambdós grups, passant de «No assolir les expectatives» a «Excel·lent». Les diferències mitjanes i els

guanys mitjans van ser significatius. L'estudi conclou que tant els jocs digitals com els tradicionals, amb la supervisió adequada d'un adult, són eines efectives per millorar la numeració en infants. Es recomana integrar activitats de joc variades a l'aula infantil per potenciar la participació i els resultats d'aprenentatge.

Paraules clau: aprenentatge basat en jocs; numeració infantil; jocs tradicionals; jocs digitals

Resumen. *Juegos digitales y tradicionales en el aula de educación infantil*

La enseñanza basada en juegos ofrece múltiples oportunidades de aprendizaje, especialmente para los niños pequeños. Este estudio examinó la efectividad del aprendizaje basado en juegos en la educación infantil y determinó si el juego digital o el tradicional mejoran más eficazmente la numeración en alumnos de jardín de infancia. Treinta niños de cinco a seis años se dividieron en dos grupos: uno utilizó juegos tradicionales y el otro juegos digitales durante las clases de matemáticas. Usando un diseño cuasi-experimental con pruebas antes y después de la intervención, se evaluó primero el nivel de numeración de los alumnos. Después de un mes de intervención, se aplicó una prueba final y se analizaron los datos. Los resultados mostraron mejoras en el desempeño numérico en ambos grupos, pasando de «No cumple con las expectativas» a «Sobresaliente». Las diferencias de medias y ganancias fueron significativas. El estudio concluye que tanto los juegos digitales como los tradicionales, cuando están supervisados adecuadamente por adultos, son herramientas efectivas para mejorar la numeración en niños de jardín de infancia. Se recomienda integrar actividades lúdicas variadas en el aula infantil para fomentar la participación y los logros educativos.

Palabras clave: aprendizaje basado en juegos; numeración en educación infantil; juegos tradicionales; juegos digitales

Summary

1. Introduction

Play is an intrinsic aspect of childhood development, integral to nurturing skills, knowledge and values in early years. The right to play is enshrined in various statutes, including the Philippine Constitution and Presidential Decree No. 603. Acknowledged by educational theorists like Lev Vygotsky, play serves as a primary source of social, physical, linguistic and cognitive development in children, a notion reinforced by contemporary research (Goldstein, 2012).

Drawing on play-based learning theory, early childhood programmes prioritize play in their practices and curriculum design. This emphasis has popularized game-based learning (GBL) as a teaching approach, leveraging educational games, both traditional and digital, to facilitate structured learning experiences. Contemporary learning theories emphasize experiential, active, problem-based and feedback-rich learning environments, qualities readily provided by game-based instruction (Connolly et al., 2012).

Studies have shown that integrating GBL is more effective than traditional instruction (Pando et al., 2022), offering advantages such as enhanced motivation, engagement, positive attitudes toward learning, and memory skill development (Bai et al., 2020). Additionally, GBL holds potential for improving instructional quality and education outcomes (Bakar et al., 2008).

While classroom games have evolved with the integration of Information and Communication Technology (ICT), traditional and digital games alike offer unique benefits. Digital games, particularly, align well with the learning preferences of 21st-century learners, often termed "digital natives", who are increasingly exposed to and engaged with digital media (Bittman et al., 2011; Lee, 2015).

Despite the recognized benefits, debates persist regarding the appropriateness and effectiveness of digital games in early childhood educational settings. Critics question whether digital games support developmental needs and improve learning outcomes, or detract from essential experiences for young learners.

Empirical studies comparing digital and traditional game-based learning in early childhood educational settings, particularly in enhancing academic achievement, remain relatively scarce. This gap underscores the need for research to better understand the efficacy of game-based learning, especially concerning the application of digital technology in kindergarten and early childhood education programmes.

This study is anchored on two major theories that support the use of game-based learning in early childhood education: self-determination theory (SDT) and Piaget's theory of cognitive development.

Self-determination theory, developed by Ryan and Deci (2017), explains how motivation influences learning and behaviour. It identifies three basic psychological needs, autonomy, competence and relatedness, as essential for fostering motivation and engagement. When learners feel in control (autonomy), capable of success (competence), and connected to others (relatedness), they are more likely to be motivated and engaged. Game-based learning addresses these needs by allowing choice, offering achievable challenges, providing feedback, and encouraging social interaction. Both intrinsic motivation (doing an activity for its own enjoyment) and extrinsic motivation (doing it for a reward or outcome) are supported in game contexts. When used well, games can enhance motivation and make learning more meaningful and enjoyable.

The second theory guiding this study is Piaget's theory of cognitive development, which describes how children build knowledge through interaction with their environment. Piaget emphasized that children learn by actively exploring and playing, which helps them adapt and make sense of new information. His stages of development highlight how children move from simple to more complex thinking. Play supports cognitive processes like assimilation (adding new information to existing knowledge) and accommodation (adjusting current understanding to new experiences). According to Piaget, learning

happens best when children are engaged and hands-on – key features of both traditional and digital educational games.

Together, these theories support the idea that game-based learning promotes both motivation and cognitive development in young children. By integrating well-designed games into the classroom, educators can create rich, playful learning experiences that meet learners' developmental needs and enhance their understanding of numeracy concepts.

2. Methodology

This study utilized quantitative methodology, specifically quasi-experimental with the pre-test post-test design. This method was used in gathering quantitative data to determine the effectiveness of employing digital games over traditional games as a teaching strategy in teaching mathematics to kindergarten learners.

Thirty kindergarten pupils were involved in this study, 15 of them comprising the control group in which traditional games were employed, while the remaining 15 were part of the experimental group, in which digital games were utilized in the teaching of numeracy.

Of the 30 respondents, 47% were male and 53% were female (Table 1). Gender distribution was not analysed further, since the effects of gender on motivation to play is negligible during the early years, before the development of identity, as noted by Kyle et al. (2019).

Table 1. Profile of respondents

	Sex		
Group	Male	Female	Total
Control Group	8 (26.7)	7 (23.3)	15 (50.00)
Experimental Group	6 (20.0)	9 (30.0)	15 (50.00)
Total	14 (46.7)	16 (53.3)	30 (100%)

Source: Author's own work.

2.1. Research Instrument

A 30-item researcher-made questionnaire subjected for validation, pilot testing and reliability testing was utilized as an instrument for the study. It aimed to assess the basic conceptual and procedural knowledge and skills in numeracy among kindergarten pupils, based on the current K–12 curriculum for kindergarten. This covers number recognition and counting (1-20), one-to-one correspondence, comparing groups, patterns, simple addition and pictographs.

Before the test was used for pilot testing, it was validated by three experts. The Cronbach's alpha was calculated using the results of the pilot testing to establish the instrument's level of reliability. For a classroom test to achieve an acceptable reliability level, a coefficient of 0.60 or higher is required (Wells &

Wollack, 2003). The result of the computation for this test gained an alpha value of 0.802, which is an acceptable result for a classroom test.

To support the quantitative data which resulted from this study, qualitative observations were also noted using the Teacher's Observation Guide as one of the instruments used. This instrument highlighted various factors and considerations based on the tenets of self-determination theory, which explains game in terms of player's motivation, engagement and participation, scaffolding and support provided, etc.

2.2. Data Gathering Procedure

The study followed three phases: preparation, implementation and post-implementation. In the preparation phase, the researcher first obtained formal approval from the appropriate school authorities to conduct the study involving kindergarten pupils. The researcher then developed the necessary materials for the study, including a teacher-made assessment tool designed for a pre-test and post-test format, a table of specifications, a detailed schedule of activities, and four weekly lesson plans. The test instrument underwent a process of validation and reliability testing to ensure its effectiveness. Permission was also sought from another institution to facilitate pilot testing of the assessment tool before it was used in the main study.

During the implementation phase, the validated assessment was administered as a pre-test to the identified kindergarten participants in both the control and experimental groups. The researcher conducted the intervention over a period of one month. The control group received instruction through traditional teaching methods, while the experimental group was exposed to mathematics instruction using digital games. Sessions were held daily, with each session lasting approximately one hour. After the one-month intervention, the same assessment was administered as a post-test. The data gathered from the pre- and post-tests were then analysed to determine the effectiveness of the intervention.

In the post-implementation phase, the researcher developed both traditional and digital games based on the findings and results of the study. These games were designed to address key kindergarten numeracy competencies such as number recognition and counting, one-to-one correspondence, comparing numbers, identifying patterns, and basic addition. In developing the traditional games, the researcher reviewed commonly used classroom games and made appropriate modifications to enhance their instructional value and playability. The digital games were created using Microsoft PowerPoint and were informed by key principles of instructional design. Considerations included the age-appropriateness of language and content, the integration of multisensory and socially interactive tasks, the logical structuring of activities, immediate feedback features to monitor learning progress, and replay options to reinforce learning and mastery.

2.3. Ethical Considerations

This study primarily involved young learners, specifically kindergarten pupils, as its major participants. Given their age and vulnerability, ethical procedures were carefully observed to uphold participants' rights and to protect their dignity and well-being throughout the research process.

Participation in the study was entirely voluntary, and no form of coercion was exercised by the researcher, teacher, school principal or parents. Informed consent was obtained from the parents or legal guardians of the pupils through a formal consent process. Consent forms explained the purpose of the study, the nature of the children's involvement, possible risks and benefits, and emphasized the voluntary nature of participation, including the right to withdraw at any time. Additionally, written permission was obtained from the class adviser, school principal, district supervisor and division head prior to the commencement of the study.

To ensure the well-being and emotional safety of the children, data collection was conducted in a familiar classroom setting under the supervision of the class adviser. All activities were age-appropriate, non-intrusive and designed to minimize any form of distress or discomfort. The researcher maintained a sensitive and supportive approach throughout the process.

The confidentiality and privacy of all participants were strictly protected. No names or personally identifiable information appear in this research. Data collected were anonymized, stored securely, and used exclusively for the purposes of this study. All ethical guidelines regarding data handling and reporting were carefully followed.

Finally, the research underwent review and received approval from the Cebu Normal University Ethics Review Committee, ensuring that the study adhered to the ethical standards required for research involving children.

3. Results and Discussion

The table below showed the level of proficiency among the respondents in both groups in terms of their pre-test and post-test level of numeracy performance. The profiling of proficiency level is based on the descriptors provided in DepEd Order No. 8, s. 2015 – Policy Guidelines on Classroom Assessment for the K to 12 Basic Education Program, issued by the Republic of the Philippines Department of Education.

The pre-test results of the pupils in the control group show that the level of numeracy performance was *fairly satisfactory*, with a mean of 19.53 (Table 2). Twenty percent of the respondents in the control (corresponding to three students) were categorized as *did not meet expectations*; 33.33% (five students) were *fairly satisfactory*; 40% (six students) were *satisfactory*; and 6.67%% (one student) was *very satisfactory*.

The post-test scores of those exposed to traditional games, on the other hand, showed the respondents' level of numeracy performance as *outstanding*,

Table 2. Pre-test and post-test levels of numeracy performance among participants

Group	Level of Proficiency	Pre-Test n=15 f(%)	Post-Test n=15 f(%)
Control	Outstanding	0 (0.00)	13 (86.67)
	Very Satisfactory	1 (6.67)	2 (13.33)
	Satisfactory	6 (40. 00)	0 (0.00)
	Fairly Satisfactory	5 (33.33)	0 (0.00)
	Did Not Meet Expectations	3 (20.00)	0 (0.00)
	Mean (SD)	19.53 (3.00)	28.67 (1.50)
	Level Description	Fairly Satisfactory	Outstanding
	95% CI	(17.87, 21.19)	(27.84, 29.50)
Experimental	Outstanding	0 (0.00)	12 (80.00)
	Very Satisfactory	1 (6.67)	5 (33.33)
	Satisfactory	2 (13.33)	0 (0.00)
	Fairly Satisfactory	6 (40.00)	0 (0.00)
	Did Not Meet Expectations	6 (40.00)	1 (6.67)
	Mean (SD)	16.87 (4.90)	27.33 (4.62)
	Level Description	Did Not Meet Expectations	Outstanding
	95% CI	(14.16, 19.58)	(24.77, 29.89)

Source: Author's own work.

with a mean of 28.67. Of these, 87% of the respondents (13 students) were categorized as *outstanding* and the remaining 13% (two students) as *very satisfactory*.

In the experimental group, pre-test performance showed that the group in general were categorized as *did not meet expectations,* with a mean of 16.87. Of these, 40% (six students) were categorized as *did not meet expectations*; 40% (six students) as *fairly satisfactory*; 13% (two students) as *satisfactory* and 7% (one student) as *very satisfactory*.

Respondent's exposed to digital games gained a post-test result of *outstanding,* with a total mean of 27.33. Of these, 80% (12 students) were categorized as *outstanding*; 33.33% (five students) were *very satisfactory*; and 7% (one student) *did not meet expectations*.

The descriptors used in rating and quantifying the level of proficiency of kindergarten participants were anchored in the provisions of DepEd Order No. 8, s. 2015 – Policies and Guidelines on Classroom Assessment for the K to 12 Basic Education Program, issued by the Republic of the Philippines Department of Education.

The grading scales, originally expressed in percentages, were converted to scores/ points to facilitate easy categorization of the level of proficiency, with 60% the criterion for passing rate. However, the definitions of each descriptor provided in this study were also closely based on DepEd Memo No. 31, s. 2012, issued by the Republic of the Philippines Department of Education, in the context of learning fundamental numerical concepts which cover number recognition and counting (1-20), one-to-one correspondence, comparing groups, patterns, simple addition and pictographs.

The descriptor *outstanding* shows that the students at this level have exceeded the core requirement of learning the expected skill and knowledge set, while *very satisfactory* means that the students have developed and learned the fundamental mathematical skills covered in this study learned through games. Participants categorized as *very satisfactory* are those who possessed the minimum knowledge and skill set in kindergarten numeracy, while those categorized as *did not meet expectations* are those who have struggled with their understanding of the fundamental knowledge and competencies included in the present study.

3.1. Effectiveness of the educational games

In testing the effectiveness of the educational games, both traditional and digital, used in the kindergarten numeracy lessons, a pre-test post-test quasi-experimental design was used. Overall, in terms of the general performance of the respondents based on the classification set by the researcher regarding the results of the pre-test and post-test conducted, it can be noted that their numeracy performance improved significantly after a series of games were employed, both traditional and digital, during the one-month implementation.

To identify the mean gain difference in the pre-test post-test of the students in both the control and intervention groups, paired difference, t-value and p-value were calculated (Table 3).

Table 3. Comparative analysis of participants' pre-test and post-test numeracy performances

	Pre-test Performance Mean (SD)	Post-test Performance Mean (SD)	Paired Difference Mean (SD)	T-Value	P-Value
Digital Games (n=15)	16.87 (4.90)	27.33 (4.62)	10.47 (3.50)	11.75	0.000*
Traditional Games (n=15)	19.53 (3.00)	28.67 (1.50)	9.13 (2.85)	12.41	0.000*

Note: *Significant at 0.05 using paired T-Test; SD means Standard Deviation

Source: Author's own work.

Specifically, using t-test for dependent variables to determine whether there is a significant increase in scores from pre-test to post-test in each group of learners showed that there is a significant increase in the numeracy performance of the pupils exposed to traditional games, which yielded a mean gain score of 9.13, from the pre-test mean of 19.53 to the post-test mean of 28.67.

The result also established that the use of traditional games contributes to the development of numeracy performance in young learners (Zulkardi, 2011). These types of games play a vital role in learning mathematical concepts such as counting, one-to-one correspondence and so on, and in learning everyday mathematical language (UNICEF, 2010).

The games provided the learners with varied learning opportunities to develop their numeracy skills. It is equally important to understand that to effectively employ traditional games with young learners, it is essential to first make them understand the rules and mechanics of the games.

On the other hand, for the experimental group, a mean gain score of 10.47 was computed from the mean post-test of 27.33 and pre-test of 16.87, with 11.57 computer t-value and p-value of less than 0.05. This further indicates that there was a significant increase between the mean pre-test and post-test scores of the experimental group exposed to digital games, implying that there are significant improvements of numeracy performance in this group of learners in which digital games were employed.

The result show that the use of digital technology and digital game-based learning in the teaching of kindergarten numeracy is effective in improving children's understanding of mathematical concepts such as patterning, number sense, number recognition, one-to-one correspondence and simple addition (Kermani, 2017).

This improvement in the numeracy performance of the participants can also be attributed to the features of digital games used, which include (a) age-appropriateness of the content and language; (b) multi-sensory tasks with an emphasis on social interaction and language; (c) orderly activities within the structure of the game and providing immediate feedback to monitor learner progress; and (d) features that allow the students to do a replay of the game.

In general, the increase in the respondents' mean scores, resulting in the difference in the mean scores, especially in the experimental group, shows an improvement in their learning achievement in terms of numeracy. This affirms our assertions on the effects of games on then students' numeracy and on the motivational effects among the learners. As Wouters et al. (2013) and Ryan and Deci (2000) suggest, games which are believed to be inherently motivating result in more engagement in game play and therefore, within the context of this study, in the learning process.

To determine which intervention is more effective, mean gains in the pre-post-test of both groups were calculated (Table 4).

Table 4. Comparative analysis of mean gains between groups of kindergarten students

	Pre-test Performance Mean (SD)	Post-test Performance Mean (SD)	Paired Difference Mean (SD)	T-Value	P-Value
Digital Games (n=15)	16.87 (4.90)	27.33 (4.62)	10.47 (3.50)	–1.14	0.263
Traditional Games (n=15)	19.53 (3.00)	28.67 (1.50)	9.13 (2.85)		

Note: *Significant at 0.05 using t-test for two independent samples; SD means Standard Deviation

Source: Author's own work.

Table 4 summarises the data comparing the mean gain scores of respondents in both the control and experimental groups. Using t-test for mean difference, with computed t-value of -1.14 and p-value of 0.263, the results show that there is no significant difference between the two-mean gain between the two groups of kindergarten students. The students exposed to digital games had a higher mean gain (10.47) than the students exposed to traditional games (9.13), yet there was no statistically significant difference in the increase in scores when comparing participants between the experimental group and the control group because the results showed that they are equally effective. This shows that both traditional games and digital games used to teach kindergarten numeracy are effective in general in increasing scores.

Despite the slightly higher results in the group exposed to digital games, no significant difference was revealed. This means that games in general are effective in increasing motivation to learn mathematics in kindergarten students, and the level of technology of the games is not a factor in increasing motivation as far as the context of the study is concerned. It would be interesting to test if the same also applies to other subjects. It would also be possible to test whether the same results can be generated by varying the games or introducing more sophisticated games. However, for the context of this study, the results suggest that teachers do not need to spend more on digital games to yield the same results when it comes to learning mathematics. A cost benefit analysis could be done in future studies to investigate the difference in cost of implementing traditional versus digital games in relation to the gains from both.

However, despite the greater improvement among the digital games group, there was no statistical difference in improvement when comparing their scores. This implies that regardless of the type of game, whether traditional or digital, there is a significant improvement in the students' numeracy performance. Thus, games in general are effective in teaching numeracy.

Mathematics is an integral subject as it provides practical knowledge that can be applied in real-world experiences. Thus, it forms a part of the core subjects even in early education. However, as many studies have shown, mathematics can be a discouraging subject for students (Dung et al., 2021). In a study by Luhan et al. (2013), reasons given by respondents included the subject being difficult, boring and useless. Research has found a link between having difficulty in mathematics and lack of success in professional life (Kiili et al., 2015).

Hence, based on the quantitative results of the pre-post test of students in both the control and the experimental group, it can be concluded that game-based learning can be a significant tool in teaching mathematics, helping increase students' conceptual knowledge (Meletiou-Mavrotheris & Prodromou, 2016), developing their arithmetic skills (Drijvers et al., 2014), and facilitating classroom engagement (Bakker et al., 2016). This might be why the subjects performed better during the post-test and achieved a higher level numeracy performance in both traditional and digital games.

In line with similar studies in the literature, this study suggests that one of the major factors contributing to the increase in the participants' perfor-

mance in numeracy was their evident motivation and engagement in the game activities (Aghalara & Tamjid, 2011; Kirkland & O'Riordan, 2008). This can be explained by the self-determination theory, which was used as basis of this study. The self-determination theory places emphasis on intrinsic motivation – a drive which is anchored in innate satisfactions resulting from an action (Ryan & Deci, 2017).

This type of motivation has been widely seen as the main type of motivation that explains the attraction of play and other game-related activities. Hence, an individual typically engages in games because they are intrinsically motivating. As Bartle (2004) found, this is because players seek the element of "fun" in game activities.

On the other hand, the theory also took into consideration extrinsic motivation, which is similarly present in games. Most often, motivation in play or games is often associated with reward systems, which in this study was provided by the researcher through prizes given at certain times during the period of the study.

The tenets of self-determination theory are consistent with the advantages of games-based learning using traditional and digital games over other tools. These advantages include the fun they provided to both groups of subjects, which can lead to a decrease in students' feeling of boredom, difficulty and uselessness when faced with a difficult subject like mathematics. Aside from the feeling of enjoyment, students can explore and try different tasks (Bakker et al., 2016) and improve their self-worth and confidence (Huang et al., 2014) through game-based learning.

Moreover, the relatively significant increase in the participants' scores and mean gains in both the control and experimental group can be closely associated with their behaviour and the way they responded to lessons and activities that employed both the traditional and digital games.

4. Conclusion

This study demonstrated a significant improvement in the numeracy performance of kindergarten students following implementation of both digital and traditional game-based learning (GBL) approaches. The marked increase in the learners' pre- and post-test scores reflected not only the effectiveness of these strategies in developing key numeracy concepts such as number recognition and counting, one-to-one correspondence, comparing groups, patterning, simple addition, and interpreting pictographs, but also their impact on student behaviour. Throughout the intervention, students exhibited higher motivation, increased participation and greater engagement, suggesting that GBL fosters both cognitive and affective development.

These outcomes show that, with proper guidance and adult scaffolding, game-based strategies create meaningful learning experiences that go beyond simple content delivery. Rooted in both Piaget's cognitive developmental theory and self-determination theory, the use of educational games promotes

active exploration, problem-solving and knowledge construction. Children learn through doing, and their cognitive growth is supported by the engaging, playful contexts that GBL provides. The games naturally tap into young learners' intrinsic motivation by offering challenge, autonomy and opportunities for social interaction, all of which are essential to both learning and development.

Moreover, this study highlights the important role of the teacher in carefully selecting and implementing educational games that are developmentally appropriate and aligned with learning goals. Educators must ensure that games used in the classroom support not only engagement and enjoyment but also conceptual understanding and cognitive skill-building. The success of GBL lies not only in the tools themselves but in how they are integrated into meaningful education.

Overall, this research affirms that both digital and traditional game-based learning approaches can serve as powerful educational tools in the kindergarten classroom. When applied thoughtfully, games enhance learners' numeracy skills while nurturing motivation, curiosity and a positive attitude towards learning. These findings suggest promising directions for early childhood educators seeking to enrich their educational practices with playful, purposeful, and cognitively stimulating experiences.

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