Choosing and Disusing Educational Technology: Examining Parents' Decision Making about Math and Literacy Apps for Their Young Children

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ABSTRACT

Each year, more educational apps are designed for young children and some research suggests that well designed apps can have positive effects on children's literacy and math skills. However, many commercially available apps are poorly designed. This highlights the importance of understanding how parents decide which educational apps they make available for their child and also why they may disuse them. Sixty-five Canadian parents (58 mothers) completed a survey of their child's literacy and math knowledge and their own decisions about literacy and math apps. Parents' naturally self-generated features for app selection yielded similarities e.g., (ease of use, age appropriateness) and differences (e.g., advertisements, games) to rubrics typically generated by researchers. Highly endorsed features were similar across app types. App quality and potential for independent use were key reasons for disuse. Parental knowledge of foundational literacy and math concepts such as phonological awareness and cardinality was low, which could pose a challenge for their assessments of apps.

KEYWORDS

Apps, parents, children, math, literacy, education, home learning environment

Educational apps are popular with parents of young children (Broekman et al., 2018; Ochoa & Reich, 2020) and research regarding high-quality apps indicates use can improve children's literacy (Arnold et al., 2021; Chuang & Jamiat, 2023) and math skills (Griffith et al., 2019; Outhwaite et al., 2023). A high-quality app should have accurate and developmentally appropriate content, as well as scaffolding features, such as levelling and feedback provided for both correct and incorrect answers (Cai et al., 2022, Cayton-Hodges et al., 2015; Outhwaite et al., 2023). Given that commercially available educational apps vary substantially in quality (Dubé et al., 2019), research has attempted to understand how parents evaluate educational apps, including how parents evaluate app store descriptions

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(Montazami et al., 2022; Pearson et al., 2023), as well as the apps themselves (Urquhart et al., 2023; Urquhart et al., 2024). One limitation in these research studies is that parents may evaluate apps one way in an experimental setting, especially when prescribed rubrics are used, and another way in their homes. Indeed, it is currently unknown if parents naturally engage in any sort of systematic app evaluation at all. The present research examines parental app evaluation within the naturally occurring Home Learning Environment (HLE). Given that math and literacy are both important for a child's development (Skwarchuk et al., 2014), the study also examines whether parents evaluate math and literacy apps differently.

The HLE includes how parents teach their child, attitudes about teaching (Lehrl et al., 2021), and what tools they use (e.g., toys and educational apps). A rich and diverse HLE has been shown to improve academic outcomes for both math and literacy (Griffith & Arnold, 2019; Lehrl et al., 2021; Rodriguez & Tamis-LeMonda, 2011; Swkarchuk et al., 2014); however, in the traditional HLE, there is greater emphasis on fostering literacy over numeracy skills (Manolitsis et al., 2013; Skwarchuk et al., 2014). It is currently unknown whether the emphasis on literacy over math extends to educational app selection. Shared enjoyment between parent and child engaging in activities can be an important piece of the HLE for both math (e.g., Eason & Ramani, 2018) and literacy (Preece & Levy, 2018). Shared engagement is generally lower for digital activities than print activities (e.g., Ewin et al., 2020; Lee & Wood, 2020), however, co-use between parent and child during technology-based activities seems to support learning outcomes (Griffith & Arnold, 2018).

Similar to toy selection, parents typically decide which educational apps (if any) to bring into their home, and also which to remove (Miller et al., 2017; Richards et al., 2020). Parents' attitudes and competencies about teaching literacy and math may influence their app selection and deletion/disuse decisions (Keating et al., 2022). For example, parental math teaching confidence has been shown to affect math app evaluations (e.g., quality) and decisions (e.g., downloading apps) (Urquhart et al., 2023). In general, parental confidence regarding teaching their child literacy and math is quite high, but these high perceptions may not always reflect actual knowledge or skill (Sonnenshein et al., 2020). In addition, differences occur across domains with higher confidence in their ability to teach literacy over math (Skwarchuk 2009). This difference might also influence educational app decisions, resulting in literacy apps being evaluated differently than math apps. Since many children have high levels of screen time (McArthur et al., 2022), it is crucial to understand how parents decide to both choose and disuse math and literacy apps for their children.

The present study investigates parental adoption and deletion/disuse decisions regarding educational apps within the HLE. The key research questions include: (RQ1) How do parents naturally choose educational apps? (1a) Are these similar to research generated criteria, (1b) Do these criteria differ for literacy versus math apps? (RQ2) Why do parents decide to disuse educational apps, if they do and are there similarities for literacy and math apps?

Method

Study Design

This study employed a survey design including both multiple choice/Likert-type scale questions and open-ended response questions. This design allowed for predetermined research questions to be tested (e.g., parents' endorsement of specific app characteristics), as well as parents' own ideas to be recorded.

Participants

The sample size was determined by the number of anticipated predictors in a linear regression (three) and aiming for twenty participants per predictor. With a final sample size of 65 and criterion set at 0.05, power for a regression with three predictors was 0.72. There were three additional participants who completed only the consent form and did not continue with the study.

Sixty-five Canadian parents (58 mothers, 6 fathers, 1 unspecified, Mage = 36.55 years, SD = 4.32) of children two- to six-years-old participated. Most participants were White (n = 42), followed by South Asian (n = 7), Southeast Asian (n = 6), two each of Middle Eastern, Latin American, Black,

and one each of Indigenous and West Asian ethnicity. Overall, participants were highly educated with 41 parents having completed an undergraduate degree, followed by completion of a graduate degree (n = 12), partial completion of an undergraduate degree (n = 4), partial completion of a graduate degree (n = 3), and completion of high school (n = 2). Most participants spoke English as their first language (n = 47). Of those with a different first language (n = 18), 61.11% reported themselves as "completely fluent" in English, 33.33% as "almost fluent", and 5.56% as "somewhat fluent". All parents indicated that they spoke English to their child at home (67.7% indicated always, 16.7% almost always, 12.3% sometimes, and 3.1% occasionally).

Participants had between one and three children (M = 1.32, SD = .50). Those who had more than one child were asked to identify one child that they would use as a referent during the survey. The mean age of referent children was 4.11 years old (SD = 1.47). Forty (61.5%) of the target children were male and 25 (38.5%) were female.

Recruitment primarily occurred through online sources (e.g., Facebook parenting groups and Instagram) as well as through bulletin boards in community centres, libraries, and grocery stores. When a potential participant expressed interest in the study, they emailed or messaged the researcher, who then scheduled a time to complete the study. To ensure that all participants were real people (not bots), participants were required to meet the researcher on Zoom to complete the study. The research was reviewed and approved by a university research ethics board. All participants were treated in accordance with APA/CPA ethical guidelines.

Procedure

The study was conducted using video conferencing software. During the call, parents were provided with a link to one online survey that assessed demographic information (including age, gender, ethnicity, and languages spoken in the home) and measures related to math, literacy and technology (see below). The researcher was available to troubleshoot technical difficulties and to clarify questions if needed.

Attitudes Towards Home Learning

A 10-item scale was created for this study to measure parents' attitudes towards their child learning at home. The scale consisted of 5 items for math and 5 mirror items for literacy. Parents rated items such as "It's a parent's job to start teaching their child [to read/ math] before they start school" from 1 (strongly disagree) to 5 (strongly agree). The scale had acceptable reliability, $\alpha = 0.76$.

Math Measures

Parents rated their child's math abilities using a 10-item scale created for this study. These items represented early numeracy skills consistent with recommendations from the National Association for the Education of Young Children & National Council of Teachers of Mathematics (2010), for example "Match numbers and quantities". Parents indicated their child's ability as 1 (my child cannot do that), 2 (my child can sometimes do that), 3 (my child can always do that), or 0 (I'm not sure if my child can do that). This scale had excellent internal reliability, $\alpha = 0.94$.

Parent self-reported math behaviours were assessed with the 15-item Home Numeracy Practices scale (Skwarchuk et al., 2014) where parents rated the frequency with which they do various math activities with their child from 1 (never) to 4 (daily); for example, "I help my child weigh, measure, and compare quantities". This scale had good internal reliability, $\alpha = 0.81$.

Parental confidence teaching math to their young children was assessed with one item, "How confident are you in your ability to teach early math skills to your child?" rated from 1 (not at all confident) to 5 (extremely confident).

Literacy Measures

Parental-report of child's literacy abilities were assessed using a ten-item scale based on a literacy taxonomy (Grant et al., 2012). The items represented early literacy skills including alphabetics and phonological awareness; for example, "identify letter sounds". Parents were rated their child's ability as 1 (my child cannot do that), 2 (my child can sometimes do that), 3 (my child can always do that), or 0 (I'm not sure if my child can do that). This scale had excellent internal reliability, $\alpha = 0.91$.

Self-reported literacy behaviours were assessed with the 12-item Home Literacy Practices scale created for this study. Parents rated the frequency with which they do various literacy activities with their child from 1 (never) to 4 (daily); for example, "reading aloud to your child and having them repeat back to you (e.g., echo reading)." This scale had good internal reliability, $\alpha = 0.87$.

Parental confidence teaching literacy to do their young children was assessed with one item, "How confident are you in your ability to teach early reading skills to your child?" rated from 1 (not at all confident) to 5 (extremely confident).

Technology Measures

The following questions were asked for both math and literacy apps. Parents were asked if they had ever downloaded an app for their child. Those who said no were not presented with the subsequent questions about apps. Those who said yes were presented with the following questions.

Participants were asked to indicate (Yes/No) whether they had ever downloaded each of a math app and a literacy app (with questions allowing for a general educational app that contained math or literacy content).

To assess the features that parents look for in apps, participants were asked to generate "what are the top two things that you would look for in a [literacy / math] app?" Each question had two open-ended response possibilities. Participants were then presented with a matrix of 16 researcher-generated features (see Table 1) and were asked to indicate if they have used this feature for math apps, literacy apps, neither, and "I have not used this criterion before but I would now".

To assess the sources of information, parents use when selecting apps, they were asked to rate to what extent they use seven sources of information (e.g., recommendations from teachers; see Figure 3 for the complete list) from 1 (strongly disagree) to 5 (strongly agree). They were also asked if they explore apps before giving it to their child, rated from 1 (always) to 5 (never).

Co-use of apps was defined as "I engage with the technology with my child" and was assessed by estimating the percentage of time that parents co-use technology with their child, rated on a sliding scale from 0% to 100% of the time.

To assess deletion/disuse of educational apps once they have been downloaded, participants were asked, "Have you ever downloaded a [math / literacy] app that you later decided to not use with your child?" with answer options of yes and no. Those who indicated yes were then presented with an open-ended text box to answer, "Tell us what made you make the decision to not use the [math / literacy] app that you had downloaded?".

Results

All data was analyzed using SPSS Version 27. Missing responses within a set of questions were replaced by the mean if there were one or two missing items in a set of questions. Results from the survey data (as described in the Materials section) permitted examination of the two key research questions. RQ1 was assessed through an analysis of parent-generated features (descriptive statistics, thematic analysis) and researcher-generated features (descriptive statistics and one-way ANOVA to compare endorsement by subject). In addition, sources of information and co-use levels were assessed using descriptive statistics and t-tests to compare by subject (literacy versus math). Finally, contributions of the home learning environment including parent confidence and ratings of their child's math and literacy skills were examined using regression analyses (binary logistic regression and linear regression respectively), with attitudes about home learning compared across subject areas (i.e., t tests). RQ2 was assessed using descriptive statistics and thematic analysis of qualitative data.

RQ1: How Do Parents Choose Literacy and Math Apps?

The majority of participants indicated that they had downloaded an educational app before: 86% for literacy and 80% for math apps.

Parent-generated App Features

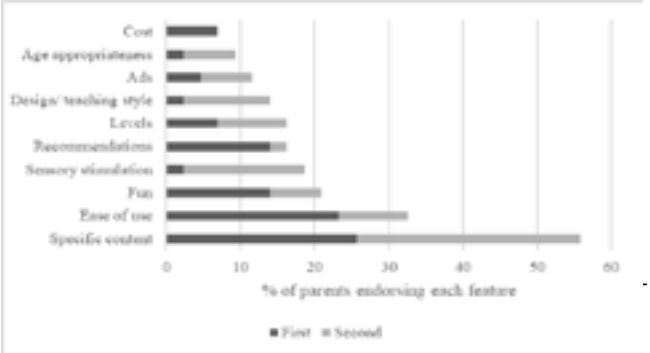
To determine criteria that parents naturally think about when selecting apps, parents were asked to generate two features that they look for when choosing an app for their child. Open coding of all responses was conducted to extract themes

(Boyatsis, 1998). Two coders independently read through all responses before generating themes and theme labels in an iterative manner. Then both coders collaboratively compared their themes and labels before reaching 100% agreement amongst themselves about classification of parent-generated responses. Ten themes were identified: ease of use, ads, fun, specific content, recommendations, levels, age appropriate, sensory, cost, and design/ teaching style. Responses within each theme tended to be similar (e.g., six parents simply wrote the word "free", which was coded into the cost theme) with the exception of the 'specific content' theme. The variety of 'specific content' responses reflected features about individual apps including comments about the animations (e.g., "five little ducks") and general approach (e.g., "phonics approach" and "helps to learn counting").

Figures 1 and 2 show the percentage of parents who endorsed each of these features for literacy and math apps, respectively. In total, for both literacy and math respectively, specific content (55.81%; 52.50%), ease of use (32.56%; 27.5%) and fun (20.93%; 42.5%) were the three most frequently identified features by parents. However, the overall order of endorsement of features was not the same across domains. For example, 'fun' was identified as second most important for math and third most important for literacy, and vice versa for 'ease of use', Order differences for some features was more varied. For example, sensory was the fourth out of ten most important for literacy and the eight out of ten most important for math. The least endorsed feature for literacy apps was cost (7%) whereas the least endorsed feature for math apps was ads (5%).

FIGURE 1

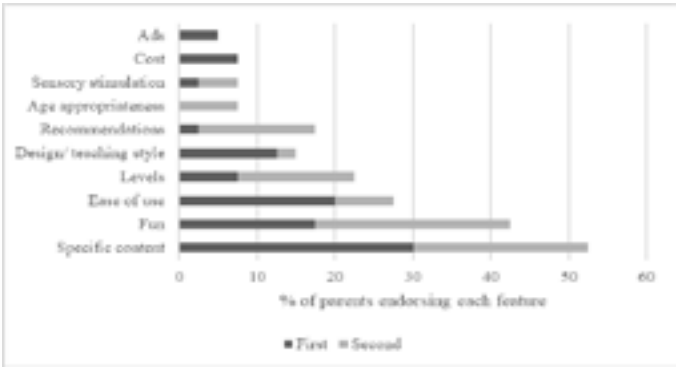
Percentage summary of parent-generated literacy app features as a function of overall prevalence and number of times each feature appeared as the first or second item listed in the open-ended questions.



quently analyzed as a function of placement (i.e., feature listed first versus second; see Figures 1 and 2). Although cost was only listed by 5% and 7% of parents across literacy and math respectively, when it was mentioned, it was listed first in 100% of these instances for both the literacy and the math responses. When age appropriateness was mentioned, it appeared as the second feature listed for both literacy and math. Other features showed differences in first and second endorsement by domain. For example, recommendations were endorsed first for literacy 86% of the time, and second for math also 86% of the time.

FIGURE 2

Percentage summary of parent-generated math app features as a function of overall prevalence and number of times each feature appeared as the first or second item listed in the open-ended questions



Researcher-generated App Features

After parents generated their own selection features, they were presented with 15 researcher-generated features and were asked to indicate which of the features they have used previously to select an app. The options included whether the feature was used for neither app domain, literacy only, math only, both domains, and not presently but I would use this in the future. Parents could indicate more than one category, for example, neither and also I would use this in the future. See Table 1 for a summary of the 15 features and the percentage of parents who endorsed each for literacy and math apps.

Table 1

Percentage of parents endorsing researcher-generated reasons for literacy and app selection

Feature	% of Parents Endorsing				
	Both Literacy and Math	Neither	Literacy Only	Math Only	Would use in Future
How easy the app is to use/ navigate.	82	0	8	0	8
The quality of the educational content in the app.	80	2	6	2	6
How fun or engaging the app is.	76	2	8	4	6
Whether my child can use the app independently (without my help).	72	12	4	0	10
Cost of the app.	70	14	2	2	4
The quality of the audio (e.g., music, talking, etc.).	66	6	0	6	12
If the app has difficulty levels.	56	18	4	6	14
The quality of the instructions in the app.	54	14	6	4	20
The type of feedback given for incorrect answers.	44	22	2	4	26
The type of feedback given for correct answers.	44	20	2	4	28
If the app automatically moves my child across levels.	40	14	10	2	24
Familiar characters that my child already likes.	36	34	0	8	18
New characters that I think my child will like.	36	32	0	10	20
The quality of the visuals (e.g., colours, easy fonts, etc.).	32	22	4	20	12
Whether the audio and visual features can be customized to accommodate sensory needs.	14	48	14	0	20

Note: Parents could use more than one category, for example, neither and also I would use this in the future thus percentages may exceed 100 percent.

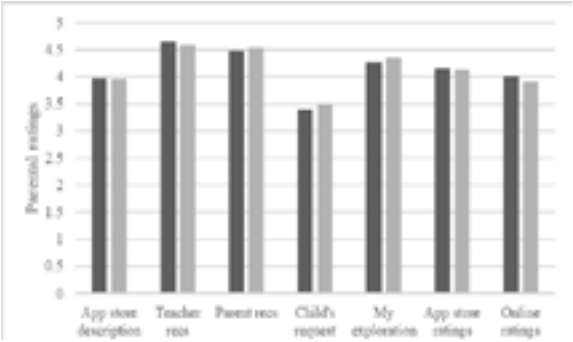
The most endorsed research-generated features were ease of use (82% for both and another 8% for literacy only), quality of the educational content (80% for both and an additional 6% for literacy only and 2% for math only), and fun (76% for both and an additional 8% for literacy only and 4% for math only). The three least endorsed features were customization (48% have not used), familiar characters (34% have not used), and new characters (32% have not used). The features that were most likely to be considered in the future were the type of feedback given for correct answers (28%), the type of feedback given for incorrect answers (26%), and if the app's levels are automatic (24%).

A one-way ANOVA showed that there was a significant difference in the number of people endorsing each of the option types (neither, literacy only, math only, both, 'future') across the 15 features, $F(4, 70) = 41.01$, $p = <0.001$, with a strong effect size, $\eta 2 = 0.70$. Bonferroni post-hoc analysis revealed that the differences were primarily driven by the 'both' option. Specifically, more people endorsed both than neither, $t = 8.22$, $p = <.001$; both than math only, $t = 10.90$, $p = <0.001$; both than literacy only, $t = 11.05$, $p = <0.001$; and both than future, $t = 8.80$, $p = <0.001$.

Sources of Information

Parents' ratings for the seven possible sources of information about both literacy and math apps approached ceiling for all but child's request; see Figure 3.

FIGURE 3
Sources of information that influence decisions to download apps



Visual inspection suggests that the means for literacy and numeracy apps were similar. To test whether differences between the types of apps occurred, two t-tests were conducted, one for the child's request category and one for online ratings as these categories reflected the largest mean difference in use of a source of information between the literacy and math apps. No significant differences were found for either of these two exemplars, $t_{literacy}(.59) = -1.22$, $p = 0.229$ and $t_{math}(0.65) = 1.09$, $p = 0.280$, further indicating that none of these categories differed by domain.

Participants were also asked if they explore an app before giving it to their child (rated from 1 =always to 5 = never). Self-reported pre-exploration was high for both literacy ($M = 2.13$, $SD = 1.03$) and math ($M = 2.08$, $SD = 0.93$), and did not significantly differ by subject, $t(0.32) = -1.00$, $p = 0.324$.

Co-Use of Apps

Overall, parents indicated that they engaged in co-use of apps approximately a third of the time for both literacy (35.61%, SD = 25.38%) and math apps (31.93%, SD = 26.07%). A comparison was made between parents who did and did not indicate that they disused an app after having downloaded it. To determine whether co-use differed among parents who had or had not disused an app a t-test was conducted for each app domain. No significant differences were found. For literacy apps, co-use in the app-disuse group was $M = 37.4\%$ ($SD = 27.4\%$) of the time, whereas co-use in the continued use group was $M = 33.9\%$ ($SD = 23.7\%$); $t(41) = 0.45$, $p = 0.653$, $d = 0.14$). For math apps co-use in the app-disuse group was $M = 36.9\%$ ($SD = 29.2\%$) of the time, whereas co-use in the continued use group was $M = 27.2\%$ ($SD = 22.4$); $t(40) = 1.23$, $p = 0.226$, $d = 0.38$).

Apps as Part of the Home Learning Environment (HLE)

Downloading Apps

Two binary logistic regressions were used, one for math and one for literacy, to test if parents' self reported behaviour (i.e., supporting HLE), confi-

-dence teaching the subject, and their child's subject abilities predicted whether they download each type of educational app. None of the variables predicted literacy app downloads (B = 0.47, p = 0.567 for HLE, B = -0.80, p = 0.056 for literacy teaching confidence, and B = -0.39, p = 0.569), though literacy teaching confidence approached significance. Similarly, none of the variables predicated math app downloads (B = 2.12, p = 0.070 for HLE, B = -0.21, p = 0.714 for child's math knowledge, and B = -0.67, p = 0.146 for math teaching confidence).

Parent-reported Child's Math Knowledge

Parents were asked to rate if their child could do ten early numeracy skills, targeting concepts such as one-to-one correspondence and cardinality. Overall, the mean rating was relatively high (M = 2.30, SD= .75, max. score = 3). Across the 10 concepts, 59.7% of parents indicated their child could always do these skills, 18.3% indicated their child could sometimes do the skills, and 14.08% indicated their child could never do the skills. The least common response was I'm not sure if my child could do that which was endorsed by 7.71% of parents. Further examination of the unsure category indicates that 10 parents indicated uncertainty for one of the ten concepts, five parents for two of the concepts, one parent for three concepts, and two parents for each of four and ten concepts.

This means two parents indicated that they were unsure if their child could do any of the items or knowledge sets. See Table 4 for the breakdown of parent-reported child's knowledge across specific knowledge sets. The most common knowledge set that parents did not know if their child could do was "know that the last number they count represents the total number in the set," which represents cardinality (n = 14 parents indicated they were not sure if their child could do this). The next most common knowledge set that parents were not sure about was "recognize numbers on dice," representing subitizing (n = 9), followed by "generate the correct number of items to match a number," representing cardinality (n = 6). Self-reported confidence teaching math to their child was reported as moderate (M = 3.88, SD = 1.10, with 5 representing "very confident").

Measures of self-reported math app co-use, pre-exploration of math apps, and child's sex significantly predicted parent-reported child's math knowledge, F (3, 36) = 3.31, p = .032, with a large effect size f = .44. This effect was specifically driven by pre-exploration of math apps, t = 3.11, p = .004. Co-use was not a significant predictor of child's math knowledge, t = .64, p = .528 and neither was child's sex, t = .01, p= .992.

Parent-reported Child's Literacy Knowledge

Parents were asked to rate if their child could do 12 early literacy skills, taken from the literacy taxonomy (Grant et al., 2012). The overall rating parents gave their children across the 12 literacy skills was relatively high (M = 2.17, SD= .73, maximum score = 3). Across the 12 features, on average, 50.78% of parents indicated their child could always do these skills, 23.33% said their child could sometimes do the skills, and 19.01% said their child could never do the skills. The least common response was I'm not sure if my child could do that which was endorsed by a mean of 6.93% of parents across the ten items. Further examination of the unsure category indicates that five parents indicated uncertainty for two of the 12 concepts, four parents for one of the concepts, three parents for three concepts, two parents for five concepts, and one parent each for 6 and 11 concepts. See Table 4 for a detailed breakdown of parents' ratings of their children's literacy knowledge. The most item that parents did not know if their child could do was "count or clap syllables," representing phonological awareness (n = 12 parents indicated they were not sure if their child could do this). The next most common item that parents were not sure about was "tell if two words start with the same sound," representing phonological awareness (n = 9), followed by "recognize rhyming words," representing phonological awareness (n = 6). Self-reported confidence teaching literacy to their child was reported as moderate (M = 4.02, SD = 1.10, with 5 representing "very confident").

Digital related measures of self-reported literacy app co-use and pre-exploration of literacy apps almost significantly predicted parent-reported child's literacy knowledge, R2 = 0.16, F (2, 35) = 3.19, p = 0.054. This effect was specifically driven by pre-exploration of literacy apps, t = 2.52, p

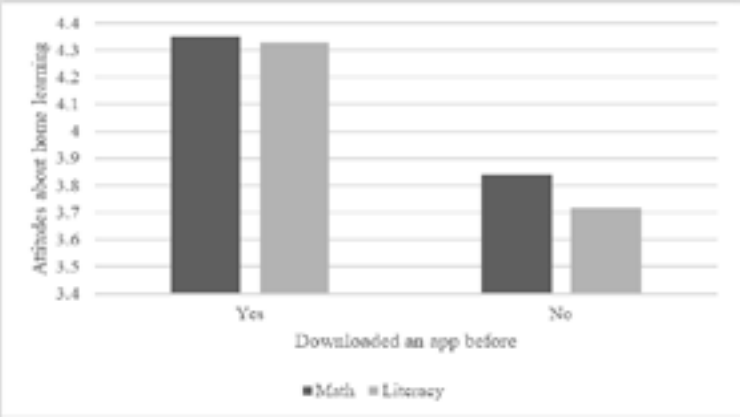
= 0.016. Co-use was not a significant predictor of child's literacy knowledge, t = 0.05, p = 0.964.

Attitudes About Home Learning

Overall, parents reported high levels of agreement with the ten item attitudes scale which assessed their attitudes towards teaching both literacy and math to their child at home (M = 4.21 out of 5, SD = 0.58). The level of endorsement of home learning differed between parents who had and had not downloaded educational apps before, see Figure 4. Specifically, independent samples t-tests showed that parents who had downloaded a math app before had more positive attitudes about home learning, t (10.87) = 2.30, p = 0.042. This was also true for parents who had downloaded a literacy app before, t (6.46) = 2.60, p = 0.038.

FIGURE 4

Self-reported attitudes about home learning compared between people who had and had not downloaded an educational app for their child before



Note. Responses on the attitudes scale could range from 1 to 5.

Table 2

Number of parents who indicated 'cannot', 'sometimes', 'always', and 'don't know' when rating their child's numeracy skills, as a function of knowledge set

Question text	Knowledge set	Cannot	Sometimes	Always	Don't Know
Generate the correct number of items to match a number.	Cardinality	9	12	37	6
Know that the last number they count represents the total number in the set.	Cardinality	6	16	28	14
Name numbers.	Identifying numbers	8	8	46	2
Identify which set has a larger or smaller amount in it.	Magnitude comparison	8	16	36	4
Match numbers and quantities.	Magnitude comparison	9	14	36	5
Count a set of items by assigning one number per item (e.g., 1, 2, 3...)	One-to-one correspondence	2	8	50	4
Count items in an organized way without skipping or duplicating items.	One-to-one correspondence	9	22	30	3
Know the counting sequence from 1-10	Stable order	4	3	55	2
Recognize numbers on dice.	Subitizing	14	6	35	9
Print numbers.	Writing numerals	21	12	29	2

Table 3

Number of parents who indicated 'cannot', 'sometimes', 'always', and 'don't know' when rating their child's literacy skills, as a function of knowledge set

Question text	Knowledge set	Cannot	Sometimes	Always	Don't Know
Name alphabet letters.	alphabetics	6	8	47	1
Identify letter sounds.	alphabetics	8	14	35	4
Match upper- and lower-case letters.	alphabetics	15	11	32	5
Print letters.	alphabetics	21	9	31	2
Point to words in print.	fluency	12	19	27	4
Print their first name.	memorization	19	4	39	1
Identify words/ signs (e.g., STOP, McDonald's).	memorization	8	18	36	1
Recognize/ read their name.	memorization	10	7	43	3
Count or clap syllables.	phonological awareness	14	21	16	12
Recognize rhyming words.	phonological awareness	10	21	26	6
Generate rhyming words.	phonological awareness	16	19	23	5
Tell if two words start with the same sound.	phonological awareness	7	19	28	9

RQ2: Deletion/Disuse of Apps

Of the parents that had downloaded each type of app before, 44.9% (literacy) and 42.9% (math) of parents reported having decided to no longer use the app with their child. Qualitative analysis following the same open-coding procedure as was used for the parent-generated features and again 100% agreement was observed between the two raters. Seven themes emerged: cost, ads, level of challenge, requiring assistance, lack of interest, other engaging sources, and productivity (see Table 4 for themes, examples, and endorsement). Prevalence of these themes were similar for both math and literacy apps, with some apparent differences (e.g., 'other engaging sources').

Table 4

Summary of themes for disuse of math and literacy apps

Theme	Example response	% of parents endorsing	
		Literacy	Math
Lack of interest	"The children weren't interested in it"	45.45	42.86
Level of challenge	"Not challenging enough" - either too easy or too hard	40.91	38.10
Cost	"A number of in app purchases required"	22.73	28.57
Requires assistance	"Required my assistance to use"	18.18	19.05
Ads	"Too many ads"	13.64	9.52
Other engaging sources	"Found a better app that my child prefers"	9.09	23.81
Productivity	"No productivity in app"	9.09	4.76

Note. The percentages reported in this table are out of the total who indicated they had disused a literacy and/or math app before (i.e., out of 22 and 21 participants).

TABLE 9
Literacy Skills Mean, Standard Deviation, and Pearson Correlation for AEPS-3 Ready Set (Teachers) and AEPS-3 FACS (Parents)

In general, the order of endorsement of each reason was the same across domains (e.g., 'lack of interest' was the most cited and 'productivity' was the least cited reason for both literacy and math). No reason was endorsed for more than half of the participants who had disused apps.

Summary of Findings

Overall, with respect to the question "How do parents naturally choose educational apps?" (RQ1), both similarities and differences were found in parent-generated app features compared to researcher-generated app features, but no differences were found between literacy and math apps. Ease of use and fun were in the top three app features in both the parent and researcher generated lists. In contrast, parents' self-generated features included specific content whereas educational quality served as a third feature from the researcher-generated features. RQ2 examined why parents decide to disuse educational apps, if they do and whether there are similarities in disuse for literacy and math apps. Consistent reasons were identified for disuse of math and literacy apps, which included some features generated and endorsed for RQ1, such as the top reason of lack of interest (similar to engaging or fun in the features list).

Discussion

The present study investigated how parents of young children choose educational literacy and math apps and criteria that might cause them to stop using an app in each of these domains. Most parents had downloaded an educational app before engaging in this study, with slightly more (86%) having downloaded a literacy app than a math app (80%) consistent with previous research that reports an emphasis on literacy over math in early childhood (Skwarchuk et al., 2014). Parents with more positive attitudes about teaching their child at home were more likely to have downloaded an educational app, indicating that parents consider educational apps to be a tool within the home learning environment. Features parents used to decide whether to download an app overlapped with features typically generated by researchers in the extant literature, however some differences were observed. Pre-exploration of both literacy and math apps significantly predicted greater literacy and perceived math knowledge (respectively), supporting the idea that carefully selected apps can be part of a diverse and rich home learning environment.

How Parents Choose Apps

Both the parent-generated and the researcher-generated features for app selection included ease of use, fun, age appropriateness, levels, cost, and sensory stimulation. Parents, however, also indicated concerns about ads and noted they looked for specific features, such as "songs" and "games". In addition, a small number of parents highlighted features such as "teaching philosophy" (coded as the Design / Teaching Style theme), however, this feature was vague and did not specify what aspect of teaching philosophy was important. Features such as "teaching philosophy" may be consistent with what parents see in app store descriptions, however, these descriptions are not necessarily accurate or useful (Pearson et al., 2023). Given that parents only were asked to identify two features, and some indicated features not appearing on traditional research generated lists, it would be important to follow up on parent-generated criteria to gain a richer and more complete understanding of parental criteria. Future focus group studies may allow for expansion of these unique criteria as well as other criteria beyond the two parents listed for the present study.

Generally, the desired features parents generated for literacy and math apps were similar, however, there were some notable differences in the order of endorsement. "Fun" was generated by 42.5% of parents for math versus 20.93% for literacy apps. Fun may be a more important consideration when looking at math apps as previous research indicates that many math apps rely on practice drills, similar to a worksheet (Outhwaite et al., 2023) which does not fully utilize the engaging multimedia potential that apps could offer. In addition, sensory stimulation was generated by 18.5% of parents regarding literacy apps and only 7.5% for math apps. It is possible that literacy apps have more varied sensory features than math apps, for example reading

aloud, and making sounds to match text content. Alternatively, parents may consider literacy more important than math (Skwarchuk et al., 2014) and this may bias their evaluations of literacy versus math apps. Further investigation of parents' perceptions about the purpose and design of math and literacy apps may be an important future direction.

Of the researcher-generated features, the most endorsed feature was ease of use / navigation, followed by educational content, fun, and child can use it independently. This aligns with previous findings that parents endorse "educational" value but also value apps that allow their child to engage independently which may allow parents an opportunity to engage in other activities (Urquhart et al., 2023). Although independent use may be an important consideration, outcomes for the sources of information parents use support that educational opportunities rather than child entertainment are a priority. Among the sources the only source of information that had an average slightly below the "agree" range was child's request. If parents were simply looking to entertain their child, child's request would likely be a higher priority.

Although parents endorse the educational potential of apps, parents may not be clear regarding instructionally important supports within apps. Fourteen parents said they had not considered feedback but they would look for this feature in future. This suggests that parents may need direct exposure and explanation of these features as in the present study. It may be important to provide explicit information through websites, app descriptions or other sources to identify critical educational/instructional features.

Parents' evaluations of educational value may also rest on their understanding of key foundational skills and their child's abilities. For example, parents were unsure of fundamental skills, such as phonological awareness and cardinality the type of skills that should be targeted in a well-designed early literacy or math app (Cayton-Hodges et al., 2015). Parents may require support in recognizing developmentally appropriate math and literacy content, a feature that may be needed in app evaluations and descriptions. The results of this study cannot identify if these parents did not know what the skills mentioned were or if they knew what the skills were but were unsure if their own child could do them. Future research could investigate parent knowledge of foundational math and literacy skills to uncover what the specific gaps may be.

Less than half of participants indicated they stopped using an educational app, which could mean most are successful at choosing high quality apps in the first place, or it could mean they do not notice when an app they have downloaded is poor quality or is not achieving desired outcomes. Parents acknowledged poor quality (e.g., "level of challenge", "ads") as important for considerations leading to disuse and that the app cannot be used independently (e.g., "requires my assistance"). It might be expected that parents who co-use educational apps with their children would be more likely to notice an app is of poor quality or failing to achieve its purpose. However, co-use levels did not differ between parents who had or had not disused an app. This nonsignificant outcome may, however, reflect the generally low co-use across the sample. More effort may be needed to inform parents of co-use as an important informal instructional support (Griffith et al., 2021).

Overall, findings suggest that parents are motivated to find educational apps for their children, they use various sources of information and consider multiple features when choosing apps. App decisions were relatively similar for math and literacy. However, gaps in parental knowledge about foundational math and literacy skills may influence their app decisions. This study adds to the literature about educational apps as a tool in the home learning environment, including specifically comparing parents' attitudes and evaluations of literacy versus math apps, as well as considering both use and disuse of apps. Understanding how parents think about educational apps can lead to the creation of tailored resources to support their decisions, with the goal of promoting student learning.

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