Registry of Efficacy and Effectiveness Studies

Study Title:
The efficacy of digital media resources in improving young children's computational thinking, problem solving, and social-emotional learning skills: An evaluation of Work it out Wombats! from PBS KIDS

Registry ID: 17861.1v1

Version History

The first version of this entry was published on November 29, 2023 11:37:27 AM EST
Currently viewing this version.

Section I: General Study Information

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Primary Funding Source(s):
No Funder

Award Number(s):
35070-EDU

IRB Name:
Education Development Ctr, Inc. IRB #1

IRB Approval Date:
2023-03-10

IRB Approval Number:
2232

Other Registration Name:
-

Other Registration Date:
-

Other Registration Number:

-

Study Start Date:

2023-12-01

Study End Date:

2024-04-30

Intervention Start Date:

2023-12-01

Timing of entry:

Prior to implementation of the intervention

Brief Abstract:

This randomized control trial will investigate the efficacy of resources from Work it out Wombats! (Wombats), a public media series that focuses on enhancing's young children's computational thinking and problem-solving skills. The Wombats resources include an app with digital games, videos and hands-on activities, as well as parent videos. Participants will be low-income 4- and 5-year-old children and their parent or legal guardian, recruited locally in 8 cities in the United States. Participants will be randomly assigned to a treatment group or a delayed-treatment control group. Both groups will receive a data-enabled tablet computer (tablet). Tablets for the treatment group will come pre-loaded with Wombats resources. Tablets for the control group will not. Tablets for both groups will be blocked from accessing PBSKIDS.org and the PBS KIDS video player app. Parent guides and weekly text message reminders will encourage parents in both groups to have their children use the tablets for at least 90 minutes per week. These materials direct the treatment group to focus on Wombats resources and the control group to focus on digital educational materials of their choosing. Families in the control group will be given access to Wombats resources at the conclusion of the study. Children will be assessed at baseline for executive function and computational thinking skills. After the 8-week intervention, the research team will measure children's computational thinking skills, problem solving skills, and social-emotional skills. In addition, at post-test we will measure sequencing skills for 50% of children and ability to use the design process to solve problems for the other 50% of children.

Keywords:

randomized control trial; RCT; quantitative; early childhood education; education technology; literacy education; informational text; digital media

Comments:

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Section II starts on the next page.

Section II: Description of Study

Type of Intervention:
Curriculum/Product

Topic Area of Intervention:
Early Childhood Education, Education Technology, Computational Thinking, Problem Solving

Number of intervention arms:
1

Target school level:
Kindergarten, Pre-K

Target school type:
Rural, Suburban, Urban

Location of Implementation:
United States : Midwest, Northeast, South, West

Further description of location:
Chicago, IL
New York, NY
Arlington, VA
Houston, TX
Philadelphia, PA
Los Angeles, CA
Nashville, TN
Waltham, MA

Brief Description of Intervention Condition:
Families assigned to both groups will receive an internet-enabled tablet computer that blocks the PBS KIDS video and games apps and all PBS KIDS webpages. Families assigned to both groups will be instructed to use the tablet at home for 8 weeks between the pre-test and the post-test. The treatment group intervention consists of a parent orientation and family guide, Wombats media resources, and weekly text messages. Treatment Group Orientation and Family Guide: To encourage parents to support their child's use of Wombats resources, parents randomized to the treatment group will receive an orientation to the Wombats resources and to CT. During the orientation, researchers will walk parents through the family guide, which includes the following: (1) Background information on Wombats that is available on the PBS KIDS Wombats parents page (2) General study information, including a description of the videos, app, and hands-on activities. We will recommend that parents use their typical approach in guiding how much media the child uses but suggest approximately 1.5 hours per week engaging with the resources. (3) CT-focused tips for parents that are available on the Wombats website (4) Weekly calendar to alert parents to the timed release of video and game content (5) Technology FAQs and troubleshooting tips Parents will receive a hard copy of the family guide during orientation. The family guide will be available in English and Spanish. Wombats resources for the treatment group include videos, games, and hands-on activities. Wombats Videos: To encourage child engagement throughout the study, the Wombats study app on treatment tablets will release bundles of five 11-minute story videos and two 1.5 minute music videos each week. Wombats Games: The Wombats study app will link to Wombats digital games. Each game focuses primarily on one CT concept. We will present one game at the start of the study and present additional on a delayed release with related content bundles. Wombats Hands-on Activities: Four Wombats hands-on activities will be available

for families throughout the entire study period. The hands-on activities will be available within the app and families will receive printed copies. Weekly Treatment Group Parent Text Messages. Parents of children assigned to the treatment group will receive three types of text messages: (1) One text message per week encouraging them to engage in the resources as described in the family guide, including a reminder of the content focus for the week. (2) One text message for both treatment and control families asking parents to report how much time their child spent using the tablet in the past week. (3) Treatment parents will receive two additional text messages with a link to a brief Wombats parent-facing video during two of the study weeks. One of these videos will outline the component skills of computational thinking. A second video will describe ways to support children's CT skill development.

Brief Description of Comparison Condition:
Families assigned to both groups will receive an internet-enabled tablet computer that blocks the PBS KIDS video and games apps and all PBS KIDS webpages. Families assigned to both groups will be instructed to use the tablet at home for 8 weeks between the pre-test and the post-test.

Families randomized to the control group will receive an orientation to the study time frame and recommendations for how much time children should engage with the tablet using educational media of their choice.
Control Group Orientation:
Following randomization, families in the control group will receive an orientation to the study, the tablet, and expectations for tablet use. During the orientation, researchers will walk families through the control group family guide, which will include:
(1) General study information, including a timeline and schedule
(2) Recommendation to parents to let their children use the tablet and engage with educational media for approximately 1.5 hours per week
(3) Technology FAQs and troubleshooting tips
Parents will receive a hard copy of the family guide during orientation, and a PDF will be available on the tablet home screen. The family guide will be available in English and Spanish.
Weekly control group parent text messages.
Parents of children assigned to the control group will receive two types of text messages each week:
(2) One text message per week reminding them to use educational media on the tablet.
(2) One text message per week for both treatment and control treatment families that will ask parents to report how much time their child spent using the tablet in the past week.

Comparison condition:
Other

Comments:
The comparison condition is an alternate-treatment group. Families in the control group will receive data enabled tablet computers as described above. They will receive access to all study resources at the conclusion of the 8-week study.

Families assigned to both groups will receive an internet-enabled tablet computer that blocks the PBS KIDS video and games apps and all PBS KIDS webpages.

Section III: Research Questions

Confirmatory research questions:
Question 1:
Does providing 8 weeks of access to Wombats resources via an internet-enabled tablet improve low-income 4- and 5-year-old children's computational thinking skills as compared to providing an internet-enabled tablet that cannot access

Wombats resources?

Question 2:
Does providing 8 weeks of access to Wombats resources via an internet-enabled tablet improve low-income 4- and 5-year-old children's problem-solving skills as compared to providing an internet-enabled tablet that cannot access Wombats resources?

Question 3:
Does providing 8 weeks of access to Wombats resources via an internet-enabled tablet improve low-income 4- and 5-year-old children's SEL skills, as compared to providing an internet-enabled tablet that cannot access Wombats resources?

Exploratory research questions:
Question 1:
Does providing 8 weeks of access to Wombats resources via an internet-enabled tablet improve low-income 4- and 5-year-old children's ability to use the design process to solve problems, as compared to providing an internet-enabled tablet that cannot access Wombats resources?

Question 2:
Does providing 8 weeks of access to Wombats resources via an internet-enabled tablet improve low-income 4- and 5-year-old children's sequencing skills, as compared to providing an internet-enabled tablet that cannot access Wombats resources?

Question 3:
How does the impact of providing 8 weeks of access to Wombats resources on low-income 4- and 5-year-old children's computational thinking skills vary by demographic variables?

Question 4:
How does the impact of providing 8 weeks of access to Wombats resources on low-income 4- and 5-year-old children's computational thinking skills vary by duration of engagement and the frequency with which Wombats resources were accessed?

Comments:
-

Section IV-A: Study Design (Selection)

Study Design:
Randomized Trial (RT)

Comments:
-

Section IV-B: Study Design (Input)

Study Design: Input

Unit of random assignment of intervention:
Student

Assignment within sites or blocks:
Yes

Define the sites or blocks:
Site

Probability of assignment to treatment the same across sites or blocks:
Yes

Probability of assignment to treatment:
.5

Unit outcome data measured:
Student

Intermediate clusters between unit of random assignment and unit of measurement:
No

Comments:
After recruited families provide informed consent, the child will complete assessments of computational thinking skills and executive function. The parent will complete a baseline survey. Children must complete both assessments to enroll in the study and be randomized to condition. Families whose child completed both assessment will be randomized to condition after assessment. A researcher will consult a list of pre-randomized conditions and assign families to the next condition on the list in the order of their completion of the baseline assessments. We will randomize families within sites (cities). Families will then be instructed to go to one of two rooms where they will attend an orientation session based on the condition to which they were assigned. During the orientation process, they will receive a tablet that has been provisioned according to condition. Pre- and post-test assessors will be blind to families' assigned condition.

Design Classification

Based on the responses above, this study has been classified as:
RT: Multisite (Blocked)

Section V: Sample Characteristics

Approximate number of students in the comparision condition within each block (Site): 30

Approximate number of students in the intervention condition within each block (Site): 30

Number of blocks (Site): 8

Were there certain students that were targeted for the study?
Yes - We will target populations that are likely to pass our inclusion/exclusion criteria below. In addition, we hope to include urban, suburban, and rural participants in our study. Further, we will make every effort to recruit a diverse sample of participants in terms of age, race/ethnicity, and gender.

Were there certain students that were excluded from the study?
Yes - To participate in the study, parents must report that: their child does not watch Wombats more than four times in a typical week, there is only one participating child per family, the child is able to participate in an English-language assessment that requires verbal responses, the child is aged 4 or 5 as of December 1, 2023, the family’s annual

household income is less than $80,000 or the family is eligible for public programs, the parent can speak English or Spanish, and the parent can receive SMS messages.

Were there certain blocks (Site) that were targeted for the study?
Yes - The 8 sites (blocks) for this study are cities in the United States: New York, Chicago, Philadelphia, Los Angeles, Houston, Washington, DC, Nashville, and Waltham

Were there certain blocks (Site) that were excluded from the study?

Comments:
-

Section VI: Outcomes (Input)

Confirmatory question 1: Outcome Measure 1

Outcome domain: Student Achievement- Computational thinking
Minimum detectable effect size: .14
Outcome measure: STEM+C
Scale of outcome measure: Continuous
Normed or state test: No
Test-retest reliability:
Internal consistency: .76
Inter-rater reliability: .95
Same outcome measure in treatment and comparison groups: Yes

Confirmatory question 2: Outcome Measure 1

Outcome domain: Student Achievement- Problem Solving Skills
Minimum detectable effect size: .19
Outcome measure: Picture Problem Solving Task Fluency Score
Scale of outcome measure: Continuous
Normed or state test: No
Test-retest reliability:
Internal consistency:
Inter-rater reliability: .8
Same outcome measure in treatment and comparison groups: Yes

Confirmatory question 3: Outcome Measure 1

Outcome domain: Student Social, Emotional, & Behavior - Persistence
Minimum detectable effect size: .20
Outcome measure: PROMIS-EC Persistence Scale
Scale of outcome measure: Continuous
Normed or state test: No
Test-retest reliability: N/A
Internal consistency: N/A
Inter-rater reliability: N/A
Same outcome measure in treatment and comparison groups: Yes

Confirmatory question 3: Outcome Measure 2

Outcome domain: Student Social, Emotional, & Behavior - Persistence

Minimum detectable effect size: .20
Outcome measure: PROMIS-EC Frustration Tolerance Scale
Scale of outcome measure: Continuous
Normed or state test: No
Test-retest reliability: N/A
Internal consistency: N/A
Inter-rater reliability: N/A
Same outcome measure in treatment and comparison groups: Yes

Confirmatory question 3: Outcome Measure 3

Outcome domain: Student Social, Emotional, & Behavior - Persistence
Minimum detectable effect size: .20
Outcome measure: PROMIS-EC Flexibility Scale
Scale of outcome measure: Continuous
Normed or state test: No
Test-retest reliability: N/A
Internal consistency: N/A
Inter-rater reliability: N/A
Same outcome measure in treatment and comparison groups: Yes

Comments:
STEM+C (Dominguez et al., 2022) is a hands-on assessment of CT for preschool-age children. It includes a series of developmentally appropriate assessment tasks designed to elicit young children's understanding of CT skills and concepts, including abstraction, algorithmic thinking and sequencing, debugging, and problem decomposition. The assessment consists of 17 items targeting specific CT skills or practices. Administration takes approximately 20 minutes.

To measure children's general problem-solving ability, we will use the Picture Problem Solving Task, designed to ask 4- to 5-year-old children to think through novel problem scenarios (Fusaro & Smith, 2018). Children are presented with a verbal explanation of a real-world, hypothetical problem and a corresponding line drawing. Children are then asked to generate as many solutions to the problem as they can. The task includes one practice item and seven test items. Children's solutions are coded according to a rubric as to whether they are effective problem solutions or not. A fluency score is calculated to reflect the average number of unique, effective solutions that children were able to generate across items. Both the fluency score and item score will be calculated as outcome measures.

To assess social-emotional learning skills, we will use the PROMIS EC (Blackwell et al. 2022), which is a parent-report measure that assesses the engagement and self-regulation of children ages 1 to 5. Factor analyses revealed four distinct scales: Persistence, Frustration Tolerance, Flexibility, and Curiosity. Each scale includes 5 or 6 items that parents rate on a 5-point Likert scale. Items are positively worded in order to capture the presence of children's strengths. These four scales show good to excellent internal reliability (alphas > .82). Psychometrics are not available for the individual scales. An example item is "My child tried a different strategy to solve a problem when one solution didn't work." These items will be included in the parent survey. The PROMIS EC scales are not intended to be combined into a composite score. We will analyze and report scores from the Persistence, Frustration Tolerance, and Flexibility scales separately. We will not administer the Curiosity scale.

Section VII: Analysis Plan

Baseline data collected prior to start of intervention:
Yes

Description of baseline data:
-Minnesota Executive Function Scale (MEFS)
-STEM+C
-PROMIS-EC

Covariates you plan to include in the model:
English Language Learner Status, Gender, Grade, Child age in months, Executive function, Family annual income, Parent education, Prior exposure to Wombats, Site (city), Race, Special Education Status, Student Pretest

Analytic model:

Our analysis of main outcomes will use the following ordinary least squares regression model:

$$Y = /beta_0 + /beta_1 TRT + /beta_2 pretest + /beta_3 covars + /beta_4 site + /varepsilon$$

Where Y represents the outcome of interest, $_0$ represents the intercept; $_1$TRT is a dummy variable equal to 1 if the child was assigned to the treatment group and zero if assigned to the control group; $_2$pretest represents the child's pre-test score on the outcome of interest; $_3$covars represents a vector of child and family demographic characteristics and baseline child EF, $_4$site represents the child's site, and ε represents the error term.

Plan to handle cases with missing outcome data:
Delete cases with missing data for the outcome being analyzed

Planned multiple comparisons adjustment, confirmatory question 2 (Student Social, Emotional, & Behavior):
Yes

Number of planned comparisons to adjust, confirmatory question 2 (Student Social, Emotional, & Behavior):
2

Correction for multiple comparisons, confirmatory question 2 (Student Social, Emotional, & Behavior):
Benjamini-Hochberg correction

Planned multiple comparisons adjustment, confirmatory question 3 :
Yes

Number of planned comparisons to adjust, confirmatory question 3 :
3

Correction for multiple comparisons, confirmatory question 3 :
Benjamini-Hochberg correction

Comments:

We plan to delete cases with missing data for the outcome being analyzed. We will apply listwise deletion of cases with missing data on pretest or posttest variables being analyzed. We will report attrition for each outcome as the number of participants who were enrolled in the study but not excluded from the impact estimate due to missing data or study dropout. Children excluded from the study prior to random assignment will not be counted as attrition.

We will include the following covariates in the model unless there is evidence of multicollinearity: pretest of the outcome measure being assessed, site, child gender, child age in months, child grade, child race or ethnicity, child's primary home language, child has an IEP or 504 plan, family annual income, parent education, prior exposure to Wombats, and baseline executive function.

Section VIII: Additional Information

Links:
No links have been added yet.

Files:
File Name: Power Analysis for Wombats Efficacy Study Nov 2023.docx
Description: Power analysis for Wombats efficacy study

Comments:
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