### Background

- Touchscreen use among young children is almost universal and educational applications (apps) are very popular.
- Little research has examined how learning from apps and physical materials differs, or has manipulated the social context of app learning.
- In three studies, we examined children’s geography learning about the 9 states and territories of Australia from either a Montessori puzzle or a Montessori app.

### Research Questions

- Do children learn more from a lesson with a physical puzzle or from an app by itself?
- How does use of the material relate to learning?
- Does social interaction impact learning from an app?

### Method

#### Participants:

- **Study 1**: 32 five-year-olds ($M = 65.1$ months; 16 female)
- **Study 2**: 32 five- & six-year-olds ($M = 66.3$ months; 14 female)
- **Study 3**: 32 five- & six-year-olds ($M = 66.2$ months; 16 female)

#### General Procedure:

- Random assignment to puzzle or app condition.
- In puzzle condition, experimenter led Montessori-style geography lesson for 10 min, then child had 10 min free play.
- In app condition, child was shown app on an iPad then had 20 min free play alone.

#### Study 1 Results

- Children in the puzzle condition learned more Australian states ($M = 9.28$, $SD = 3.02$, range = 5-16) than children in the app condition ($M = 5.22$, $SD = 4.48$, range = 0-18): $t(30) = 3.01$, $p = .005$, Cohen’s $d = 1.06$.

#### Study 2

- In Study 1, children learned more from a lesson with a puzzle than from using an app alone in a controlled laboratory setting. How does this translate into real world?

#### Study 2 Method

- Children were randomly assigned to puzzle or app condition, underwent the same procedure as Study 1, and were tested on recognition and recall (Time 1).
- Then, children took home the material (puzzle or app on iPad) for one week.
- Parents recorded time spent with the material and level of engagement (1 = unengaged, 5 = very engaged).
- Children returned after one week for 2nd posttest (Time 2).

#### Study 2 Results

- **Time 1**: As in Study 1, children in the puzzle condition learned more Australian states ($M = 10.63$, $SD = 4.52$, range = 4.5-18) than children in the app condition ($M = 6.06$, $SD = 4.12$, range = 1-16): $t(30) = 2.98$, $p = .006$, $d = 1.06$.
- **Time 2**: No difference between puzzle ($M = 13.71$, $SD = 3.90$, range = 6.5-18) & app ($M = 11.38$, $SD = 5.32$, range = 0-18) conditions after one week: $t(30) = 1.42$, $p = .165$, $d = 0.50$. although when examined by usage time, puzzle was more efficient.

#### Use, Engagement, and Relation to Learning

- Children used the app more than the puzzle over the week. App = 79 min Puzzle = 33 min
- Children were equally engaged with puzzle and app.
- Children who used the puzzle more learned more ($r = .43$)
- Children who used the app showed no relation between usage time and learning.

### Study 3

- In first two studies, experimenter provided lesson for puzzle condition but app provided lesson for app condition.
- Will children learn better from an app with similar lesson?

#### Study 3 Method

- Children were taught a Montessori-style lesson by the experimenter using the app, then had 10 min free play.
- Children from the “social app” condition were compared to puzzle and app conditions from Study 1 and 2 (Time 1 only)

#### Study 3 Results

Children in the social app ($M = 12.06$, $SE = 0.64$) and puzzle ($M = 10.51$, $SE = 0.64$) conditions learned more than children in the app condition ($M = 5.41$, $SE = 0.64$), $F(2, 93) = 28.99$, $p < .001$, $h_g^2 = 0.39$.

### Summary and Conclusions

- Children learned more from a Montessori lesson with a physical puzzle or an app than from using the app alone.
- After a week of exposure, children learned equally from app and puzzle but puzzle was more efficient, and only time with the puzzle related to learning.
- Whether materials are physical or digital, social interaction is crucial for learning.
- Future research should examine aspects of social interaction that promote learning from physical objects and apps.

### References


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