# The Role of Interactivity in Multimedia Learning Materials: an Experimental Study with 8-10-year-olds

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**Keywords**

**Interactivity, multimedia, CATLM, cognitive load, third and fourth grade students**

## 1. Introduction

Interactivity has become an important feature of educational systems. Simulation games represent one of the important domains where interactivity is implemented. This kind of interactivity is called **problem solving interactivity** (Moreno & Mayer, 2007). The main question is, does the problem solving interactivity influence learning and resulting learning outcomes in a positive way? Or does it harm learning? We are aware of only few studies which investigated this question and all of them were conducted with older audiences (Moreno & Mayer, 2005).

**The goal** of this study is to investigate if **problem solving interactivity** implemented in a short educational game **enhances learning outcomes** and improves intrinsic motivation of children 8-10 years of age (3rd and 4th grade).

## 2. Theory, Questions

- Cognitive Theory of Multimedia Learning (Mayer, 2014)
- Cognitive-Affective Theory of Learning from Media (Moreno, 2005, Fig.1).
- Self Determination Theory (Ryan & Deci, 2000).

- Will **problem solving interactivity** implemented in a simulation game enhance **learning outcomes** and **affective-motivational states**?

## 3. Method

**Participants**
- 8-10-year-olds were recruited in collaboration with the children channel of Czech television
- $N$=139 (exp. group=69, control group=70); 58% boys, 42% girls
- $M_{age}$ = 8.78; $SD_{age}$ = 0.67

**Design**
- 2 groups – interactive version (game) and non-interactive version (animation)

**Intervention**
- a short educational simulation game and a short educational animation developed for this study (the topic: photosynthesis)
- materials had almost identical content except of presence or absence of interactivity

**Length**
- children played/watched for about 15 minutes the game/animation

**Key dependent variables**
- learning outcomes (comprehension, transfer)
- affective-motivational factors (enjoyment, contrast evaluation, free-choice preference)

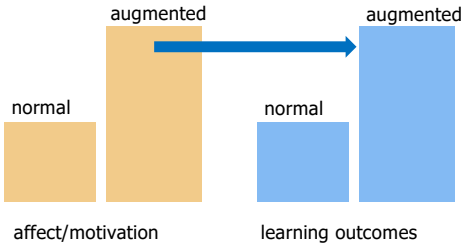


**Figure 1.** *Alleged affective-motivational potential of game elements (e.g., interactivity).*

**Figure 2.** *Illustration of game/animation..*

## 4. Results

- **no effect** of interactivity **on learning outcomes**
  - Comprehension ($t$(139 ) = 0.92, $p$ = .361, $d$ = 0.155 )
  - Transfer ($t$(139 ) = –0.05, $p$ = .957, $d$ = –0.009 )
- **significant effect** of interactivity **on evaluation** of versions against each other ($t$(136) = –8.84, $p$ = .<001, $d$ = –0.758)
- marginal effect of interactivity on enjoyment of learning ($t$(139 ) = –1.88, $p$ = .063, $d$ = –0.319)
- **preference of game** in the free-choice period
  87.5% choices for game, 12.5% for animation ($p$ = .<001)

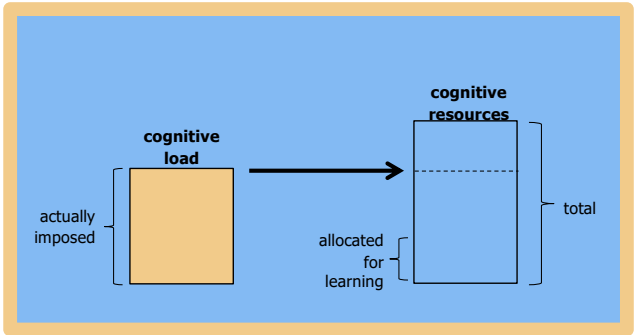


**Figure 3.** *Cognitive load and cognitive resources.*

## 5. Conclusion

Problem solving interactivity implemented in simulation game **improved motivational-affective states**, but we found **no significant difference in learning outcomes** between the interactive and non-interactive materials.
Possible explanation for this fact is that positive effects of interactivity were probably **counterbalanced** by negative effects of increased **cognitive load** (Sweller, 2011; Fig. 3).
Our results also have a practical implication, i.e. that animations (as cheaper versions of games and easier tools for use in school contexts) are sufficient for learning.

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