Learning with animation: The impact of cueing and sequencing of information on cognitive load, knowledge acquisition and attention

ABSTRACT

According to Cognitive Load Theory, visual cues and a sequenced presentation of information can foster learning in particular by reducing extraneous cognitive load due to, for example, avoiding unnecessary search processes through attention guidance. Especially when learning with volatile media such as videos or animations, reducing search processes are indispensable to gather as much relevant information as possible in a limited period. In this study, we experimentally investigated the effects of various types of cueing and sequencing in animations on learning performance, cognitive load, and attention. 215 participants aged 18-30 were randomly assigned to five groups. The animations differed in type of cueing and sequencing: without cueing and sequencing, with static cueing, with dynamic cueing, with sequencing, and with cueing and sequencing. Only dynamic cueing, sequenced cueing, and sequencing fostered performance, improved cognitive load, and increased attention; this suggest that only dynamic processing aids positively affect learning with volatile media.

THEORY

A sequenced and cued presentation of information in complex content can both foster knowledge acquisition and reduce cognitive load (Chandler & Sweller, 1991; Mayer, 2012; Schnotz & Lowe, 2008; van Gog, 2014). This can especially be explained by the signaling- and sequencing-principle of the Cognitive Load Theory (Chandler & Sweller, 1991) and the Cognitive Theory of Multimedia Learning (Mayer, 2012).

RESEARCH QUESTION

What impact do static cueing, dynamic cueing, sequencing and sequenced cueing of information have on knowledge acquisition, cognitive load, and attention?

METHOD

Participants

215 people aged 18 to 30 (mean = 22.08; SD = 3.25, 124 female and 91 male), randomly assigned to a control group or one of four experimental groups.

Design

Incomplete 3 x 2 design

<table>
<thead>
<tr>
<th>Cueing</th>
<th>Sequencing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Static</td>
<td>Yes</td>
</tr>
<tr>
<td>Dynamic</td>
<td>No</td>
</tr>
<tr>
<td>CG</td>
<td>EG1</td>
</tr>
<tr>
<td>EG2</td>
<td>EG3</td>
</tr>
<tr>
<td>EG4</td>
<td>EG5</td>
</tr>
</tbody>
</table>

Note: EG = experimental group, CG = control group

Procedure

Pre Intervention

Questionnaire
- demographics
- native language
- fear of flying
- divergence in color perception
- Pre-Test
  - multiple-choice-test
  - labeling-pictures-task

Intervention

standardized Video
- CG = video no cueing no sequencing
- EG1 = video static cueing no sequencing
- EG2 = video dynamic cueing no sequencing
- EG3 = video no cueing with sequencing
- EG4 = video sequenced cueing

Post Intervention

Post-Test
- multiple-choice-test
- labeling-picture-task

Questionnaire
- cognitive load
- attention

Features of the scales

<table>
<thead>
<tr>
<th>Scales</th>
<th>Items</th>
<th>M</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA Pre-Test</td>
<td>11</td>
<td>10.57</td>
<td>4.29</td>
<td>.65</td>
</tr>
<tr>
<td>KA Post-Test</td>
<td>11</td>
<td>23.51</td>
<td>3.72</td>
<td>.73</td>
</tr>
<tr>
<td>ICL</td>
<td>3</td>
<td>67.68</td>
<td>20.36</td>
<td>.90</td>
</tr>
<tr>
<td>ECL</td>
<td>6</td>
<td>19.91</td>
<td>16.86</td>
<td>.88</td>
</tr>
<tr>
<td>GCL</td>
<td>4</td>
<td>71.85</td>
<td>20.07</td>
<td>.90</td>
</tr>
<tr>
<td>Attention</td>
<td>5</td>
<td>71.89</td>
<td>25.23</td>
<td>.94</td>
</tr>
</tbody>
</table>

Note: α = Cronbach’s α; KA = knowledge acquisition; ICL = intrinsic cognitive load; ECL = extraneous cognitive load; GCL = germane cognitive load; A = attention.

RESULTS

A group comparison using a one-factor analysis of variance showed no significant differences with regard to age (p=.97) and prior knowledge (p=.86). One-factor analysis of variance with a priori contrasts confirmed that dynamic cueing, sequenced cueing, as well as sequencing fostered knowledge acquisition, improved cognitive load, and increased attention. Regarding knowledge acquisition static cueing did not outperform the control condition (p=.23).

DISCUSSION

The findings indicate that in learning with complex content especially dynamic presentation styles had a positive effect on knowledge acquisition, cognitive load, and attention, even if there is no cueing. Susceptibility in case of complex content, the decision for a dynamic presentation and against a static one makes sense.

REFERENCES


