

Target Group-specific Learning Success Optimization of Beekeeping Learning Materials using Eye-Tracking

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MOTIVATION – OBJECTIVE – RESEARCH QUESTIONS

Motivation

- learning material for novice beekeepers can often be improved in terms of didactic and methodological design

Objective

- analysis of visual attention distribution using eye-tracking (heatmaps) on subjects work-

ing with digitally presented basic beekeeping learning material for beginners where subjects have no prior beekeeping knowledge

Research Questions

- What visual focus points do experienced readers without prior beekeeping knowledge show on the learning material (eye-tracking)?

- How successful are the participants in answering test questions provided in the learning material (number of questions answered correctly)?

- How did the participants experience the learning material in terms of its suitability for learning (free questionnaire answers)?

METHOD – STATE OF RESEARCH – LEARNING MATERIAL

Method

- eye-tracking analyses in detail eye movements when observing learning material and, thus, the visual information intake at the beginning of the information processing process [2,3]
- eye-tracking data shows the focus of visual attention (fixations) and its movements (saccades) in the stimuli [4,5]

State of Research

- learning is effectively supported by high-quality learning material [1]
- eye-tracking studies examine the visual attention of test subjects [3]

eye-tracking data can provide insights into the viewing behavior of learners. This provides information about their visual perception of the stimuli presented [6]

- “multimedia principle:” individuals better learn from combinations of text and images/illustrations than from text alone. [7]

Learning Material

- established training material in Germany [8]
- according to “Deutsches Bienenjournal” and “Bienen und Natur:” material for beginner courses and advanced courses
- material combines text and illustrations (graphics, tables, and photos) with contents-related test questions at the end (see Fig. 1)



Figure 1: Page 1 of the learning unit analyzed

APPROACH & SAMPLES

Approach

- presentation of the digitized learning material on a screen (4 A4 pages in total)
- participants are asked to read the material and finally answer questions
- continuous eye-tracking

Samples

- 12 indiv., no prior beekeeping knowledge
- competent readers

ANALYSIS

- aggregation of eye-tracking data collected
- result: heatmaps of visual attention
- heatmap: visual representation of attention distribution across a screen surface based on eye-tracking data
- color scale: red (high), yellow (medium), and blue (low) intensity of gaze
- advantage of heatmap: quick assessment of focus areas, prioritization of contents

RESULTS & INTERPRETATION (1/2)

Eye-Tracking Results



Figure 2: Heatmap while reading (left), heatmap while working on tasks (right)
→ text viewed with varying intensity
→ images & illustrations hardly viewed at all

RESULTS & INTERPRETATION (2/2)

Test Question Results on the Contents

- 39.7 % correct answers
- 60.3 % incorrect answers

→ poor learning success

Results of Free-text Answers

- 7 participants criticize: too many foreign words not explained; too many figures in the text, illustrations not clear enough, texts do not always refer to illustrations, photos only used as decoration, too much information, too many details, facts cannot really be understood without prior knowledge
- 5 participants are mostly satisfied; they perceive text and illustrations as mostly helpful

→ learning material was largely unhelpful

CONCLUSION

- only include meaningful, targeted (not purely decorative) illustrations to support the text; avoid unnecessary illustrations
- text must refer to illustrations
- reduce eye movement by ensuring that illustrations and text match (this reduces cognitive load!)
- reduce text and illustrations to essential information: no unnecessary digressions or outdated, technically incorrect or folkloric representations
- only use technical terms after they have been introduced & explained
- initially, clearly state the goal of the learning unit
- use simple language; observe the principles of accessible learning

LIMITATIONS – OUTLOOK – REFERENCES

Limitations & Outlook

- here: exploratory study; not representative
- conduct scanpath analyses; they allow for more qualified and detailed insight into the visual perception of learning materials
- increase number of samples
- analyze additional training and learning material

References

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The number of new beekeepers in the EU is rising steadily - more than 100,000 new beekeepers were registered between 2019 and 2022. In Germany, small beekeeping businesses are predominant, many with a recreational focus. The increased number of new beekeepers results in an increased need for training courses, which are ideally designed for specific target groups. Target groups are, for example, young or old people and people with disabilities. There are a number of training programmes on offer, e.g. from adult education centres and in particular from regional beekeeping associations. For the latter, training courses require a great deal of time from volunteer members. The teaching and learning materials are equally diverse and not specific to the target group. This has shown that the materials vary greatly in quality, which is not necessarily conducive to efficient learning success. There is a need for improvement. Eye-tracking technology is available to analyse existing learning materials in terms of their learning effectiveness and to identify suggestions for their possible improvement. The eye tracker records a learner's eye movements and correlates them with the learning material presented. Analyses based on this can clarify, which areas of the learning materials were viewed with which duration, sequence or frequency and thus allow conclusions to be drawn about the didactic-methodological suitability of the learning material or provide information on necessary improvements. In the context of the present research project, an eye tracker has been implemented and the eye-tracking technique was applied to established learning materials for hobby beekeeping training. This revealed the extent to which selected learning materials were effective and what indications there were for improvement - possibly also for specific target groups. In view of the high number of new beekeepers from a wide range of target groups, the high demand for training and the high personal time commitment of local beekeeping associations, beekeeping teaching materials must be optimised in terms of didactics and methodology with regard to learning success. These optimisations can be carried out systematically using the eye-tracking method. They therefore make a major contribution to targeted and efficient beekeeper training.