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PR 4: Learning laboratory (01/04/2023 – 31/12/2023)

Copenhagen Business School - SenseLab

Training and learning workshop

The aim of the workshop was to generate ideas to outline the value of applying bio-metric and neuro-metric data in the process of planning and improving online learning material. The workshop took place in one week in May 2024 at Copenhagen Business School, Department of Marketing in their SenseLab. The workshop combined theoretical and practical reflections and included lectures by experts in online learning (Department for Teaching & Learning, CBS) and experts in bio-metric and neuro-metric testing (iMotions).

Lectures in online learning provided insights into the state of art in university pedagogics, accessibility and inclusion. Accessibility is seen as the valuable enabler for online students and the focus is on course design e.g., using higher contrast, colors coding, and less text on slides, which makes it easier to visually interpret the content. A brief guide to creating accessible online teaching materials was presented and can be found online (https://teach.cbs.dk/resources/accessibility/). The idea of accessibility was further debated in the workshop and concepts like online engagement fatigue and AI as online assessment were added to potential research questions.

Insights into the use of bio-metric techniques included insights into software for bio- metric and neuro-metric data collection, outlining what is doable and what cannot be measured. A special focus was on the online eye-tracking technique and how this can be combined with real time online teaching. Testing the voice/speech in online material was demonstrated and results from a pilot study was presented (see Pilot Study). In the last part of the workshop, members of the network outlined ideas and advices for running bio-matric studies. These were pre-tested in SenseLab and followed by sharing reflections and debating next steps for practical and theoretical contribution (shown below).

Potential research design

Research 1
Potential research question: Text vs. illustration – what works best?
Description: When to use text and when to use illustrations for explaining content of theory? The question can be related to textbooks, PowerPoints, and videos. For the videos the speech could be an independent variable related to rhythm, prosody, pauses, …
Research design: A pilot study was made with five test persons in SenseLab at CBS – eye-tracking and emotional response (face recording)

Research 2
Potential research question: Domain of text – will a summary increase motivation for learning?
Description: When will a short text (summary/abstract) in a learning situation increase motivation for learning and which kind of glossaries and keywords can support the learning? Will highlighting of these words increase the value of summary/abstracts. The study could differentiate between actors, such as students (academic learning) and employees (organizational learning).
Research Design: Short and long study could be relevant - eye-tracking supplemented with questionnaire

Research 3
Potential research question: Subtitles in videos – are subtitles good for learning?
Description: When will subtitles support the learning and when will it take away attention from the video content? Where do people look and how will they divide the attention? Which variables (sound/illustration/graphs/…) could influence the ration between subtitles and video content? Can personality be variables that explain the value of using subtitles?
Research Design: Relevant for eye-tracking

Research 4
Potential research question: Does AI support learning?
Description: Will AI be noticed by the viewer? Does it influence the learning outcome? Can AI help individuals and personalize the learning material? Will personality explain the willingness to accept? Will an avatar be accepted in a learning situation?
Research Design: Relevant for EEG + GSR and also qualitative research

Research 5
Potential research question: Can voice increase learning in online videos?
Description: What is the impact of the teacher's voice in a video (memory/liking/acceptance/…)? Testing “talking heads” vs. “full body” appearance. Fluency and mother tongue could be added as variables.
Research Design: Voice analysis in combination with eye-tracking. Some of these were tested in the pilot study in SenseLab at CBS

Research 6
Potential research question: What is the optimal duration of an online learning material?
Description: Testing time for optimal learning material. How long can/will be best for learning? Time of day could be a relevant variable. Memory test could/should be added.
Research Design: A pilot study was made with test persons in SenseLab at CBS – EEG + GSR

Research 7
Potential research question: When is enough enough?
Description: This could be an add on to the RQ about duration, as measuring fatigue is central. When does it happen and how to plan a learning material based on this insight. Is fatigue related to personality (big five), age, gender, stress, time, …?
Research Design: Suitable for EEG + GSR + HVR (heart rate variability)

Research 8
Potential research question: How can feedback be optimized?
Description: What is the value of feedback in online learning material?
This could be applied to the invented app.

Pilot Study 1 – Testing pre-recorded learning materials

The aim of this pilot study is to understand students' learning processes when they are faced with pre-recorded online learning materials. Findings are aimed to provide guidelines for designing optimal online learning materials, by combining data from eye-movements and response to the teacher's voice with data related to the test persons' learning outcome, which is measured in level of correctness in a multiple-choice test. Four different pre-recorded online learning materials are tested.

The sound of a voice has a lot of different features that can be measured and analysed as its prosody. This is the most classic approach to voice analysis and comprises several features of a person's voice. Pitch is the feature that refers to frequency of a voice and describes the perceived frequency, which is either high or low. Voice frequency is measured in Hertz (Hz) and can be used to describe the difference between male voices (85-155 Hz) and female voices (165-255 Hz). Loudness is the feature that describes the perceived loudness of the voice, and a fluctuation in loudness is perceived as a contrast and can indicate a need for attention. Speaking rate refers to the rate with which a person speaks, and it is measured in numbers of syllables per second. Variations in speaking rate might indicate some important utterance. Lastly does intonation describe rise and fall of the voice or whether the speech is monotone or lively. The sentence structure is not part of the prosody.

The pilot study combines eye-tracking, voice analysis and learning outcomes/memory. The study will reveal how visual elements in online material are able to grab attention and reveal where and when a viewer of an online learning material loses attention and risks missing core objectives. The findings can provide guidelines for designing online learning material and be combined with the guidelines from the Department for Teaching & Learning, CBS.

The study utilizes eye-tracking and voice analysis, and surveys. Eye-tracking provides data on visual attention and search patterns. Face recording and voice analysis provide data on emotional engagement, and the survey provides data on level of memory of the learning material. The study tested four videos individually exposed in a randomized order to 50 test persons. After each video the test person answered multiple-choice questions about specific content in the video described as the learning objectives for the material.

The findings from this pilot study show that better memory of the content provided in a learning video can be increased by switching tone. Similar findings were related to change in speaking rate, which outlines that variation in teacher's voice can lead to better memory and in the end higher learning outcome. One simple way to make the variation is by making pauses in the speech and especially after the core learning objectives. In line with the guidelines from the Department of Teaching & Learning, CBS a clear layout helps in memorizing the content and prevents students from mixing the learning

objectives together. From the visual attention data, it is found that looking at the learning objective several times increases the memory.

At the end of the project, a survey was conducted confirming the interest of the target groups in knowing about this way of enhancing teaching and learning materials and their usefulness. PR4 ensured to all partners knowledge about eye-tracking and knowledge about its implementation with the purpose of upgrading learning materials. At the same time, the project results and their dissemination ensured the transfer of this knowledge to other interested parties at the universities and to other interested stakeholders, as well as sustainability.