Shall we learn together in loud spaces? Towards understanding the effects of sound in collaborative learning environments

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Abstract: In this paper we question the role of environmental sound on the process of CL. The first pilot study is presented where we investigated effects of environmental sound on EDA and voice VA of the participants. The created visualization presents the dependence between mentioned parameters and serves as an awareness tool for participants in CL. Preliminary results are provocative; there seems to be mentioned dependences and participants accept the proposed visualization as a useful tool to support self-regulation during CL.

Introduction

Investigating the process of collaboration in learning remains challenge due to many unclear aspects of socio-emotional and cognitive interactions (Pijeira-Díaz, Drachsler, Järvelä & Kirschner, 2016). Additionally, broad application of collaborative learning finds its challenges in implementation because it is "so noisy" due to participants' interaction that can hinder learning (Graetz & Goliber, 2002). As in any other activity, interactions are tightly related to the environment (Malmberg, et al. 2018), and successful learning should be supported by the space where it takes place (Yeoman, 2008). The effect of environmental sound on CL has been underexplored in the sense of its effect on aspects of collaboration such as cognitive and socio-emotional interactions, that are reflected through physiological changes and conversation. Electrodermal activity (EDA) and voice activity (VA) measurements could help us understand and further explore connection between the environmental sound and collaborative learning process. Examples in the literature show different ways of visualizing physiological data with graphical user interface such as SLAM-KIT (Noroozi et al, 2018) and voice data with Reflect, a reactive table that monitors the collaborative interaction based on voice activity of participants (Bachour, Kaplan & Dillenbourg, 2010). We focus on loud spaces within university campus, used for collaborative activities, given their pedagogical interest, orchestration complexity and their direct relation to the sound footprints of learning spaces. We present a pilot study that opens the question of the role of environmental sound in Collaborative Learning (CL), using multimodal learning analytics (MMLA), that supports CL in many ways (Ochoa et al, 2013; Spikol, Ruffaldi & Cukurova, 2017). We also propose visualization of the changes of EDA and VA and their relation to sound footprints of learning spaces.

Understanding the effect of sound in CL through a pilot study

We have conducted a first pilot study, measuring EDA and VA, where qualitative data is also collected through interviews with participants. Two types of environments were identified (a quiet room where only the participants stayed and a loud space with many people). The same type activity was carried out in both spaces, with the same level of difficulty and duration of activity. The first group performs activity first in the loud environment, then in a quite one, while the other group first performs activity in a quiet environment, and then in a loud one. Activity is based on learning a set of words in Swahili language (Carpenter, et al, 2008), where participants receive a list of English-Swahili pairs of words from where they should learn. Participants had no prior knowledge of Swahili.

Visualization and discussion of preliminary results

We propose a visual representation (Figure 1) that aims to clearly present two measured parameters from participants (EDA and VA) and characteristics of environmental sound, where it is possible to understand the changes that occur in time. The level of sound from the environment was expressed by means of decibels, EDA by number of peaks in the signal occurred above the certain threshold that indicates arousal, while the voice activity was presented by time periods during which the speech occurred. Results indicate that there may be a dependence between the environment and the behaviour of the participants as shown in the Figure 1, where the EDA and VA values greatly differ in two environments. The visualization of the data was shown to all participants in order to understand if it can be used as an awareness tool. All participants stated that the visual representation is an effective way to look at all the parameters at the same time as it can be used as a tool for determining interdependence of collaboration parameters.

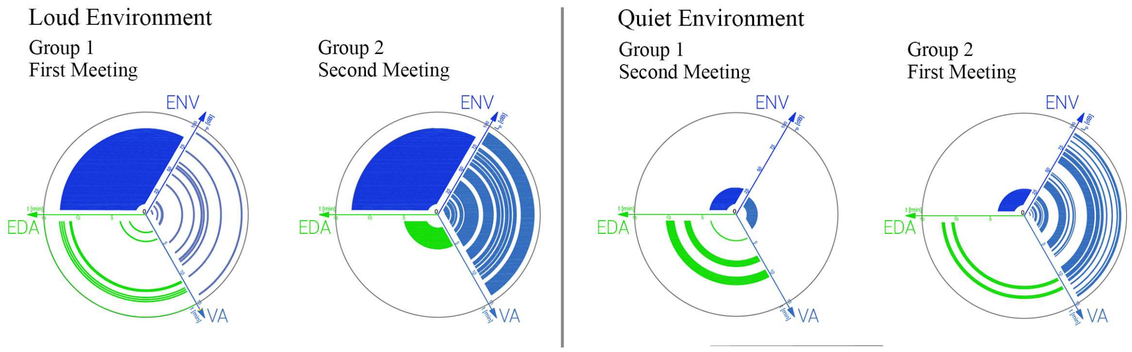

Figure 1. Visualization – unique graphic presentation for three measured parameters

Conclusion

Based on the pilot study, we cannot make clear conclusions because of the small sample in which the experiment was conducted, but we can see that there are differences in EDA and VA measured in different environments. This tells us that it is necessary to expand the study to a larger number of samples in order to see how and to what extent the sound from the environment affects the aspects of collaborative learning. The future work implies the extension of the study towards understanding what kind and level of environmental sound can be beneficial for collaboration, as well as the further development of visualization and its implementation in the process of collaboration as a conscious tool.

References

Bachour, K., Kaplan, F., & Dillenbourg, P. (2010). An interactive table for supporting participation balance in face-to-face collaborative learning. *IEEE Transactions on Learning Technologies*, *3*(3), 203-213.

Carpenter, S. K., Pashler, H., Wixted, J. T., & Vul, E. (2008). The effects of tests on learning and forgetting. Memory & Cognition, 36(2), 438-448. https://doi.org/10.3758/mc.36.2.438

Graetz, K. A., & Goliber, M. J. (2002). Designing collaborative learning places: Psychological foundations and new frontiers. *New Directions for Teaching and Learning*, *2002*(92), 13-22. https://doi.org/10.1002/tl.75

Malmberg, J., Järvelä, S., Holappa, J., Haataja, E., Huang, X., & Siipo, A. (2018). Going beyond what is visible: What multichannel data can reveal about interaction in the context of collaborative learning?. *Computers in Human Behavior*.

Noroozi, O., Alikhani, I., Järvelä, S., Kirschner, P. A., Juuso, I., & Seppänen, T. (2018). Multimodal data to design visual learning analytics for understanding regulation of learning. *Computers in Human Behavior*.

Ochoa, X., Chiluiza, K., Méndez, G., Luzardo, G., Guamán, B., & Castells, J. (2013, December). Expertise estimation based on simple multimodal features. In *Proceedings of the 15th ACM on International conference on multimodal interaction* (pp. 583-590). ACM.

Pijeira-Díaz, H. J., Drachsler, H., Järvelä, S., & Kirschner, P. A. (2016). Investigating collaborative learning success with physiological coupling indices based on electrodermal activity. In *Proceedings of the sixth international conference on learning analytics & knowledge* (pp. 64-73). ACM. https://doi.org/10.1145/2883851.2883897

Spikol, D., Ruffaldi, E., & Cukurova, M. (2017). Using multimodal learning analytics to identify aspects of collaboration in project-based learning. Philadelphia, PA: International Society of the Learning Sciences.

Yeoman, P. (2018). The Material Correspondence of Learning. In *Spaces of Teaching and Learning* (pp. 81-103). Springer, Singapore. https://doi.org/10.1007/978-981-10-7155-3

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