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A DISTANCE EXPERIMENT WITH A BLIND PARTNER

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Abstract. - This paper describes a study involving auditory graphs used in an experiment with two students in a distance education setting. The content of the experiment was derived from motion and graphing problems in the existing Turkish high school curricula. In this experiment, two 9^{th} grade student partners in different cities generated, collected and analyzed data via the Internet without meeting in a laboratory or classroom setting. Novel aspects of this study include the use of the auditory graphs and that one of the student partners was blind. Researchers guided the experiment and coordinated the communication between the students. The experiment began with the students listening to audiographs, performing an experiment, and finished with again listening to the audiographs to check the experiment. Discussion of experiments via the Internet for remotely located partners will not only be beneficial for blind students but this approach can also help develop lifelong learning and make experiments more entertaining.

Keywords: Distance experiment; Blindness; Cooperative/collaborative learning

1. Introduction

The "Distance experiment" concept is used for remote experiments in which a student controls specially designed machines or mechanisms in a laboratory to provide distance education from home[1] or which scientists use to remotely control experimental apparatus in dangerous areas like ocean going autonomous underwater vehicles (AUV). [2] In this study it was used to express the distance between tho students who did the experiment. One of the students partners was living in Kars and the other student, who is blind, was living in Ankara.

The students interacted with each other for the first time in this study and did not know each other beforehand. Both students were in the 9^{th} grade and they had learned about motion and graphing concepts. However, this study involved topics about force and motion which were from a different unit than was covered in their previous studies.

2. Method

The students used computer programs to play the audio graphs, the open-source multi-platform audio editor and recorder program Audacity[3] for recording and analyzing voice, e-mail for communication, and the open-source office program Open Office[4] to input data and draw graphs. Although the students did not use laboratory tools for this experiment, the focus of this study was to investigate the feasibility of communication and interpretation of data with a remote blind student. This type of experiment which supports current trends in education like distance and inclusion education will be a useful model for understanding real life with physics.

Audio graphs of the graphs shown in Figure 1 were sent to the blind student and she listened them. After deciding which graph had a constant slope (a), increasing slope (b) or decreasing slope (c), she generated and returned to the investigator three sound files in response.

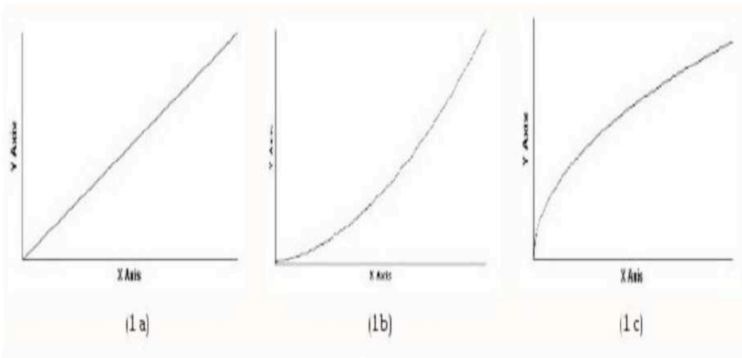

Fig. 1 Audio graphs and virtual graphs (from http://falcon.physics.uww.edu/survey/intro.html)

The subject generated audio graphs that represented the derivative information of the original audio graph that was listened to. The subject generated graphs were a series of marker sounds spaced in time. A linearly increasing graph such as $y = x$ has a constant slope and the derivative audio markers are equally spaced in time. A graph with an increasing slope such as that of $y = x^2$ has audio markers that occur more frequently as time progresses as the slope increases with increasing x. A graph with decreasing slope with an increasing value of x such as that of the equation $y = \sqrt{x}$ has audio markers that occur less frequently as time progresses. The audio recording files of the subject generated audio graphs are portrayed in Figure 2 of the Audacity program screen image of the analysis of the subject generated sound files.

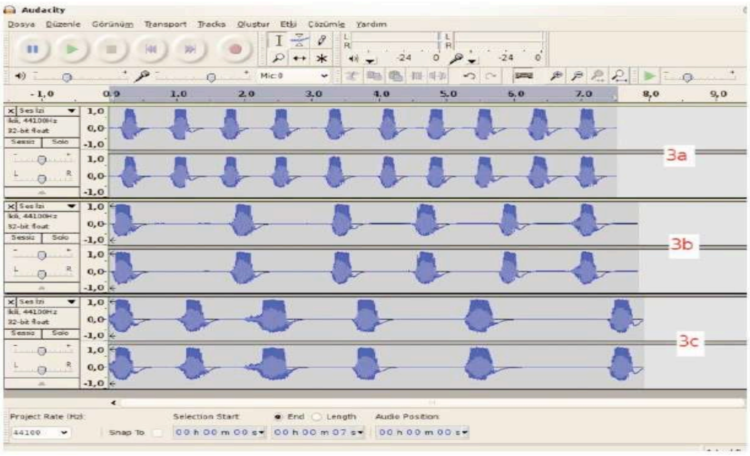

Fig. 2 Audacity screen image showing three subject generated audio graphs. 3a represents a linearly increasing graph, 3b a graph with increasing slope, and 3c a graph with decreasing slope.

The sound files were then sent to the second subject for analysis and interpretation. The student in Kars listened to the three graphs generated by the blind student and created a table with values representing the frequency of subject generated derivative markers and graphed the result as shown in Figure 3. The data and graphs that were drawn by the second subject were sent to the researcher and also sent to the blind subject in Ankara who generated the audio graphs. The blind subject then determined which data set was associated with each of the three audio graphs. Both students correctly created data sets that appropriately represented the data from which the audio graphs were originally generated.

Finally, the researcher sent the students a report that explained what had happened during the distance experiment. The entire procedure is represented in the process diagram shown in Figure 4. According to the expressions of the subjects after learning about the results of the experiment, the success of the experiment made them happy and improved their view about experiments and physics.

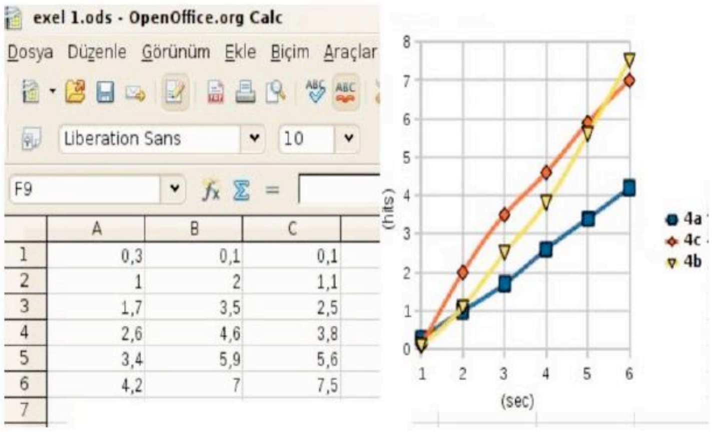

Fig. 3 Graphs derived from the sound files generated by the blind partner.

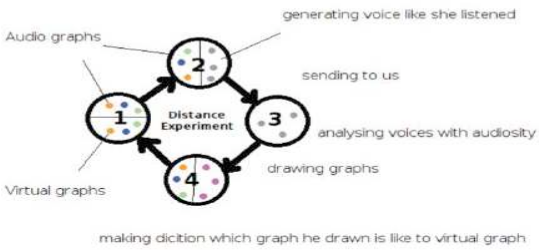

Fig. 4 Graphs derived from the sound files generated by the blind partner.

3. Conclusion

It was known that audio graphs are helpful for students to distinguish between mathematical functions and physics questions.[5] This study shows that these types of graphs are useful in a different context and culture from that which they were originally developed. The results were consistent with prior experiments and had the novel aspect of having the blind subject generate audio graphs and transmit the data. Sharing laboratory duties like recording, analyzing and interpreting is cooperative learning and this approach will help to develop lifelong learning and make experiments more entertaining whether it becomes widespread.

REFERENCES

[1] M. Hiroyasu, S. Atsuo, and K. Hisao, A Distance Experiment Mothod with Individual Remote Teaching Assistance and Writing Paper Support. IEIC Technical Report **101**, 706, 723-730 (2002).

[2] S. Tsukioka, T. Aoki, I. Yamamoto, H. Yoshida, T. Hyakudome, S. Ishibashi, S. Sawa, T. Ishikawa, and K. Hirokawa, Results of A Long Distance Experiment With The AUV "Urashima". IEEE Techno Ocean **3** (3), 1714-1720 (2004).

[3] Audacity, Retrieved 2009 from `http://audacity.sourceforge.net/`

[4] OpenOffice, Retrieved 2009 from `http://www.openoffice.org`

[5] S. Sahyun, A Comparison Of Auditory And Visual Graphs For Use In Physics And Mathematics. Unpublished Doctoral Thesis, Oregon State University, USA 1999.