Information visualization as it pertains to classroom technology.

Rationale

Information visualization as it is defined currently, can be traced back to maps, geometric diagrams, and rudimentary schematics in the 16th century[1] but humanity has been turning information into an image for as long as stories have been illustrated. Effective information visualization however is a relatively new concept. Purchase et al. defined a set of parameters in 2008 that proper information visualization must possess. One in particular that stuck out was this, "[Must be an] exploration and manipulation of the internal data model by the system in order to discover interrelationships, trends and patterns, so as to enable them to be represented appropriately[2]." One field in particular that would benefit greatly from this particular aspect of effective information visualization is education. The whole purpose of our education system is to pass on knowledge to the next generation. If the information presented to the students does not properly represent trends, patterns, or even processes, then there may be a disconnect between subject and material that could cause the student to miss vital connections. This can especially be seen in the modern day public school classroom.

As technology has increased in leaps and bounds over the last fifty years, the structure of the public-school classroom has changed very little. The instructor stands in front of a varying number of students and gives a lecture on the day's material. The students take notes either physically or electronically, and there may be a classroom activity. If one should enter any

[1] Chen, 2017.

[2] Purchase et al., 2008.

public-school classroom in the United States, they would see this picture. It has been noted in previous research that instructors, overall, are not using the technology provided to them for the classroom very effectively[3]. In addition, instructors do not receive the proper training on effective information visualization This can cause a detriment in their students as they may not receive their lecture material in a way that is best for the subject material.

Because visualization provides an additional way for the human brain to interpret new information, it is important that the way the information is presented matches the field that it is in. Visualization improves cognition in multiple ways; displaying large amounts of data in a more readable manner, demonstrating a process, or even provide an image of an abstract idea or concept[4]. For example, a biology instructor may want to demonstrate to students the sheer number of different animal species that exist on the planet. A teacher who is properly trained in information visualization may choose to display this type of information in the form of a pie chart demonstrating percentages of each animal phylum. This would be an excellent way of both providing the students with the proper information and providing that information in such a way that the students will have an easier time understanding just what that information means.

Participants

At least two high-school classrooms recruited from Houghton County will participate in this study. Each class will be randomly assigned to a topic order described below. All classroom participation will be strictly voluntary and will require written informed consent from each of the

[3] Hastings, 2009.

[4] Gershon et al., 1998.

student's parents or guardians if under the age of 18. Student participants must have the ability to read and write in English and those are unable to meet this requirement will not be considered as participants.

Apparatus and Procedure

This study will be a 2 (matching task & learning task) by 2 (proper information visualization & no information visualization) within subject's factorial study. Upon entry to the classroom, the students will be seated and provided will a test packet consisting of two matching worksheets, two pathway worksheets, and two number 2 pencils. Student participants will be instructed to leave all materials in the packet until instructed to remove them by the experimenter. The experimenter will then begin the lesson. The lessons will be given to each classroom participating in a different order.

One lesson will consist of students matching plant species. Plant species get divided up into different classification trees due to both internal and external characteristics. This lesson will have students matching internal characteristics of differing plant species while the instructor provides the information in a way that demonstrates ineffective visualization. The lesson will then consist of the students matching external characteristics of differing plant species while the instructor provides the information in a way that demonstrates effective visualization. This matching task will allow the researcher to determine if student memory scores improve with the implementation of good information visualization[5].

[5] Healey & Enns, 2012.

The other lesson will consist of students learning the path that blood takes through the heart and the body. The experimenter instructor will teach the students the pathway that both oxygenated and de-oxygenated blood take through the heart using ineffective information visualization techniques. The students will then have to put the pathway in order when some of the steps are missing. Then students will learn the pathway that both oxygenated and de-oxygenated blood take through the body using effective information visualization techniques. The students will then again have to put the pathway together when missing some of the steps. This will allow the experimenter to determine if students were able to put the pathway together even if steps are missing better if they received good information visualization.

After completion of the four lessons and the resulting classroom activity/worksheet, the experimenter will debrief the students and will conduct interviews with the students determining their perceptions of the two different styles of lessons. In addition to analyzing the data from the results of the classroom activities. The experimenter will also factor in student's own perceptions of how effective their learning experience was due to the introduction of proper information visualization techniques.

As this is a 2 (proper information visualization techniques vs. no information visualization) x 2 (matching task vs. learning task) between subjects' factorial experiment, the results will be analyzed using a factorial ANOVA. The survey responses will be coded for clarity and then analyzed.

Closing Statement

If this study is shown to be fruitful, it should spur administrations to provide effective information visualization training to their instructors.

References

1. Chen, H. M. (2017). An Overview of Information Visualization. Library Technology Reports, 53(3), 5–7.
2. Purchase, H. C., Andrienko, N., Jankun-Kelly, T. J., & Ward, M. (2008). Theoretical foundations of information visualization. Notes in Computer Science, 46-64. doi:10.1007/978-3-540-70956-5_3
3. Hastings, T. (2009). Factors that Predict Quality Classroom Technology Use. (Electronic Thesis or Dissertation). Retrieved from https://etd.ohiolink.edu/
4. Gershon, N., Eick, S. G., & Card, S. (1998). Information visualization. Interactions, 5(2), 9-15. doi:https://doi.org/10.1145/274430.274432
5. Healey, C., & Enns, J. (2012). Attention and Visual Memory in Visualization and Computer Graphics. IEEE Transactions on Visualization and Computer Graphics, 18(7), 1170-1188. doi:10.1109/TVCG.2011.127