An Analysis on the Preferred Learning Methods of Grade 12 STEM Visual Learners from De La Salle University - Manila

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Abstract: Visual learners utilize graphs, charts, maps and other forms of diagrams to better grasp the learning materials. Both traditional and digital learning strategies pose benefits and challenges to these types of learners. In this study, the positive and negative points of both traditional and digital learning methods from the perspective of Grade 12 Senior High School students of the University were analyzed in order to formulate a set of guidelines that software developers can use in designing digital learner applications that can cater well to the needs of visual learners. The study was conducted by administering pre-tests, post-tests, and surveys to two groups of visual learners, wherein one group was given traditional handouts as a reviewing tool while the second group used a digital learning tool, Khan Academy, on cell anatomy. Measurements of central tendency together with cluster analyses were then used to compare the differences in the final scores of the students from both groups on their pre-test and post-tests. Results show that for multiple choice items, students who used Khan Academy achieved a higher average increase in scores compared to those students who used the traditional handouts. On the other hand, for test items that included the labelling of parts, the traditional handouts method was the more effective learning tool.

Key Words: online learning; traditional learning; khan academy; visual learners

1. INTRODUCTION

Learning is classified into different styles based on how people learn concepts better. These learning styles are categorized as visual, auditory, and bodily-kinesthetic (Flemming and Mills, 1992). Among these, the visual category is the most populated as it holds 40% of the total population of College students (Clarke et al., 2006). Despite this, most learning institutions have yet to adapt learning methods which can cater to these learners more effectively.

Most institutions make use of traditional learning approaches which include the use of handouts, printed books, recitations, and oral discussions which may not maximize the learning potential of visual learners. The inconsistency and the inability of these learning methods to offer an equal platform in learning for different types of learners causes learners, specifically visual learners, to perform less productively as compared to others (Clarke et al., 2006).

The Internet era brought with it a new form of learning -- online learning -- wherein learners study through the use of educational software

applications and web sites without having to attend formal classroom settings. This allows learners to study at their own pace and in their desired environment, possibly making them more stimulated to learn (Woo and Kimmick, 2000).

One such learning environment is the Khan Academy, which makes use of videos, pictures, and subtitles in the presentation of the learning materials. These facilities may address the problems that visual learners have with traditional learning methods. However, digital learning tools have their own limitations such as the need for better time management and self-motivation among the learners (Kumar, 2015). Furthermore, the interface design of these systems may pose certain challenges that can limit the learning potential of their users.

In this study, traditional learning methods, specifically the hand-outs, are compared with the Khan Academy, in order to determine which of these strategies is more effective in assisting visual learners in reviewing. Characteristics and features which make traditional and digital learning tools effective to visual learners are also identified in order to provide a set of recommendations for the improvement of the digital learning tool. These suggestions can inform the design of the mobile version of the learning tool that can serve the preferences and needs of visual learners.

2. METHODOLOGY

The study utilized both quantitative and qualitative strategies to determine the factors of both traditional and digital learning which are beneficial to visual learners. The mobile version of Khan Academy is used as the digital learning tool. The learning material included in this study is on cell anatomy, which is a topic covered in the General Biology 1 subject that is taken by Grade 12 STEM students of De La Salle University-Manila.

Prior to the selection of students, informed consent forms were released to their parents. From these, 100 STEM students whose parents gave their positive consent were selected. The students were oriented about the purpose and procedure of the study, what they can expect from the tests, how their data will be analyzed, and how their information will be kept confidentiality. They were afforded ample time to raise questions and give their assent to participate in the VARK assessment, and if identified as visual learner, in the pre-test and post-test on cell anatomy.

The VARK questionnaire (Flemming and Mills, 1992) is an assessment tool that is administered to a subpopulation of Senior High School students in order to determine their learning style. The questionnaire was validated by Dr. Nino Mateo, who is a faculty member of the Counselling and Educational Psychology Department of the University.

40 participants who were identified as visual learners based from their VARK assessment were then grouped into two -- Group A or traditional learning using handouts, and Group B or digital learning using Khan Academy. The traditional handout contains mostly text-based definition of terms, and enumerated list of characteristics and components of Eukaryotes and Prokaryotes. A visual image is also included in the traditional handout, as depicted in Fig. 1.
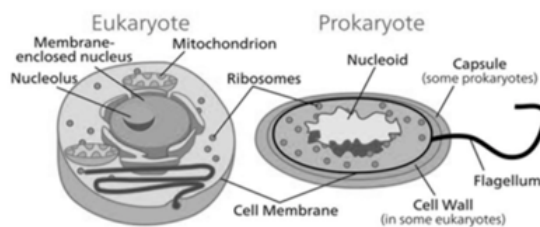

Fig. 1. Parts of a Eukaryote and Prokaryote

Each respondent was given 15 minutes to answer the pre-test, followed by a 30-minute review of the learning materials using the learning tool identified for their group. After the 30-minute review period, each respondent is again given 15 minutes to answer the post-test. The pre-tests and post-tests were based on the tests from Khan Academy and the website SEER training modules. Each test consisted of a 10-item exam subdivided into two parts -- five (5) multiple choice questions and a labeling task. The pre-test, post-test, and handouts were validated by Professor Mark Redillas, who is a faculty member of the Biology Department of the University. The raw scores from the pre-test and post-test were then encoded in a Microsoft Excel file to calculate the averages and central tendency.

A survey questionnaire was also administered after the students have completed their post-tests, to gather feedback regarding the respondents' satisfaction on the reviewing tool, and to identify features of these tools that are helpful for learning and those that need to be enhanced to

better support the learning task. The questionnaire uses a 10-point Likert scale for rating the learning materials based on the organization and quality of the content, font size and color, and audio quality. The questionnaire also solicited qualitative feedback for these attributes to determine the learner preferences, completeness and insufficiency of the learning materials, as well as the effect of the aesthetics and audio quality on learning.

3. RESULTS AND DISCUSSION

The scores garnered by the students from pre-test and post-test were compared through the use of the measures of central tendency and variability in order to determine the effectiveness of the review methods. Table 1 shows the average pre-test and post-test scores of the participants.

Table 1. Average scores for pre-tests and post-tests

Average Scores and Differences				
Type of Learning Tool	Pre-test Score	Post test Score	Difference	Percent Difference
Traditional Learning Tool	5.50	8.60	3.10	42.53
Digital Learning Tool	4.65	6.20	1.55	33.81

The respondents in Group A or traditional learning have an average pre-test and post-test scores of 5.50 and 8.60, respectively, compared to the 4.65 and 6.20 scores of Group B or digital learning tool. Furthermore, Group A students achieved an average of 3.10 points increase after using the traditional handouts for review, compared to the average 1.55 points increase for Group B students who used the video in Khan Academy as review material.

A cluster analysis on positive, no change and negative change based on pre-test and post-test scores was also conducted to determine the improvements in scores of the students. Fig. 2 depicts this cluster analysis for traditional and digital learning tools. As can be seen in the figure, 75% of the population or 15 students in each of the groups exhibited a positive change in their post-test scores. On the other hand, 5% of the population in Group A and 15% in Group 5 exhibited a negative change or lower scores in their post-tests, while the remaining 20% in Group A and 10% in Group B maintained

their their scores. From these data, it can be observed that both learning tools are effective as review materials.

Feedback from the participants regarding the visual design of Khan Academy can shed light on the minimal learning gains achieved by the students in Group B. While the participants found the topics to be organized, easily accessible, and broad in coverage, the absence of a table of contents made it difficult to navigate through the list of available videos.
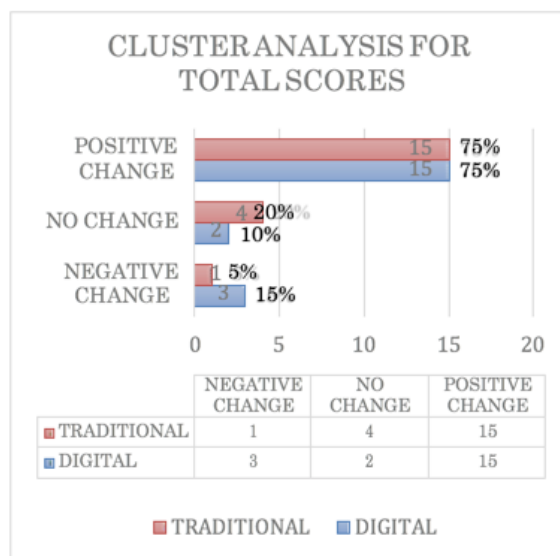

Fig. 2. Cluster Analysis on Pre-test and Post-test Scores

Furthermore, concerns on information retention surfaced among the participants. While the videos are in high resolutions, and the illustrations are found to be relevant, presenting the materials purely in video form contributed to the lower scores of the Group B respondents as they had difficulty in retaining key terms, such as the labels for the parts of a cell. One respondent pointed out that key points of the lesson "may not have been discussed as thoroughly as they would have been in textbooks or in lecture slides", while another stated that "some of the aspects of the topics were not elaborated". This led to a suggestion for the inclusion of typewritten materials to supplement the videos to help in retention.

For Group A participants, having a physical copy of the learning material helped them to better

visualize and understand the lesson, although the font size should be made larger and the images should be printed in color. The use of high resolution printers to improve the quality of the handouts would also be beneficial to the learners.

4. CONCLUSIONS

Fast internet connection, coupled with mobile devices, paved the way for students to gain access to alternative forms of learning materials. These resources are usually delivered in multiple media, combining text, audio, video and interactive elements. The combined use of different media enable these resources to cater to the needs of different learning styles, notably the visual learners.

Visual learners utilize graphs, charts, maps and other forms of diagrams to better grasp the learning materials. Both traditional and digital learning strategies pose benefits and challenges to these types of learners. In this study, the positive and negative points of both traditional and digital learning methods from the perspective of Grade 12 Senior High School students of the University were analyzed.

40 participants, subdivided into two groups, comprised the study. Group A used traditional learning tool in the form of handouts that contain mixed text and diagrams to present the lesson on cell anatomy. Group B, on the other hand, used Khan Academy as a digital learning tool to watch a video presentation of the same topic. Pre-tests and post-tests were then administered to the participants to determine their learning gains. A survey form was also used to solicit feedback regarding the learning tools that were used.

Results showed that the traditional learning tool are a more effective tool in assisting visual learners during their review session. The respondents who used the handouts on cell anatomy garnered higher post-test scores and learning gains as compared to the scores of the respondents who used Khan Academy to review the same topic.

Moreover, based on the survey, majority of the respondents appreciate the features afforded by both of the digital and traditional learning tools. The respondents who used the digital learning tool commended the organization of content and the videos provided by Khan Academy, stating that these helped them understand the lesson better. On the other hand, the respondents who used the traditional learning tools preferred having a physical copy over a digital copy presented through a mobile device.

Overall, while most of the respondents were quite fond of the individual features of the digital and traditional learning tools, there were a few suggestions as to how these can be improved. To help in information retention and better understanding, the quality of texts and images in Khan Academy, and the use of colors and high quality printers in the printed handouts should be improved. Additional text-based materials should also be used in the digital learning tool to supplement the videos.

There are multiple opportunities for future studies to expand the findings from this research. First, other subjects such as Physics that use visual representations for problems in projectile motion, can be explored. Second, other styles of learning from the VARK test can be studied to determine if similar findings regarding the learning tools can be derived. Third, the use of an entirely different and more updated learning style assessment, such as the multiple intelligence tests by Howard Gardner, can also be explored, to identify more varieties of learners. Finally, the use of other digital learning tools, such as Coursera and Udemy, can also be investigated.

5. REFERENCES

Clarke, I., Flaherty, T.B. and Yankey, M. (2006). Teaching the Visual Learner: The Use of Visual Summaries in Marketing Education. *Journal of Marketing Education*, 28(3), 218-226, December 2006. https://doi.org/10.1177/0273475306291466

Flemming and Mills (1992). The VARK Modalities. http://vark-learn.com/introduction-to-vark/the-vark- modalities/

Kumar, S. (2015). Common Problems Faced by Students in eLearning and how to Overcome Them. Retrieved from https://elearningindustry.com/5-common-problems-faced-by-students-in-elearning-overcome.

Woo, M.A. and Kimmick, J.V. (2000). Comparison of Internet versus Lecture Instructional Methods for Teaching Nursing Research. *Journal of Professional Nursing*, 16(3), 132-139.