Infographic pedagogy for first year college students

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Work in Progress: Infographic pedagogy for first year college students

Abstract

Infographics are an effective way to present complex and large data. In the 21st century, having design skills to promote the ideas and be able to find a larger audience is crucial for success. Hence, it is important to equip young students with this important design ability. In this work in progress research, the goal is to analyze and compare the students' infographics from two years study, with the total sample number of 92. For the second year, the research team designed new course material for the students and then evaluated the effectiveness of the new content, assessment and pedagogy tools. The proposed course material includes a new designed rubric with thirteen components for assessing students' infographics and the needed content pedagogy for teaching infographics. The students' infographics were graded in both years and the scores were analyzed, from which the statistics illustrated significant improvement in students' visualization skills. The results of students' grades show strengths and weaknesses related to different components of the new rubric. This study provides a complete description of this course content, assessment and pedagogy of teaching infographics to college students.

Introduction

The previous study (Kardgar, Mentzer, Laux, Chesley & Whittinghill, 2017) provided sample course materials for teaching and assessing student's infographic in a design thinking course, at an undergraduate level, in a large research-based university. For that pilot study, two treatment and comparison groups were conducted, and student's infographics were analyzed. The results did not show a significant difference and there may have been sampling issues. This research selected vaster and more diverse sample pool. Also, two research assistants initially analyzed the data to reduce bias in the assessment.

Infographic course content

Infographics are the combination of data and picture. In this course (Design Thinking in Technology (3 credit hours)), which is offered to all first-year technology students, allows them to learn how to connect data and pictures together. The students will understand the data first and then learn the techniques to create infographics. They will then identify which particular visualization technique can be applied for their project. The infographic course will begin by introducing the most important components of infographics and then focus on teaching different tools for designing them. Once the students have learned how to design infographics and what their important components are, they will start to design their own infographics. In this course, each learner will design their own infographic and then share it with the whole class to have peer feedback about their design.

Thus, the students will learn what an infographic is and the process of designing it. The first key idea is understanding the data, specifically with respect to the principle of data visualization. The second major idea is the understanding of the data visualization techniques and making sure that they know several of them. The third big idea is that they need to map and apply those two together. Table 1 provides a visual concept map for teaching infographic design.

The guiding concept is data, data visualization and their connection. Students need to convert their data into the visual format, with a guiding concept based on communication. The essential questions of this unit are:

- What is data?
- What are different data visualization techniques?
- How to choose the right technique for mapping the appropriate data?
- What kind of tools do you need to design an infographic?
- How can an infographic be designed that contains the various important features? These important features include audience; communicate a message, storytelling, facts and figures, title, visual and textual composition, effective use of color, fonts, size and proportion and citation.

Table 1 provides a visual concept map for teaching infographic design. In Figure 1, Green indicates the course topic. Grey indicates the background knowledge required for this course, which students need to achieve in other core courses in the college. Red indicates the big idea, and Blue indicates the enduring understanding. Purple reflects important to know ideas and yellow shows good familiar with. The concept map indicates the relationship between all concepts of infographic design.

Table 1: Visual table for infographic design

Big Ideas	Guiding Concepts	Essential Questions	Enduring Outcomes	• Important to Know	Good to be familiar with
Understanding the data	• Data	• What is data?	• Determine all important parts of infographic.	• Knowing the concept of data.	• Basic descriptive statistics
Understanding the data visualization technique	• Data visualization	• What are different data visualization techniques? • What kind of tools do you need to design an infographic?		• Knowing different techniques of data visualization.	• How to design different kinds of chart • Sketching

Choosing the right technique for appropriate data	• The connection of data and data visualization	• How to choose the right technique for mapping the appropriate data? • How design an infographic that contains the important features of it?	• Learn how to design an infographic	• Knowing how interpret data to mapping to the correct data visualization. • Provide feedback	• Identify flow • Learning about color harmony

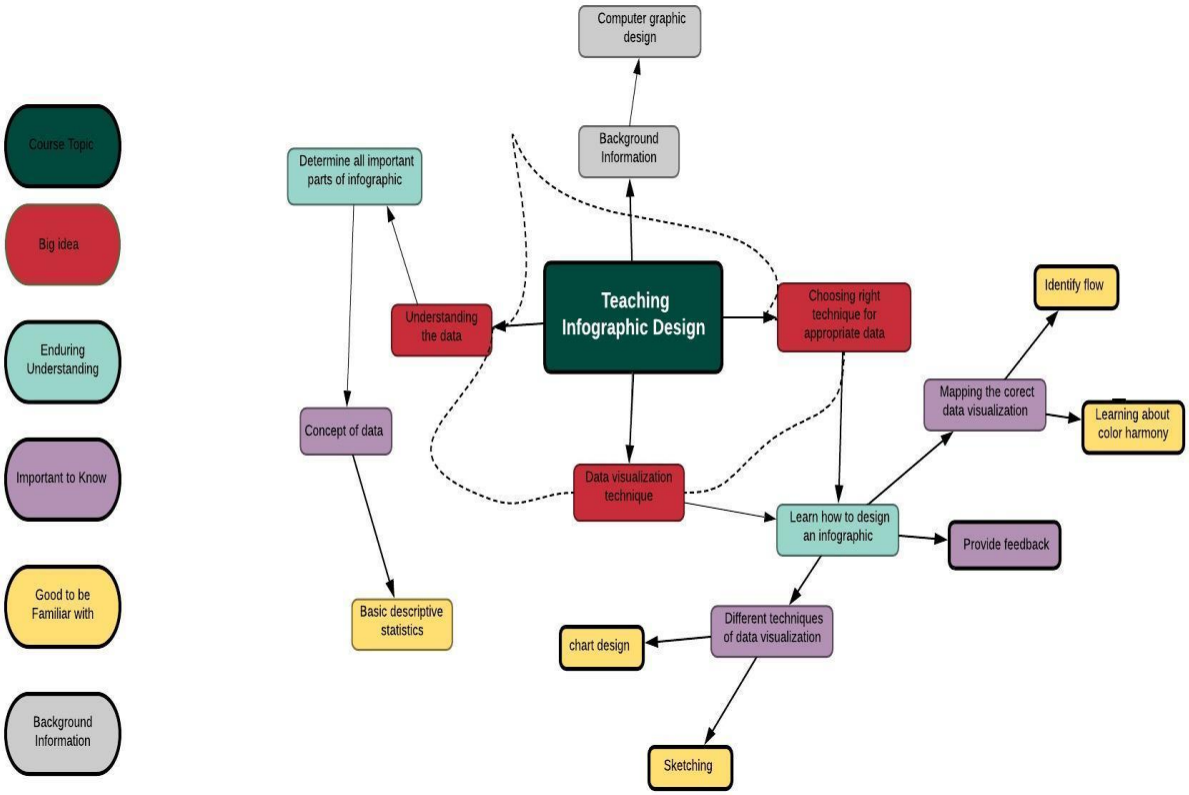


Figure 1: Concept Map of Curricular Priorities

There are three main areas of misconceptions and difficulties in this material. How the student understands the data is the most difficult concept of this unit. The second misconception is about data visualization techniques. Which data visualization technique is appropriate for each data set and how to map data with different data visualization techniques? The third misconception is about

designing an infographic that indicates flow both visually and cognitively. There is misconception about color harmony and about providing peer review and providing feedback. The threshold concept of this unit is learning important components of infographic design, according to the assigned rubric.

Infographic Assessment
The most important learning objectives (LO) of this unit are:

LO1. Students shall be able to determine data.
LO2. Students shall be able to determine all important parts of an infographic, according to the assigned rubric.
LO3. Students shall be able to recognize different software and tools to create an infographic.
LO4. Students shall be able to choose the best data visualization techniques for their data.
LO5. Students shall be able to design an infographic to show their data.
LO6. Students shall be able to combine typography, images, color and other design elements to create organized visual relationships.
LO7. Students shall be able to compose digital images that have an adequate format, resolution, color and space.
LO8. Students shall be able to provide feedback for their classmates' infographics.

Table 2 shows the mapping of learning objectives on difficult concept, misconceptions and threshold concepts.

Table 2: Mapping of learning objectives on difficult concept, misconceptions and thresholds

Dimension	Course Objectives
Difficult Concept	LO1. Students shall be able to determine data.
Misconception	LO3. Students shall be able to recognize the different software and tools to create an infographic. LO4. Students shall be able to choose best data visualization techniques for the data. LO5. Students shall be able to design an infographic to show the data. LO6. Students shall be able to combine typography, images, color and other design elements to create organized visual relationships. LO7. Students shall be able to compose digital images that have an adequate format, resolution, color and space. LO8. Students shall be able to provide feedback for their classmates' infographics.

Threshold concepts	LO2. Students shall be able to determine all important parts of infographic according to the assigned rubric.

Figure 2 illustrates the assessment triangle for one of the learning objectives of this unit.

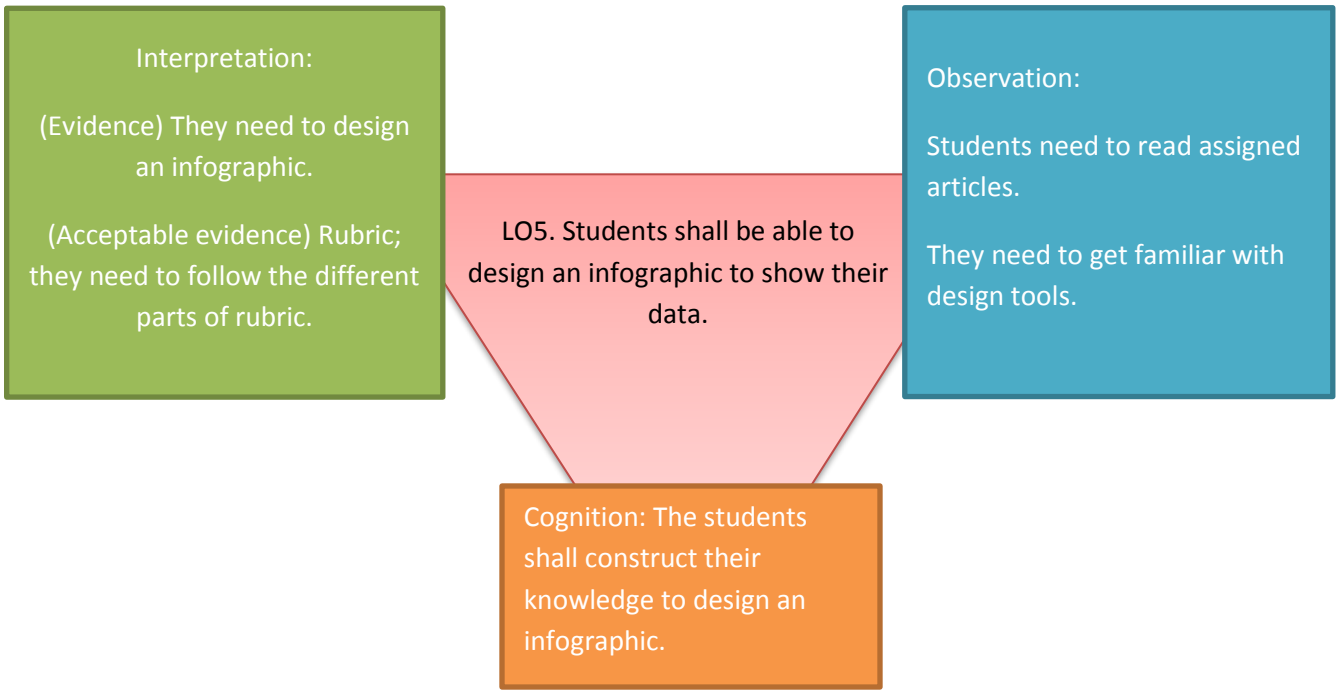


Figure 2: Triangle assessment

Table 3 (Kardgar, Mentzer, Laux, Chesley & Whittinghill, 2017) is used for assessing student infographic.

Table 3: Rubric for Assessing Student Infographics

COMPONENTS	MEETS EXPECTATIONS	NEEDS MORE WORK	UNSATISFACTORY
Audience	The audience is identified and described. The infographic is	The infographic is not completely appropriate for the target audience or	The infographic is not appropriate for the target audience.

	appropriate for the target audience.	the audience is not identified.	
Communicates a message	The infographic is simple and easy to understand.	The infographic couldn't advance idea into a simple visual form.	The infographic is not easy to understand.
Storytelling	Focuses on the flow, both cognitively and visually.	There is just cognitively or visually flow.	There is no flow.
Facts and figures	The statistics are true, and sources are reliable.	The statistics are not true, or the sources are not reliable.	The facts and figures are not accurate.
Title	The title describes the infographic and grabs the user's attention. It is short and easy to understand quickly.	The title of the infographic may be a bit too broad to allow the viewer to understand the main points.	There is no title.
Visual and textual composition	Infographic has a good balance of visual information, with written information.	There is not a good balance of visual information, with written information.	There is too much written information.
Effective use of color	There is a good balance and contrast of color.	Bright font colors on bright background or vice versa.	There is not a good balance of color or contrast.
Fonts	By using an appropriate font, it is easy to view and read.	Some fonts in the infographic are too small to read.	The font(s) used in infographic make the text almost unreadable.
Size and Proportion	Length and width proportions are appropriate.	The infographic is not in the right length.	The infographic is too big or too small.

	Make it manageable length and size.		
Citations	Full bibliographic APA format citations for all sources used are included.	The URL of sources used are included.	No citations are included.
File Format	Great! Submitted as a single pdf. Includes your name, the course, and assignment information in the top.	Has file as one single pdf or has included proper documentation on the top right, but not both.	Not in pdf format.

Pedagogy

The major component of this course is designing an infographic, which the students will do using online tools. Each infographic needs to follow the important components mentioned in the assigned rubric.

Students are expected to be active in class discussions. For most of this unit, there will be assigned readings, which students are expected to read before class. The course project in this unit has three components: 1) drafts, 2) project final report, 3) infographic presentation. The project presentation is about briefing the infographic poster in the class.

Students need to provide feedback for their classmates' infographics, according to the assigned rubric.

The class will be an active learning environment, with many hands-on projects. The active learning will include different techniques of group discussion and problem solving as well as design and hands-on work. Students will expect that instructor present is during most of the classes on time, creating an engaging, safe and interactive classroom environment, designing different activities to help increase the learning, providing formative feedback on every assignment and project, encouraging community of practice and grading fairly.

For being successful in this class, it is important that student attends each session and is involved in in-class activities as well as reading the course materials and complete projects on time.

Students are expected to complete the assigned homework and projects in advance as well as pay attention to the rubric for each assignment and take quizzes before respective deadlines.

The class material will provide the information about each topic of the session, to include the topic, why it is important, and how the student can use it.

Successful students will engage in class discussion and activities, be an active member in their teams, ask questions and be present at all class sessions.

Method

In an introductory design course, where information visualization is a key component, does implementing an empirically derived rubric, take home quiz and readings about infographics improve students' scores compared to only providing an infographic template? This study compared 42 infographics from fall 2015 and 50 from fall 2016. These data were analyzed by one graduate student who scored all 92 samples. This study was done after the pilot study, once the researcher had already negotiated with another graduate student to reduce the risk of bias. We conducted a hypothesis test to determine whether the structured testing impacted the score and improved them from 2015. To best test this theory, we used the difference in means in the two populations to see if, on average, the students from the 2016 population performed better than the students from the 2015 population.

Hypothesis

• H0: The structured treatment (developed course materials) will not have an effect on students' perceived levels of data visualization or their abilities to create good infographics. Therefore, the average scores among the two populations will not be significantly different.

• HA: The structured treatment (developed course material) will have a positive effect on students' perceived levels of data visualization or their abilities to create good infographics. This will be reflected in the data by 2016 students having a higher average score than 2015 students.

The possible scores range between 0 and 13. The 2015 average score was 9.94 and 2016 average were 10.51. After carrying a difference in mean t-test, we achieved the p value of 0.028279. This is lower than the threshold 0.05 significance, thus we reject the null hypothesis that the structured treatment doesn't have an effect on the scores in the favor of the alternative hypothesis, which states that there is an increase in the student average score among students with the structured treatment.

Data

Variable Name

- Fall 2015 particiant grade (comparisson group)
- Fall 2016 participant grade (treatment group)

Full Description (SPSS Label)

- The infographic grade of students for Fall 2015.
- The infographic grade of students for Fall 2016.

Description of Coding

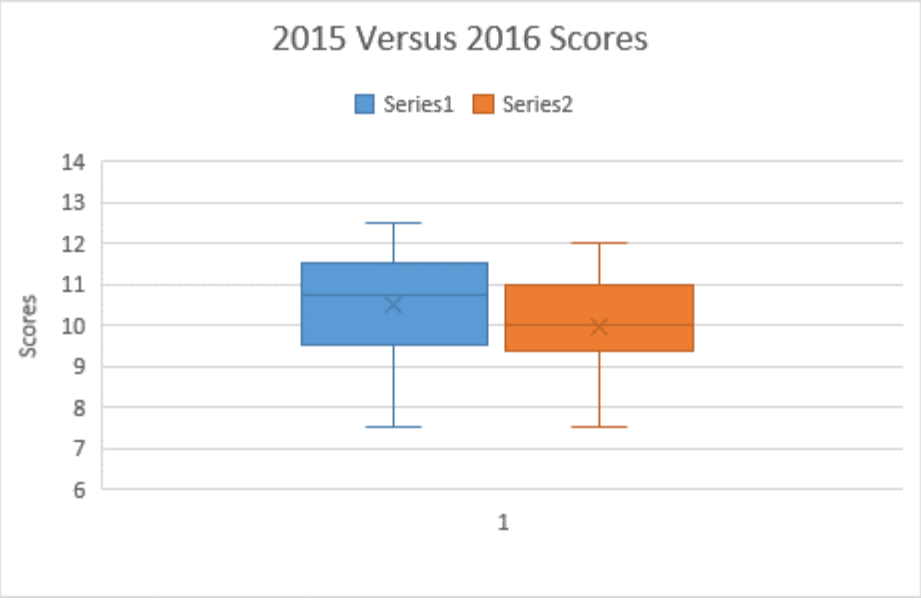
- F2015G
- F2016G

Results and Discussion

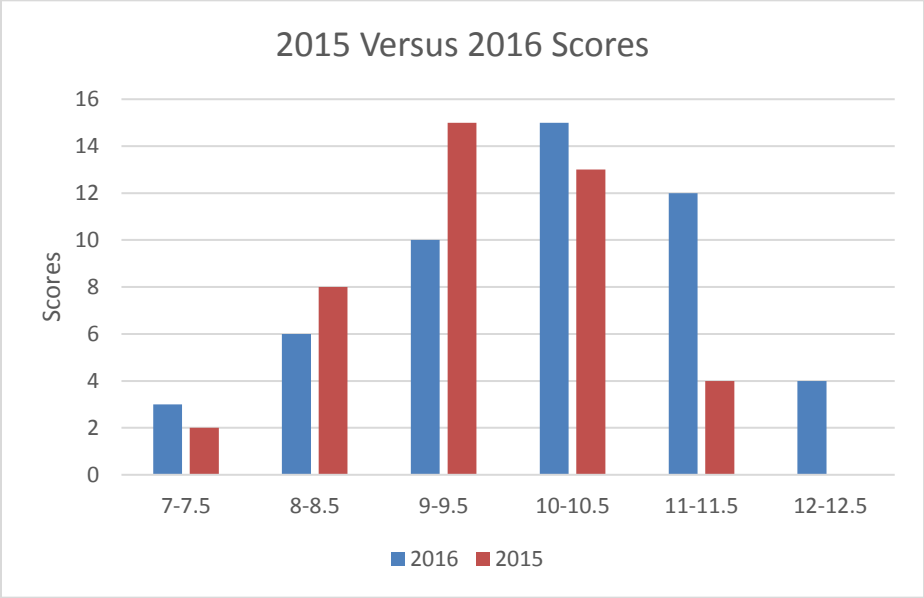
Table 4 shows a summary of the total results for the larger study and Figures 3 and 4 list a comparison of the 2015 and the 2016 scores. Fig. 3 illustrates the comparison of scores for 2015 and 2016, while Figure 4 presents the histogram for these two years. The difference in the averages is better reflected in the calculation, but the difference between the means can still be observed.

Table 4: Summary of Total Result

	Variable 1 (2015 Data)	Variable 2 (2016 Data)
Mean	9.940476	10.51
Variance	1.185395	1.851939
Observations	42	50
P Value	0.028279	



Figures 3: Comparison of 2015 Scores versus 2016 Scores for total result



Figures 4: Histogram of the 2015 Scores versus 2016 Scores for total result

As visualized in these figures, it can be seen that as we move towards the higher scores, they are mostly from 2016 data.

Figure 5 reports the distribution of data for fall 2016 and Figure 6 shows the distribution of data for fall 2015. Again, we can see that the scores are skewed left for the treatment group in favor of higher scored, whereas the data is more centered on the average for the control group. While it can be discussed that there is a larger variance amongst the treatment group, we believe that because of such a low p-value, the fact that the highest score got higher is not falsely showing the average to be only reflective of a few students.

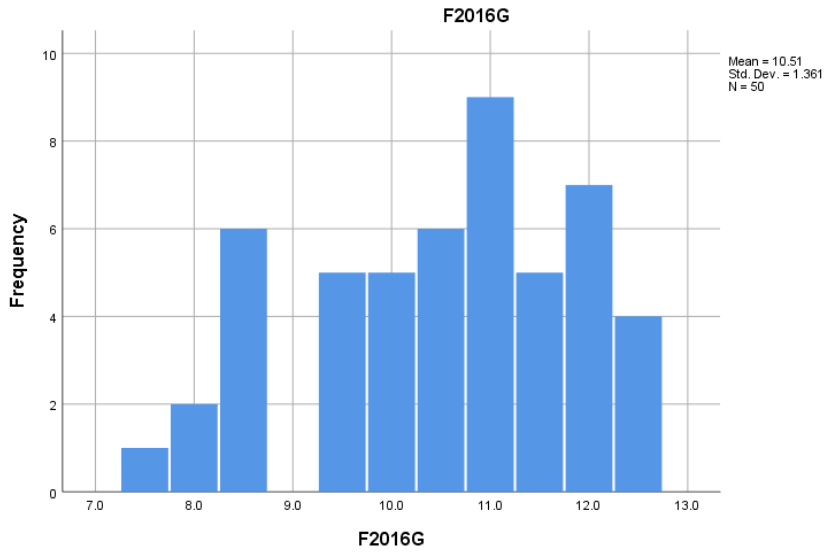


Figure 5. Histogram for fall 2016

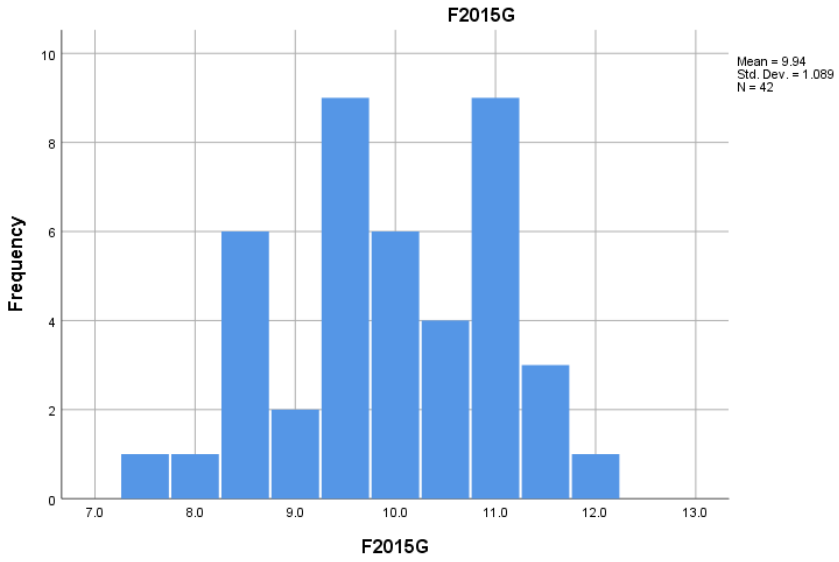


Figure 6. Histogram for fall 2015

Table 5 indicates the descriptive statistics of the data for both fall 2015 and 2016, where it illlustrates that the minimum score for each group is 7.5. The maximum score for fall 2015 is 12 and 12.5 for fall 2016, increasing for the latter. Additionally, as we discussed above, by looking at the graphs and the p-value, we can say that the average is not a wrong choice for the representation of the data despite the increase in the highest values.

Table 5: Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error
F2016G	50	5.0	7.5	12.5	10.510	.1925	1.3609	1.852	-.446	.337
F2015G	42	4.5	7.5	12.0	9.940	.1680	1.0888	1.185	-.212	.365
Valid N (listwise)	42									

Table 6 shows an overall report of the study that includes the median score and kurtosis.

Table 6: Overall report of the study

	F2016G	F2015G
Mean	10.510	9.940
N	50	42
Std. Deviation	1.3609	1.0888

Variance	1.852	1.185
Kurtosis	-.721	-.724
Std. Error of Kurtosis	.662	.717
Skewness	-.446	-.212
Median	10.750	10.000
Minimum	7.5	7.5
Maximum	12.5	12.0
Range	5.0	4.5

The median score for fall 2016 is 10.75 and 10 for fall 2015. So, we can see that because of the positive shift in both the average and the median, the individual scores have been increased for the 2016 population.

Table 7 indicates the result of the t-test, where 2.22936 is the difference of mean and since P (T<=t) one-tail, is 0.014139, the results are significant ($p<0.05$) and there is significant evidence to reject the null hypothesis and support that there has been an increase in the scores of the treatment population. This indicates that the empirically derived rubric does enhance students' performance. These results can be used to not only advocate for further research in learning enhancement, but also to enforce change in traditional rubrics in favor of empirically designed ones.

Table 7: t-Test, two samples assuming unequal variance

	Variable 1	*Variable 2*
Mean	10.51	9.940476
Variance	1.851939	1.185395
Observations	50	42
Hypothesized M	0	
df	90	
t Stat	2.22936	
P(T<=t) one-tail	0.014139	
t Critical one-tail	1.661961	
P(T<=t) two-tail	0.028279	
t Critical two-tail	1.986675	

Conclusion

In the modern 21st century, using technology to teach different concepts to students is crucial. This research finds that infographics are a new and effective way to teach different concepts to students and improve their visualization skills. Since the research illustrates that most people are

visual learners and they can learn faster through visualization concepts, increasing the use of infographics in classrooms, at all levels, is highly recommended.

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