A New Approach to Equip Students with Visual Literacy Skills: Use of Infographics in Education*

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Abstract. In today's ever more visual world, visual literacy skills became more critical for learners. Therefore teaching visual literacy helps students interpret visual media and becoming a much broader and extensive body of learning and comprehension in education. In this paper, how to use infographics as a learning tool was discussed in order to equip students with visual literacy. Research was conducted with 64 teacher candidates. The aim of the study is to expose the usage of infographics as a learning tool. Teacher candidates designed infographics of instructional design model themed individually within the course. As a result of the rubric evaluation the scores of "visualization" and "components" dimensions was found lowest; scores of "colors", "fonts" and "information organization" dimensions was found relatively higher.

Keywords: Infographics, visual literacy, instructional design, teacher education.

1 Introduction

The increased number of visual messages surrounding individuals creates visual information processing needs and has led to the movement for developing visual literacy and spatial skills [1]. Visual literacy is defined as 'A group of acquired competencies for interpreting and composing visible messages' [2]. Visual literacy allows a deeper interaction with messages of all kinds and introduces the process of analytical thinking about representation and meaning. Educators have realized that this visual age requires visual literacy skills as well as verbal skills and that both of them must be developed [3]. Therefore teaching visual literacy helps students interpret visual media and to access a much broader and more extensive body of learning and comprehension in education.

"A visually literate person is able to: (a) discriminate, and make sense of visible objects as part of visual acuity, (b) create static and dynamic visible objects effectively in a defined space, (c) comprehend and appreciate the visual testaments of others, and (d) conjure objects in the mind's eye" [2]. In order to use especially

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visually intensive information and communication technology applications effectively teachers and students should be able to communicate visually [4]. To prepare students to be successful learners, confident and creative individuals, and active and informed citizens, they must be able to comprehend, interpret and extrapolate from information presented in a wide variety of formats. Infographic is one of those formats which is defined as "visualization of data or ideas that tries to convey complex information to an audience in a manner that can be quickly consumed and easily understood" [5].

As technology advances, teachers and teacher candidates should gain skill in teaching visual literacy skills. Two ways to improve image literacy skills are recommended: 1) to help learners read or decode visuals through practicing analysis techniques 2) to help learners write or encode visuals as a tool for communication [6]. In this paper how to equip students with visual literacy using infographics as a learning tool is discussed.

1.1 Infographic Design

An infographic is the visual display of any data or information with the aim of presenting the information in a quick and clear way. It may be named as data visualization, information design or architecture of information depending on its aim [5]. The history of the infographics, which are quite common in the digital environment today, goes back to the prehistoric ages when patterns were drawn on the cave walls for communication purposes. Modern infographics may be complicated such as displaying a visual analysis of the global economy, or it may be as simple as a traffic sign, but the purpose is to aid communication [7]. Visual presentations became more complicated with the utilization of technology and it is important to discuss how to interpret and design infographics in the context of visual literacy in education [8].

Regardless of being verbal or visual, the most important characteristics of an effective communication method are its "appeal", "comprehension" and "retention" aspects [7]. In the light of these three characteristics, the communication process should be realized in a clear and comprehensible way and the aim should be to create impressive knowledge for individuals. The order of importance attributed to the appeal, comprehension and retention in designs depends upon the fields of use. With respect to educational infographics, how appeal, comprehension and retention elements should be balanced is shaped according to the design and utilization purposes of the infographic.

Infographics could be quite essential in visual summarization; however, this could shade the importance of the content to support the most appropriate discussion. In order to avoid such cases the visualization should not dominate a strong discussion and an appealing wording. Knowledge that could impress the reader should depend on clear and detailed analyses. Knowledge should be presented in such a way to ensure that the reader could find examples of practice according to his/her fields of interest. Design should enable readers to understand the knowledge by revealing patterns and by facilitating reading. The design material should support the reader in review of the topic through providing filtering and search options [9].

Infographic design is studied in graphic design and computer sciences, changing according to the aim such as data, information or knowledge visualization, knowledge design and architecture. The increase in its utilization in the field of education has revealed the need for research on educational technology with respect to infographics.

1.2 Instructional Technology

Due to its dynamic structure, instructional technology has diverse definitions. Technological developments, innovations, new ideas and diverse perspectives of the scientists working on varied dimensions in the field has led to continuous updates on the definition of instructional technology. On the other hand, interdisciplinary interaction enriches the field while changing its definitions. Instructional technology developments can be analyzed within five periods. First it was perceived as media, then as a process. It was subsequently perceived to be beyond a process, and then perceived as combining the roles of the media, systematic instructional design and performance technology. Finally it has come to be perceived as instructional design and technology [10]. The instructional technology concept has moved beyond the notion of a process and been defined as "the theory and practice including design, improvement, implementation, management and evaluation of processes and resources for learning to occur [11]. It is defined as "ensuring learning and improving performance through "design", "utilization" and "management" of appropriate technological processes and resources" [12].

The most important issues of the information age that should be subjected by instructional technology are "structuring high-quality knowledge, and producing and designing information". Within this framework, the questions, "Could infographics be used in the learning process for learners to construct and design information as well as structuring knowledge?" and "Could infographics that are developed based on their qualifications along with the principles of design and learning, be a way of ensuring qualified information when they are used in learning environments?" need to be discussed. Additionally for success on this issue improvement of visual literacy skills of learners is an important topic that could be investigated by using infographics in educational contexts. These discussions could provide some solutions to the problems of the information age. This study aims to analyze the utilization of infographics within the learning process as research and learning tools with a focus on their usage in structuring knowledge, designing and constructing information through the instructional design example.

2 Method

The research was conducted with 64 (32 female and 32 male) 2nd year students, who enrolled in the Computer Education and Instructional Technology Department of the Faculty of Education at Hacettepe University during the spring semester of 2012 – 2013 academic year. The entire process was in the Instructional Design course in Turkish. In the previous semesters, students had attended courses in "Material Design and Utilization in Education" and "Principles and Methods of Teaching", which are pre-requisites for the instructional design course content.

2.1 Implementation Process

Course Description. The instructional design course, during which the research was conducted, involved, "identifying problems through analyzing the existing education and teaching environment with respect to the instructional design principles, finding solutions to the identified problems and designing new models using the instructional design theories, and designing instructional materials for online learning environments". In line with these outcomes, the theoretical part of the instructional design course involved the basics and history of instructional design and technology, identification and analysis of the needs, characteristics of learners in learning environments, teaching strategies and conceptual teaching, concept maps, worksheets, instructional design models and infographics as learning tools. In line with the theoretical course content, the practice part involved a process where learners attained practical skills about instructional design. Students were expected to select one of the instructional design models and design an infographic to be used as an instructional design tool as term project.

Implementation on Infographic. The implementation process was initiated in the second week of the research with an infographic titled "How to Design Instructional Design Process" that was assigned to the students online along with the instruction saying, "As an instructional designer of a team which produce educational solutions…". The infographic (Fig.1) that was given to the students as a road map was composed of two cycles. The macro level, cycle was about the position of the instructional designer in the educational team, while the cycle at the micro level indicated the purpose of their positions as instructional designers and provided the framework of their responsibilities. The application process that was initiated with the infographic, provided a solid structure and they were able to enrich or expand the visual material presented in line with their readings or requirements.

The infographic involved a design pattern from the general to the specific. The cyclical display centered the field expert and the resource continued with an external and internal intercyclical pattern with the inclusion of the instructional designer, visual designer and the linguist respectively. The second cycle, which remained within the field expertize of the instructional designer, started with the questions asking, "What kind of educational design are you asked for?" and "Is the content that you have is enough for design?" In answering the question on the type of the instructional design, students were provided with the keywords symbolized with question marks. The keywords, were individual, online, implementation, group work, discussion, instruction, question and answer, sliding, web, face-to-face, visual, book, digital, verbal and print. These were introduced to the students in the form of word clouds as reminders of how to find answers to the given questions.

The instructional design cycle started with the reading and analysis of the content provided by the field expert. The data developed in an intercyclical process within the process rather than being a sequenced structure where the data in the micro cycle involved those in the macro cycle including structure was explained to the students face-to-face during the lessons. Considering the situations where the field expert could be absent, the content was requested to be obtained from the resources to be

followed by compilation and analysis. In order to emphasize the continuous communication with the field expert within the cycle, dimensions of cooperation with the field expert or scanning other resources in the event that the knowledge is obtained from a resource were added to the cycle.

After the content is created, it was suggested that the script be divided into meaningful sections and that the key words or key concepts in the script be determined. This was one of the most important phases in terms of ensuring that the instructional designer mastered the content. Questioning the systematics of the script and organizing the systematics between the meaningful sections, determining the relationships, completing the missing points in the content as determined in the research or removing the unnecessary sections indicated the progress in creating the script. After the modifications in the meaning dimension such as finding a title or emphasizing the essential points in a script, the visual organizations came as the next phase.

The initial phase of the instructional design involved organization of the script and wording. Students were expected to analyze the script in line with the given sample content and follow the steps explained above using the given figure. The importance of this phase, which set the basis for the following phases, was emphasized and the instructional design process was presented to the students by placing the other relevant experts (field expert, visual designer, and linguist) in the instructional design team on the same infographic. The infographic was designed using the questions and keywords in a flexible way, which could be extended with the purpose of ensuring students to experience the process through inquiry.

For the following week, the instruction saying "We are seeking an answer to the question on how we could turn the scripts we organized into an online course?" was provided and the students were expected to divide the scripts into meaningful sections and place them on a white background using the intended software (PowerPoint, and Flash) while supporting with the visuals. During this week, when the figure and script exercise were performed, students were requested to search "education" on Pinterest which is a kind of social network that consist of visual bookmarks as pins and evaluate the infographics they found so that they could see as many examples as possible.

With the aim of assisting students in their infographic design and script analysis, conceptual teaching and concept maps were emphasized and students were expected to create concept maps using the given script. The functioning of the mind, attainment and processing of knowledge and "the construction of meaning" were studied as the processes that an instructional designer should consider in design. Instructional design models were examined and the learners were expected to work individually on the instructional design models starting from the script organization phase. The question on why infographics should be preferred as educational tools was focused. The purposes for using infographics, infographic design process, and infographic design dynamics along with the types of approaches and design were studied in the theoretical course. Diverse educational infographic samples were examined.

Fig. 1. Instructional design process infographic

3 Data Collection Tool

The infographics designed by the students were evaluated through the rubric that was developed by the researchers (Table1). The rubric was composed of the title, elements, visualization, font, colors, page format and organization of information dimensions. The infographics were scored for each dimension as 0, 1, 2 and 3.

Table 1. Infographic design scoring measures

Dimensions	Score	Measure
Title	0	There is no title or there is a title that is irrelevant with the topic.
	1	The title is unclear.
	2	The title could be more comprehensive in order to present the essential points in the content.
	3	The title is in line with the content and informative.
Elements	0	Elements are never used or they are used irrelevantly.
	1	Elements are used in varied patterns and this complicated the readability of the design.
	2	Elements are used in varied patterns reflecting the content.
	3	Elements include repetitions for the transfer of the content and for the learner to understand easier.
Visualization	0	There is no visualization or the visuals are irrelevant.
	1	More varied visualization patterns should be used for the visualization of the content.
	2	The implemented visualization pattern reflects the content; however, some of them complicate comprehensibility.
	3	Visualization pattern reflects the content and ensures that the content is comprehended easily and rapidly.
Font	0	There is no font.
	1	The font complicates the reading of the script.
	2	There is more than a single font and/or the font is not in line with the topic.
	3	The font completes the content and readable
Colors	0	There are no colors or the selection of colors is irrelevant to each other and the topic.
	1	Selection of colors is not visually satisfying and it decreased the level of visibility.
	2	There is a good selection of colors; however too many colors have been used.
	3	Selection of colors increased visibility; different tones of the same color have been used wisely.
Page Layout	0	There is no page layout or there is a disorder irrelevant to the content.
	1	The page layout is not organized in such a way to address the content-related components.
	2	The page layout involves content-related components; however it is not arranged from the general to the specific or from the specific to the general.
	3	The page layout involves the components that reflect the content and it is organized from the general to the specific or from the specific to the general.
Organization of information	0	There is no organization of information (place, alphabetical order, timeline, category, hierarchy).
	1	There is an organization of information but the display of knowledge lacks conformity.
	2	One of the methods for organization of information is used.
	3	One of the methods for organization of information is used in such a way to reflect the content.

4 Findings

The scores obtained from the rubric were presented in Table 2. The highest percentages in the 0 and 1 categories belonged to the “elements” (0: 26 %, 1: 29,7 %) and “visualization” (0: 12,5 %, 1: 45,3 %) dimensions which means the students scored quite low in elements and visualization. The highest percentages in the 3rd

category belonged to the "organization of information (21,9 %), "colors" (23,4 %) and "fonts" (26,6 %) dimensions that means students were more successful in the organization of information, colors and fonts.

Table 2. Infographic design scores

Dimensions	Score	f	%	Dimensions	Score	f	%
Title	0	3	4.7	Visualization	0	8	12.5
	1	19	29.7		1	29	45.3
	2	34	53.1		2	20	31.3
	3	8	12.5		3	7	10.9
Elements	0	17	26.6	Font	0	0	0
	1	19	29.7		1	28	43.8
	2	23	35.9		2	19	29.7
	3	5	7.8		3	17	26.6
Organization of information	0	4	6.3	Colors	0	2	3.1
	1	17	26.6		1	28	43.8
	2	29	45.3		2	19	29.7
	3	14	21.9		3	15	23.4
Page Layout	0	3	4.7				
	1	31	48.4				
	2	20	31.3				
	3	10	15.6				

In terms of dimensions and measures, the scores indicated that the highest percentages belonged to (1) "the title could be more comprehensive in order to present the essential points in the content" in the title dimension, (2) "elements are used in varied patterns reflecting the content" in elements dimension, (3) "one of the methods for organization of information is used" in the organization of information dimension, (4) "the page layout is not organized in such a way to address the content-related components" in the page layout dimension, (5) "more varied visualization patterns should be used for the visualization of the content" in visualization dimension, (6) "the font complicates the reading of the script" in the fonts dimension, and (7) "selection of colors is not visually satisfying and it decreased the level of visibility" in the colors dimension (Table 2).

Using the rubric the overall infographic design score (M=1.65; SD = .66) was calculated. The distribution graphic showed that the design scores were normal with a positively skewed distribution. It could be interpreted that the design scores of students had a normal distribution and there was a condensation in the low degrees.

5 Discussion, Conclusion and Recommendations

This research has introduced the instructional design course example, throughout which infographic design is used within the learning process for the learners to structure knowledge and construct information. The findings of the research have provided presumptions for the development of a learning model based on the relationship between infographic and instructional design. According to students'

design scores, the accumulation is observed to have occurred in the low degrees and this indicates that sub-applications should be made with respect to the dimensions.

The low scores obtained by the students in "elements" and "visualization" dimensions have shown that these two dimensions are quite challenging for the students, which could be derived from visual literacy skills of learners. The "Elements" dimension looks at the provision of visual unity in a script and the design solutions that are produced for reinforcing the meaning through repetitions during the transfer of the knowledge. In the elements dimension, students are observed to have used irrelevant and complicated elements, which affected readability negatively. They are observed to have the same problem with visualization. In order for students to produce better design solutions, they could be advised to work periodically on their drafts in small groups starting from the moment they work individually on their themes. In order to assess the quality of an infographic, which is in the form of a summary, it is important to determine how much it acknowledges, impresses and attracts the attention of the reader [9]. In this respect, the feedback that peers of the students may provide about their design solutions could assist them in producing better solutions. The criticism made by their peers could enable students to organize their own design processes and ensure that they evaluate and improve their visual design solutions through communication-based applications to be performed in groups.

In addition to the search and analysis made on Pinterest, students could be expected to analyze more infographic examples to be able to perform better in the visualization phase. These infographic samples could be evaluated in groups using rubrics. Within the scope of the visualization dimension, students' visual literacy also comes to the forefront. Visual literacy refers to the name given to a series of visual competencies developed by individuals through using their eyesight. Improvement in these competencies set the basis for students learning. An individual with such competencies has improved skills to recognize and interpret visual actions, objects, symbols and other things in his/her environment. Utilization of these competencies in a creative way would enable individuals to establish more effective communication with others and use visual communication in a better way [13]. Curriculum could be enriched with the inclusion of courses that improve students' visual literacy levels.

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