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APPROACHES OF DESIGNERS IN THE DEVELOPED EDUCATIONAL PURPOSES OF INFOGRAPHICS' DESIGN PROCESSES

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Abstract:
Infographics enable users to receive information by using various visuals such as texts, pictures, drawings, diagrams, graphs and so on in an organized structure. The use of infographics, which can be designed in different platforms from visual design programs to web environment developed specifically for the creation of infographics, in the learning environments becomes more widespread. The number of studies investigated design processes and view of designers in regard with infographics that are commonly used in the learning environments is very limited. In this study, views and approaches of designers in regard with infographics design process for educational purposes are presented. A total of 64 participants including 35 female and 29 male participated in the study. The results of the study show that female and male have similar understanding in terms of copyright, publicity, references, design preferences, production environments and production processes. On the other hand, designers have different approaches and preferences in terms of design concept, design process, readability level, sharing and contribution to the personal development, visual components, colours, information sources, themes and quality perception.

Keywords: infographics, infographic design, preferences of infographics designers, infographic designer, infographic designers' approaches

1. Introduction

Today, the materials used in learning environments are varied or assumed to alternative forms. Infographics are one of the materials that are commonly used and

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becoming more widespread in learning environments. Infographics have become of the new trends in today's learning approach since they includes many components that are used in the visualization of knowledge and enable knowledge to be presented in different visual forms (Williams 2002). Toth (2013) defines infographics as materials created as a combination of visuals and texts that are prepared in order to provide easy and understandable information about a subject to their readers. Lamb and Jhonson (2014) define infographics as visual presentation of information, which is prepared for readers to visualize the information that is normally difficult to understand.

Infographics provide information to be a part of a certain flow (Krum 2013). In this way, too much information can be presented with a little explanation and relationships can be shown (Lester 2011). Using infographics is one of the popular methods that can transfer complex information to learners by appealing to their multiple senses (Abilock and Williams 2014; Lamb and Jhonson 2014). In other words, infographics offer new ways engaging with a logical sequence in order to present the content in an interesting way. Flexible structure of infographics, being able to visualize information and prepare in alternative forms can be listed among strengths of infographics (Schroeder 2004). Since infographics can present extensive information easily, they can be used to serve different purposes such as reminding the available information, showing the relationship between concepts, transfer of processes and events, presentation of course content and summarizing the information obtained (Meeusah and Tangkijviwat 2013).

Although infographics are new teaching materials, the components used to prepare these materials are not very new. Actually, Toth (2013) states that the history of infographics dates back to Egyptian hieroglyphs. Many components such as pictures, drawings, figures, symbols, graphics, and texts which are used in infographics, are often used for presentation of information in different learning environments. At this point, innovation brought by infographics is the use of visual components and constructing the content in the presentation of information (Dick 2014).

The information to be transferred with the help of infographics can be presented in a visual form by following a certain flow with various displaying methods such as pictures, videos, charts, lists and texts (Krum 2013; Toth 2013). These features allow infographics to be created by utilizing all types of multimedia components. According to Lamb and Jhonson (2014), visual types in infographics with visual components in particular are as follows:

- Graphics and drawings
- Diagrams
- Visualizations / Photos (Illustrations)

- Maps
- Organizers (Concept maps, cause and effect modifiers, venn diagrams, etc.)
- Photographs
- Symbols

Infographics are categorized in different ways according to their visual types, level of interactivity and multimedia components. Krum (2013) categorized infographics as static, zooming, clickable, animated, video and interactive infographics. Infographics in static structure that requires less effort than others and very common in the web environments is encountered as the most common type for readers. According to Krum (2013), the types and features of infographics are as follows:

- **Static:** It is the simplest and most common type. It can be created as an image or PDF file. Printed forms are available.
- **Zooming:** In addition to static structure of the infographics, it has an interactive layer that can be zoomed in and out. They are published on the web in general.
- **Clickable:** In addition to the features of static infographics, there some sections including HTML links at certain points of the infographics. İnfographics in this form are usually presented on the web.
- **Animated:** These infographics are hosting a variety of animations for readers to watch. These are not video files, but infographics shared on the web environment and prepared with animations and images or supported by HTML.
- **Video:** These infographics are created in video format. These video infographics created in the form of a presentation can be shared in various video-sharing environments.
- **Interactive:** These infographics include controls that allow readers to make changes on the data and visualizations. Readers can devote more time to the visuals and information presented by interactive infographics.

In differently from the classification of Krum (2013); Lankow, Ritchie and Crooks (2012) categorize infographics according to the level of interaction presented by infographics to their readers and list these categories as interactive, semi-interactive and non-interactive infographics according to the multimedia components they host. According to Lankow, Ritchie and Crooks (2012), the basic features of interactive, semi-interactive and non-interactive infographics are as follows:

- **Non-interactive:** Non-interactive infographics contain fixed texts and visual components. The information is limited to the content offered. It is possible to use printed versions of these infographics.
- **Semi-interactive:** Semi-interactive infographics are defined as motion infographics. Motion infographics are created by revitalization of a content, and

presenting it within the frame of a story and in the form of a video. These infographics use audio and visual components to present the content.

- **Interactive:** Interactive infographics enable content to be presented in an interactive form and allow a top-level reader-content interaction. Level of interaction can vary from a very simple component to very high level. In interactive infographics, information resources in the same or different media can be used. In addition, it is possible to make search in the content or have access to different information according to the selection.

The types of infographics stand with different features. However, it is possible to produce information using different media types or different programs according to the types of infographics. Each component of infographics can be created by using a different software and environment. On the other hand, all components can be created in a single environment. Infographics can be created through websites hosting software dedicated for the creation of infographics or ready-made templates and icon charts. For example, Lamb and Jhonson (2014) list the software and environments that can be used to create infographics as follows:

- Production software (Word, PowerPoint, etc.).
- Infographics creating software via a computer (Life etc.).
- Professional design software (Illustrator, Photoshop, Fireworks etc.).
- Online private infographics creation environments (Easel.ly, Visually etc.).

Creating infographics is not only bringing texts and visuals in an interesting form by using creation environments. Paying necessary attention to the basic features of infographics while creating them will be useful. The basic design features of infographics can be expressed as follows (Davidson 2014; Lamb and Jhonson 2014):

- Infographics should be simple.
- Infographics should be able to present complex information quickly and clearly.
- Infographics should be integrated to the visuals and texts for presentation of information.
- Infographics should contain limited number of words and amount of text.
- Text should be self-explanatory.
- Infographics should have diversity of understanding to visualize the information to be displayed.
- Infographics should be beautiful and attractive for readers.
- Design principles should be applied.

According to the earlier studies in the literature, designers should have some understanding in order to highlight basic features of infographics. In order to create infographics, using an effective approach in the presentation of information in addition

to visual design is important. Therefore, finding, analyzing and using information and using teaching design models while creating infographics is quite important. The points required to be considered for an effective infographic are as follows (Lankow, Ritchie and Crooks 2012; Davis and Quinn 2013; Davidson 2014; Lamb and Jhonson 2014):

- **Preparation**
  - The purpose should be determined
  - The type of infographic should be selected
  - The information to be transferred should be determined
  - The multimedia components that can be used should be determined
  - The characteristics of the target audience should be taken into account
  - The ideas and information to be proposed should be well organized
  - Data and information should be meaningful
- **Presentation of Information**
  - Information should be presented in an appropriate flow or context
  - The target audience should be taken into account in the presentation of information
  - Information should be presented in a comparative form
  - The complex relationship between information must be shown
- **Design**
  - The title should include the content and message to be presented
  - It should be easy to read the text
  - Opposite colours to the background colour should be used for the readability of text
  - The fonts, shapes and colours should be consistent
  - Visuals should be open and consistent with the content
  - Images should be original or there should be no copyright problems

Infographics are considered to be an effective communication tool for communication and transfer of information (Smiciklas 2012; Lazard and Atkinson 2015). This is due to the accessibility features and distribution of infographics. The potential of social media environments facilitate the distribution of infographics and allows access of potential readers to infographics (Li 2013). In fact, some infographics become more attention grabbing compared to web pages (Lamb and Jhonson 2014). Effective and well prepared infographics contributes to the readers and they are among the alternative learning materials. Davis and Quinn (2013) suggest that well-prepared infographics are useful to support the development of students. Similarly, Lazard and Atkinson (2015) state that infographics consisting of text and visuals have a positive effect on the development of the readers.

Infographics make various contributions to both readers and designers. The preparation process infographics include steps such as the use of information available, learning new information, organizing and presenting information. Therefore, creating infographics develops critical thinking, analysis and synthesis skills of designers and leads to the habit of using instructional design skills (Hart 2013).

2. Method

In this study, it was aimed to present views and approaches of designers in regard with infographics design process for educational purposes. Identification of design approaches and design preferences of designers is quite important in terms of the use of infographics in the teaching environments. For this purpose, the following research questions were sought to be answered.

1. How designers perceive infographics?

a) How designers perceive infographics' understanding of design?
b) How designers perceive design process of infographics?
c) How are the approaches of designers towards copyright rules while creating infographics?
d) How designers perceive introduction of infographics they created?
e) How are the approaches of designers towards readability level of infographics?
f) What are the views of the designers regarding sharing infographics?
g) What are the views of the designers in regard with specifying references used to create infographics?
h) What are the views of the designers in regard with effect of infographics on their personal development?

2. How are the approaches of designers in the creation process of infographics?

a) What type of infographics designers prefer to design?
b) What are the most preferred structures of infographics by designers?
c) What type of visual components designers prefer using to create infographics?
d) What colours designers prefer while creating infographics?

3. What are the tendencies of designers while creating infographics?

a) What information sources designers use to create infographics?
b) Which software environments designers prefer to create infographics?
c) What points are considered by designers while determining visual themes of infographics?

d) What processes are followed by designers while creating infographics?

e) What is the effect of basic features of infographics on their quality?

2.1 Population/Sample

The sample of this study consists of a total of 64 second and third class students (35 female, 29 male) studying, Computer and Instructional Technologies Education Department in Kazim Karabekir Education Faculty at Ataturk University. Convenience sampling method was used in the study. The age of participants ranged from 20 to 28. All participants are experiences in various types of infographics. In addition, all participants have the skills and experience to prepare teaching materials. Therefore, participants included in the study were defined as designers.

2.2 Limitations of the Study

This study is limited to the students of Computer and Instructional Technologies Department and designed educational infographics.

2.3 Research Model

In this study, one group posttest design, which is one of the quantitative research designs, was used. In this method, measurement is made after applying the test on a single group (Jhonson and Christensen 2014). The study was lasted for 25 weeks in order to introduce infographics to designers and form real approaches in the preparation of infographics. In the first three weeks of the study, designers were introduced with infographics. In the introduced period, they were informed about types and specifications of infographics and ways to reach infographics and design tools. In the following 22-week period, designers were asked to create infographics about a certain subject for various educational purposes. Each designer has created at least 11 infographics. Designers were free to review the literature, presenting the content and design of infographics.

2.4 Data Collection Tool

Data collection tool consists of three sections. The first section containing four questions collect demographic information of designers. In the second section, the Infographic Designer Opinion Questionnaire, which was developed by Yildirim, Yildirim and Celik (2015), was used. The reliability coefficient of the questionnaire including eight factors and 27 5-points Likert-type questions was found to be 0.772. The factors of the questionnaire are understanding of design, design process, copyright, introduction, readability, sharing, references and development (the reliability coefficient of the factors

are .755, .779, .711, .675, .614, .752, .663, .564, respectively). In the third section of data collection tool, 9 questions including grading, classification and scoring are asked in order to present opinions, approaches, priorities of designers in regard with infographics and tendencies of designers in terms of creating infographics.

2.5 Data Collecting and Analyzing

The data were collected in the spring semester of the 2014-2015 academic year. Printed questionnaires were given to the designers. The data were analyzed with SPSS 18 software package. Percentage and independent samples t-test, which are descriptive statistical methods, were used to analyze the data. The significance level was accepted as .05. Reverse transformation of expressions was performed. In the descriptive assessments the following categorization was used: 1.00 - 1.80: Strongly Disagree, 1.81 - 2.60: Disagree, 2.61 - 3.40: Rarely Agree, 3.41 - 4.20: Agree, 4.21 - 5.00: Strongly Agree. In addition, in the assessment of factors affecting the quality, the following categorization was used: 1.00 - 1.80: Very Low, 1.81 - 2.60: Low, 2.61 - 3.40: Moderate, 3.41 - 4.20: High, 4.21 - 5.00: Very High.

In the data collection period, designers were asked to list their opinions about features of infographics and component and application preferences. The actual ranking of each opinion was determined after reviewing their responses. In this process, ranking points were determined as the number of opinion/preferences of designer used to answer the questions. For example, in a list including 6 different views, the first view selected was given 6 points, and the 4th view was given 3 points. In this way, the actual ranking was determined by calculating the total score of the view.

3. Classification and Definitions Used in the Study

In this study, a variety of classifications and definitions were used for infographics. A large part of the classification used in the study is given in the introduction. Classifications that are not given in this section and used in the study are discussed in this section.

Design Type: Indicates the scope of infographics. Single infographics has a structure that transfers all information through a single infographic. Serial infographics present all inter-related information through multiple infographics.

Direction: Indicates the reading direction of infographics. Vertical infographics are infographics created with information to be placed on a vertical plane of content to read from top to bottom. Horizontal infographics are the infographics created with

placing all content on a horizontal plane in order to ensure continuity of the flow to the right or left direction.

Colour Preference: It represents the colours used in the creation process of infographics. Warm colours represent yellow, orange and red colours. These colours evoke the feeling of warmth and keep the attention. They create an effect that tires the eyes in long-term use. Cool colours are green, blue and purple. These are calming and relaxing colours.

Visual Theme: Refers to the background, visual forms, all typographic components forming infographics and the harmony between them.

4. Findings

In this study, the opinions of designers in regard with preparation of infographics were discussed. All designers completed the application and they were included in the data collection process. The findings obtained from the designers were organized according to the research questions.

1. How designers perceive infographics?

Opinions of designers about infographics were presented by using the data obtained from infographics designer opinions questionnaire that was given in the second section of the data collection tool. Before the analysis, distribution of data is analyzed by the gender variable and normal distribution was seen in both groups. Opinions of designers were analyzed with descriptive statistical methods and independent samples t-test was conducted to compare the results on the basis of gender variable. In the findings, the statistically significant t-test results were presented.

a) How designers perceive infographics' understanding of design?

In the study, opinions of designers in regard with the design of infographics were investigated. Their opinions, which were collected with the help of 5 questionnaire expressions, are given in Table 1.

Table 1: Opinions about Understanding of Design Process

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
4	I pay attention to make sure that the titles of infographics are attention-grabbing.	28	4.11	1.031	33	4.58	.502	61	4.36	.817
1	I pay attention to make sure that the information given in infographics and the visuals used to present such information are	28	4.07	.716	34	4.53	.563	62	4.32	.672

	consistent.									
2	I pay attention to make sure that I have prepared easily readable infographics.	29	4.03	.944	33	4.36	.783	62	4.21	.871
5	I try to use an interesting introductory expression in infographics.	29	4.17	.658	33	4.24	.708	62	4.21	.681
3	In visualizing information, I try to prepare visuals that will exactly represent the information presented.	29	3.90	.860	34	4.32	.768	63	4.13	.833

As it can be seen in Table 1, there is a high level of participation in all opinions about the understanding of design. In all responses about the understanding of design, the average participation level of male designers is "Agree" and the average participation level of female designers is "Strongly agree". Designers preferred to use attention-grabbing headlines while preparing infographics. They paid attention to the consistency of visuals and tried to facilitate reading. In addition, they state that they used an engaging introduction and prepared visuals that reflect the information to be given.

Views of designers in regard with understanding of design were analyzed with independent samples t-test in terms of gender variable. The analysis results are shown in Table 2.

Table 2: Independent Samples t-test Results of Understanding of Design

Q	Sex	N	$\bar{X}$	S	sd	t	p
1	Male	28	4.07	.716	60	2.818	.007
	Female	34	4.53	.563			
3	Male	29	3.90	.860	61	2.083	.041
	Female	34	4.32	.768			
4	Male	28	4,11	1.031	59	2.311	.024
	Female	33	4.58	.502			

According to t-test results, there is a significant difference between the views of designers in regard with information included in infographics and consistency of visuals used to present these information in terms of the gender variable ($t=2.818$ $p<.05$). In addition, there is a significant difference between t-test results about an item in the questionnaire; "In visualizing information, I try to prepare visuals that will exactly represent the information presented." ($t=2.083$ $p<.05$). There is also a significant difference between design concepts of the male and female participants in terms of paying attention to create attention-grabbing headlines for infographics ($t=2.311$ $p<.05$).

b) How designers perceive design process of infographics?

In the study, opinions of designers in regard with the design process of infographics were investigated. The design process was discussed through four main elements including visualizing information, finding appropriate visuals, planning the design process and deciding about infographics. Views of the designers in regard with the design process of infographics are given in Table 3.

Table 3: Views of the Designers in Regard with the Design Process

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
8	I find it hard to plan the preparation process of infographics.	29	3.00	1.254	35	2.40	1.035	64	2.67	1.169
9	I find it hard to decide on how to construct infographics in the preparation process.	29	2.55	1.088	35	2.29	1.073	64	2.41	1.080
7	It is hard for me to find visuals suitable for use as content when preparing infographics.	29	2.38	1.178	35	2.17	1.200	64	2.27	1.185
6	I find it hard to visualize information when preparing infographics.	29	2.10	1.047	33	2.27	1.180	62	2.19	1.114

As it can be seen in Table 3, responses of the participants were as "Disagree". Designers don't agree with the statements suggesting that visualizing information, finding appropriate visuals, planning the design process and deciding about infographics steps are difficult.

Views of designers in regard with design process were analyzed with independent samples t-test in terms of gender variable. The analysis results are shown in Table 4.

Table 4: Independent Samples t-test Results about Design Process

Q	Sex	N	$\bar{X}$	S	sd	t	p
8	Male	29	3.00	1.254	62	2.098	.040
	Female	35	2.40	1.035			

According to t-test results, there is a significant difference between views of the participants towards the difficulty of planning the process in terms of gender variable ($t=2.098$ $p<.05$).

c) How are the approaches of designers towards copyright rules while creating infographics?

In the study, opinions of designers in regard with sources and multimedia components as well as copyright of infographics were investigated. The opinions of designers about copyright are given in Table 5.

Table 5: Views of Designers about Copyright

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
12	I prepare infographics in compliance with copyrights.	27	3.59	1.217	33	3.45	1.034	60	3.52	1.112
10	I pay attention to make sure that the visuals I use in preparing infographics do not have any copyright problem.	28	3.07	1.120	34	3.53	.992	62	3.32	1.068
11	I publish the copyright information by using copyright mark on the infographics I prepare.	29	3.28	1.192	35	3.26	1.120	64	3.27	1.144

As it can be seen in Table 5, designers' state that they prepared infographics by respecting copyright rules. However, they rarely paid attention to the copyright of the visuals used to create infographics. They also rarely paid attention to protect copyright of their own designs. The views of designers for copyright not a significant difference in terms of gender variable.

d) How designers perceive introduction of infographics they created?

In the study, opinions of designers in regard with introduction their infographics to reach the readers were investigated. The opinions of designers about introduction are shown in Table 6.

Table 6: Views of Designers about Introduction

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
14	I try to add keywords that convey the basic message of the infographic.	29	4.07	.753	32	3.84	1.110	61	3.95	.956
13	I add keywords that describe the infographic into the title section of the page where I will share the infographic.	29	3.52	1.122	32	3.69	1.148	61	3.61	1.130
15	I add the expressions that describe the infographic into the page where I will share the infographic.	28	3.61	.956	29	3.52	1.271	57	3.56	1.118

As it can be seen in Table 6, all participants agree with the expressions about introduction infographics. Designers care about the use of keywords to show content and aim of infographics. They add these keywords to both infographics and web environments hosting these infographics. In addition, they state that they added the texts including information provided by infographics to the webpage hosting infographics. The views of designers for copyright not a significant difference in terms of gender variable.

e) How are the approaches of designers towards readability level of infographics?

In the study, opinions of designers in regard with readability level of infographics were discussed. Statements trying to organize readability level of infographics and showing preferences of designers about readability are shown in Table 7.

Table 7: Views of Designers about Readability Level of Infographics

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
18	I design infographics in such a format that will minimize the eye movements of readers.	29	4.00	.707	33	4.24	.561	62	4.13	.640
17	I pay attention to make sure that the infographics I prepare have a short reading time.	29	3.83	1.136	33	4.33	.816	62	4.10	1.003
16	I design infographics in a one-dimensional form to shorten the reading time.	29	3.83	.966	32	4.28	.683	61	4.07	.854

As shown in Table 7, designers agree with all expressions towards readability level of infographics. Designers state that they pay attention to the mobility of the eye of the reader in infographics. In addition, they try to shorten the reading time by designing the visuals.

Views of designers in regard with readability level of infographics were analyzed with independent samples t-test in terms of gender variable. The analysis results are shown in Table 8.

Table 8: Independent Samples t-test Results about Readability Level of Infographics

Q	Sex	N	$\bar{X}$	S	Sd	t	p
16	Male	29	3.83	.966	59	2.133	.037
	Female	32	4.28	.683			
17	Male	29	3.83	1.136	60	2.030	.047
	Female	33	4.33	.816			

According to the t-test results given in Table 8, the opinions about creating infographics in one dimension to shorten the reading time significantly different in terms of gender variable (t=2.133 p<.05). In addition, the opinions of designers in regard with shortening the reading time of infographics significantly different in terms of gender variable (t=2.030 p<.05).

f) What are the views of the designers regarding sharing infographics?

In the study, opinions of designers in regard with sharing infographics were discussed. The responses of designers showing their opinions in regard with sharing infographics are shown in Table 9.

Table 9: Views of Designers about Sharing Infographics

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
19	I share the infographics I prepare on social media platforms.	29	3.69	1.198	33	4.33	.692	62	4.03	1.008
20	I add social media sharing buttons into the infographics I prepare, so that they can be easily shared by readers.	29	3.66	1.143	33	3.97	1.045	62	3.82	1.094
22	I write the website addresses where I will publish infographics on the infographics.	29	3.34	1.173	34	3.65	1.228	63	3.51	1.203
21	I pay attention to make sure that the website addresses where I will publish infographics are simple.	29	3.03	1.085	34	3.85	.989	63	3.48	1.105

As seen in Table 9, designers put social media sharing buttons on infographics to share the information presented by these infographics. In addition, they stated that they added the hosting website to the infographic and tried to select simple addresses.

In the study, views of designers in regard with sharing infographics were analyzed with independent samples t-test in terms of gender variable. The analysis results are shown in Table 10.

Table 10: Independent Samples t-test Results about Views of Designers in regard with Sharing Infographics

Q	Sex	N	$\bar{X}$	S	Sd	t	P
19	Male	29	3.69	1.198	60	2.628	.011
	Female	33	4.33	.692			
21	Male	29	3,03	1.085	61	3.131	.003
	Female	34	3.85	.989			

According to the t-test results shown in Table 10, female designers significantly different from male designers in terms of sharing infographics through social media channels (t=2.628 p<.05). In addition, female designers significantly different from male designers in terms of using simple website domain names (t=3.131 p<.05).

g) What are the views of the designers in regard with specifying references used to create infographics?

In the study, opinions of designers in regard with specifying references used to create infographics were discussed. The responses of designers in regard with specifying references are given in Table 11.

Table 11: Opinions of Designers in Regard with Specifying References

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
23	I indicate in the references section the sources of information I have used in designing infographics.	29	3.72	1.131	33	3.73	1.069	62	3.73	1.089
24	I indicate the source references on my infographics.	29	3.69	1.198	35	3.51	1.147	64	3.59	1.165

As it can be seen in Table 11, the sources used by designers to create infographics are shown in the references section of the study. In addition, designers state that they have given references. There is no significant difference between views of the participants in regard with specifying the sources in terms of gender variable.

h) What are the views of the designers in regard with effect of infographics on their personal development?

In the study, opinions of designers in regard with effect of infographics on their personal development were discussed. The responses of designers in regard with effect of infographics on their personal development are given in Table 12.

Table 12: Opinions of Designers in Regard with Effect of Infographics on Their Personal Development

Q	Statement	Male			Female			General		
		N	$\bar{X}$	Std.	N	$\bar{X}$	Std.	N	$\bar{X}$	Std.
26	My skills in associating different pieces of information with each other have improved through the design of infographics.	29	4.07	.884	35	4.60	.497	64	4.36	.743
27	I have acquired more information on the subject through the design of infographics.	29	3.93	.799	35	4.29	.750	64	4.13	.787

25	My computational thinking skills have improved through the design of infographics	29	3.62	.903	35	3.94	.968	64	3.80	.946

As shown in Table 12, designers think that their ability to create relationships between information develops. Although arithmetic mean of female designers is higher than arithmetic mean of male designers, there was no statistically significant difference between them. Designers state that creating infographics positively affect their computational thinking skills.

In the study, views of designers in regard with effect of infographics on their personal development were analyzed with independent samples t-test in terms of gender variable. The analysis results are shown in Table 13.

Table 13: Independent Samples T-Test Results about Views of Designers in Regard with Effect of Infographics on Their Personal Development

Q	Sex	N	$\bar{X}$	S	Sd	t	p
27	Male	29	3.93	.799	62	3.027	.004
	Female	35	4.29	.750			

According to the t-test results shown in Table 13, female designers significantly different from male designers in terms of being informed about the subject of the infographics to be created ($t=3.027$ $p<.05$).

2. How are the approaches of designers in the creation process of infographics?

In this section, approaches of designers in the creation process of infographics were discussed. The approaches of designers in the creation process of infographics were obtained by open-ended questions, order of preferences and impact scoring.

a) What type of infographics designers prefer to design?

In the study, designers were asked to list the type of infographics they prefer to create in an order. Designers listed 6 different types of infographics (static, zooming, clickable, animated, video and interactive) in an order. Results are shown in Table 14.

Table 14: The Types of Infographics Preferred by Designers

Place	Male		Female	
	Form	**Score**	**Form**	**Score**
1	Interactive	125	Animated	140
2	Animated	112	Interactive	132
3	Video	106	Video	130

4	Clickable	95	Clickable	107
5	Static	94	Static	97
6	Zooming	78	Zooming	79

As shown in Table 14, interactive and animated infographics are the most preferred infographics by designers. Male designers mostly prefer to create interactive infographics while female designers mostly prefer to create animated infographics. In addition, video infographics is another type preferred by the designers frequently. The least preferred infographics are clickable, static and zooming infographics. The order of preference for these four types is same for all designers.

b) What are the most preferred structures of infographics by designers?

In the study, the multiple choices of designers for the most preferred infographic structures are determined by three main criteria as the shape, type and position of the design. The type of design is categorized as single or serial; the type is categorized as interactive or non-interactive; and the position is categorized as vertical or horizontal. Designers selected one or multiple categories to show their preferences. The responses of designers were considered in terms of gender variable and shown in Table 15.

Table 15: The Most Preferred Infographic Structure

Sex	**Design Type**		**Form**		**Direction**	
	Single	**Serial**	**Non-interactive**	**Interactive**	**Horizontal**	**Vertical**
Male	19	12	7	21	4	11
Female	25	9	1	28	0	24
General	44	21	8	49	4	35

As seen in Table 15, both preferences of male and female designers are parallel to each other. Designers prefer to create infographics with a single structure. The majority of the designers prefer to create interactive infographics. In addition, they often prefer to create infographics in the vertical form.

c) What type of visual components designers prefer using to create infographics?

In the study, the visual components used by designers to create infographics were discussed. Their preference of using two-dimensional visual components such as images, diagrams, drawings etc. to create infographics was investigated. Preferences of designers are shown in Table 16.

Table 16: Visual Components Used in Infographics

Place	Male		Female	
	Component	**Score**	**Component**	**Score**
1	Graphic	171	Picture	197
2	Picture	161	Graphic	177
3	Drawing	107	Diagram	155
4	Diagram	100	Drawing	120
5	Map	96	Text	103
6	Text	91	Table	102
7	Table	86	Map	99

As seen in Table 16, the orders of preference of male and female designers in terms of visual components they use to create infographics are completely different from each other. Pictures and graphics are the most preferred visual components. In addition, drawings and diagrams are also in the upper section of the preference ranking among visual components. The least preferred components are maps, texts and tables.

d) What colours designers prefer while creating infographics?

In the study, the colour preferences of designer in the creation process of infographics were discussed. Their colour preferences were investigated as warm and cool colours. Their colour preferences were ranked according to the use of these colours in infographics. Preferences of designers are shown in Table 17.

Table 17: Warm-Cool Colour Preferences

	Warm Colours (Yellow, Orange, Red)			**Cool Colours (Green, Blue, Purple)**	
Men					
Place	**Choice**	**Score**	**Place**	**Choice**	**Score**
1	Pay attention	110	**1**	Text	79
2	Emphasize	91	**2**	Representation of the relationships	75
3	Visualizations (Shape, etc.)	82	**3**	Background	71
4	Background	81	**4**	Visualizations (Shape, etc.)	61
5	Text	53	**5**	Emphasize	49
6	Representation of the relationships	49	**6**	Pay attention	33
Women					
Place	**Choice**	**Score**	**Place**	**Choice**	**Score**
1	Visualizations (Shape, etc.)	142	**1**	Text	119
2	Pay attention	93	**2**	Background	86
3	Emphasize	89	**3**	Representation of the relationships	83
4	Background	88	**4**	Visualizations (Shape, etc.)	65
5	Text	67	**5**	Pay attention	64
6	Representation of the relationships	60	**6**	Emphasize	58

As shown in Table 17, visual objects such as figures, drawings are created with warm colours. In addition, designers prefer warm colours in order to draw the attention of readers and highlight the content. Cool colours are preferred in texts, representation of the relationships and in the background. The rankings of both warm and cool colour preferences differentiate between male and female designers.

3. What are the tendencies of designers while creating infographics?

In the study, tendencies of designers in the creation process of infographics were discussed. Trends were investigated in terms of source selection, production environment, the choice of theme, design processes and quality perceptions.

a) What information sources designers use to create infographics?

In the study, information sources designers use to create infographics were discussed. Designers listed environments they use to create infographics in an order. Information source preferences of designers are shown in Table 18.

Table 18: Information Sources Used to Create Infographics

Place	Male		Female	
	Source	**Score**	**Source**	**Score**
1	Infographics	174	Web pages	239
2	Web pages	167	Learning materials	199
3	Learning materials	152	Infographics	192
4	Statistic databases	118	Scientific article/report	165
5	Scientific article/ report	116	Statistic databases	146
6	Textbooks	115	Textbooks	145
7	Newspaper/ Magazine	109	Newspaper/ Magazine	89

As it can be seen in Table 18, designers mostly use infographics, web pages and learning materials while creating infographics. The most preferred information sources of male designers are infographics in the process of creating infographics. On the other hand, infographics is the 3rd source of information for female designers. In addition, designers put information sources such as articles, reports and similar publications as well as statistical databases into the middle of the list. The least preferred information sources are textbooks, newspapers and magazines.

b) Which software environments designers prefer to create infographics?

In the study, software environments preferred by designers to create infographics were investigated. Preferences of designers are shown in Table 19.

Table 19: The Environments Preferred by Designers to Create Infographics

Place	Male		Female	
	Environment	**Score**	**Environment**	**Score**
1	Web based infographic design platforms	136	Web based infographic design platforms	165
2	Visual design software	129	Visual design software	162
3	Desktop infographic design software	113	Desktop infographic design software	128
4	Shape/icon design software	96	Shape/icon design software	122
5	Text design software	77	Text design software	99
6	Others	37	Others	39

As shown in Table 19, preferences of both male and female designers are consistent with each other. Designers prefer design platforms in the web environment to produce infographics. In addition, visual design programs installed in computers and infographics design environments are often preferred by designers. Shape/icon programs and text design environments are less preferred compared to other programs. In addition, various animation, video and interactive content creation programs are used by some designers.

c) What points are considered by designers while determining visual themes of infographics?

In the study, the important points that are considered by designers while determining visual themes of infographics were discussed. Their visual theme preferences are shown in Table 20.

Table 20: The Important Points Considered While Determining Visual Themes

Place	Male		Female	
	Factor	**Score**	**Factor**	**Score**
1	Conformity of subject	63	Information amount	70
2	Information amount	58	Relations between information	70
3	Target group	54	Conformity of subject	63
4	Relations between information	51	Instructional design principles	56
5	Instructional design principles	29	Target group	39

As it can be seen in Table 20, the visual theme preferences differentiate between male and female designers. Male designers determine visual themes by taking conformity

with the subject, amount of information and the target audience into account. Relations between information and instructional design principles are the least considered points by male designers while determining visual themes. Female designers determine visual themes by taking the amount of information, relations between information and conformity with the subject into account. The target audience is the east considered points by female designers while determining visual themes.

d) What processes are followed by designers while creating infographics?

In the study, the processes followed by designers while creating infographics and order of these processes were discussed. The processes followed by designers while creating infographics and order of these processes are given in Table 21.

Table 21: Preparation Processes of Infographics

Place	Male		Female	
	Process	**Score**	**Process**	**Score**
1	Research of subject	187	Research of subject	159
2	Preparation of presentation scenario	150	Preparation of presentation scenario	125
3	Decide base design components	149	Decide base design components	123
4	Identification of information importance level	125	Identification of information importance level	101
5	Design procedures of readers' attention	125	Design procedures of readers' attention	97
6	Set up relations between information	108	Set up relations between information	94
7	Preparing text	106	Making visualizations	72
8	Making visualizations	94	Preparing slogan	65
9	Preparing slogan	77	Preparing text	60
10	Compound all design components	46	Compound all design components	29

As shown in Table 21, designers began the process of creating infographics with acquiring the relevant information. Then, they focus on information and presentation scenarios to be presented. Finally, they bring all the components of infographics together. Male and female designers follow different paths from each other in the process of merging components of infographics. Male designers prepare texts, visuals and slogan after establishing the relationship between information, whereas female designers prepare visuals, slogan and texts after establishing the relationship between information.

e) What is the effect of basic features of infographics on their quality?

In the study, designers were asked to rate the degree of effect of basic features of infographics on their quality. The scoring was between 0 and 5. Features were divided

into 7 categories as follows; visual quality, the level of information visualization, information quality, information-visual consistency, typographic features, sources used and person or institution prepared. The views of designers are shown in Table 22.

Table 22: The Effect of Features of Infographics on Their Quality

Male				**Female**			
Place	**Feature**	**Effect**	**Level**	**Place**	**Feature**	**Effect**	**Level**
1	Information-visual consistency	4,67	Very High	**1**	Visual quality	4,79	Very High
2	Visual quality	4,62	Very High	**2**	Information-visual consistency	4,58	Very High
3	Information quality	4,48	Very High	**3**	Information quality	4,58	Very High
4	Level of information visualization	4,29	Very High	**4**	Level of information visualization	4,54	Very High
5	Typographic features	3,86	High	**5**	Typographic features	4,38	Very High
6	Resources	3,67	High	**6**	Designer person/organization	4,04	High
7	Designer person/organization	3,43	High	**7**	Resources	3,87	High

As shown in Table 22, the views of male and female designers differentiate in terms of effect of features of infographics on their quality. However, visual quality, information-visual consistency and quality of information stands out as the components that are considered to have the highest effect on the quality of infographics. Aim and information visualization levels are also considered to be affecting the quality of infographics by both male and female designers. In addition, the average effect of these components is very high. The least important features are found to be typographic features, sources used and person or institution prepared the infographics.

5. Discussion

This study aims to present views and approaches of designers in regard with infographics design process for educational purposes. In this study, views, approaches and tendencies of designers in regard with infographics design process for educational purposes are presented.

Designers prepare interesting expressions for infographics. They may want to attract attention, interest and curiosity of the readers and make them feel to read the infographics by using these expressions. Similarly, Lankow, Ritchie and Crooks (2012)

state that infographics are prepared for purposes such as presenting information, grabbing attention and publicity. Designers prepare infographics in a form that is easy to read, because they don't want readers to expose to high cognitive load. Infographics can provide excessive levels of information through different transmission tools of multimedia elements containing multiple components. This excessive information can make it difficult to learn because of limited capacity and knowledge that can be processed (Mayer and Moreno 2003). As it stated in the literature, heavy cognitive load makes it difficult to learn and detect links in content (Sweller 1994). Designers are careful to add attention-grabbing headlines in infographics. Lamb and Jhonson (2014) state that infographics should have introductory headlines. Female designers show more attention to the use of attention-grabbing headlines, because they may want their infographics to come to people's attention among other infographics. According to Krum (2013), readers care about headlines since they don't want to waste their time and go over irrelevant infographics. Fleming and Levie (1993) state that headlines enable readers to notice the content of infographics at first glance. Visualizations should be made in accordance with accurate design rules in order to make information easy to follow and more understandable (DeCarlo and Stone 2013). With this understanding, designers pay attention to the consistency of visuals used to demonstrate information in a consistent manner. However, female give more importance to the consistency of visuals and they spend more effort to create more consistent content. This can be interpreted that female designers care about multimedia design principles more than male designers.

Designers believe that it is easy to prepare infographics. This may be due to their experience in material design and creating infographics. Their experience level may facilitate the learning processes and apply information. Kalyuga, Ayres, Chandler and Sweller (2003) suggest that experience level of learners brings the expanded scheme to memory in order to organize the existing knowledge. Since this allows easy adaptation of designers to the process, it can explain the positive feelings. Female designers think that planning creation process of infographics is easy. This may be due to more use of the ability to create plan processes by female designers compared to male designers. In line with this statement, Borun, Schaller, Chambers and Allison Bunnell (2010) indicate that female designers prefer to design through online training activities. However, Nuhoğlu Kibar and Akkoyunlu (2015) state that visualization process is very difficult for learners designing infographics.

Designers create infographics by respecting copyright rules. Because they may not want to face legal sanctions because of the content and information used in the infographics they produced. In addition, they may be respectful to copyrights due to

their ethical values. Golombisky and Hagen (2013) recommend designers to show the necessary sensitivity to copyright rules while preparing the content of infographics. However, designers do not show the similar care to the copyright of the visuals they used to create infographics. This may be explained by that the visuals used by designers may not have protection of copyright, they may be free of copyright or open to the use of the public. Similarly, Rockenbach and Fabian (2008) state that although copyright of the visual materials is often discussed, the legal documentation is not very well done. Royalty free approach predicts applications and contents to be accessed unlimitedly and freely (Eby 2013). In addition, the unique way of designing visuals to be used in infographics can be effective in this situation. Designers rarely apply for copyright protection for infographics they created. This may be due to that they produce infographics open to the public, adopt royalty-free approach and they don't have commercial concerns. However, Siricharoen (2013) states that copyright and all rights in infographics should be indicated clearly.

Designers give importance to the introduction of infographics. Because they probably want to attract the attention of potential readers. Designers create keywords to show content and aim of infographics and use these keywords on the web. This may be due to that they want their infographics to be easily identified and found in the web environment. Hattwig, Bussert, Medaille and Burgess (2012) indicate that learners use search engines to search the visual materials and often make text-based searches. Designers prepare identifier texts to the web pages hosting infographics. Designers may want readers to be aware of the contents of infographics and facilitate selection process of infographics. Similarly, Hattwig, Bussert, Medaille and Burgess (2012) state that texts may be needed for learners in order to explain the meaning of visuals used in infographics. Descriptive text can be seen as an effective way to provide supplementary information which couldn't be transferred through infographics.

The main purpose of visualizing the data is helping people understand the data (Phetteplace 2012). Designers take the necessary measures to maintain a high level of readability of infographics. They try to guide eye movements of readers on infographics by their design preferences. Designers may want readers to follow a certain path they want. However, Halsanova, Holmberg and Holmquist (2005) state that the number of integrative eye movements does not explain infographics and text-visual integration by itself. Readability of infographics is more important to female designers compared to male designers. Female designers want reading time of infographics shorter than male designers do. This may be because they don't want to bore the reader and give the main message without losing the attractiveness of infographics. Halsanova, Holmberg and Holmquist (2005) indicate that infographics integrated into text lead to less eye

movement compared to the separate ones and this prolongs the process of reading for newspaper readers. This shows that infographics make readers focusing on the content as a whole and come forward if they are presented as integrated to the text. In addition, female designers significantly differentiate from male designers in terms of creating infographics in one dimension to shorten the reading time. Because female designers want their readers to focus on the content only. Similarly, Lamb and Jhonson (2014) suggest that infographics should be created to encourage the reading.

Designers take all necessary measures to ensure the sharing of infographics and share their infographics via social media and add social media sharing buttons attached to infographics. Because they want infographics to be shared in an easy and quick way. Similarly, Davis and Quinn (2014) state that infographics are easy to share and allow their readers to learn and communicate in cooperation. However, there is a significant difference in favor of female designers in sharing infographics via social media. This may be explained by female's social media sharing habits. In addition, they are more confident about their infographics and want to reach more people. Designers put sharing addresses of infographics on infographics. They want readers to identify the original source of infographics and facilitate the access of other contents in this source. Female designers choose simpler domain names to share infographics they produce compared to male designers. Because female designers prefer simpler and easier access.

Designers present sources used in infographics and give references of the sources. Because they try to increase the level of credibility of infographics. Similarly, according to Krum (2013), infographics without references are not found convincing by readers. In addition they may want to provide easy access to readers if they want to see the original source of information. Similarly, according to the earlier studies in the literature, references should be given in order to meet the additional information demand of readers (Lamb and Jhonson 2014; Golombisky and Hagen 2013).

Designers think that they are informed about the subject of the infographics they prepare. Because they spend mental effort to create infographics. Interpretation of infographics, which is an activity performed with mental effort, improves visualization skills of learners and increases the probability of reaching the desired outcomes (Saurbier 2014). In addition, there is a significant difference in favor of female designers in terms of having information on the subject. This may be due to the process of creating knowledge by female designers. Grimley (2007) states that female need better materials to improve outcomes of the learning process. Vanichvasin (2013) indicates that infographics ensure awareness of the readers and make it easier to remember, while Zinonyev (2010) suggests that visualization facilitates the analysis of the message given in infographics and help readers to remember. In this regard, the effort spent on

visualization and production has a positive impact on learning and increased level of visual literacy of designers. Visual literacy contributes to the integrative learning of learners (Little, Felten and Berry 2010). Designers consider that creating infographics develops skills of establishing relationships between data and numerical thinking. This may be due to the effort spent on presenting information in a simpler and logical way. Similarly, Hattwig, Bussert, Medaille and Burgess (2012) state that producing visual products contributes to students' skills such as critical thinking, interpretation, evaluation and making selection between visual presentation ideas.

Designers mostly prefer to create interactive or animated infographics. The common feature of these infographics is providing additional information for readers who want to learn more. Because interactive or animated infographics offer more information to the reader and allow them to make comparisons if they need more detailed explanations about the information presented in infographics. According to Flemming and Levie (1993), interacting with educational messages for the realization of learning has a positive impacts on learning. Male designers prefer interactive infographics because they may want to offer a structure that can analyze different situations. On the other hand, female designers prefer to create animated infographics because they may want to present information without details. Video infographics are also often preferred by designers. Video infographics help designers to present information with no unnecessary details. One of the important features of infographics is being understandable by the reader without looking to external sources (Toth 2013). In addition, designers' wishes to address the learning habits of readers may be another reason of this. As it is known, videos are often used in the classroom environment and considered to be one of the components positively affecting success of learners (Merkt, Weigand, Heier and Schwan 2011). Clickable infographics is one of the least preferred infographics that provide external information. Because readers can move away from the main subject when they use clickable infographics. Mayer (2001) suggests that the negativity caused by realization of information processing in different times can be eliminated by presenting information and visuals close to each other (spatial proximity). The least preferred infographics are static and zooming infographics. Because these infographics cannot store more information and need different environments in order to transmit external information.

Designers prefer to produce infographics within a single structure. Because they want to present information as a whole. Similarly, infographics integrated into text and transmitting all dimensions attract long-term and in-depth attention of readers (Halsanova, Holmberg and Holmquist 2005). Designers prefer to prepare interactive infographics. This may be due to the request to produce infographics that will appeal to

different needs of readers. Designers prefer to design infographics on vertical form and appropriate to the presentation of information. Because readers want a presentation form that is suitable for their reading habits. Krum (2013) states that infographics in vertical graphical layout is more often preferred by readers. In addition, possible readers don't prefer using vertical scrolling option of infographics. Moss and Gunn (2007) reported that designers prefer vertical layout structure on web pages and this is not differentiated in terms of gender of designers.

The components most frequently used by both male and female designers in the creation of infographics are graphics and pictures. Because designers want to present information in an integrated form with all the details. Fleming and Levie (1993) states that visual quality and visualization are very important to the transfer of information. Graphics stand out as the key component in the designs of male designers, while images stand out as the key component in the designs of female designers due to their design approaches and desire to leave a lasting impression. Designers often prefer the drawings and diagrams in infographics. Since drawings and diagrams can present information in a simple, organized and comparable form, they may be often preferred by designers. Similarly, the drawings are recommended for further use in the teaching materials because they contain less detail (Fleming and Levie 1993). Maps, texts and tables are least preferred by male designers while creating infographics. Maps are rarely preferred by designers because they may be associated with geographic designs focusing on a certain area. On the other hand, tables are the least preferred components to be used in infographics by male designers because they desire to provide information in a more visual form. This conclusion is also supported by the fact that they mostly use graphics in their designs. Fleming and Levie (1993) indicate that visuals are more permanent and well-prepared visuals have positive impacts on the cognitive processes of the learners. Maps are the least preferred components to be used in infographics by female designers. Because maps can be used for a certain geographic area and female designers have a tendency of providing similar details through photographs. Borkin, Vo, Bylinskii, Isola, Sunkavalli, Oliva and Pfister (2013) state that the best-remembered visualizations are the objects and environmental characteristics reflecting the reality better than others. Texts with less visual power are less preferred by designers compared to other components in the creation of infographics. Because designers consider texts as supporting components. Similarly, Toth (2013) indicates that visuals are more effective on senses and they are more remembered compared to texts and integration of texts and visuals is a fast and efficient way to transfer complex information.

Colour preferences of both male and female designers are similar to each other. Designers use warm colours (yellow, orange, red) in order to draw attention of readers to the content about figures, drawings and similar visual objects and highlight these objects. This shows that designers use warm colours to highlight the important content and grab attention of readers on a certain point they want. Colours used in the process of visualization and shapes familiar to readers increase memorability (Michelle, Azalea, Zoya, Phillip, Shashank, Aude and Hanspeter 2013). Cool colours (green, blue, purple) are preferred by designers in the representation of the relationships, colouring texts and backgrounds. Because designers want to create elements supporting the content and don't want readers to focus on certain objects. The contrast created by warm and cool colours may positively affect the effectiveness of the information to be transmitted (Dursun and Odabasi 2011). Using warm (red) and cool (green) colours on different components of infographics allows colour-blind to easily use these infographics. Hart (2013) and Holtze (2006) suggest colour-blind to be considered while creating infographics and these colours should be less used by designers.

The information sources used by designers while creating infographics differentiate from each other. The most preferred sources used by male designers in the creation process of infographics are other infographics. Because they want to reach organized information and investigate understanding of other designers regarding the subject. Well prepared infographics are seen among effective teaching materials (Davis and Quinn 2014). Other infographics are the 3rd preferred information sources used by female designers in the process of creating infographics. Lamb, Polman, Newman and Smith (2014) noted that infographics are preferable as much as other teaching materials to learn something. Webpages are the most preferred information sources by female designers while creating infographics. Webpages are frequently used by male designers as well. Easy access, variety and availability of information may lead designers to use these information sources. This is also supported by the fact that printed materials such as textbooks, newspaper/magazines are the least preferred materials by both male and female designers while creating infographics. Teaching materials are among the top information sources used by both male and female designers. Because these materials are produced for teaching purposes and the information obtained from these sources may require less time and effort to organize. Both male and female designers prefer using statistical databases and scientific papers/reports at a moderate level. This shows that designers trust these sources. However, these sources are less preferred by designers because they have to spend more time and effort to organize information obtained from these sources. Similarly, Flemming and Levie (1993) indicate that sources with higher reliability are more convincing to learners.

In the process of creating infographics, environment preferences of both male and female designers are same. Designers mostly prefer using web-based infographic design environments in the process of creating infographics. Web-based environments are the first choice of designers, because web-based infographic design environments offer all components needed to create infographics with a variety of collections (Yildirim, Yildirim, Celik and Aydin 2014), they are created especially for creation of infographics and contain various design tools. Visual design programs are the second-preferred environment by designers while creating infographics. Because Indesign, Photoshop and similar programs allow designers to create visuals in the desired size and add interaction to these visuals. In addition, designers use these programs due to their past experiences and program using skills. Desktop infographic design programs are other design environments preferred by designers. Since these programs contain all the elements needed to create infographics, they are preferred by designers. In addition, designers use utility programs in the creation of infographics to create shapes, icons and texts. Since these components are used when ready-made components don't meet needs of the designer, they may be less preferred by designers compared to other environments. In addition, animation, video and interacted content creation programs may also be less preferred by designers due to similar reasons.

Male and female designers use different criteria in determining the visual themes of infographics. The most important criterion for male designers is selecting an appropriate theme for the subject. Because they prioritize the supportive power of themes. However, appropriate theme for the subject is the 3rd important criterion for female designers. The most important criteria for female designers are the amount of information and relationships between information. This suggests that female designers adopt a structure that will facilitate the presentation of information. This conclusion is supported by the fact that appropriate theme for the subject is the 3rd important criterion for female designers. Male designers give priority to the amount of information and target audience while determining the theme. This shows that male designers make their decisions in a wide range by considering the amount of information and target audience in addition to the subject. On the other hand, the least preferred criterion by female designers is the target audience because they focus on the transfer of content to the readers. Instructional design principles are seen as one of the least considered criteria in the theme selection. Because designers may think that the impact of themes selected in accordance with characteristics of information and target audience would be enough.

The processes followed by both male and female designers in the process of creating infographics are similar to each other in the analysis and design stages. Similar

to the instructional design process, designers investigate the subject, decide on the information offered and presentation type of these information, present the basic design concept, determine the importance level of information, identify strategies needed to manage the attention of the readers and establish the relationship between information in the process of creating infographics. This suggests that male and female designers transfer instructional design processes into the creation process of infographics. As stated by Krasuss (2012), approaches of designers are consistent with basic processes of creating infographics. Male and female designers produce components of infographics with different sorts in the creation process of infographics. Male designers prepare texts, visuals and slogan after establishing the relationship between information, whereas female designers prepare visuals, slogan and texts after establishing the relationship between information. This shows that designers have different focuses. This may be a reflection of the content development approach. According to Moss and Gunn (2007) and Moss and Gunn (2009), typographic structure, content and layout structures differentiate at various points in the website production approaches of male and female designers.

The rankings of features that affect the quality of the infographics and efficiency of these features are similar for both male and female designers. According to both male and female designers, the quality of visuals, information-visual consistency, quality information and visualization of information are the most important factors affecting the quality of infographics. Because designers think that quality information and information-visual consistency is essential for infographics. Similarly, Krum (2013) noted that readers of infographics expect to see visualization for a faster learning and less text in infographics. Male designers consider that visualization level of information affect the quality of infographics at a very high level, whereas female designers think that visualization level of information affect the quality of infographics at a high level. This suggests that male designers consider infographics as a whole. Two features with lowest effect on the quality of infographics are considered as sources utilized and the person or institution prepared these sources by both male and female designers. They give high scores to these two features. Because the quality of information presented by infographics is more important than the person and institution presented this information.

6. Conclusion and Recommendations

This study reveals the perceptions of designers, who design infographics for instructional purposes, towards infographics and creation approaches. According to the

results of the study, approaches of designers towards the creation process of infographics differ on many points by gender. However, designers exhibit similar approaches in terms of basic production processes and creation steps of infographics.

Designers are striving to make infographics they create readable. They try to create attractive promotional statements and get high-level readability. Female designers spend more effort on readability level of infographics. At this point, female designers prefer using one-dimensional designs in order to shorten the reading time of infographics they created. Visual-information consistency is considered as another factor affecting the quality of infographics by designers. However, female designers pay much more attention on visual-information consistency compared to male designers. The quality understanding of both male and female designers is similar to each other. According to the quality understanding of designers, the factors increasing quality of infographics are visual quality, visual-information consistency, quality of information and visualization level of information.

Designers think that it is easy to create infographics. They have the perception that planning the creation process of infographics is simple. This perception seems much more in female designers. Designers think that creating infographics have positive impacts on their knowledge levels, establishing relationships between information and computational thinking skills. Female designers believe that creating infographics in a certain subject contribute to themselves in terms of being informed about the subject.

Designers spend efforts for the introduction of infographics. Designers use interesting headlines for infographics. Female designers are more sensitive in finding attractive and interesting headlines. They share informative texts and keywords that will promote infographics in the web environment. They benefit from social media to facilitate sharing. Female designers use social media channels more than male designers to share information about their infographics. In addition, designers add social media sharing buttons attached to infographics for their readers to share the content with others. Designers put sharing addresses of infographics on infographics. Female designers choose simpler domain names to share infographics they produce compared to male designers.

Designers prefer single, interactive infographics with a vertical layout as the ideal structure of infographics. The general tendency of designers is creating infographics with a structure that offer external information to the reader without getting away from the infographic. However, male designers prefer designing interactive infographics at most, whereas female designers prefer designing animated

infographics. Static and zooming infographics are the least preferred types. Designers keep visual components at the forefront in the creation process of infographics. Graphics are the most important components for male designers, while pictures are the most important components for female designers. Drawings and diagrams are also seen as very important design components for both designer group. Web pages, teaching materials and graphics are the most preferred sources of information. Male designers prefer using other infographics as their information source while webpages are more preferred by female designers. Warm colours are used for basic components of infographics and cool colours are used for complementary elements such as text, background and relationships between information. Many sources of information are used by designers in the creation process of infographics.

Designers follow similar steps in the creation process of infographics as in the introduction process of other teaching materials. The single difference between male and female designers is the order of steps followed to produce components. Female designers firstly prepare visuals, whereas male designers firstly prepare texts to be used in infographics. Designers have similar environment preferences in the creation process of infographics. Web environments and visual design programs developed especially for creating infographics are the most preferred environments by designers. Visual theme determination of designers differentiate from each other. The most important criterion for male designers is selecting an appropriate theme for the subject while female designers focus on the amount of information and target audience. Designers try to respect the copyrights when creating infographics. However, they rarely paid attention to the copyright of the visuals used to create infographics. They also rarely paid attention to protect copyright of their own infographics. In addition, they give the information sources used to create infographics.

This study was conducted with a total of 64 students, who have teaching material design experience, determined with appropriate sampling strategies by using posttest design with a single group, which is one of the poor experimental designs. This group may not be sufficient to present views of all designers. However, this study will provide useful information to understand designers who develop materials for teaching purposes. Knowing designer approaches and creation approaches of infographics, which is becoming more widespread in the teaching environments, may contribute to establish a common approach suitable for learners and needs in the educational environments. Inclusion of all design structures in the study may provide guidance for future studies in terms of creating an overview in the subject. Conducting further studies analyzing approaches of designers over their products or showing their approaches according to their behaviours in the process of production would be useful

to evaluate the approaches presented in the study. Similar studies to be conducted with different designer groups can make the results of this study more effective and comparable.

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