A study on the development of an infographic designer questionnaire and designer opinions

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Abstract. Technological developments and changes in how learning is understood have not only changed learning environments, but also how educational materials are developed. Infographics, one of the materials that are becoming increasingly more popular in learning environments, have nowadays become quite commonplace. Demonstrating the understanding of those who design such instructional materials is important with respect to the organisation of learning processes. In this study, we devised a questionnaire that aims to demonstrate the understanding infographic designers have of infographic design. A total of 94 students from the Department of Computer and Instructional Technologies Education of the Kazım Karabekir Faculty of Education took part in this study conducted during the fall semester of the 2013-2014 academic year. The participants were given a questionnaire consisting of 41 items that enquired about the readers' views regarding infographic design. The collected data were assessed using Principal Component Analysis. Based on the analysis results, a questionnaire form consisting of 27 items and 8 factors (Understanding of Design, Design Process, Copyrights, Introduction, Readability, Sharing, References, Development) was developed.

1 Introduction

A variety of different educational materials are used in educational activities. Educational materials that constitute the basis of, or contribute to, communication in learning are shaped by today's technology and understanding of learning. Today, technology has made readers carrying out learning activities both the designer and the consumer of educational materials (1). Web technologies and the environments shaped by such technologies have put learners into a position where they can generate information and design content (2). Both the new role of learners and the characteristics of learning environments have moved learning outside the classroom walls, and paved the way for non-spatial learning. As a natural result of this, various changes and innovations have taken place in educational materials.

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Printed, electronic, interactive, etc. forms are used to convey information. The focus of learning processes is increasingly shifting towards visuals and materials with visual features. Visuals are materials that are organised to present information visually, and which convey a particular situation (3). In this respect, the presentation of information, supporting information with visuals, conveying information through visuals, and the selection of suitable materials for learners are quite important for the learning process. In this context, there are several variables involved when making a selection, such as the characteristics and purpose of use of the information to be learnt, and the learner's traits (4).

Various types of visuals are used to present information. Visuals make it possible to graph a piece of information so that it can be compared with other information; to schematise a situation or operation; and to prepare drawings that delineate the associated and connected situations. Thus, information that requires long explanations can be conveyed through visuals more easily. Nowadays, educational materials defined as infographics in the current literature - which allow the conveying of information by taking advantage of the strength of visuals - have become quite common in learning environments. Infographics ensure that information is presented in a certain flow and within a certain context (5). Infographics prepared with effective visualisations enable the presentation of an abundance of information with very few explanations.

Like all educational materials, the design of infographics entails the use of various design principles. The design principles used for each multimedia component should be likewise used in infographics as well. Furthermore, to prepare a good infographic, one should organise the information very diligently, convey recallable and comparable information (6), and organise the flow and construct effectively. This makes it possible to develop educational materials in accordance with both the design principles and the nature of infographics. Infographics are also used to fulfil various purposes such as implementing learning processes, recalling information, indicating associated situations, schematising processes and events, and summarising the things learnt (7).

Infographics are designed using texts as well as multimedia components such as pictures, drawings, figures, tables, flow diagrams, photographs and videos (5). Infographics are not only the combination of multimedia components, but are also the product of using such components in a certain flow, logical sequence, and basic context. One of the innovations introduced by infographics is the use of various visual and diagrammatic components in presenting information and the understanding of constructing the content (8). This new understanding has allowed infographics to be one of the new materials used in learning process (9). Moreover, among the strengths of infographics are their flexibility and the possibility to design them in alternative forms (10).

Infographics are classified as interactive, non-interactive and semi-interactive, depending on the multimedia components used in preparing them and the features of those components (6). By their very nature, interactive infographics allow access to different environments and different information through various selection and change components (6). However, non-interactive infographics are stationary and contain limited texts and visuals to present information (6). Interactive and semi-interactive infographics can meet the reader's need to receive additional information.

Davis and Quinn (11) note that high-quality infographics positively affect reader development. Smiciklas (12) describes that infographics are a good means for communication in learning. Furthermore, the preparation of infographics is said to have various positive effects such as improving critical thinking skills, analysis and synthesis capabilities, and forming a habit of using educational design principles (13). There are only a limited number of studies in the literature on infographics, which are said to have positive effects on both readers and designers. Determining the approaches used by designers may provided useful information with regards to determining the actual effects of infographics.

In this context, a questionnaire was devised to demonstrate the designers' understanding of design processes in the preparation of infographics, and the opinions of designers were determined and presented.

2 Methods

2.1 Study Purpose

This study aimed to devise a questionnaire that demonstrates the opinions of infographic designers, and to convey the opinions of designers in relation to their design processes.

2.2 Study Sample

The study sample consisted of 94 students (42 male and 52 female) from the Kazım Karabekir Faculty of Education, Department of Computer and Instructional Technologies Education at Atatürk University. The study was conducted in the Fall semester of the 2013-2014 academic year. The sampling method employed in the study was purposive sampling, which is a type of nonprobability sampling. Purposive sampling allows researchers to easily reach the group, with the group being ready for the application of study procedures (14). This method is frequently used in studies where respondents take part voluntarily (15).

2.3 Questionnaire Development Process

The questionnaire development process was carried out in three stages. In the first stage, the relevant literature was reviewed, the factors that would demonstrate the designer opinions regarding the design of infographics were determined based on the views of experts, and 41 preliminary items were written. A 5-point Likert scale was used to assess the items. The format of the 5-point Likert scale was as follows: 1: (Strongly disagree); 2: (Disagree); 3: (Neither agree nor disagree); 4: (Agree); 5: (Strongly agree). In the second stage, the items were presented to the evaluation of two linguists, and a pilot study was conducted. Forty seven students registered in the Department of Computer and Instructional Technologies Education took part in the pilot study. The statements in the scale were corrected based on the feedbacks obtained in the second stage. In the last stage of the questionnaire development process, construct validity was tested. Ninety four students were asked to fill in the questionnaire form to test the construct validity. The questionnaire was analysed using the Principal Components Analysis, after which the scale was given its final form. Internal consistency of the questionnaire was tested using Cronbach's Alpha reliability test.

2.4 Collection and Analysis of Data

The data were collected using the printed questionnaire form. All study participants were verbally informed about the study. The SPSS 18 statistical package software was used for the statistical analysis of the data. The factor analysis was conducted using Principal Component Analysis and Varimax rotation. In this technique, a set of numerous variables considered as being correlated are converted to a set with a smaller number of uncorrelated (or minimally correlated) components.

3. Results

3.1 Factor (Principal Component) Analysis

Following the factor analysis, a questionnaire consisting of 8 factors and 27 items was developed. Fourteen preliminary items were removed from the scale due to low loading values. Table 1 shows the results of the converted principal component analysis.

Table 1. Results of the Factor Analysis (Rotated Principal Component Analysis)

Item No.	Factor Cov.	Factor1 Loading	Loading After Rotation							
			Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
1	.791	.587	.817	-.076	-.039	-.053	-.080	.205	.114	.161
3	.632	.423	.679	-.105	.072	-.106	-.038	-.098	.328	.130
4	.584	.646	.651	.189	.171	.158	.135	.105	-.099	.110
5	.679	.533	.529	-.012	.127	.126	-.086	.073	.116	-.267
6	.826	.702	.091	.822	-.151	-.030	.031	.254	.227	-.023
7	.793	.734	.098	.816	-.116	-.126	-.106	.231	.048	-.100
8	.703	.652	.014	.781	.083	-.027	.117	-.179	-.172	-.003
9	.696	.524	-.116	.716	.225	-.032	.016	-.284	-.155	-.005
10	.756	.534	.195	-.003	.798	.135	-.008	.173	-.068	.149
11	.781	.399	-.109	-.061	.743	.084	.074	.266	.223	-.229
12	.713	.484	-.084	.180	.581	.099	-.296	.217	.250	.140
13	.779	.476	-.110	-.060	.002	.822	.204	.097	.015	.141
14	.835	.443	.320	-.003	.081	.786	-.284	.013	-.096	-.129
15	.635	.430	-.040	-.192	.207	.639	.247	.043	.180	.202
16	.709	.483	-.038	.076	-.135	.050	.747	.012	-.163	.132
17	.775	.522	.448	.015	.017	.097	.729	.034	.174	.040
18	.784	.494	.179	-.037	.255	.113	.618	.405	-.320	-.125
19	.744	.533	.183	.084	.202	-.064	.093	.786	-.150	.027
20	.800	.563	-.071	-.079	.235	.247	.044	.760	.108	.157
21	.782	.585	.301	.021	.052	-.048	.254	.748	-.165	.167
22	.706	.605	.062	.079	.160	.312	.058	.629	-.132	.033
23	.738	.644	.119	-.017	-.004	-.042	-.018	.044	.834	.036
24	.709	.718	.151	-.046	.231	.174	-.151	-.185	.687	-.267
25	.745	.445	-.062	-.182	-.068	.080	.163	.100	-.231	.764
26	.664	.405	.306	.054	.120	.184	-.104	.091	.148	.683
27	.642	.468	.310	-.007	.443	-.066	.080	-.105	-.065	.656

Total Variance Explained: 72.664%
Factor 1: 11.859%; Factor 2: 9.906%; Factor 3: 8.153%; Factor 4: 7.699%; Factor 5: 7.642%; Factor 6: 13.971%; Factor 7: 7.024%; Factor 8: 6.409%.

According to the results of the factor analysis, designers' opinions on preparation of infographics have 8 factors. The first factor consisted of 5 items and reflected the understanding of infographic design. It explained 11.859% of the total variance. Factor 1 was named "Understanding of Design". The second factor demonstrated the approaches used by designers during the infographic preparation process. This factor consisted of 4 items and explained 9.906% of the total variance. It was named as "Design Process". The third factor was named as "Copyrights". It consisted of 3 items concerning the copyrights

of information and visuals used by designers in preparing infographics, and explained 8.153% of the total variance. The fourth factor indicated the designers' approaches towards keywords and introductory expressions that describe the infographics, and was named as "Introduction". It consisted of 3 items and explained 7.699% of the total variance. The fifth factor consisted of 3 items. It explained 7.642% of the total variance, and was named "Readability". This factor reflected the designers' opinions on the readability level of infographics. The sixth factor consisted of 4 items, and described the designers' understanding on creating sharing opportunities when designing infographics. It explained 13.971% of the total variance. Factor 6 was named as "Sharing". The seventh factor was about the citation of references for the information used by designers in infographics. This factor consisting of 2 items was named as "References", and explained 7.024% of the total variance. The eighth factor was named "Development". It consisted of 3 items that reflected the opinions regarding the change in knowledge and skills that took place in designers preparing infographics, and explained 6.409% of the total variance. Items constituting the inventory and their loadings are shown in Table 2.

Table 2. Questionnaire Factors, Items, and Loadings of Items

1.	**Understanding of Design**	
	1. I pay attention to make sure that the information given in infographics and the visuals used to present such information are consistent.	**.817**
	2. I pay attention to make sure that I have prepared easily readable infographics.	**.754**
	3. In visualising information, I try to prepare visuals that will exactly represent the information presented.	**.679**
	4. I pay attention to make sure that the titles of infographics are attention-grabbing.	**.651**
	5. I try to use an interesting introductory expression in infographics.	**.529**
2.	**Design Process**	
	6. I find it hard to visualise information when preparing infographics.	**.822**
	7. It is hard for me to find visuals suitable for use as content when preparing infographics.	**.816**
	8. I find it hard to plan the preparation process of infographics.	**.781**
	9. I find it hard to decide on how to construct infographics in the preparation process.	**.716**
3.	**Copyrights**	
	10.I pay attention to make sure that the visuals I use in preparing infographics do not have any copyright problem.	**.798**
	11.I publish the copyright information by using copyright mark on the infographics I prepare.	**.743**
	12.I prepare infographics in compliance with copyrights.	**.581**
4.	**Introduction**	
	13.I add keywords that describe the infographic into the title section of the page where I will share the infographic.	**.822**
	14.I try to add keywords that convey the basic message of the infographic.	**.786**
	15.I add the expressions that describe the infographic into the page where I will share the infographic.	**.639**
5.	**Readability**	
	16.I design infographics in a one-dimensional form to shorten the reading time.	**.747**
	17.I pay attention to make sure that the infographics I prepare have a short reading time.	**.729**
	18.I design infographics in such a format that will minimise the eye movements of readers.	**.618**
6.	**Sharing**	
	19.I share the infographics I prepare on social media platforms.	**.786**
	20.I add social media sharing buttons into the infographics I prepare, so that they can be easily shared by readers.	**.760**
	21.I pay attention to make sure that the website addresses where I will publish infographics are simple.	**.748**
	22.I write the website addresses where I will publish infographics on the infographics.	**.629**
7.	**References**	
	23.I indicate in the references section the sources of information I have used in designing infographics.	**.834**
	24.I indicate the source references on my infographics.	**.687**
8.	**Development**	
	25.My computational thinking skills have improved through the design of infographics.	**.764**
	26.My skills in associating different pieces of information with each other have improved through the design of infographics.	**.683**
	27.I have acquired more information on the subject through the design of infographics.	**.656**

3.1.1 Internal Consistency

Internal consistency tests were conducted to assess the questionnaire. Cronbach's alpha coefficient was used to determine the internal consistency of the questionnaire. Internal consistency tests were conducted in such a manner as to explain the entire questionnaire and each factor individually. In the internal consistency test of the questionnaire, the Cronbach's alpha coefficient was calculated as .772. Cronbach's alpha values for each factor are given below.

- Factor 1: .755
- Factor 2: .779
- Factor 3: .711
- Factor 4: .675
- Factor 5: .614
- Factor 6: .752
- Factor 7: .653
- Factor 8: .564

3.1.2 Respondent Opinions

The opinions of the questionnaire respondents on infographic designers were assessed. The means scores of the answers given by the respondents to the questionnaire items are as shown in Table 3.

As shown in Table 3, the respondents strongly agreed with the statements concerning the understanding of design. The statement concerning the consistency of the information and visuals in the infographics was the item with which most respondents strongly agreed. Furthermore, designers stated that they add attention-grabbing titles to infographics, and that they pay attention to making sure that the of infographics' level of readability is high. Designers also stated that they focus on making interesting introductions to infographics.

The designers' understanding of design in the process of preparing infographics was assessed. The point which most designers found difficult when preparing infographics was visualisation. The other aspects they found difficult was finding suitable visuals and deciding on how to construct the infographic.

Designers neither agreed nor disagreed with the statement concerning copyrights. Designers stated that they do not pay much attention to copyrights of information and visuals. Furthermore, it was clear from the designers' opinions that they do not pay attention to protecting the copyrights of their own infographics.

Designers stated that they try to add descriptive expressions onto the infographics they prepare. Moreover, designers agreed with the statements concerning the addition of introductory/descriptive expressions into the pages where they will share the infographics.

The designers' opinions on the level of readability of infographics were also assessed. Designers stated that they take necessary design measures to make sure that the infographics can be read quickly. Similarly, they stated that they pay attention to make sure that the layout of the content does not require much eye movement.

Designers described that they share the infographics they design on social media platforms. Moreover, designers expressed that they add social media buttons so that readers can share the infographics. Designers neither agreed nor disagreed with the statement that they pay attention to making sure that the website addresses on which infographics will be published are simple. Designers stated that they indicate in the references section the

references of the information they use in preparing infographics. They also stated that they indicate the references on infographics.

Table 3. Questionnaire Scores

		X	STD
1.	**Understanding of Design**		
	1. I pay attention to make sure that the information given in infographics and the visuals used to present such information are consistent.	4.38	.626
	2. I pay attention to make sure that I have prepared easily readable infographics.	4.27	.800
	3. In visualising information, I try to prepare visuals that will exactly represent the information presented.	4.16	.770
	4. I pay attention to make sure that the titles of infographics are attention-grabbing.	4.31	.788
	5. I try to use an interesting introductory expression in infographics.	4.15	.759
2.	**Design Process**		
	6. I find it hard to visualise information when preparing infographics.	3.77	1.13
	7. It is hard for me to find visuals suitable for use as content when preparing infographics.	3.66	1.178
	8. I find it hard to plan the preparation process of infographics.	3.3	1.15
	9. I find it hard to decide on how to construct infographics in the preparation process.	3.56	1.103
3.	**Copyrights**		
	10.I pay attention to make sure that the visuals I use in preparing infographics do not have any copyright problem.	3.14	1.173
	11.I publish the copyright information by using copyright mark on the infographics I prepare.	3.03	1.257
	12.I prepare infographics in compliance with copyrights.	3.26	1.211
4.	**Introduction**		
	13.I add keywords that describe the infographic into the title section of the page where I will share the infographic.	3.50	1.164
	14.I try to add keywords that convey the basic message of the infographic.	4.05	.861
	15.I add the expressions that describe the infographic into the page where I will share the infographic.	3.49	1.093
5.	**Readability**		
	16.I design infographics in a one-dimensional form to shorten the reading time.	3.93	.917
	17.I pay attention to make sure that the infographics I prepare have a short reading time.	4.11	.931
	18.I design infographics in such a format that will minimise the eye movements of readers.	3.98	.802
6.	**Sharing**		
	19.I share the infographics I prepare on social media platforms.	3.82	1.170
	20.I add social media sharing buttons into the infographics I prepare, so that they can be easily shared by readers.	3.50	1.227
	21.I pay attention to make sure that the website addresses where I will publish infographics are simple.	3.35	1.129
	22.I write the website addresses where I will publish infographics on the infographics.	3.24	1.314
7.	**References**		
	23.I indicate in the references section the sources of information I have used in designing infographics.	3.88	1.078
	24.I indicate the source references on my infographics.	3.77	1.13
8.	**Development**		
	25. My computational thinking skills have improved through the design of infographics.	3.69	.904
	26. My skills in associating different pieces of information with each other have improved through the design of infographics.	4.20	.712
	27.I have acquired more information on the subject through the design of infographics.	4.36	.716

Designers expressed that preparation of infographics increases their level of knowledge. Designers considered that their ability to associate of pieces of information with each other

have improved. Furthermore, they stated that their computational thinking skills have improved.

4 Discussion and Recommendations

Through the principal component analysis, a questionnaire consisting of 27 items and 8 factors was obtained. The internal consistency value of the entire questionnaire indicates that the scale's reliability was satisfactory. These results suggest that the questionnaire is sufficient to assess the opinions of infographic designers.

The answers given to the questionnaire items demonstrate that designers use titles that will grab the attention of readers when designing infographics. This may be due to the fact that they want their infographics to catch the attention of readers. Moreover, they may have adopted this approach to ensure that infographics can easily reach the target audience. Krum (5) notes that infographic readers pay attention to the title of infographics so as not to spend time learning a subject they are not interested in or examining an irrelevant infographic. Designers state that they pay attention to the consistency of information and visuals on an infographic. This may be due to their intention to increase the level of informativeness of the infographics. Besides, it may be due to the fact that designers want to make visuals one of the basic components of presentation of content, rather than just tools that support the information presented. Flemming and Levie (4) described that visuals make learning more permanent, and well-prepared visuals have positive effects on the cognitive processes of learners.

Designers described that they find it hard to visualise information in preparing infographics. This may be due to the difficulty in determining an appropriate visualisation approach/understanding when presenting information visually. Furthermore, designers may have had difficulty due to the fact that every piece of information conveyed is not in the same taxonomic level, and different visualisation approaches are adopted depending on such levels.

Designers expressed that they do not pay much attention to copyrights issues. This may be due to the fact that they design unique visuals, or draw on visuals that do not have copyright problems. Similarly, they did not pay much attention to add copyright marks onto the unique visuals they prepare. This may be due to their approach in relation to the sharing of educational products. Furthermore, the fact that they generate and share content without any motive of profit may have caused them to not feel any need to protect their designs with copyrights.

Designers add various descriptive expressions about the content into infographics. This may be due to the fact that they want readers to have preliminary information about the infographic. However, they agreed to a far lesser extent with the statement that they add descriptive expressions into the platforms where the infographic will be published. This may be due to the fact that designers think that the infographic should, as the focus of attention, be able to introduce itself.

Designers stated that they take necessary measures to make sure that infographics can be read quickly. This may be due to the willingness of designers to support the learning process of potential readers. Moreover, it may be due to the fact that they pay attention to make sure that readers are not exposed to excessive cognitive burden, and try to observe visual design principles. As is known, excessive cognitive burden to which learners are exposed during the learning process makes it more difficult for learners to learn the subject and perceive the connections within the content.

Designers expressed that they share infographics on social media platforms. This may be due to the fact that they want to share infographics quickly. Furthermore, they furnish infographics with sharing buttons that enable users to share them on social media platforms.

The sharing of infographics by designers on social media platforms and the addition of social media sharing buttons into the infographics may be due to fact that they want to allow the contents to be distributed quickly and conveyed easily to anyone who is interested. Davis and Quiin (11) similarly note that infographics allow for easy sharing and learning in cooperation, while also promoting communication. It is clear that the simplicity of websites other than social media platforms are not very important for designers. This may be due to their absence of willingness to create a special platform or use the existing platforms to share infographics.

Designers present to readers the sources from which information on infographics was obtained. This may be due to that fact that they want to increase the credibility of infographics. Flemming and Levie (4) describe that sources with higher reliability are more satisfying for learners. Krum (5) states that infographics with no references cited are not considered credible by readers. Besides, the indication of references may be associated with the designers' willingness to allow readers who want to learn more about the subject to access the sources from which the information on infographics was taken. This is also supported by the fact that they indicate the source references as well.

Designers stated that preparation of infographics affects their personal development positively. It was particularly stated that the subject of a prepared infographic is learnt by its designer. This indicates that the designer that activates his/her mental processes to present information experiences an effective learning process. Zinonyev (16) notes that visualisations facilitate the analysis of the message in the content and ensure remembrance. Similarly, designers think that their skills concerning association of pieces of information with each other have improved. This may be due to the fact that they constantly repeat activities involving the placement, association and presentation of information.

In conclusion:

- Designers pay attention to the consistency of information and visuals in designing infographics.
- They use titles that will grab the attention of readers to the infographic.
- They draw on expressions that introduce and describe the infographic quickly and effectively.
- They have the most difficulty in visualising the information during design.
- They have difficulty in determining the basic structure of the infographic.
- They do not care much about copyrights.
- They pay attention to introductory/descriptive expressions on the infographic that introduce it, but care less about such expressions on the media where the infographic is shared.
- Designers design infographics in such a manner as not to tire readers and to promote their fast learning.
- Designers care about sharing infographics on social media platforms. They do not, to the same extent, care about sharing infographics on other web-based sharing platforms.
- They try to indicate the references for the information used in infographics.
- They think that preparing infographics improves their skills and level of knowledge.

This questionnaire was developed based on a study conducted with a group of respondents with a high level of computer literacy and good technology skills. Administering the questionnaire to groups with different profiles may further enhance its power.

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