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Research Article

Development and Evaluation of a Design Framework for Preparing Infographic Forms for Scholarly Publications

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Abstract: In this study, it is aimed to develop a design framework for the preparation of info graphics for scholarly articles and to evaluate the developed design framework in accordance with expert opinions. Qualitative research method was preferred in the study and the applications were evaluated as cases. In this direction, the study was carried out with the formative research technique, which is a derivative of design-based research. The study group was determined according to the typical case sampling method, purposive sampling method. During the course of the study, two interview forms were developed and implemented on the basis of current literature on the topic, and expert opinions. The data were analyzed by content analysis method. As a result of this study, it has been shown that infographics are an effective material for presenting academic publications. Findings have suggested that infographic designs provide various advantages for authors, readers, publishers and publications per se. Therefore, it is considered that the frequency of using such materials in scholarly publications will increase and academicians with a visual design understanding will have more positive perspective on infographics.

Keywords: Infographics, visual literacy, creating infographics, qualitative research, presentation of academic data with infographics.

Araştırma Makalesi

Akademik Yayınlara Ait Bilgi Grafik Formlarının Hazırlanmasına Yönelik Bir Tasarım Çerçevesinin Geliştirilmesi ve Değerlendirilmesi

Öz: Bu çalışmada bilimsel amaçla hazırlanmış akademik yayınların bilgi grafik formunda hazırlanmasına yönelik bir tasarım çerçevesinin geliştirilmesi ve geliştirilen tasarım çerçevesinin uzman görüşleri doğrultusunda değerlendirilmesi amaçlanmıştır. Çalışmada nitel araştırma yöntemi tercih edilmiş ve uygulamalar durum olarak değerlendirilmiştir. Bu doğrultuda çalışma, tasarım tabanlı araştırmanın türevlerinden olan biçimlendirici araştırma tekniği ile sürdürülmüştür. Çalışma gurubu, amaçlı örnekleme yöntemlerinden tipik durum örneklemesine göre belirlenmiştir. Çalışma sürecinde alanyazın ve uzman görüşleri temel alınarak iki adet görüşme formu geliştirilmiş ve uygulanmıştır. Veriler içerik analizi yöntemi ile analiz edilmiştir. Çalışma sonucunda bilgi grafiklerinin akademik yayınları sunmak için etkili bir materyal olduğu ortaya konmuştur. Bulgular ışığında bilgi grafik tasarımlarının yazar, okuyucu, yayıncı ve yayın açısından çeşitli avantajlar sağladığı belirlenmiştir. Bununla birlikte gelecekte akademik yayınlara yönelik bu tarz materyallerin kullanım sıklığının artacağı ve görsel tasarım anlayışına sahip akademisyenlerin bilgi grafiklere yönelik daha olumlu bir bakış açılarının olacağı düşünülmektedir.
Anahtar Kelimeler: Akademik verilerin bilgi grafiklerle sunumu, bilgi grafikler, bilgi grafik tasarlama, görsel okuryazarlik, nitel araştirma.

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1. Introduction

We can say that in today's world, where information is constantly growing, it is as much important to perceive the information in the easiest way as to reach it the fastest. In such a situation, it may be necessary to filter the existing information, that is, remove redundant or unwanted information from the existing information. Nowadays, the use of visuals is becoming widespread, which can transfer several information at once more easily, alongside text-based information sources. Visual symbols taking place in individuals' learning activities provide positive effects on their learning, development and culture levels [1]. Visuals are expressed as components that positively affect readers' learning motivation [2].

It can be said that the sources of information that are boring and difficult to understand, that is, low in readability, need to be enriched. Due to this situation, many studies have been carried out in different fields aimed at understanding the researches and at increasing the frequency of reading [3]. On the other hand, it is stated that in order for academic publications prepared for scientific purposes to reach their aim of writing, all sections (abstract, main text, tables, etc.) should be comprehended by the readers in a good way and the articles focused on this topic should be arranged in such a manner so as to be understandable and readable [4]. Additionally, when scholarly articles are evaluated according to the criteria such as teaching, explaining, and disseminating the subject matter, the use of pictures, signs, tables, and so on is stated to be an indispensable practice in these publications [5]. Besides, Hart [6] stated that human are vision intense creatures and that visuals can arouse feelings that dull word groups cannot.

Inforgraphics are defined as visualization of complex information in a way that the audience can easily understand and consume quickly [7]. It is stated that the analysis of inter-related information, and the easy comprehension of the information can be provided through infographics [7]. In other words, infographics can be explained as the transmittance of information in an easily understandable form with the help of visuals and graphics, freeing it from complexity, annoyance and incomprehensibility.

It is clear that there are many scholarly publications today and these publications are accessible in a variety of ways and media. Academic publications are generally published in scientific journals and can be reviewed by scientists who have access to these journals. In addition, academic publications prepared as text-based are long and time-consuming texts to read. The fact that articles that only appeal to academics and which require long periods of time to read and to elicit the core idea are not presented in a way to appeal to a larger mass of audience can be seen as a problem in terms of the spread of science. Infographics can be an effective solution to eliminate this problem and to ensure that academic publications are quickly perceived by also the general reader audience. In this context, the idea of benefiting from the effective nature of infographics by bringing a different perspective to the presentation of academic publications has emerged. In this study, through the potentials of ensuring the presentation of academic publications in a form that can be examined quickly, being able to appeal to a larger reader audience, and making academic publications more visible; it is aimed to reveal the views of academicians over conversion of academic publications into an infographics form. At this point, the effects of presentation of academic publications in the form of infographics on the intelligibility of the publication, sharing, access, retention of information it bears and other such qualities of the publication was kept on focus.

2. Literature Review

2.1. Visual Literacy

The perception of visuals used in infographics and the ability to discover what they mean and for what purpose they are used depends on the level of visual literacy of the reader [8]. The concept of visual reading, first dealt with by Jhon Debes in 1968, is defined as a group of learning skills that individuals can develop along with other experiences of seeing and other perceptions (Debes, 1968. Act. [9]). Moore [10] stated that the concept of visual literacy is developed from ideas adopted from many other fields such as philosophy, art, linguistics, perceptual psychology, and imagination theory and communication research. Çelik [11] defined the concept of visual literacy as the ability of an individual, by taking advantage of the innovations brought by the informatics, to interpret the messages given through visuals, and to produce new messages with visuals. To Elkins [12], the concept of visual literacy is if they understand how people perceive objects, what they see, and what they learn from them. This concept, which began to manifest itself in the mid-1960s and shaped in

by various definitions, commonly focused on the concepts of understanding, and explaining [13]. From this point of view, it is possible to define the concept of visual literacy as a communication process, with the aid of information technologies, in which the individual is both a recipient and a source.

In order to become individuals with visual literacy skills that involve complex processes, guidance is needed and this skill should be evaluated as an educational process [9]. As with written texts, visual messages also have a designer and designers have created their messages for a readership [14]. In order to design products that are suitable for their purpose, it is important to know some design principles along with visual literacy skills. The prominent of these principles are: information processing theory, gestalt theory and dual-coding theory. It is thought that individuals with this knowledge will have better skills in reading and designing infographics.

2.2. Information Processing Theory

When the model of Atkinson and Shiffrin [15], which are among the pioneers of the theory, is examined, three types of memory are mentioned, which are sensory memory, short-term memory, and long-term memory. In addition, Schunk [16], by stating that cognitive processes in the theory of information processing are a dimension that affects the learning of the individual, put forward the elements of cognitive process as attention, perception, storage, coding and retrieval.

2.3. Gestalt Theory

Gestalt, a German word translates as form, shape, or configuration, was first introduced in 1886 [17]. Senemoğlu [18] stated that Gestalt psychologists deal with perception and problem solving processes and in addition, they base their views on learning upon the studies they conducted on perception. According to Smith-Gratto and Fisher [19], the Laws of Perception developed by Gestalt psychologists can help students interpret and remember the materials presented to them. The most important issue in perception is that the human mind tends to perceive the simplest ones first [20]. Altun and Çolak [21] grouped these perception laws under five topics; Figure-Ground relationship (aka Multi-stability), Similarity (aka Invariance), Proximity (aka Emergence), Closure (aka Reification), and Continuation.

2.4. Dual-Coding Theory

The theory was hypothesized by Allan Paivio, one of the founders of the theory who approached behaviorism in a critical way in the 1960s. According to Jared, Poh and Paivio [22], Dual-coding theory, unlike cognitive theories that operate on a single channel, is hypothesized aiming at stimulating various propositions, semantic representations, and explanations related to computational processes, and more abstract mental representations of suchlike. According to dual coding theory, it is stated that individuals have separate information processing systems for visual and verbal information [23]. In addition, Sezgin [24] states that the subsystems shown as symbolic in dual coding theory are not a fixed and clear system, but a system which is dynamic, and functioning in accordance with the probabilities.

2.5. Infographics

According to Hart [6], infographics aim to show the relations between the elements in a map, to schematically convey the relations between parts of a whole, or to numerically transmit information in a network diagram. Infographics are visual representations of data or information designed to enable the reader to understand and absorb the data or information clearly and quickly [25]. Davidson [26] states that infographics has incorporated art into the stationary world of digital information. Lamb and Johnson [27] expressed infographics as a graphical presentation that helps users visualize the “big picture” of an idea that might otherwise be difficult to comprehend.

Stating that there is no recognized classification of infographics, Dalton and Design [25] has grouped different infographic types under three topics as static, interactive and motion (dynamic by Borucu [28], Topçu Özçelik [29]). Lankow, Ritchie, and Crooks [30] also state that static infographics can be used in some cases as exploratory, or at best be used to describe a topic. The static infographics, which also has a rapid impact on the reader, conveys the information to the reader as a whole, and at once [29]. Krum [31] expresses that the static info graphic type, which does not require a special application or browser extension and is the most suitable format for online sharing, is the simplest and most common infographic type in terms of infographic

design. On the other hand, the ability to be created easier and faster compared to the interactive and dynamic ones, and being able to provide visual content for time-sensitive information make static infographics the most suitable choice for many applications [30].

Dynamic infographics are generally used to convey invariant information. Since the output is animated or motion, such as a video, it is best for explanation of a topic or subject [30]. As for Interactive infographics are types of which are open to intervention or interaction of the reader and can dynamically respond accordingly as per user needs or actions [8].

An infographic is a claim that conveys its message through visual metaphors, and reasonable selection and arrangement thanks to the original relationships created by the designer [32]. However, the message that the designer wants to convey should not be created in such a way as to cause an image pollution by random use of images or other alternative media formats. In this respect, infographics design should be prepared according to certain rules and attention should be paid to the proper use of visuals. In order to use infographics as an aid in the communication process, when performing designs, it is useful to model the thinking process about text and images as well as the issues on focus [33].

Davidson [26] mentions five features that infographics should have, which are given below.

- A good infographic tells a story or presents an idea.
- Title of the infographic should be striking and appropriate to the content.
- Texts on the infographics should be legible and be in contrast to the background.
- Visuals used in infographics should be clear, relevant and original or copyright free.
- Fonts, shapes and colors used in infographics should be consistent throughout the whole design.

Krauss [34] mentioned five simple steps to be followed in designing infographics:

- Step one: Getting an idea,
- Step two: Drafting,
- Step three: Collecting data,
- Step four: Developing evidence of concepts,
- Step five: Placing elements in designs.

3. Method

3.1. Study Group

The study group of this study was determined according to the typical case sampling method, which is one of purposeful sampling methods. Purposeful sampling focuses on information-rich situations that will shed light on the questions sought [35]. While Yıldırım and Şimşek [4] express that purposeful sampling methods would be useful in revealing and clarifying cases and events, they define typical case sampling as the studying of researcher on the most typical one or more of a series of cases for introducing an innovation or novelty. In accordance with the purpose of the research, the researcher can determine the clusters, groups and units as he deems appropriate [36]. In this respect, the study group consists of 8 academicians employed at Atatürk University, which has been selected by considering the expertness of those who have conducted courses or researches in the fields of visual learning, material development and multimedia design. Demographic information of academics is given in Table-1. In the A1 stage, 7 academicians were included in the study process and in the A2 stage, the study was carried out with the whole study group.

Table 1: Participants' Academic Backgrounds

Title	Male	Female	Graduated Program	The Number of Participants
Prof. Dr.	1		Faculty of Economics and Administrative Sciences	1
Assoc. Dr.	1		Faculty of Education	1
Assoc. Dr.	1		Faculty of Economics and Administrative Sciences	1
Dr. Lecturer	2	1	Faculty of Education	3
Dr. Lecturer		1	Faculty of Communication	1
Lecturer		1	Faculty of Education	1
Total				8

3.2. Data Collection Tools

The data sources of this study are infographics and semi-structured interview forms prepared during the study process. Semi-structured interview forms have such a structure that allowed the interview questions prepared by the researcher, by giving some flexibility to the subjects during the interview, to be discussed and rearranged before being presented [37]. In this context, semi-structured interview form (IF 1) used in A1 stage was prepared with 9 questions and is intended to elicit expert opinions on designing an academic publication as an infographic. The semi-structured interview form (IF 2), consisting of 8 questions, used in A2 stage was prepared for evaluation of the design framework created in accordance with the findings and results of IF 1 as well as the information reported in the literature, and of the infographics prepared using this framework by field experts.

3.3. Analysis of Data

The data obtained in the study were analyzed by content analysis method. Yıldırım and Şimşek [4] explained main purpose of a content analysis as obtaining concepts and data that could explain the collected data. Open-ended questions are used to obtain as much detail as possible and make it easier for informers to express their thoughts more freely by enabling them to respond from their own reference frameworks rather than being limited to the structure of pre-arranged questions [38]. The data obtained by semi-structured interview forms (GF 1, GF 2) containing open-ended questions were analyzed by content analysis. The meaningful fragmentation by reviewing the set of textualized notes and maintaining the integrity of the relationships between the parts thereof constitutes the essence of coding analysis [39]. Each data was tagged in the computer environment by the researcher and basic code structures were created. The existing codes should then be put under categories that form a pattern; and categories should be collected under themes in a way that they will be related to each other [40]. In this respect, the interrelated codes were categorized. With the answers given to the questions, the data obtained were conceptualized to create appropriate themes that we could establish more comprehensible and open relationships. In this context, in the A1 stage of the study, 50 pages of data were obtained by transcribing 165 minutes of audio recording, and in stage A2, 72 pages of data were obtained by transcribing 190 minutes of audio recording, which were then all transferred to a computer.

3.4. Design Framework Development and Implementation Process

Step 1 (Selection of Academic Publication): As the first step of the application process, academic publications, for which infographics can be designed, were tried to be determined. In this respect, three criteria have been taken into consideration in the selection of publications that will form the publication repository. The first of these criteria is that the studies are conducted in different fields, the second is that the studies are conducted with different research designs, and the third is to include the publications of the experts in the study group. The implementation process for the selection of academic publications to be converted into infographics is schematized in Figure 1. According to the determined criteria, a total of 28 publications were randomly selected and added to the publication repository. The aim of these criteria was to ensure diversity in the publications repository. According to the results of the A1 stage, during which participatory views on infographics production were focused on and necessary criteria for the production of infographics were

determined, academic publications conducted using procedures that base on quantitative methods were decided to be selected. While selecting the mentioned publications, the participants' own publications were included in order to be able to get in-depth information, and to present their opinions on preparation of their publications in a different form. Moreover, a qualitative study was decided to be converted into an infographic form in order to constitute a control case. The aim of stage A1 of this study was to determine which of the types of academic publications would be more appropriate to be converted into infographics. Thus, according to expert opinions, the publications in the publication repository that would be more appropriate to convert into infographics were determined. Each publication in the publication repository was numbered and tagged. According to the expert opinions, 8 studies were selected and the process of determining the publications to be converted into infographics was completed.

Step 2 (Infographics Generation): Publications in the academic publication repository have been converted into infographics by taking into consideration both the results obtained in the A1 stage which yield the answers to the question of how an academic publication should be converted into infographics, and the material design principles such as shape-ground relationship, similarity law, proximity law, color harmony, meaningfulness, balance, and alignment. At the same time, the literature was utilized for detailed information on infographics. With respect to the findings, among different types of infographics, the static infographics which is considered appropriate for the purpose of the study were used. In infographic design process, two different form design concepts were implemented, which are called short forms and long forms. Short form is a kind of infographics that includes the basic parts of academic publications such as title, method, findings, discussion and conclusion. Long form, on the other hand, is a form that contains all parts of academic publications and contains more detailed information than short form. In this regard, of 8 academic publications, randomly selected 4 were produced in short form and the remaining 4 were produced in both short and long forms. As a result, a total of 12 infographics were designed for 8 academic papers selected for use in the study. The designs were evaluated by 2 field experts holding a PhD degree and having experience in infographic design. The infographics were rearranged according to the feedback submitted by the experts and finalized by making the necessary revisions. When producing infographics, piktochart (https://piktochart.com/) platform was used. This platform has been preferred because it includes simple and advanced options that every researcher who wants to see their works as infographics. While designing infographics for academic publications, firstly the steps and characteristics of infographics preparation have been thoroughly examined in general terms. The common and non-common items of these steps and characteristics were simplified and prepared as a list. Then, the A1 stage was implemented and the criteria which to be peculiarly considered for academic publications in the infographics design were determined. These criteria were prepared as a list and were suitably incorporated into the infographics preparation steps. The theory of information processing, Gestalt theory and binary coding theory, which were previously mentioned in the theoretical framework section, were implemented in order to produce effective products at the design phase. At the application phase, in addition to above theories, visual design and message design principles reported in the literature have been scrutinized and observed to ensure gains and make general corrections in designs. In this respect, a new design framework was tried to be created by identifying the step suggestions which are thought to be useful to follow in the production of infographics. The procedures and the steps taken accordingly are determined to be as follows:

1. Determining the objective of the academic publication that is intended to be converted into an infographic as the idea to be presented through the infographic,in recognition of that a good infographic should tell a story or convey an idea,

2. Evaluating the level of conformity of the design and content of the academic publication to be converted into an infographic,in the light of the findings obtained in A1 stage,

3. Drafting the idea to be presented in the infographic, and listing the points that should be highlighted by reading, repeatedly and in detail, the academic publication to be converted into infographic,

• Establishing communication with the author where necessary in relation to what to point out in the academic publication to be converted into infographic, in the light of the findings obtained in A1 stage,

4. For the sake of being in compliance with the principle of defining the audience that gives importance to the subject, choosing a common design structure for academics in the scientific community and practitioners interested in the subject of the academic publication,

5. For the purpose of ensuring that the title of the infographic is striking and appropriate to the content, collecting data and developing evidence of concepts; copying the title of the academic publication as it is, and passing it onto the infographic, in a text-based and emphasized manner,

6. With respect to placement of items in designs, to which options or changes to consider for making decisions, and to what issues or topics the readers are interested in; designing the sections of the infographic to be prepared for the academic publications in accordance with the suitability levels, in the light of the findings obtained in A1 stage,

7. With respect to the way of thinking that should be acted on to organize the collected data, the best way to display syntheses in the infographics, and which simulation, visualization, and/or design to be implemented in order to consistently present the whole subject to the audience; considering the design principles pointed out by the experts, in the light of the findings obtained in A1 stage,

8. With respect to the readability of texts on the infographics and their being in contrast with the background; implementation of:

• design principles for instructional messages by [41],

• the finding by [42] that short and left-aligned text are highly readable,

• reflecting the focal points according to the attention component of cognitive processes in the information processing theory,

• designing appropriate visuals according to the retrieving component of the cognitive processes in the information processing theory and adding them to the infographic,

• designing symbols according to shape-ground relationship of the laws of perception specified in Gestalt theory and adding them to infographics,

• presenting in groups the visuals and texts that express the same subject according to the law of similarity of laws of perception specified in the Gestalt theory and arranging the relations within the groups according to the law of proximity,

• reflecting the elements in a certain order which were vertically presented in groups according to the continuity law of perception laws specified in Gestalt theory,

• the simultaneous use of visual elements and text-based expressions to support verbal and non-verbal systems presumed to exist in the human mind as mentioned in the binary coding theory,

9. With respect to the visuals used in the infographics being clear, relevant and original or copyright free; using visuals that are readily present on the platform where infographics were prepared, or that are uploaded by the researcher,

10. For the realization of the principle that requires fonts, shapes, and colors used in infographics be consistent throughout the whole design; creating the designs using ready templates offered on the platform where infographics were prepared,

11. Reviewing and finalizing the completed designs with the necessary arrangements.

In addition, the participant opinions obtained in A1 stage regarding the basic characteristics of the infographics were taken into consideration during the preparation of the infographics. At this point, the process of converting was started with the selection of remarkable designs that are appropriate to the content and type of the academic publication from among the infographic templates. However, the information presented in the academic publication has been summarized and organized in such a way as to enable readers to quickly review it. In addition, in order to increase their persistence in mind, visuals that are capable of evoking the same concept to anyone for terms used in academic publications were attempted to be designed and incorporated into the infographics. In order to increase the readability of the infographics, the designs were presented in a

certain flow and so as to reflect the whole academic publication. Subsequently, designs with intensive information was avoided due to the difficulties that might be experienced in the conversion of academic publications into infographics, on the other hand gaining experience was aimed by having designed infographics on different subjects.

In relation to the conversion structure of infographics specific to academic publications, in all of the infographics designed in vertical form, the title section is located at the very top section. However, in the light of the findings obtained in A1 stage; it was decided that the objective section is reflected concisely and the introduction section is reflected in brief through infographics. On the other hand, since the idea that is prominent in the infographic preparation steps is determined to be the objective of the academic publication, and as the objective statement in academic publications is generally contained in the introduction section, the objective statement which is supported by appropriate visuals were placed just below the title section as text-based. In the continuation of the designs; methods, findings, results and discussion sections are presented through infographics having the level they were represented in the academic publication. In addition to the access address of the academic publication, publishing information and author details were put in an appropriate place in small size near the title section. In some designs, however, sections such as the sample, scale development process, etc. that are desired to be transferred are segmented and reflected on the infographics by communicating with the author.

After the completion of the designs, the aspects of infographics mentioned in the design concept such as color harmony, consistency, concept relations and shape-ground relationship were reviewed according to the findings obtained in A1 stage. Nevertheless, final forms of the designs have been revealed by making the necessary arrangements in the infographics according to the opinions received from experts.

4. Findings

In the study, it is aimed to develop a design framework for the preparation of infographic forms for academic publications prepared for scientific purposes and to evaluate the developed design framework in line with expert opinions. For this purpose, the study was carried out as a two-stage process.

Expert Opinions on the Development of a Design Framework for the Preparation of Infographic Forms for Academic Publications (Stage A1)

In the first stage of the study, data was collected as a result of interviews with experts for the preparation of academic publications in inforgraphic form. Some of the data collected from the experts at stage A1 are as follows:

- - "Giving more messages in less space." (Exp7)
- - "I think it will enable me to make inferences." (Exp4)
- - "For speed reading, of course comprehensibility." (Exp1)
- - "An infographic prepared by a novice may also have distracting elements."(Exp2)

The findings are divided into three themes: key features of knowledge graphs, conversion challenges, and conversion structure. These themes are presented as categories and codes in Table 2.

Table 2. Converting Academic Publications into Infographics

Theme	Category	Code
Key features	Structural features	Knowledge transfer skill
		Remarkable
		Motivating
		Summarizer
		Personal preference
		Fast reviewability
	Instructional structure	Didactic effect
		Legibility
		Memorability
		Reflecting the whole
Conversion challenges	Structure of the content	Concept confusion

		Not all content can be visualized
		Knowledge intensive
	Transfer	Bad design
		Wrong transmission
		Experience
		The process of preparing an infographic
	Publication type	Quantitative
		Mixed
		Qualitative
		Content and space
	Chapters of publications	Title
		Method
		Findings
		Conclusion and discussion
		Access address
		Summary
		Purpose
		Research question
Conversion structure		Key words
		Introduction
		References
	Design approach	Text design
		Color matching
		Aperture
		Consistency
		Fluency
		Simplicity
		Figure-ground relationship
		Concept relationship
		Structured form
		Positional proximity
		Assimilation

When the findings are analyzed, the opinions of the participants on the creation of infographics are grouped under three themes. The structural features category of the theme identified as key features focused on the impact the infographic would have on readers at first glance. The instructional structure category focused on the effect of the information obtained from the infographic on the reader. In the theme of conversion challenges, the focus was on the visualization of information and the knowledge of the designer. Finally, when we examined the theme regarding the conversion structure, data were obtained on the research method of the publication to be transformed, which sections should be included in the academic publication to be transformed, and the person who will make the conversion decides which design approach to determine.

Evaluation of Infographic Designs Prepared in Line with the Design Framework (A2 Stage)

In line with the main purpose of the study, academic publications were prepared in the form of infographics. Some of the data collected from experts at stage A2 are as follows:

- - "Of course, this is not valid for everyone, but visualization arouses a little more interest, in other words, it makes it more memorable, I think so, and that's why I think I would prefer it more." (Exp8)
- - "I would like to see it, I mean, it attracts more attention, faster, to a wider audience." (Exp3)
- - "For the reader, it is really readable, it is catchy, it is remarkable..." (Exp5)
- - "I would like to see the discussion and conclusion section the most, I mean, okay, something has been done, what has been found or how it has been compared in the literature. I would most like to see that section in detail." (Exp8)

In the process of preparing the infographics, attention was paid to the issues mentioned in the literature and the findings obtained from the first phase of the study. Additionally, the themes, categories and codes obtained from stage a2 are included in Table-3.

Table 3. Academic Publications Prepared in Infographic Form

Theme: Reason for preference	
Category: Infographics	**Category: Articles**
Remarkable	Examine how information is supported
Memorability	To be able to refer to
Reflecting the whole	Read in detail
Fast and easy comprehension	
Summarizer	
Visual learning disposition	
Theme: Potential advantages and limitations of infographic designs	
Category: Author	**Category: Reader**
Request	Fast review
Seeing relationships as a whole	Provides convenience
Awareness of the publication	Memorability
Experience	Reduces cognitive load
Cost	Superficial presentation of information
Category: Publisher	**Category: Publication**
Staff need	Readable
Workload	Reflects the whole
Copyright	It appeals to everyone
Potential benefits	Benefit to society
Availability of the publication	Understandability of the broadcast
They have tendencies	Redirects to article
Publication evaluation process	
Theme: Design recommendations for infographics	
Category: Recommendations for the amount of information	**Category: Recommendations for transfer**
According to the article	Standard must be ensured
Department based	Important places should be transferred
Short form	The meaning should not be lost
Succinct	Must comply with design principles
Long form	Professional people should design
Category: Recommendations for multimedia assets and infographic types	Advanced design tools
	Writer and designer should work together
Social media links	**Category: Importance**
Environment	Future uses
Audio and video	
This situation is enough	
Animation	
Interactive	

Infographics were designed in the light of the information obtained in the first stage of the research and the information obtained from the literature. These infographics were presented to experts and evaluated. The information obtained in this direction was collected under three themes. The first of these themes, the reason for preference, was about the situations in which experts choose infographics or academic publications. In the second theme, the potential advantages and disadvantages of infographics are discussed in terms of author, reader, publisher and publication. Finally, design suggestions for infographics were evaluated.

5. Results and Discussion

5.1. Results Related to Developing a Design Framework for The Preparation of Infographic Forms for Academic Publications (Stage A1)

The results obtained with regards to converting the academic articles prepared for scientific purposes into infographics form are grouped mainly under three categories, which are; key features of infographics, the difficulties/challenges in converting to infographics, and the conversion structure of infographics.

5.1.1. Key Features of Infographics

The basic characteristics of infographics allow for academic publications to be presented in a new form. In this respect, Ay [5] stated that the order in which the subject matter is presented, its emphasis, signs and tables that have been used all of great importance in scientific publications prepared to convey, teach or disseminate a subject. Besides, Beegel [43] emphasized that the power of infographics is due to that they can convey the intended message or information in a short and friendly manner; so much so that rather than a thick book of 50 pages, a three- or four-page infographic (with a few striking sentences) can convey important data. Also, Olfert et al [44] concluded that statistical data were easier to understand with infographics. This situation supports the opinion that academic publications should be enriched and presented with visual supplements such as infographics. In this way, high level ability to transfer information, attention attractiveness and its positive motivation for reading, and offering quick reviewing through presentation of summative information are emphasized as the structural features that are prominent for the use of infographics. This situation may be due to the acceptance of the ability of infographics to transfer persistent information with the help of visualizations, without taking up readers' much time. In addition, effectiveness provided by the use of infographics, such as ability to quickly review articles that might otherwise require long review times, noticing the important points at a glance and assessing the relevance of the article's subject to readers' own focus may have led to this situation. The presentation of these materials with the support of visual elements can also be associated with academic publications being more remarkable and freed from being boring. Fleming and Levie [41] stated that making changes in the organization and presentation of the content would increase interest and motivation by attracting the learner's attention and promote their willingness to learn. Similarly, Duman [45] stated that the use of materials supported by written and visual elements will make the subject more interesting and that the subject will be kept from being boring.

It has been concluded that instructional contribution of infographics is profound in terms of acquiring knowledge presented in academic publications. This can be considered to be related to the basic features of the infographics, such as the fact that the content of the articles transmitted by the infographics is more readable than their presentation in original form and that the information related to the content is reflected as a whole at once. It can also be said that the information conveyed through infographics is kept in mind for a longer time and the perception that these materials supported by visual elements has a high instructive effect. According to the study by Turck et al [46], readers have concluded that the presented data allows faster and more efficient reading with infographics than text-only forms, and also that infographics are more likely to facilitate the long-term retention of data. Smiciklas [7] stated that infographics provide benefits for learning, retaining and remembering information. In parallel with these results, it was determined that teaching activities carried out with incorporation of visual materials had a more significant effect on students' achievement and on retention of their learning compared to traditional teaching activities [47]. Besides, Akengin and İbrahimoğlu [48] stated that using visual materials can positively affect students' academic success.

5.1.2. Challenges In Conversion

There are some challenges in converting academic articles prepared for scientific purposes into the form of infographics. These conversional challenges come in two categories: the structure of the content of the academic article and the transference.

While converting academic articles prepared for scientific purposes into infographics form, it is concluded that the difficulty of process is dependent on the content of the article. The difficulties that may arise at this point may be due to the extensive information contained in academic articles or due to that not all information contained is suitable for conversion. However, it can also be said that a situation of contradiction with respect to a failure of retaining the relationship between the visualized information and actual intended expression creates a challenge that in turn requires the conversion process to be carried out more carefully. Similarly, Dursun and Odabaşı [49] stated that the designers, misinterpreting the support of multimedia elements to the instructive content, often make users exposed to products having poor-quality designs. When we consider the issue in this respect, in this study, it turns out that in the results obtained in A1 stage, with regard to the conversion challenges, transference is as important as the structure of the content. This may be related to the fact that the level of the designer having a certain graphic design experience will have an impact on infographics preparation process, and that improper designs can lead to incorrect transfer of content. At the

same time, the designer's awareness of the effective use of design principles to uncover the focal point of the message to be conveyed may be due to the idea that it can eliminate the negativity with regards to transmission. In parallel with this result, Ashman and Patterson [50] mentioned the difficulties in producing infographics, as well as stating how infographics, computer and design skills can greatly help in ensuring the clarity of the message.

The basic structure of the infographics in general and the challenges in conversion were tried to be conveyed in line with the opinions of the participants. The criteria, as the conversion structure, that should be taken into consideration for presenting academic publications in infographic form will be examined in accordance with participants' opinions.

5.1.3. Conversion Structure

In conversion of academic articles into infographics, a certain conversion structure should be employed. In this regard, the issue should be dealt in three categories: publication type, publication chapters and sense of design. At this point, while preparing infographics, it is concluded that the designers should effectively implement the design principles regarding, for example, text design, color harmony, clarity, consistency, fluency, shape-ground relationship and apply these to their designs. The acceptance of the use of infographics in the presentation of academic publications may be due to the fact that the effective use of these design principles is able to yield positive results. The performing of shape-ground placement in the most obvious level is very effective in terms of perception of the content [41]. In parallel with this result, individuals who use materials prepared according to design principles to get information on a certain subject were found to be more successful than individuals who use traditional approaches [51]. Similarly, short and left-aligned texts were found to be highly readable while long and justified paragraphs were intermediate [42]. Additionally, the evaluation and revision of infographic designs by different experts is a general conclusion emphasized in the literature in order for the production of effective infographics and for elimination or minimization of design errors that might be overlooked. This may be attributed to the potential contribution of different perspectives to infographic design. It is also a concern that the designer may experience mental fatigue by working continuously. Producing infographics by making necessary improvements and revisions represents a much more readable, user-friendly and non-threatening view of performed work, allowing for quick interpretation of results [50].

In terms of suitability level of academic publications for being converted into infographics according to their research methodologies, publications for researches conducted with quantitative research methodologies were found to be more suitable for conversion process. This situation may be due to the fact that the rich numerical data presented in quantitative patterns can be more easily reflected in graphs. In this respect, when the literature is reviewed, only one study dealt with the use of infographics for academic publications was spotted. Ashman and Patterson [50], in their study focused on a certain field, aimed to present the academic publications prepared in quantitative design in infographics form, however, they did not specify the reason for choosing quantitative pattern. In addition, it is seen that several information containing numerical data, from survey results to population data, is presented using graphs or SmartArt [52]. This can be attributed to the fact that sections of the quantitative research, such as Findings, are presented more visually.

During the literature review no studies aimed at reflecting parts of academic publications in infographics form were spotted due to the fact that studies similar to the structure of this study is limited. In the A1 stage of the study, it was concluded that the title, and the sections, i.e. methods, findings, results and discussion, of the academic publication are prominent parts that should be present in the infographics. This can be attributed to the idea of conveying the important points of the academic publication in the infographics and encouraging, where necessary, the reader to examine the original version of the publication.

5.2. Results Related to Evaluation of Infographic Designs Prepared According to The Developed Design Framework (Stage A2).

The results obtained with regards to the academic articles prepared in infographics form are grouped mainly under three categories, being the reason for preference, the effects of infographics, and the formal structure.

5.2.1. Results Related to the Preference of Infographics or Articles

At this stage of the study, two different situations were considered. First, it was examined why experts prefer infographics or academic publications. Secondly, opinions on designing long or short infographic forms were discussed. Two main factors have emerged in general in terms of choosing the infographic form for the presentation of academic publication. These two factors that determined the choice of infographics are predisposition to visual learning and characteristics of infographics.

According to the results of the study, participants prefer infographics or original forms of the articles according to certain conditions. The prominent characteristics that come to the fore in terms of the preference for viewing and analyzing information as infographics are inferred to be persistence in mind, noticeability, quick and easy comprehension, seeing the whole structure in glance, and summation of extensive information. This may be due to the presentation of information in a holistic perspective and logical framework by using text-based and visual elements in combination thanks to the design structure of infographics. In addition, the fact that the articles prepared as long texts can be examined in a shorter form, requiring less reading time and presented to the reader by transferring information over both verbal and non-verbal channels might have affected this situation. However, the idea that infographics can provide both a broad overview and the ability to summarize large information owing to their short structure might have had an influence, too. In parallel to this result, Turck et al [46] stated that when the participants had been presented infographics and text-only data, almost all of the participants preferred the data presented in the form of infographics and he associated this situation with participants' preference of efficient reading and with the idea of better retention of information provided through infographics. Similarly, Donofrio [53] states that infographics have a striking structure and are one of the best and most widely used tactics to draw attention to the information to be conveyed. In addition, Vanichvasin [54] states that infographics enable the presentation of catchy content and that the content presented in this way provides quick comprehension and is easy to understand, as well as increase the retention skills of individuals. On the other hand, Martin et al [55] showed that, in the field of medicine, the participants preferred the abstracts presented as infographics to those that are text-only.

Another reason for the preference of infographics in reading academic publications is that readers are more apt to visual learning methods. Participants emphasize that they enjoy reading infographics and are more interested in such content. This may be due to the information transmission power of the visual components of the infographics. This may also be a result of the fact that readers prefer to learn, with less effort, through visuals that are more memorable than texts. In addition, having had the opportunity to examine more academic publications, had access to more important information in the same unit of time might have enabled them to prefer infographics and enjoy these contents. Likewise, Siricharoen [56], stated that infographics can quickly transfer the intended message through a limited area. Furthermore, since the information contained in the infographics, in comparison to the whole content, is more precious and important to the readers, it can be said to be this that makes infographics enjoying [56].

The participants whose opinions were received stated that they were pleased to review their publications through infographics. In other words, the authors of the academic articles were concluded to have been satisfied with their publications being presented in the infographics form. While this may be attributed to the fact that participants had conducted studies on this visual learning, it was revealed that the participants were, in general, willing with regard to presentation of academic publications in infographic form, and would prefer reviewing publications in this form. Furthermore, the fact that their publications become more easily accessible or that they can be distributed more effectively may explain their satisfaction. Similarly, Yekta [57] concluded that the reader responses were positive in the study where he examined the use of infographics on websites.

When academic publications are presented with infographics, the preferences of the participants are primarily for infographics. This may be due to personal interests of the participants and the fact that the presentations supported by visuals are more remarkable. Similarly, Soydaş and Yılmaz [58] have revealed that digital stories prepared using visuals were 4 to 5 times more preferred compared to written texts.

There are cases in which participants prefer to use the original presentations of academic publications. With respect to situations that involve the use of articles in their own research, reading in more detail, and citing the publication being examined, the original forms were concluded to be preferred. This can be

explained by the desire to receive in-depth information. Moreover, the conventions of scientific writing and citing rules and styles may have caused this view. On the other hand, the fact that academic article readers do not want to go beyond the forms they are accustomed to in relation to their age status can be seen as one of the possible reasons for this situation. Accordingly, Turck et al [46], in their study comparing the preference of text-only data or infographics according to age groups, concluded that the preference of infographics was lower in the 70-year and older group compared to the other groups. Similarly, Young and Hinesly [59] put forth that traditional text presentation approaches are necessary for details, in their studies which was aimed at testing whether information transmitted through infographics provides superior results in terms of user preferences, comprehension, and reader efficiency compared to a text format.

5.2.2. Results with Regard to Design Recommendations of Infographics

At this stage of the study, results were obtained for the amount of information that should be present on an infographic, the multimedia elements in which they can be supported, and the types of infographics as well as recommendations in terms of transmission of infographics. Regarding the suggestions on the amount of information that should be present on an infographic, it has been concluded that there may be differences depending on the article and that the amount of information may also vary depending on the nature of the article. This situation can be associated with the structure of the process carried out in academic studies and the results obtained from these processes. In addition, among short and long forms of infographics, the short form, in a general sense, that contains the basic information succinctly was found to be more effective. This may be due to the fact that infographics are generally seen as materials that provide a general idea about the subject at first glance. In addition, the idea that the request for more detailed information can be met with the original form of the article may have contributed to this situation. At the same time, due to the nature of infographics, capability of transferring as much information as possible through a limited area can be the focal point of this idea. Supporting this result, in their studies, Meeusah and Tangkijviwat [60] showed that the content of an infographic that was created with a smaller amount of data set was best to understand. Elsen [61] stated in his study that visualization of candidate information booklets with infographics has an important potential and suggested that it would be beneficial to consider the quality and accessibility of the information as well as the amount of information needed to be presented through infographics. Along with these results, instead of designing infographics in two different forms, short or long, separately, suggestions for producing infographics having two different contents, one detailing in different sections (findings, methods, etc.), being for the scientific community and another one being for the practitioners of the results that are obtained from academic publications. In other words, section-based designs of infographics can be created separately for academics and practitioners. Thus, considering the preferences of the target audience, the idea that there will be an increase in the number of views of the publication can be seen as a focal point in the emergence of this result. In this respect, it is inferred that the re-arrangement of step 4 which was given under the design framework proposals created after the A1 stage in accordance with the results obtained in the A2 stage (making separate designs for academicians and practitioners instead of a common design) can help produce more successful designs.

It was concluded that the collaboration of the author and the designer in the conversion of academic publications into infographics would create more effective infographics. This may be related to the fact that it is important to convey the information in the articles and that not to go beyond the point to be emphasized in the article. Also, the idea that the author knows the features of the subject to be conveyed and that the designer has the comprehensive knowledge regarding the use of the design principles may have created the position that the production of effective infographics would be positively affected thereby. In other words, the author's contribution to the designer with respect to the content of the article, and designer’s contribution to the author with respect to visualization, attention and the implementation of the design principles in the process of application is deemed to be a crucial collaboration that may have revealed this situation. In this regard, it is inferred that step 3 (collaboration of author and designer) which was given under the design framework proposals created after the A1 stage is affirmed in accordance with the results obtained in the A2 stage. Parallel to this result, Lamb et al. [52] stated that creating their own infographics under the guidance of teachers enables students to create more effective infographics and better learned the dealt information. In addition, Soydaş and Yılmaz [58] stated, in their study, that there are important points to be considered while creating content.

In the A2 stage, it was concluded that the impact levels of the infographics prepared in accordance with the sub-items of the 7th and 8th steps (taking into account the design principles and the theoretical framework pointed out by the experts) given under the design recommendations which were created after the A1 stage were generally high. This can be attributed to the benefit of the theoretical framework to designs. At the same time, the potential advantages of using the remarkable aspects of infographics in the scientific community can be seen as the focal point of this outcome. In this way, the proper use of design principles and the getting the designs shaped by professionals can be considered as an important step in transferring the important points of an academic publication to readers. As a similar conclusion, the colors used in infographics are deemed to be as important and will affect the understanding of the content [60].

It is seen that there are participants' views regarding the careful use of visuals added to the infographic designs and the absence of loss of meaning.While this opinion, in A2, is in line with the step 9 of the suggestions in the design framework created after the A1 stage which suggests the use of texts as they are, in terms of the use of the visuals a result that suggests a limited use has been obtained in A2. This situation can be associated with more than one outcome. The first of these is that since academic publications are prepared for people in the scientific community, the focus of the academic publication may be missed. Secondly, the visuals used in infographics may not contribute to understanding the subject. Third, changes to academic publications may have a negative impact on readers. The fourth one can be considered as moving away from an academic publication that can be benefited from. Aldağ and Sezgin [62], in support of this result, showed that additions and ornaments should be avoided. In their study, Milovanovic and Ivanisevic [63] specifically emphasized that, from a similar perspective, the potential of deception should be prevented by prioritizing the quality of information and honesty, in the infographics used for the marketing.

The results obtained in A2 stage according to the sub-items of step 8 (benefiting from the theoretical framework) given under the design framework created after stage A1 are as follows;

- It has been concluded that the potential advantages of the prepared infographics according to the attention element of cognitive processes addressed in information processing theory are at the highest level. This can be attributed to the elimination of stimuli, present in the introduction section of academic publications, which are outside the focus of the subject, and to highlighting the core information in the infographics. In parallel with this result, Bilginer [64] stated that attention and perception are important for classroom learning and asserted that the cognitive processes constituting the information processing model should be taken into consideration in the learning environment.

- No results could be obtained for perception, coding and storage elements which are related to the individual's previous experiences and internal processes, in the theory of information processing. This situation may be associated with the fact that academic publications, which have been transformed into infographics, are selected from different fields. However, one of the participants expressed that it had been a long time since their study was conducted and opined that the designs aimed for "retrieval" element can be used in the infographic forms.

- The results that suggest that the infographics prepared according to the shape-ground relationship, one of the laws of perception specified in the Gestalt theory, reached their purpose and that the groupings created making use of the similarity law made the subject easier to understand were obtained. This may have originated from the idea that the contents of the chapters can be presented in groups, making it easier to converge on the particular focus. Also, the relations' being arranged according to the law of proximity, within the groups, was accepted by the participants. This can be attributed to the fact that the relationships within the groups create the possibility to be easily observed. Similarly, Koç and Bulut [65] revealed that the shape-ground relationship, similarity law, proximity law and continuity law, which are parts of Gestalt theory, have an effect on map reading and interpretation skills.

- The infographics prepared, by taking into consideration the law of continuity of Gestalt theory, in a vertical direction and representing a certain flow were accepted by all participants. This situation is thought to be caused by the habit of reading academic publications in a certain order. In addition, it may be associated with the presentation of the chapters in a certain order that provides the opportunity to explore the publication fluently by arousing curiosity on the reader.

• As mentioned in the dual coding theory, the use of visual elements and text-based expressions to support verbal and non-verbal systems that are assumed to exist in the human mind was welcomed by majority of the participants. This can be attributed to the fact that the participants thought that the use of text and visual elements together supports the understandability of the subject. In addition, close and simultaneous presentation of related texts and images may be the focal point of this situation. Aldağ and Sezgin [62] concluded that the explanations about an image in the page should be given above or below the image and that it should be presented simultaneously.

The use of the static type of infographics in academic publications was accepted by all participants. This situation can be associated with the situation assessment peculiar to academic publications and to the fact that the static infographics type is deemed to be sufficient for this subject. The idea that it is easier to prepare and share static infographic type compared to other types may have caused this situation. Additionally, high level of similarity between static infographics and academic publications may also justify this match. Krum [31] stated that static infographics type is the most suitable format for online sharing, for it does not require a special application or browser extension, and is the simplest and most common type in terms of info graphic design. However, some participants emphasized that it would be more effective to use different kinds of multimedia components, in combinations and at reasonable levels, in infographics in order to prepare different types of infographics such as motion or interactive whenever deemed necessary. This may be due to the attitude of intending to meet the expectations of each reader by presenting the content of academic publications with easier and alternative multimedia components. Beegel [43] stated that for some subjects, static infographics may have limitations that may harm the reader's understanding of the subject, which can be overcome by making an effective use of interactive or motion infographics.

The results suggest that the use of such materials in academic publications will increase in the future and young generation academicians will have a more positive perspective on the use of infographics. This may be due to the fact that many expressions are conveyed through visual elements in today's world and that such elements are very frequently used in social media platforms. In addition, the fact that individuals in the z generation prefer content based on multimedia components may have developed this view. In parallel with this result, Young and Hinesly [59] openly assert that the popularity of infographics will increase.

List of Results Related to Potential Advantages and Limitations of Infographic Designs

In the A1 stage of the study, infographics of academic publications were prepared in accordance with the design framework. In this respect, the results obtained from A2 stage regarding the potential advantages and limitations of infographic designs on the authors, readers, publishers and others are as follows;

• When academic publications are presented with infographics, the preferences of the participants are, in first place, for infographics.

a. Prominent features, in the point of preference of infographics, are; persistence in mind, strikingness, quick and easy comprehension, seeing the whole structure at a glance and presenting extensive information in summary.

b. Another reason for opting for infographics in reading academic publications is the personal interest of the readers.

c. Participants are pleased to review their publications in infographics form.

• Participants prefer to have academic publications in their original form in order to make detailed readings and cite in the references in their academic publications.

• The potential advantages of infographic designs are regarded to be; for the author, ensuring the recognition of the publication; for the publisher, increasing the accessibility of the publication; and for the publication per se, being useful to the general public by addressing not only academics but everyone.

• Although preparing academic publications in the form of infographics is likely to create a workload for the publisher, it is believed that publishers in different fields have a tendency to use infographics-like presentations.

• Infographic designs allow the author to see the relationships related to his research as a whole.

- Some advantages are provided in terms of the potential advantages of infographic designs for readers.

a. Infographics can increase the retention in mind by reducing the cognitive burden on readers.

b. Even though information provided through the infographics may be superficial and may cause loss of depth, Infographics can still please the reader as they present the academic publication in a more readable format.

- There may be differences in the amount of information that should be available on an infographic depending on the article, but in general the short form containing basic information is thought to be more effective.

- According to the participants' opinions, there are some suggestions in terms of the transferring of academic publications into infographics.

a. It should be prepared in accordance with the principles of infographics design in order to convey the important points of the information contained in the academic publications and to avoid losing meaning.

b. The collaboration of the author and the designer in the conversion of academic publications into infographics may provide more effective infographics.

c. Infographics for academic publications should be prepared by professionals.

- It is sufficient to use the static type of infographics in academic publications.

a. In some cases, multimedia components can be used meaningfully in infographics and, if necessary, different types of info graphics, such as motion or interactive, can be prepared.

- It is considered that the frequency of using such materials for academic publications will increase in the future and young generation academicians will have a more positive perspective on infographics.

5.3. Implications for Practice

In this study, it is aimed to develop a design framework for the preparation of infographic forms for academic publications prepared for scientific purposes and to assess the developed design framework in accordance with expert opinions. In this context, important results were obtained regarding the reasons for preference of infographics, and for the potential advantages and limitations of infographic designs over readers, writers, publishers and publications per se. In this respect, suggestions to the authors, publishers and designers who want to prepare academic publications in infographics format are as follows;

- Before starting designing an infographic, it may be useful to determine the level of appropriateness of the academic publication for being presented in the infographic form with regards to the content, research design, sections, structure, and purpose.

- It is considered that if a draft form is created by the designer by imbibing the content of the academic publication beforehand, and then this draft is reviewed by the author will be useful in terms of reflecting the important points.

- It is thought that the disaggregation of content of the sections of academic publication that are functional for the scientific community or for the practitioners will facilitate the preparation of separate designs.

- Selection of the tools that can practically be used by the designer in order to minimize the hitches that might be encountered during the design process and knowing design principles at a level sufficient for implementation are important both in terms of presentation and productivity in the preparation process.

- It is considered that it would be beneficial to review the designs and get them assessed by alternative experts for different perspectives.

5.4. Future Research

When the results obtained in the study are taken into consideration, various suggestions have been made to the researchers for further studies on designing academic publications as infographics. These recommendations are as follows;

• Quantitative researches can be conducted by bringing the categories that emerged in this study into a questionnaire.

• A study can be conducted to examine the views of designers and readers for the preparation of academic publications as infographics.

• A similar study can be conducted on academic publications with regards to the use of motion or interactive type infographics.

6. Conclusion

The idea, in this study, of presenting academic publications in the form of infographics was generally accepted. In addition, it was concluded that the process of converting academic publications into infographics form would be more effective when carried out in accordance with a design framework. Thus, a design framework was developed to prepare academic publications in the form of infographics.

The deficiencies and the arrangements made within the developed design framework and re-listed here in order to constitute a reference for further use. Accordingly, the design framework, which is thought to be beneficial, is as follows;

1. Determining the objective of the academic publication that is intended to be converted into an infographic as the idea to be presented through the infographic,

2. Evaluating the level of conformity of the design and content of the academic publication to be converted into an infographic,

3. Drafting the idea to be presented in the infographic, and listing the points that should be highlighted by reading, repeatedly and in detail, the academic publication to be converted into infographic,

• Establishing communication with the author where necessary in relation to what to point out in the academic publication,

4. Creation of separate, section-based, short-form designs with separate content for academics in the scientific community and for practitioners interested in the subject of the academic publication (eg: findings section for academicians, results section for practitioners),

5. Copying the title of the academic publication as it is, and passing it onto the infographic, in a text-based and emphasized manner,

6. Designing the sections of the infographic to be prepared for the academic publications in accordance with the suitability levels,

7. Considering design principles such as text design, color harmony, clarity, consistency, fluency, simplicity, shape-ground relationship, and concept relationship,

8. Utilizing the theoretical framework;

• design principles for instructional messages by Fleming and Levie [41],

• the finding by Yılmaz and Topaktaş [42] that short and left-aligned text are highly readable,

• reflecting the focal points according to the attention component of cognitive processes in the information processing theory,

• designing appropriate visuals according to the retrieving component of the cognitive processes in the information processing theory and adding them to the infographic,

• designing symbols according to shape-ground relationship of the laws of perception specified in Gestalt theory and adding them to infographic,

• presenting in groups the visuals and texts that express the same subject according to the law of similarity of laws of perception specified in the Gestalt theory and arranging the relations within the groups according to the law of proximity,

• reflecting the elements in a certain order which were vertically presented in groups according to the continuity law of perception laws specified in Gestalt theory,

• the simultaneous use of visual elements and text-based expressions to support verbal and non-verbal systems presumed to exist in the human mind as mentioned in the binary coding theory.

9. Giving the prime importance to the relevancy of the visuals used in the infographic designs to the subject and keep them limited in number, and paying attention not to include any visuals in the design other than those used for conveying the message,

10. Creating the designs using ready templates offered on the platform where infographics were prepared,

11. Reviewing and finalizing the completed designs with the necessary arrangements.

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