Infographics as an Analysis tool in Student Research

Line Kolås, Oddlaug Marie Lindgaard, and Ninni Anita Rotmo Olsen

Nord University, Levanger, Norway

Abstract. Higher education students learn to develop new knowledge through student research projects like bachelor's and master's theses. They learn to use research methods during their projects, and, in a fast-paced world, using visualizations like infographics can be valuable. Infographics are data visualizations that convey a message by presenting complex information quickly and clearly. Based on our previous teaching experience, IT students are skilled at collecting data but have difficulties with the analysis process of their research projects. The aim of this action research project is to examine the implications of using infographics as a teaching and learning method during student research projects. Our investigation aims to promote the use of infographics as a tool for analysis as opposed to its traditional use of merely presenting findings. Through several action research iterations, including planning, acting, observing, and reflecting, we propose a teaching method with different types of workshop activities to help students analyze their data using infographics. Key factors of infographics as an analysis tool are clarification, categorization, quality assurance, reflection, and interaction. The use of infographics leads to a more personalized understanding and an aesthetic perspective on the data and data analysis. This paper shows that graphics, in combination with academic writing, have the potential to decode and activate meaning in a visual way and to create more distinct ideas.

Keywords: Infographics, student research, analysis, learning, higher education

1 Introduction

In today's educational system and society, students are accustomed to seeing and using visualizations in their everyday lives, whether in the form of emojis, GIFs, and memes or diagrams, simulations, and infographics. Naparin and Saad (2017) define infographics as "data visualizations that present complex information quickly and clearly, which includes signs, photos, maps, graphics, and charts. Infographics are visual representations that integrate information derived from data and graphics to convey a message." Students are accustomed to a fast-paced world in which "individuals prefer shorter as well as quicker forms of communication and this makes infographics a popular form of communication" (Jaleniauskiene and Kasperiunien, 2022). In our study, the term "infographics" refers to graphic elements bearing meaning and not a poster-like display of information.

Jaleniauskiene and Kasperiunien's (2022) scoping review of literature about infographics in higher education (HE) covers the use of professional, teacher-generated,

and student-generated infographics. The scoping review, however, does not sufficiently address the use of infographics in students' research projects. Based on previous teaching experiences, we find that IT students are skilled at collecting data but have difficulties with the analysis phase of their research projects (e.g., bachelor's or master's projects). Our experiences with student researchers and their analysis and presentation of findings relate to those of Cornford and Smithson (1996), who state that students often conduct data analysis in a weak manner. Their data analysis is incomplete, leaving the reader to question what else could have been found, or they overwhelm the reader with numerous quotes, large tables, and the intricate use of statistics that, overall, conceal what the students seek to convey. Data analysis is a "messy" process for inexperienced researchers, and even papers submitted to research journals focused on computing education often present raw data that lacks analysis (Fincher et al., 2019). There are many techniques and tools that can be used for data analysis. This study investigates the use of infographics as a learning design to help students analyze their data and clarify their findings. This paper's problem statement is the following: How can infographics be used in teaching or supervising student research projects? The problem statement is operationalized using two research questions: 1) How can infographics improve the analysis process in student research projects? and 2) How can teachers or supervisors use infographics scaffold the students' research projects?

Infographics are often used for scientific communication (e.g., as a "visual abstract" to summarize findings; Saunders et al., 2017). Kibar and Akkoyunlu (2017) describe how infographics created by students make them active creators of knowledge, but there is a gap in the literature regarding the use of infographics as a tool for students to analyze their own data. Although Kibar and Akkoyunlu (2017) also consider infographics "to be a visualization method for the creation of content and interactive communication during learning and teaching activities," they do not specify infographics as a method of analyzing student data in research-based HE. Instead, they refer to examples in which students produce infographics based on existing literature or use infographics to share the results of their research.

2 Theory

We will first present relevant theory of visual perception and infographics, followed by theory related to infographics in education, student-generated infographics, and research-based learning, all of which are relevant to this study's research questions.

2.1 Visual perception and infographics

According to Arnheim (1974), perceptual shapes are, in practical terms, graphic representations such as lines, circles, and squares. Shapes are the foundation of a visual language that transmits information. Perceptual shapes transmitted to the brain are understood based on the viewer's previous experiences. Each shape carries inherent perceptual qualities that trigger specific responses; for example, circles and squares can convey stability and balance, while jagged shapes might evoke a sense of tension or

unease. In the context of infographics, these shapes can be used strategically to enhance the conveyance of meaning.
Infographics are often produced to represent reality and real data in a comprehensive manner. The role of infographics is to inform rather than to express something aesthetically. The student's perception is culturally influenced, and infographics can be understood differently by different persons based on personal interests and knowledge. When students analyze shapes in infographics, they are encouraged to engage in visual thinking. The shapes' arrangement and the relationships between them contribute to the overall narrative and guide viewers' interpretations, either in a diffuse or distinct sense, through "trajectories" (Kress, 2006). Visual shapes in different settings can implicitly or explicitly express a variety of meanings, e.g. conveying whispering or convincing voices.

Arnheim's (1974) "visual perception" connects to Barthes' (1999) conceptual distinctions between connotation and denotation applied to images. Denotation refers to the explicit, literal meaning of an image, while connotation encompasses its interpretive and cultural associations. The broader concept of visual rhetoric involves the nuanced interpretation of visual stimuli and has a significant influence on learning processes. Within this complex process, symbols, icons, and signs produce intricate visual representations, just as text serves as a crucial component of a multifaceted puzzle. Each element – be it the color, size, arrangement, or graphical representation – contributes to the overall narrative.

The path that the viewer's eye takes as it navigates through a visual expression is guided by design elements, such as lines, shapes, and colors. This influences how the different parts of an image are perceived and interpreted (Arnheim, 1974). Trajectories play a crucial role in infographics; they lead the viewer's gaze from one element to another, constructing a narrative or conveying specific meanings. For example, due to cultural associations, a graphic figure of a person holding a game controller can indicate actions in certain video games. Design can utilize trajectories to strategically lead the viewer's attention toward elements that carry connotative meanings. Both explicit information and deeper interpretive meanings can enhance the viewer's understanding and engagement with the content.

2.2 Infographics in education

In Jaleniauskiene and Kasperiunien's (2022) scoping review of eleven articles, they conclude that infographics can be used in varied ways and for a number of educational purposes. They argue that ready-made infographics as course materials match the visual preferences of today's students and that infographics can contribute to overcoming challenges related to their relatively short attention spans. Most importantly, their findings confirm that student-made infographics contribute to the development of a set of important skills such as critical thinking, information literacy, digital and visual literacy, research skills, creativity, communication skills, and synthesizing skills. It must be noted that their understanding of "analyzing and researching skills" mainly involves research of existing literature. In only one of the eleven studies (Schulz et al., 2020) do the students use their own data for their infographics, but within a narrow social media analysis project. Ibrahem and Alamro (2020) studied the different effects

of infographics used as instructional tools for presenting complex information in HE and found indications that infographics are effective for improving students' achievement, e-learning and computer skills, and achievement motivation.

Drawing can, with socio-cultural lenses, be seen as a cognitive and cultural tool, alongside language, writing, and counting (Dysthe, 2001, s. 76). Rienecker et al. (2020) describe Vygotsky's explanation of the internalization process that occurs through mediation via artifacts (e.g., concrete things or mental aids). Mental aids, such as symbols, signs, and drawings, can therefore be valuable tools for the learning process. Signs and symbols are examples of artifacts with culturally transmitted meanings. Vygotsky (1978) also introduced the zone of proximal development, which is the gap between a child's current developmental level and the potential developmental level that can be reached when the child is aided by a more knowledgeable individual (often an adult or a peer), emphasizing the importance of collaborative learning. Infographics can be created individually or collaboratively. "Whenever learners are given collaboration-based tasks to create infographics, this practice serves as a venue for collective knowledge creation and learning to collaborate" (Jaleniauskiene and Kasperiunien, 2022, p.3). Although Vygotsky's theories focus on children's development, socio-cultural theories are widely used in HE. Creating infographics is a concrete example of the mediated perspective and collaborative learning focus of socio-cultural theories.

2.3 Student-generated infographics

In an educational setting, there is a significant difference between teacher- and student-made infographics, "these two practices can be evaluated in terms of passive or active learning" (Jaleniauskiene and Kasperiunien, 2022, p.3). Unlike our study, several other studies about student-generated infographics have focused on students generating poster-like infographics, and students appear to benefit from those creations. For example, Blackburn (2019) found that poster-like infographics helped the students find key information when reading research papers, and Davidson (2014) exemplifies how secondary education science students can present their results in infographics based on their own data.

Krishnan et al. (2021) argue that integrating infographics thoughtfully into a process-oriented approach to writing can support students in cultivating their concepts and structuring their composition process. This visual representation of students' cognition can offer teachers a streamlined method with which to promptly evaluate students' writing abilities and offer constructive feedback.

Jaleniauskiene and Kasperiunien (2022) suggest tasks to engage students in the creation of infographics. Their tasks focus on topics, content, visual design, social aspects, reflection and revision, proficiency development, assessment, and final infographics. The authors also conclude that infographics might foster divergent thinking instead of convergent thinking (i.e., everyone needs to attain one right answer or apply the same procedure) because students have the freedom to choose the content and design.

2.4 Research-based learning

Higher education's characteristics are connected to research-based learning, and the Norwegian Report to the Storting (white paper) no. 16 emphasizes that "active participation in research among students has a clear connection with students' ability for critical thinking, investigation and lifelong learning" (Ministry of Education and Research, 2017, p. 54). A Norwegian teacher survey concludes that findings from recent research are included in HE courses, and that the curriculum is updated and adapted to societal developments. The survey further concludes that students are less exposed to research-like work and participate even less in research and development work (Lid et al., 2018). Griffiths (2004, p.722) defined four models of the research-teaching nexus: 1) research-led teaching, in which the curriculum is based on research findings; 2) research-oriented teaching, in which the emphasis is on understanding the processes by which knowledge is produced; 3) research-based teaching, in which the curriculum is designed around inquiry-based learning activities; and 4) research-informed teaching, which uses systematic inquiries of the teaching and learning process itself. Master's and bachelor's projects can ensure that students learn through inquiry-based learning activities, corresponding to Griffiths' (2004, p. 722) third model.

Tsujioka (2018) suggests that data visualization might help researchers write more clearly when drafting academic texts. Bazeley (2009) describes methods that might help students understand and interpret the data they gather. These methods involve meaning making of different categories or topics, looking for patterns and differences, considering different opinions and cases that do not fit the usual patterns, returning to what others have written about the topic, creating visual aids like charts and graphs, and using writing to analyze thoughts. Jaleniauskiene and Kasperiunien's (2022) description of how students make infographics includes a process of "searching for suitable sources and thinking critically of what needs to be included as well as summarized in shorter ways," but it does not include the processes of student research in, for example, bachelor's or master's projects, where students also collect and analyze their own data. HSiao et al. (2019) report that using an infographic as a learning tool to teach students a research method and to create and present research was a positive experience.

3 Research method

To answer the research questions, we chose an action research design. Action research aims to improve practice (Elliott, 1991), starting with a problem that must be solved through interventions (actions) and a systematic and cyclical process of data collection, analysis, and reflection. The aim of the action research was to study how the use of infographics can help students in their learning process during a 5-month-long student research project. The target group was third-year bachelor's degree students in a creative IT study program who were working on their final project. This chapter's structure is based on Lewin's four main stages of an action research process: planning, acting, observing, and reflecting (Lewin in Cohen et al., 2018). Figure 1 shows the iterations of our action research project.

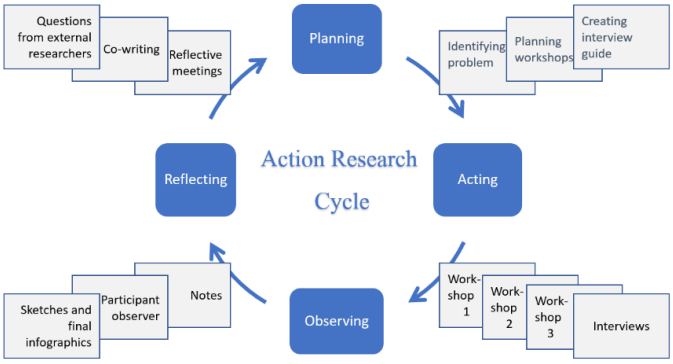

Fig. 1. The action research cycle as used in our project.

3.1 Planning

Based on the problem statement and research questions related to an experienced problem and defined at an early stage of the project, we decided to perform the first two interventions as a teacher and student workshop. After the teacher workshop, we planned the content of new workshops based our experiences and felt needs. The first student workshop was a refined and target-specific version of the teacher workshop. The second student workshop was necessary to provide sufficient time for analysis of the students' data as well as for reflections, iterations, and feedback.

The interview guide was designed at an early stage; however, during the project, we decided to remove several irrelevant questions from the guide.

3.2 Acting

Our project's main actions were the three workshops, the first of which was held in February 2023 for teachers. We hired an external expert in infographics and visual communication who ran the first workshop. The workshop was voluntary, and seven teachers from the Games and Entertainment Technology study program attended. The 3-hour workshop included an introduction to infographics, practical exercises in which participants made their own infographics and discussed the drafts, and a discussion of how they could use infographics in their teaching and supervising practice. Four participants were supervising bachelor's projects during the spring semester.

The second workshop, which was conducted by the same external expert, was held in March for the bachelor's students. The 3-hour workshop included an introduction to infographics and exercises to create infographics based on available test-data. Twenty-one bachelor's students currently working on their bachelor's projects were invited to the voluntary workshop, and seven students took part.

The third and final workshop was conducted by the teacher and one of the researchers in April. During this workshop, the four participating students were working, both individually and collaboratively, on infographics related to data collected for their individual bachelor's projects. Because HSiao et al. (2019) suggest that

students may benefit from first sketching their infographics using paper and pencil, we decided to focus on non-digital infographics in the workshops. The students did, however, create and refine their final infographics for their bachelor's theses in digital formats.

Two students who actively used infographics throughout the research process were interviewed following the completion of their bachelor's projects. The interviews were conducted by one of the action researchers using a co-created interview guide used for the semi-structured interviews. The interviews lasted approximately 30 minutes and were fully transcribed.

3.3 Observing

The action research team joined all the workshops. The observations focused on the students' initial sketches as well as the discussions between students and between students and workshop organizers. In addition, one of the action researchers observed the students' work with infographics as an analysis tool in her role as a bachelor's project supervisor. We also observed the students' process from the sketches to the final products.

3.4 Reflecting

The action research team conducted a series of reflective meetings before and after each action. We also conducted co-reflection sessions during the iterative co-writing process of this article. Furthermore, we held two presentations in an external forum of educational researchers. Team reflections were required before the presentations, and questions from the external forum were discussed and reflected upon.

We also examined the final infographics in the interviewed students' bachelor's theses. Cohen et al. (p. 704) describe how visual images can be analyzed "in a similar way to that of analyzing texts, for example, through 'reading' the meanings, backgrounds, and values." The units of reflection were the following: infographics as part of the research process, infographics in early analysis, infographics as an overview of findings, qualitative versus quantitative infographics, to what degree the infographics "stand alone," maturity of icons and symbols, and self-made versus reused symbols.

We aimed to "practice what we preach" by sketching, drawing, and presenting our ideas, experiences, and reflections through infographics, focusing on the use of infographics as an analysis tool instead of only as a presentation tool.

3.5 Trustworthiness

The use of several data collection methods, such as observation, interviews, and collection of the students' infographics, ensured the study's trustworthiness. The study was approved by the Norwegian Agency for Shared Services in Education and Research (SIKT), and informants could refuse to participate.

The study was conducted with a group of students in a creative IT study program Due to their background and interests, these students may be more familiar with the use

of symbols, signs, etc. than the average student. They also have experience with digital creative tools. Action research studies are always connected to the context in which they are performed. Nonetheless, the study contributes to the focus on a more general problem and a possible solution, and the study's problem and possible solutions can be considered a valuable phenomenon in other contexts.

4 Findings

Based upon observations, reflections, and students' feedback, the main findings of our study are an overview of key factors of infographics used as an analysis tool, a proposed teaching method structured around several workshops, and recommendations for concrete workshop learning activities.

The number of workshops is not specified, but the workshops should include an initial one in which students, through practical tasks, learn about infographics, examples of qualitative and quantitative infographics, cultural implications of visualizations, and the potential uses of infographics in student research projects. In addition, there should be one or two workshops in which students can work on their own data. The timing of the workshops should align with the early phases of a student research project and, most importantly, the project's analysis phase. The work on infographics in the phase of presenting findings can be processed through supervisor feedback.

4.1 Key factors of infographics as an analysis tool

In terms of content, the analysis workshop should include the following elements: clarification of ideas, categorization, iterations, reflections, and infographics as an interaction tool. Figure 2 illustrates key factors of how infographics can be useful in the analysis phase.

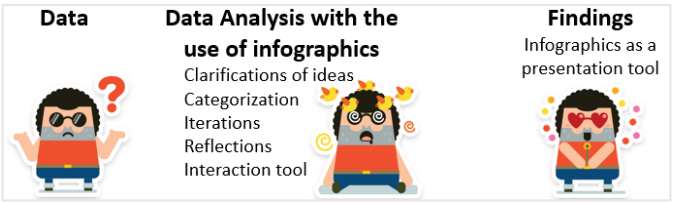

Fig. 2. Overview of three main phases of a student research project and the key factors of infographics in the analysis phase

Clarification of ideas: Using their own drawings and existing figures, the students start to clarify their ideas using visual figures. By remodeling and combining figures, their analysis constructs (e.g., codes and categories) are clarified.

Categorization: There are several techniques for categorizing qualitative data (e.g., color coding) or using software systems to cluster (e.g., citations). Adding symbols or figures to the data is one way of using infographics to categorize data.

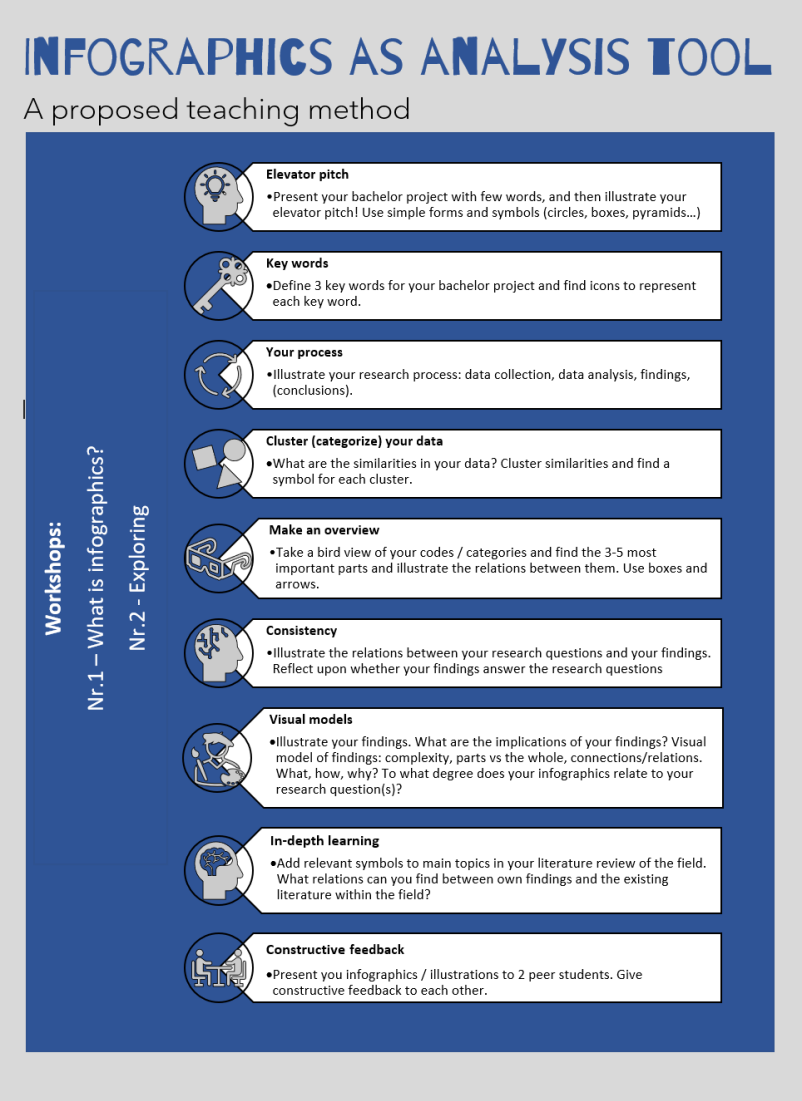

Fig. 3. Workshop tasks for students to succeed in using infographics as an analysis tool.

Iterations: The creation of infographics during the analysis process requires several iterations and refinements of the students' work and reflections as they move forward with their design and the analysis process.

Reflections: In-depth learning requires reflections, and the workshop tasks should include opportunities for students to reflect upon their problem statement, their analysis process, the consistency of their study, and the connections between their data and existing literature. Productive reflections require opportunities and time, both during and between workshops.

Infographics as interaction tools: In the process of using infographics, discussing the sketches proved valuable. The workshops should therefore include learning activities in which students individually sketch signs and symbols relevant to their data and then receive feedback on the sketches from peers and/or teachers. One goal is to test the cultural meanings of the sketches, and another is for students to use the visual representations of the data to help them articulate their ideas through speech, which can be helpful for the text production. Text and infographics will be closely connected.

4.2 Teaching method

The proposed teaching method is illustrated in Figure 3. The workshops must include practical drawing tasks. We recommend providing students with paper and pencils.

5 Discussion

In the following section, we will discuss our proposed teaching method in relation to existing theories in the field. First, we will discuss the choice of workshops as the main learning activity. Then, we will discuss the key factors of infographics as an analysis tool: clarification of ideas, categorization, iterations, reflections, and interaction.

5.1 Use of workshops as the teaching design

The proposed teaching method acts as scaffolding in the learning process. This relates to Vygotsky's ideas of mediated learning and drawing as cognitive and cultural tools. The visual expressions provide students with several ways to clearly communicate to themselves how they understand the data, codes, and categories. The teaching method also creates awareness and a focus on the vital analysis phase of the research process.

The workshops were a social arena with practical and hands-on tasks and a focus on student-generated infographics, which, according to Jaleniauskiene and Kasperiunien (2022), provide active learning. Damsgaard (2019) found that student activity is a key element for the transitions of students' learning, along with mastering, structure, and relationships with peers and teachers. All these elements can be addressed in a teacher-led, well-planned workshop. The concept of "trajectory" (Kress, 2006), which is related to Vygotsky's theories (1978) of scaffolding and learning, offers a meaningful connection to teaching strategies. Vygotsky's ideas emphasize the importance of guiding learners along a path of development that aligns with their current abilities while gradually introducing challenges that foster growth. This scaffolding concept, when applied to trajectories, confirms educators' significant role in structuring learning experiences and methods. Just as a skilled educator scaffolds learning experiences, trajectories within visual representations can guide learners through a progression of understanding, starting from the learner's existing knowledge and gradually evolving towards more advanced concepts. Scaffolding strategies, such as providing prompts, cues, and support, can be analogous to trajectories that help students navigate their intellectual journey.

One student's response regarding how the workshops influenced the learning process was as follows: “That was definitely what was most fun this semester. To actually experience something different than just sitting alone writing. That gets boring and the motivation is a bit like ‘meh’ … But the workshops – the ones who joined them and the ones who I have talked to, we all thought that we learned a lot and that it was good use of our time.”

5.2 Clarification of ideas

Student-made infographics based on existing literature – where students must start by researching the topic to understand the content and think critically to present it in their infographics – differ significantly from student research projects. These are defined as two different models by Griffiths (2004). The student must go through several research stages, from the initial choice of topic and definition of a problem statement to research design, data collection, data analysis, presentation, and discussion of findings before reaching the conclusion to the problem statement. In the existing literature, the data are already analyzed, and the main findings are highlighted using summaries, headings, figures, etc. Analyzing the collected data can be a complicated process; it is often difficult to determine, as an inexperienced researcher, how to proceed and when “saturation” has been reached.

In the educational realm, the integration of perceptual shapes within infographics might offer a way for students to dissect complex concepts. Infographics, with their combination of visuals and succinct text, serve as a bridge between analytical thinking and creative interpretation. When students create infographics, they are not only consuming information but also actively participating in the decoding process, which enhances their critical thinking skills. Analyzing perceptual shapes can reveal layers of meaning, according to Arnheim’s (1974) visual language. One of the participating students described their experience: “It helped me to have a clearer view of what I found. And it gave me the opportunity to present my interpretations of the findings in a way that I found very supportive.”

5.3 Categorization

Categorization is only one of many analysis techniques. Grouping, classification, patterns, trends, etc. are, in a broad sense, important constructs in data analysis. Qualitative analysis includes “organizing, describing, understanding, accounting for, and explaining data, making sense of data…noting patterns, themes, categories and regularities” (Cohen et al., 2018, p. 643). We argue that the use of infographics can also be valuable in quantitative research, when beginners try to understand and explain the findings, which are often visually presented as diagrams, tables etc.

Jaleniauskiene and Kasperiunien (2022) describe the value of synthesizing skills in the use of infographics, but often in connection to existing literature rather than to students’ own data. Based on the students’ analysis of their own data, we found that infographics and the use of symbols and signs were useful in the categorization process. One student did not realize that they were using an infographic as part of the analysis,

mainly because the research theory concepts were new. They first claimed that they only used infographics to present findings, but later described how infographics were used to categorize the data: “I'm not very good at writing, so for me it’s really helpful when I can sit and draw different things and be able to categorize that way.”

5.4 Iterations

HSiao et al. (2019) recommend that students start sketching their infographic using paper and pencil, review several examples, and discuss the elements of effective and ineffective infographics. One student reported that they were using a paper sketchbook throughout the process, while another student was clear that s/he would have preferred to only work digitally with infographics.

Because translating ideas into a graphical format is a process, several iterations of the infographic may be necessary before it is finalized (Hsiao et al., 2019). As supervisors, we observed that the student-generated infographics were closely connected to the raw data in the first iteration. One student concluded that “It's a very good idea to use infographics in the first stages / early stage of the research” and that “it is a very powerful tool. Even in the early stages of the research.” The student later categorized, interpreted, and refined the data through several iterations with feedback, which lead to a further understanding of what analysis is, before the final version was presented. Regarding their work on icons, one student reported that s/he made many versions: “I think there were 6-7 different versions. I felt it necessary.”

5.5 Reflections

In their suggestions for tasks to engage students in creating infographics, Jaleniauskiene and Kasperiunien (2022) highlight reflection as an important task. They exemplify this by focusing on self-reflection on the process and reflection on infographics made by peers. In our suggested workshop tasks, reflections are related to different phases of the research process, including the infographics’ relations to research questions, the infographics’ relations to findings, the research questions’ relations to findings, and the findings’ relations to existing literature. This is to ensure consistency in the research project and in-depth learning through the understanding of concepts, methods, and content relations, in addition to meta-reflections, such as the following from one of the students: “I was thinking about using some kind of infographic for my thesis before the workshop. But I was not sure if I could. If I was allowed to do it. And in what way and to what extent I could use them.”

5.6 Infographics as interaction tool

Socio-cultural learning theories emphasize the active and social learner, and we also experienced the importance and power of infographics as a tool for social interactions. Some studies in Jaleniauskiene and Kasperiunien (2022) scoping review address the use of infographics in groupwork; however, in our case, the students worked on individual projects. Some of the workshop tasks focused on sharing ideas and sketches

and receiving constructive feedback from peers. Like Kibar and Akkoyunlu (2017), we experienced infographics as a visualization method for the creation of content and interactive communication in learning.

In Jaleniauskiene and Kasperiunien's (2022) suggestions for the design of tasks that engage students in creating infographics, one of the eight tasks is named "social aspects." However, their focus is on collaborative infographics. They conclude that whenever students are given collaboration-based tasks to create infographics, it leads to collective knowledge creation, and the students learn to collaborate. We agree with their finding but seek to emphasize that infographics are also a useful interaction tool for individual student research projects. The emphasis on social interaction and collaboration aligns with trajectories (Kress, 2006) that emphasize guided learning. In a collaborative setting, learners can collectively follow trajectories, and the shared exploration enriches the learning experience. In the study by Schulz et al. (2020), infographics were a tool for feedback collection, as they were in our study. One student described how they used peers in the iterative process of creating visuals: "I showed them what I had created so far and asked them what they thought it expressed. I got different answers, and I realized that I had to make changes. I further described what I wanted to communicate and asked if they could suggest icons that would work better."

6 Conclusions

Our action research study aimed to contribute to solving IT students' difficulty with analyzing collected data in their bachelor's projects. Analysis is a crucial phase in any research project, and we considered it necessary to improve teaching and learning, with a focus on analysis for inexperienced researchers. To help students with their analysis, our intervention aimed to use infographics as an analysis tool through workshops and interviews. Based on several action research iterations of planning, acting, observing, and reflecting, we presented an overview of the key factors of infographics as an analysis tool and proposed a teaching method with concrete workshop activities to help students analyze their data with infographics. This paper shows that symbols, icons, and drawings, in combination with academic writing, have the potential to create more distinct ideas. Further research should investigate the use of infographics as an analysis tool in master's projects and within fields other than IT.

References

1. Arnheim, R. (1974). Art and Visual Perception. A Psychology of the Creative Eye. The new Version. University of California Press. Berkeley, Los Angeles, London.
2. Barthes, R. (1999). Rhetoric of the image. In Visual culture: the reader (pp. 33–40).
3. Bazeley, P. (2009). Analysing Qualitative Data: More Than 'Identifying Themes'.
4. Blackburn, R.A.R. (2019). Using Infographic Creation as Tool for Science-Communication Assessment and a Means of Connecting Students to Their Departmental Research. Journal of Chemical Education, 2019. 96(7): p. 1510-1514.

5. Cohen, L., Manion, L and Morrison, K. (2018). Research methods in education, 8th ed. Routledge, London and New York.
6. Cornford, T. and Smithson, S. (1996). Analyzing research data, in Project Research in Information Systems: A Student's Guide. Macmillan Education UK: London. p. 108-135.
7. Damsgaard, H. (2019). Studielivskvalitet. Universitetsforlaget.
8. Davidson, R. (2014). Using infographics in the science classroom. The Science Teacher, 2014.
9. Dysthe, O. (Red.). (2001). Dialog, samspel og læring (3. utg.). Abstrakt forlag.
10. Elliot, J. (1991). Action Research for Educational Change. Buckingham, UK: Open university press
11. Fincher, S.A., Tenenberg, J., Dorn, B., Hundhausen, C., McCarney, R. and Murphy, L. (2019). Computing education research today. In Fincher, S.A and Robins, A.V. (ed.) The Cambridge Handbook of Computing Education research, Cambridge University Press.
12. Griffiths, R. (2004). Knowledge production and the research–teaching nexus: The case of the built environment disciplines. Studies in Higher Education, 29(6), 709–726. https://doi.org/10.1080/0307507042000287212.
13. Hsiao, P. Y., Laquatra, I., Johnson, R. M., and Smolic, C. E. (2019). Using Infographics to Teach the Evidence Analysis Process to Senior Undergraduate Students. Journal of the Academy of Nutrition and Dietetics, 119(1), 26,30–29,30. https://doi.org/10.1016/j.jand.2017.10.022
14. Jaleniauskiene, E., and Kasperiuniene, J. (2022). Infographics in higher education: A scoping review. E-Learning and Digital Media, 0(0). https://doi.org/10.1177/20427530221107774
15. Kibar, P.N. and Akkoyunlu, B. (2017) Fostering and assessing infographic design for learning: the development of infographic design criteria, Journal of Visual Literacy, 36:1, 20-40, DOI: 10.1080/1051144X.2017.1331680
16. Krishnan, J., Maamuujav, U. and Collins, P. (2021). Multiple utilities of infographics in undergraduate students' process-based writing. Writing and Pedagogy, 2021. 12(2-3): p. 369–394.
17. Ministry of Education and Research (2017). Meld. St. 16 (2016–2017). Quality Culture in Higher Education. Ministry of Education and Research. https://www.regjeringen.no/en/dokumenter/meld.-st.-16-20162017/id2536007/
18. Naparin, H and Saad, A.B. (2017). Infographics in education: Review on infographics design. The International Journal of Multimedia and Its Applications (IJMA) Vol.9, No.4/5/6.
19. Rienecker, L., Stray Jørgensen, P., Dolin, J., Ingerslev, G. H., and Mørcke, A. M. (2020). Universitetspædagogik. Samfundslitteratur.
20. Saunders D.H., Horrell, A. and Murray, A. (2017). Infographics for student assessment: more than meets the eye. British Journal of Sports Medicine. 52(23): 1487–1488.
21. Schulz, D., van der Woud, A., and Westhof, J. (2020). The best indycaster project: Analysing and understanding meaningful YouTube content, dialogue and commitment as part of responsible management education. The international journal of management education, 18(1), 100335.
22. Tsujioka, K., 2018. A case study of ICT used by big data processing in education, in: Proceedings of the 6th international Conference on Information and Educational Technology. https://doi.org/10.1145/3178158.3178190
23. Vygotskij, L. S. (1978). Mind in society: the development of higher psychological processes. Harvard University Press.