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A methodological approach to content analysis of qualitative data in science education: An applied example

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Abstract

Effective learning processes in science education require the use of different research methods. In this context, content analysis, a qualitative research method, is a powerful tool for science education. While descriptive analysis is a statistically descriptive method summarising the basic features of data, content analysis is a method that uncovers meaning, themes and patterns by examining texts or qualitative data in depth. Although descriptive and content analyses are used in research, they have different purposes and techniques. This study aims to create a case study in which qualitative data's meaning, themes and patterns are revealed and analysed in depth within a scenario constructed using accurate data. As part of this scenario, we will assume that interviews were conducted with students and teachers, the researcher used a semi-structured observation form, and open-ended self-evaluation reports were prepared in which students evaluated themselves. We will explain how the data obtained from student-teacher interviews, observation and student self-assessment reports should be followed according to the content analysis stages. The stages of collecting and analysing qualitative data require detailed planning, which is a crucial part of the research process. In this study, in addition to the content analysis used in analysing qualitative data, it is also important that the other stages should be planned and implemented in detail. The processes before and after collecting the data and finally reporting the data should be planned in line with the purpose of the research. Before the content analysis process, it will be necessary to use many data collection tools to collect the data per the research subject.

Keywords: Qualitative data, qualitative data analysis, content analysis, Science education.

Introduction

Content analysis is an important research method widely used in social sciences and has been used extensively in psychology and social sciences, especially since the 1980s (Alanka, 2024). Content analysis, a qualitative and quantitative analysis technique in many disciplines, is based on systematically examining written and visual materials. This method aims to identify, categorize and interpret the main components of a text or discourse (Neuendorf, 2017). Content analysis can be defined as the process of quantifying people's written and spoken expressions. In this context, it is based on analyzing the frequency of use of specified categories (Alanka, 2024).

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Content analysis is widely used in various fields, such as social sciences, psychology, sociology, communication and business (Neuendorf, 2017). The suitability of this method for human-coded and computer-assisted analysis makes it increasingly used in scientific studies. For researchers, content analysis offers broad interpretive possibilities and highlights methodological differences between qualitative and quantitative researchers. Traditionally, quantitative researchers are considered neutral collectors of information, while qualitative researchers are seen as those who create and interpret information and take an active role in the research process (Alanka, 2024; Kümbetoğlu, 2008). Content analysis is important in qualitative and quantitative analysis as it enables the systematic examination and interpretation of written and oral expressions. Content analysis is frequently used in science teaching in educational sciences as in many disciplines (Arduç, 2024; Devran et al., 2021; Ültay & Sungur, 2024; Yanarateş, 2022).

Science education is an important field that enables students to develop scientific thinking skills and gain scientific literacy. In order to learn and question nature, environment and living life in a meaningful way and to associate them with their own lives, science teaching should be implemented with the most appropriate methods. By using appropriate methods in this way, students will be able to contribute to the development of scientific thinking skills, inquiry skills and critical thinking skills. As a result, they can make sense of multiple disciplines together. Different research methods should be utilized to design and implement effective learning processes in science teaching. In this context, content analysis, one of the qualitative research methods, is a practical analysis method that can be used in science education (Ültay & Sungur, 2024). Conducting only quantitative studies in the field of science involves significant limitations in revealing and interpreting the results of the desired study. Quantitative studies cannot answer questions such as why, how and why. In this case, qualitative data are needed to interpret the results in depth. One of the most effective methods for interpreting the data obtained from qualitative data collection tools suitable for the study is content analysis.

The primary purpose of content analysis is to reach concepts and relationships that can explain the data obtained. Through content analysis, it is attempted to define the data and to reveal the facts that may be hidden in the data. The basic process in content analysis is to bring together and interpret similar data within the framework of specific concepts and themes (Yıldırım & Şimşek, 2021). Science subject scopes include many complex concepts and abstract expressions (Yanarateş, 2022). This situation can negatively impact the learning process when students cannot make sense of concepts and abstract expressions. In order to interpret students' achievement and learning process, data obtained from different data collection tools such as interviews, observations and self-assessments are needed. With the meaningful interpretation of the data collected in this way, success or failure in learning processes can be expressed much more meaningfully.

Descriptive analysis and content analysis are different concepts and should not be confused. Many studies have tried to conduct content analysis in the literature but have remained at the descriptive analysis stage. While descriptive analysis is a statistically descriptive method that summarises the basic features of the data, content analysis is a method in which meaning, themes and patterns are revealed by examining texts or qualitative data in depth. Although descriptive analysis and content analysis are both analysis methods used in research, they have different purposes and techniques.

In qualitative data analysis, content analysis makes unstructured data such as text, visual, or audio recordings meaningful and reveals their basic patterns. The following purposes are practical in conducting content analysis (Krippendorff, 2018).

Structuring and Categorising Data: Categorising data through coding makes complex data more understandable. This structuring allows for organisation and comparison within the masses of data.

Revealing Hidden Meanings: Content analysis plays a crucial role in qualitative data analysis by skimming the surface but diving deep into the data, revealing unseen meanings and providing a deeper understanding of the participants' hidden thoughts, beliefs, or attitudes. This aspect of content analysis significantly enhances the depth and richness of understanding in qualitative data analysis.

Identification of Themes and Patterns: Content analysis does not just uncover data; it organises it into meaningful themes by identifying repetitive expressions or concepts in large amounts of data. This makes it more straightforward to determine which topics stand out in the collected data, bringing clarity and structure to the analysis.

Analysing the Frequency of Concepts and Meanings: Content analysis examines how often certain words or concepts are used and determines the extent to which the subject being studied is emphasised.

Supporting the Findings with Quantitative Analysis: Content analysis significantly improves the measurable nature of qualitative data, thereby strengthening the findings with quantitative analyses. This approach ensures that quantitative analyses robustly support qualitative findings, leading to more substantial and reliable results.

Content analysis allows researchers to deeply examine the data's meaning (Krippendorff, 2018).

Content analysis is an important research method that provides systematic access to information in data sets. Content analysis is divided into three main categories: quantitative, qualitative and mixed content analysis. These three types of analysis are selected depending on the purpose of the research and data structure and are frequently used in social sciences (Gül & Nizam, 2021). Quantitative content analysis is an approach that focuses on objective, systematic and measurable elements of data (White & Marsh, 2006). This technique is applied by counting the repetition frequency of certain text words and calculating the time allocated to specific topics during the interview (Gönç Şavran, 2018). The primary purpose here is to objectively evaluate communication processes by numerically expressing the concepts contained in the text (Stemler, 2000). Qualitative content analysis is a subjective but systematic interpretation process that identifies text themes and patterns. This technique analyses the text's context and meanings beyond counting the frequency of words or concepts (Zhang & Wildemuth, 2009). In qualitative content analysis, data are coded and divided into themes gradually and systematically, and an interpretive approach is adopted in this process (Mayring, 2011). Mixed content analysis is a method that combines quantitative and qualitative content analysis and deals with the analysis of numerical data and the interpretation of meanings together depending on the requirements of the research topic (Bal, 2013). This method allows the same material to be subjected to quantitative and qualitative processes, enabling a more comprehensive and in-depth analysis (Gül & Nizam, 2021).

Content analysis is a research method that has versatile uses in science education. It can be used in many areas, from analyzing textbooks to identifying student misconceptions. Researchers and teachers in science education can make science teaching more effective by using the content analysis method. They can analyze students' learning in depth and reveal the cause of some learning difficulties in a multidimensional, integrated way. Teachers can create a more effective lesson plan by examining the root causes of success or failure. Therefore, the broader use of content analysis in science education can improve the quality of education.

In this study, all process stages will be demonstrated practically through a fictionalised scenario using actual data to conduct content analysis. The data were taken from Çetinkaya's (2015) doctoral thesis study. As a sample scenario, it will be assumed that a web-supported teaching material was used for the systems in our body unit in the 6th-grade science course, interviews (interviews) were conducted with students and teachers, the researcher used a semi-structured observation form, and open-ended self-evaluation reports were prepared in which students evaluated themselves. The qualitative research data obtained through student-teacher interviews, observation, and student self-evaluation reports will be analysed in four stages. These stages are: i) coding the data, ii) finding draft themes, iii) organising the codes and themes, and iv) describing and interpreting the findings (Yıldırım & Şimşek, 2021).

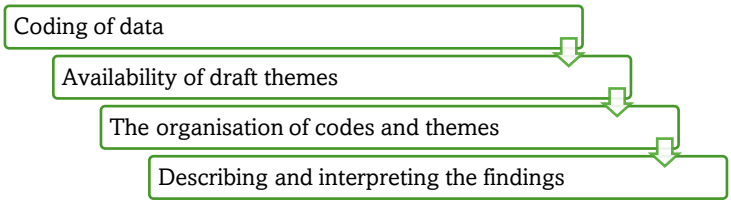

Figure 1 Analysing qualitative research data in four stages.

In addition to the four stages in Figure 1, conducting reliability and validity checks at the end of the process is crucial. An independent researcher can re-code the content analysis to increase its accuracy, or the validity of the codes and categories determined by expert opinions can be evaluated. This independent review is not just a formality but a critical part of the analysis process that helps ensure the findings' quality and trustworthiness, thereby enhancing the robustness and reliability of the analysis.

This study aims to create a case study in which qualitative data's meaning, themes and patterns are revealed and examined in depth within a scenario constructed using accurate data. In this direction, it aims to present a study that will guide teachers and researchers to effectively apply the processes of creating and interpreting content analysis with a methodological approach in their studies in science teaching, potentially revolutionizing the field of science education.

Qualitative data analysis stages

Before embarking on the data collection process, it is crucial to establish the research questions. These questions not only guide the data collection, ensuring its relevance and value but also set the direction and purpose of the analysis. They provide a framework for understanding the data and help to focus the research on the most critical aspects of the topic. The qualitative data to be analysed (interview transcripts, written documents, social media posts, etc.) are then collected and prepared for analysis.

Figure 2 presents the stages of data analysis used to analyse the data obtained from interviews

with students and teachers, self-evaluation reports, and semi-structured observation forms. The process of organising, coding, interpreting, and writing the data is carried out in 11 stages.

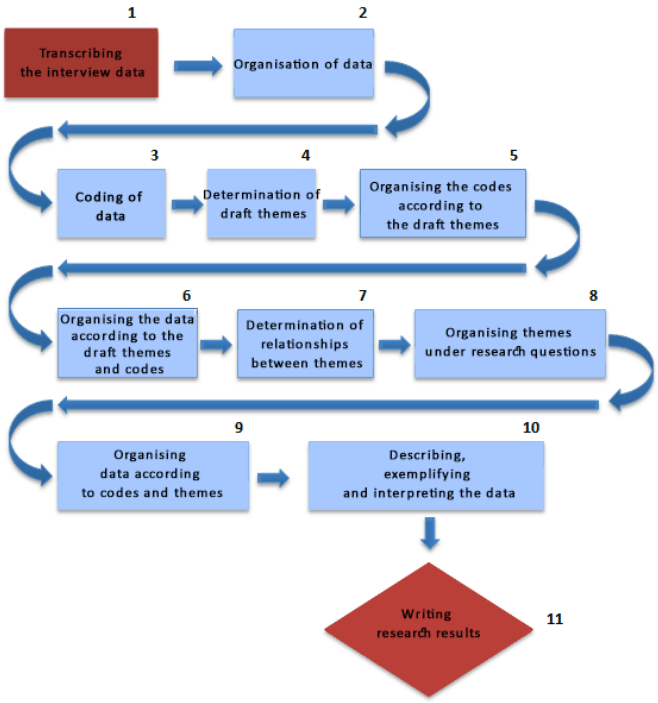

Figure 2 Stages followed in the analysis of interview data (Çetinkaya, 2015; Yıldırım & Şimşek, 2021).

Coding of data

Coding allows the researcher to divide the data into meaningful parts and place each in a conceptual framework. The concepts used in coding can be derived from the researcher's interpretations, the relevant literature or the data content. The success of the coding process is critical for the research to reach reliable and valid results (İlgar & İlgar, 2014). Especially for researchers working with large and complex data sets, selectivity ensures that the analysis process proceeds in a focused and systematic way. The coding reliability is tested by having multiple researchers independently code the same data set and statistically comparing the coding agreements. One of the commonly used methods for measuring reliability is the formula "Agreement/(Agreement + Disagreement) x 100" proposed by Miles and Huberman (1994). An acceptable level of reliability in research is generally determined to be at least 70%. Achieving this threshold value indicates that a common understanding of coding has been formed among the researchers and that the findings obtained are reproducible. The systematic and consistent coding process significantly enhances the scientific validity of qualitative content analysis, providing researchers with reassurance and confidence in the reliability of their results. Therefore, the coding phase is not only the data organisation but also a process that strengthens the researcher's interaction with the data and his/her analytical perspective (İlgar & İlgar, 2014).

At the coding stage, the data obtained is carefully analysed and divided into meaningful sections. For instance, the data from self-assessment reports and observations are evaluated as written documents, with key points and themes identified. Similarly, during the interview process with students and teachers, the data obtained with the help of a voice recorder are transcribed and then coded for analysis.

Coding the data starts with labelling the data units divided into meaningful sections. In order to avoid ethical problems regarding the students and teachers from whom the data are obtained, they are encrypted. In the coding process, codes such as "S" and sequence number (S_1, $S_{2,}$ ...) for the students with whom the interviews were conducted, and "F" and sequence number ($F_{1,}$F2, ...) for the teachers can be used. For observations, observation sequence numbers can be coded as (G_1, G2, ...), for self-assessment forms as "Self" and sequence number (Self 1, Self 2, ...). The first stage of coding the data should be carried out superficially, and then it would be appropriate to review it once again for confirmation.

Availability of Draft Themes

Based on the codes that emerged in the first stage, themes that can be organised under specific categories are created. The codes are first analysed to bring themes together. Commonalities between the codes are tried to be found. The similarities and differences of the codes that emerged in the first stage are determined, and themes are determined by bringing together the codes that are related to each other accordingly.

Whether the data under the theme forms a meaningful whole regarding internal consistency should be considered when determining the themes. In addition to the emerging themes being different, it also tries to ensure that they form a meaningful whole among themselves. This way, it is tried to ensure external consistency in thematic coding.

The Organisation of Codes and Themes

After completing the thematic coding stage, the data are organised according to the emerging codes and themes. The data under the same code or theme are defined and presented interrelatedly. At this stage, the researcher should not include his/her own opinions and interpretations.

Describing and Interpreting the Findings

At this stage, the relationships between the findings are explained to give meaning to the data obtained. In addition, the importance of the results obtained by establishing cause-and-effect relationships and drawing conclusions from the findings should be explained.

The interviews conducted in the sample scenario were with three science teachers and nine students. The qualitative data will be analysed by coding the students as S_1, S2, S3,... and the teachers as F_1, F_2, F_3,... (Table 1).

Table 1 Distribution and coding of students and teachers participating in the ınterview according to schools

School Code	Student Codes	Science Teachers' Codes
O1	S1, S2, S3	F1
O2	S4, S5, S6	F2
O3	S7, S8, S9	F3
Total	9	3

Content analysis of the qualitative data in the sample scenario was described under the themes of "Physical Environment", "Social Environment", "Interdisciplinary Approach", "Personal Gain", "Effective Teaching", "Cognitive Characteristics", "Affective Characteristics", and "Measurement and Evaluation". In creating codes and themes, the researcher used self-evaluation forms, interviews with students and teachers, and observation notes organised.

A pattern was formed from the emerging themes, and Figure 3 presents the holistic structure of the findings.

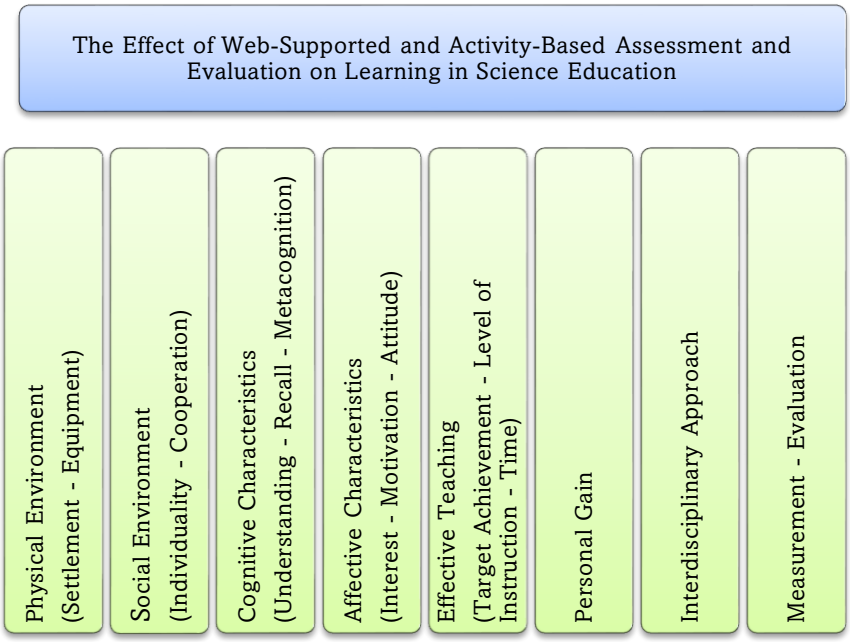

Figure 3 Pattern obtained from qualitative data (themes and codes).

Based on the sample scenario, eight themes and sub-themes emerged in some themes. One of these eight themes, the theme named "Social Environment," and the sub-themes named "Individuality" and "Cooperation" belonging to this theme, is given an example in which the evidence of the sub-themes is presented, and descriptive explanations are made. The stages of describing the content of the other seven themes include processes like the example below. Based on this example, other themes can be described similarly.

Below is an example of how the "individuality" and "cooperation" sub-themes under the "Social Environment" theme are interpreted.

Example: Interpretation of Themes

a. Social Environment

The social environment in which students construct knowledge is an essential feature of the constructivist learning approach. As a result of the content analysis of the qualitative data obtained from the classes in which the experimental study was conducted, the themes of "Individuality" and "Cooperation" were reached. How learners construct and make sense of knowledge is influenced by social and cultural factors as well as physical and personal factors. The social and cultural environment should be considered when making learning meaningful for students (Stears & Gopal, 2010). Vygotsky's theory that the development direction is from society to the individual (Vygotsky, 2012) is effective in this respect. Learning does not take place cognitively alone but in environments of social interaction and activity, informed by the day-to-day possibilities of culture. From a social constructivist perspective, learning occurs best in the social environment mutually created by the student and the teacher (Stears & Gopal, 2010).

The material we have prepared positively reflects students' social environment. These themes are analysed in detail below.

a1. Individuality

The data obtained from interviews with students, observations and self-assessment forms are as follows;

> "It was nice to be able to access activities outside the classroom and to do as much as we wanted on our own." (S2)
>
> "I learn the parts I do not understand by using the activities while working on my own at home." (S4)
>
> "I realised that I could learn better when our teacher showed it in the classroom with a projector, and then I studied online at home. ...I was able to learn the parts I did not understand on my own." (S9)
>
> "It was beneficial when I was working because I like to work on my own." (Self 17)
>
> "I could not work on my own, but I learnt that I could work." (Self 28)

Students stated that interactive activities that help them learn while working independently outside the classroom facilitated their learning. The observations made in the classes where the implementation was carried out also supported the students' views. Some of the students tended to solve the activities individually. The students with this tendency could identify their incorrect or incomplete knowledge through the questions asked. When directed to do the related activity, they repeated it as often as they wanted.

The data obtained from student opinions, self-evaluations, and observations suggest that the prepared material effectively aids students' work.

The data obtained from the interviews with the teachers are as follows;

> It was one of the different aspects of the course that the students were more enthusiastic about participating in the lesson, especially since they did the activities individually in the computer classroom and did them all together in the classroom environment. (F3)
>
> Providing students the opportunity to work individually and repeat as much as they want is important in increasing their success. With this student-centred study, students are more active and willing. (F2)

Considering students' different perception levels, it is known that some students can learn by repeating more than once. Teacher opinions found the positive effects of the material we used on student achievement, and it does not impose any restrictions on this issue. It was stated that the fact that the activities carried out under the teacher's guidance in the classroom environment through the projection device were also possible to be used individually in the computer laboratory made a difference in the teaching of the course.

a2. Cooperation

As of 2005, in the science and technology curriculum, revised based on the constructivist approach, collaborative practices are frequently included within the scope of activity-based teaching. The 2013 and 2018 revised science curriculums stated the importance of including collaborative learning environments in lesson planning and implementation. It is understood from student self-evaluations and student and teacher opinions that the reflections of the curriculum, which is based on the principle that students work by helping and encouraging each other, are also seen in our study.

The data obtained from the interviews with the students and self-assessment forms are as follows;

> "The activities that helped us find the truth by dragging words into the gaps were good. I liked doing it with my friends." (S2)
>
> "My friends helped me with the activities I could not do, and we did them together. Our teacher allowed us to do it together with our friends." (S3)
>
> "At school, our teacher took us to the computer class so that everyone could do the activities. There, I both revised and asked my friends and my teacher about the parts I did not understand." (S6)
>
> "... it was nice to do some activities with our friends." (S5)
>
> "I enjoyed doing it with my friends." (Self 4)
>
> "My friend and I did it together at home; we repeated the activities of the places we did not know." (Self 21)

The students frequently expressed the positive effects of the opportunity to work with the help of a more talented friend in addition to their work. Data supporting the students' statements were obtained during the implementation observations. Not placing any restrictions during the application and allowing them to cooperate made the students feel more comfortable. In addition, it was observed that students tended to ask their friends around them before asking the teacher about the parts they could not understand.

The data obtained from the interviews with the teachers are as follows;

> "Students enjoy collaborating and making use of technology. Such details gain importance in the preparation of learning environments. From this point of view, I think you have positively contributed to the course's teaching." (F3)
>
> "Projection of the activities I used during lecturing the subjects and discussing them with the students increased the students' participation in the lesson. They did some activities alone and with their friends in the computer class, which made the lesson different from our previous lessons." (F2)
>
> "While lecturing in the classroom, discussing as a class by projection and correcting each other's mistakes in some activities created a more active and positive atmosphere in the classroom." (F1)
>
> "Providing individual use of the activities we used during the lesson in the computer class and allowing the students to repeat some subjects on their own was the biggest difference between my other class where we did not do the application. I was happy that some students helped each other and even shared about the activity with each other." (F2)

When the teacher statements are analysed, it is seen that the web-supported activities prepared during the lecture on the unit subjects are projected with a projection, and the whole class participates in the lecture. They especially emphasised that the learning environment is prepared to allow students to actively participate in the lesson based on the constructivist approach, which enables them to learn individually and interact with each other. The positive effects of the students' use of technological materials during the lesson's teaching were observed in the observations. In the meantime, the teacher constantly monitored the individual and cooperative work of the students by walking around the classroom. In addition to gaining cognitive process

skills, students' thoughts about social skills and cooperative teaching are frequently expressed in teacher and student opinions. In this context, our study provides the opportunity for students to work individually as well as to interact with each other.

Discussion

Qualitative data analysis in science education research can be used for many purposes. For example, qualitative data analysis allows a detailed examination of student learning processes, teachers' pedagogical approaches, and classroom interactions (Creswell & Poth, 2018). This method is a powerful tool to identify how students understand scientific concepts, their misconceptions, and difficulties in their learning processes (Bogdan & Biklen, 2007). In particular, data collection tools such as unstructured or semi-structured interviews, classroom observations, and open-ended questionnaires allow students to express their thoughts more freely (Merriam & Tisdell, 2015). Qualitative data analysis in science education helps better understand students' and teachers' science education experiences (Patton, 2015). Researchers can adapt to new developments that may emerge in the research process and revise the data collection process. It is also reported to be effective in determining how students understand scientific concepts and common misconceptions (Yin, 2018). Qualitative data analysis has limitations as well as advantages. Since qualitative research is usually conducted with small sample groups, the generalizability of the findings is limited (Cohen et al., 2018). Qualitative data analysis is time-consuming, requiring manual analysis of large data sets (Miles et al., 2014). The interpretation of data may depend on the researcher's perspective, which can lead to biased results (Denzin & Lincoln, 2011).

Qualitative data analysis in science education is a powerful method for better understanding students' learning processes, improving teaching methods, and evaluating perceptions of scientific concepts. However, it's important to acknowledge and address the limitations such as generalizability and researcher subjectivity. These limitations can be minimized by the methods applied in content analysis processes. Computer-assisted content analysis software (such as NVivo and MAXQDA) can help speed up the process and contribute to more objective analysis (Bazeley & Jackson, 2013). Using quantitative and qualitative content analysis can allow for a more comprehensive evaluation of the findings (Krippendorff, 2018). By overcoming these limitations, educators and researchers can feel a sense of accomplishment and be more motivated and determined in their research.

It is essential to use reliable data to interpret content analysis results. The coding reliability of data obtained from different data collection tools, such as interviews and observations, is tested by having more than one researcher code the same data set independently and statistically comparing the coding agreements. One of the methods used for reliability is the consensus formula proposed by Miles and Huberman (1994). An acceptable level of reliability in research is usually set at least seventy per cent. The closer this reference value is to one hundred per cent, the more likely it is that researcher-induced errors that may occur during coding will be minimized. Forming a standard coding close to each other between the researchers is an important indicator that the findings obtained are reproducible. Carrying out the coding process systematically and consistently increases the scientific validity of content analysis and enables the research to reach reliable results, instilling confidence in the audience about the validity of the research.

Science education is a discipline that aims to help individuals understand scientific processes, develop critical thinking skills and gain scientific literacy. Research methods used in science education are of great importance in evaluating students' learning processes, conceptual understanding and the effectiveness of teaching approaches. As an effective qualitative data analysis method used in science education research, content analysis allows for a systematic examination of students' and teachers' conceptual perceptions, learning processes and instructional materials. Content analysis in science education research systematically analyses texts, course materials, student writing, and teacher discourse (Krippendorff, 2018). Content analysis is a powerful tool, especially for assessing how students perceive scientific concepts and the effectiveness of teaching materials. This method allows for identifying patterns and themes by categorizing written or oral data (Elo & Kyngäs, 2008). Content analysis in science education provides reliable and repeatable results because it is based on a specific methodology (Neuendorf, 2017). It can be applied to various data sources from different data collection tools such as textbooks, student reports, teacher discourse, observations and digital sources (Mayring, 2014). Furthermore, content analysis allows for the analysis of in-depth conceptual frameworks that are not explicitly expressed in texts or discourses (Hsieh & Shannon, 2005).

This study focuses on the importance of content analysis, which can be used to analyse qualitative data, and how to do it. In addition, the stages of collecting and analysing qualitative data require careful planning. The processes before and after collecting the data and finally reporting the data should be planned in line with the purpose of the research. Before proceeding to the content analysis process, it will be necessary to use many data collection tools to collect data based on the research topic. Qualitative data are collected through various methods to understand a subject in depth and to explore individuals' thoughts, feelings and behaviours. These methods are usually based on unstructured or semi-structured data collection techniques. Interviews, observation, document analyses and open-ended questionnaires can be used to collect qualitative data. While collecting qualitative data, interviews can be conducted in unstructured, semi-structured, and focus group ways. Observations can be made as participant and direct observations. Document reviews can be done by analysing pre-existing documents such as books, reports, letters, diaries, and photographs. In open-ended questionnaires, questions are prepared as unstructured or open-ended. Participants express their answers freely. It is beneficial for obtaining short but detailed information from many people. These methods contribute to collecting detailed, in-depth and meaningful data in qualitative research. Which method to choose depends on the purpose of the research, suitability to the subject and access opportunities (Miles, Huberman, & Saldaña, 2014).

In qualitative data analysis, content analysis is essential in categorising the data into meaningful categories, identifying themes and revealing the relationships between these themes. Content analysis allows the researcher to analyse large amounts of qualitative data systematically and objectively. In this way, complex piles of data become more understandable and interpretable. Content analysis is a powerful tool for organising, interpreting, and interpreting data in qualitative research (Krippendorff, 2018). This analysis method provides in-depth information and reaches systematic and reliable results in the researcher's study.

Validity and reliability processes must also be ensured while analysing qualitative data. Validity and reliability in qualitative data analysis are essential in increasing the scientific value of the research and ensuring the findings' reliability. In qualitative research, validity refers to whether

the correct information appropriate to the research subject has been reached. In other words, validity is a criterion that evaluates whether the research represents the phenomenon or situation to be analysed. This depends on the reliability of the data collection methods and analysis processes and the researcher's ability to collect and analyse data without prejudice. Reliability refers to the reproducibility and continuity of the findings obtained. When another researcher repeats the same research, similar results should be obtained. In order to ensure reliability in qualitative research, the researcher needs to be systematic and transparent in data collection, analysis, and reporting processes, as well as document all processes in detail. In this way, the research becomes evaluable and verifiable by others. Validity and reliability are necessary to achieve accurate, reliable and scientifically acceptable results in the analysis of qualitative data (Miles, Huberman, & Saldaña, 2014; Yıldırım & Şimşek, 2021).

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