



Content analysis of studies on thought experiments

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Abstract

Thought experiments are experiments in which the experiment is not applied physically, and the event (situation) presented in the experiment is visualized by thinking only. Thought experiments, one of the in-class activities, are seen to be used in the interpretation of scientific thinking, thinking processes and revealing the individual's thinking processes. In this context, it is important to determine the studies on thought experiments. The aim of this study; To reveal the descriptive features of the studies published in the field of Thought Experiments between 2008-2021 in Turkey. For this purpose, a total of 14 studies, including five master's theses, one doctoral thesis, and eight articles, published in our country, and the document analysis method, one of the qualitative research methods, were used. Your studies; publication year, sample group, sample numbers, and the most used keywords were examined. Within the scope of the study, the data obtained in the articles and theses analyzed by the content analysis were analyzed using descriptive statistical methods (percentage and frequency analysis). As a result of the analysis, it was found that the most thought experiments were conducted in 2014, 2015, and 2018. Considering the studies on thought experiments, it was seen that the majority of the sample group was at the secondary school (9-12) level, and the least number of studies was at the graduate level. It was found that the sample numbers were between 31-100 at most and 1-10 at least. It was concluded that the most used keywords in the studies were thought experiments, physics education, and argumentation.

Keywords: Thought experiments, content analysis, document review

Introduction

Danish physicist Hans Christian Orsted first mentioned the concept of thought experiments in the 19th century. According to Orsted, thought experiments have a role on the hypotheses and predictions, but he did not discuss them by analyzing (Witt-Hansen, 1976). According to the literature, Ernst Mach is known as the first scientist to use thought experiments (Galili, 2009). Although Hans Christian Orsted first used the concept of thought experiments, in historical development of thought experiment subject, Ernst Mach is known as the first scientist who is examining thought experiments and expressing his ideas on the subject. At the same time, Mach emphasizes the importance of the thought experiment method in scientific research and the development of the mind (Gendler, 1998).

It is difficult to say exactly what thought experiments are. However, it has been claimed that looking at a few features such as being made in the mind, being based on experience and having something happen in them is enough to recognize them (Brown, 1991). In the literature, many definitions of existing thought experiments have been made as seen below:

- ;
- Thought experiments aim to achieve their goals without practice (Sorensen, 1992).

- During the creation, the application aspects of the experiments were removed and the design aspects were strengthened (Sorensen, 1992).
- They are thought designs created to test the validity of a thesis or to make others accept that the thesis is valid. (Gilbert and Reiner, 2000).
- They are special types of windows through which the mind can open to universal realities (Brown, 1991).
- They are experiments done by changing the variables of a theory by looking at the inconsistencies in our experiences (Sorensen, 1992).

According to the definitions made in the literature, the following definition can be made based on these. Experiments in which the experiment is not applied physically, but the event (situation) presented in the experiment is only contemplated and visualized in the mind, are known as thought experiments.

Thought experiments take place by making use of students' own experiences, with their own internal processes and with their active participation. By making a thought experiment, students; they can gain creative thinking, practical thinking, design ability and develop their imagination. Do a thought experiment; it gives students the ability to think critically, constructively and scientifically. While doing thought experiments, students use their imaginations. For these reasons, it is important to use thought experiments in education. In this study, it has been tried to draw attention to this issue and to shed light on future studies by examining the studies on thought experiments in Turkey.

Purpose of the study;

In this study, it is aimed to contribute to the literature for new studies by revealing the descriptive features of the studies published in the field of Thought Experiments between 2008 and 2021. While searching on Thought Experiments in Turkey, the below main problem and sub problems were noted.

Problem Statement: What is the distribution of studies on thought experiment according to years, sample group and numbers, and the most used concepts? Depending on the main problem, the following questions were answered by examining the literature.

- What is the distribution of studies conducted in the field of Thought Experiments in Turkey by years?
- What are the findings of the sample group in Thought Experiments in Turkey?
- What are the findings of number of participants in samples in Thought Experiments in Turkey?
- What is the distribution of the most used key concepts in Thought Experiments in Turkey?

Method

In this study, document analysis, which is one of the qualitative research methods were used to reveal the trend in the theses and articles on thought experiments in Turkey. Qualitative research offers researchers the opportunity to examine an event, phenomenon, institutions, people, documents in depth and as a whole (Yıldırım & Şimşek, 2008). In document analysis, which is one of the qualitative research methods; It allows the analysis of information and content in the written and visual media regarding the problem situation discussed within the scope of the purpose of the research (Ary, Jacobs, & Sorensen, 2010). For this purpose, in the study, document analysis was preferred in order to reveal the trend in the theses and articles on thought experiments between the years 2008-2021 in the relevant literature.

In this study; Since the general tendencies of the studies published in the field of thought experiments in Turkey are examined, the theoretical population of the study consists of 8 articles and 6 theses published between 2008-2021 in Turkey. 5 of the theses are Master's Thesis and 1 of them is PhD thesis.

As a data collection tool in the study, an Excel form was created by using the publication classification form developed for mathematics education by Çiltaş, Güler and Sözbilir (2012). The data in the articles and theses were collected by passing them into this form. Document analysis was used as a data collection method in the study. In the first stage of the document analysis, the articles and theses in the sample group were transferred to the computer

in pdf format. In the second stage, the articles and theses transferred to the computer environment were read and their properties were transferred to the excel form. Within the scope of the study, the data obtained in the articles and theses analyzed by content analysis were analyzed using descriptive statistical methods (percentage and frequency analysis). The results are presented in the findings in the form of graphs and tables.

Findings

The findings obtained in the study were analyzed based on the research questions and are presented below. The distribution of studies conducted in the field of thought experiments by years is given in Table 1 and presented in Figure 1.

Table 1. Distribution of studies published in the field of Thought Experiments by years

Years	08	09	10	11	12	13	14	15	16	17	18	19	20	21	Total
f	1	1	1	1	0	1	2	1	0	0	2	1	2	1	14
%	7	7	7	7	0	7	14	7	0	0	14	7	14	7	100

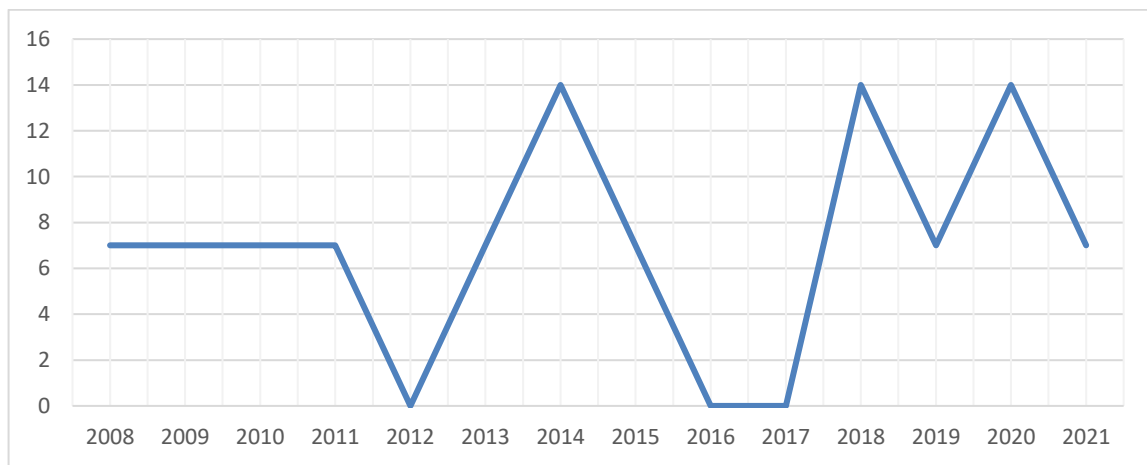


Figure 1. Percentage Distribution of Studies Due To Years

As seen in Table 1 and Figure 1, a total of 14 studies on thought experiments were published between 2008 and 2021, and no studies were found in 2012, 2016 and 2017. It is seen that the most studies were in 2014, 2018 and 2020. The findings regarding the sample group used in Thought Experiments studies are shown in Table 2.

Table 2. Findings regarding the sample group used in Thought Experiments studies

Sample Groups	f	%
Elementary School (1-8)	2	12
Secondary School (9-12)	9	53
License	5	29
Master's Degree	1	6
Total	16	100

According to Table 2, the studies were conducted with the students from elementary schools, secondary schools and in the educational levels of license and master's degree. It is seen that most of the studies are performed at the Secondary Education (9-12) level, and the least is for the master's degree. It is seen that two studies are for both secondary education and undergraduate level. The findings regarding the number of participants used in Thought

Experiments studies are shown in also Table 1. Additionally to the findings in Table 1, it is seen that the most work is between 31-100 people and the least work is between 1-10 people. When the studies were qualitative research studies, the sample numbers were kept low. The findings regarding the key concepts used in Thought Experiments studies are shown in Table 3.

Table 3. Findings related to key concepts used in Thought Experiments studies

Keywords	f
Thought Experiments	14
Physics Education	5
Argumentation	4
Chemistry Education	3
Problem solving	3
Critical Thinking	3
Laws of Motion	2
Alternative views	2

When Table 3 is examined, it is seen that the concept of thought experiments is used in all studies. It is seen that the concept of physics education and the concept of argumentation are mostly used after the concept of thought experiments.

Results, Conclusions and Recommendations

The findings obtained within the scope of the study show that the researches carried out within the scope of thought experiments were carried out mostly in 2014, 2018 and 2020 (Acar and Gürel, 2014; Bademci and Sarı, 2014; Eyceyurt-Türk, Tüysüz and Tüzün, 2018; Tuzun and Köseoğlu, 2018; Tüysüz. and Tüzün, 2020) have been published. This shows that studies on thought experiments have increased in recent years. However the total number of the studies on thought experiments is still low. New studies should be arranged to understand the effects of thought experiments.

When the sample group data is examined; It is seen that most of the studies were published at the secondary education (9-12) level (Tüzün & Köseoğlu, 2018; Tüzün, 2010; Dayı, 2011; Acar & Gürel, 2014; Eyceyurt-Türk, Tüysüz & Tüzün, 2018; Karakuyu & Tortop, 2009). In two studies (Acar, 2013; Acar and Gürel, 2016), it is seen that both secondary education (9-12) and undergraduate level sample groups were studied. According to this finding, it is obviously seen that, no studies were conducted with teachers, so new studies can be arranged the opinions or attitudes of teachers towards thought experiments.

It is seen that the number of sample of the studies carried out within the scope of thought experiments are between 30-100 at most (Acar & Gürel, 2014; Bademci & Sarı, 2014; Bademci, 2008; Tüzün, 2020) and very few studies are between 1-10 (Uyar, 2021). . Considering these results, the number of participants were kept low, since all of the studies were qualitative studies and most of the studies were conducted in the form of interviews. That shows quantitative studies can be arranged with the students from all levels of education and teachers.

The concept of 'thought experiments' was used as a keyword in all of the studies. After the concept of thought experiments, the concept of 'physics education' and 'Argumentation' were used. Within the scope of this study, only the theses and articles published in Turkey were examined. For future studies, it may be recommended to analyze thought experiments published in journals in international indexes. Thus, the results regarding the general trend will be revealed, and the results will be a guide for the situation of Turkey in the international context.

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