



## Metaphors in the Learning Process: Analysing the Concepts of Innovation and Research and Development (R&D)

*Öğrenme Sürecinde Metaforlar: İnovasyon ve Araştırma-Geliştirme (AR-GE) Kavramlarının Analizi*

### ABSTRACT

The aim of this study based on semi-structured interviews is to reveal the perceptions of students by asking them to use metaphors to describe the concepts of "research and development" and "innovation" within the scope of the "R&D and Project Management" lessons. The metaphor analysis applied in this study is promising and is expected to contribute to professionals interested in metaphors in education. In this study, the metaphor extraction method was used. The data obtained from the study were evaluated by qualitative (content analysis) analysis. The study group of research consisted of 51 students who chose the R&D and Project Management course at Kocaeli University in the 2022-2023 academic year. The forms containing metaphor sentences were carried out in two studies, at the beginning and at the end of the semester. The questions were sent to a group of students by hand and to a group of students electronically. In the study, the students were asked "Innovation is like ..... Because.....", and "Research and Development are like..... Because....." were determined and these metaphors were thematised by categorising their common features. The answers received from the students were categorised by content analysis. As a result of the two studies, the different metaphors created by the students for the concepts of innovation research and development and the changes in metaphors were categorised. In this category, there were 44 metaphors in 100 forms in the first study and 25 metaphors in 100 forms in the second study. All of the metaphors created are positive. These metaphors provide positive indicators of students' perspectives on innovation and R&D concepts. The results of the first and second studies also reveal the outcomes of the teaching method of the lesson. This article provides theoretical contributions to the concept of innovation with the metaphor method. The similes from the study are added to the curriculum and contribute to the development of the course. It contributes to the academics to analyze the inputs and outputs of the course well.

**Keywords:** Innovation, R&D, Metaphorical Analysis, R&D and Project Management

### ÖZET

Yarı yapılandırılmış görüşmelere dayanan bu çalışmanın amacı, öğrencilerden "Ar-Ge ve Proje Yönetimi" dersleri kapsamında "araştırma ve geliştirme" ve "inovasyon" kavramlarını metaforlar kullanarak tanımlamalarını isteyerek algılarını ortaya çıkarmaktır. Bu çalışmada uygulanan metafor analizinin umut verici olduğu ve eğitimde metaforlarla ilgilenen profesyonellere katkı sağlayacağı düşünülmektedir. Bu çalışmada metafor çıkarma yöntemi kullanılmıştır. Çalışmadan elde edilen veriler nitel (içerik analizi) analiz ile değerlendirilmiştir. Araştırmanın çalışma grubunu 2022-2023 akademik yılında Kocaeli Üniversitesi'nde Ar-Ge ve Proje Yönetimi dersini seçen 51 öğrenci oluşturmuştur. Metafor cümleleri içeren formlar dönem başı ve dönem sonu olmak üzere iki çalışmada gerçekleştirilmiştir. Sorular bir grup öğrenciye elden, bir grup öğrenciye ise elektronik ortamda gönderilmiştir. Çalışmada öğrencilere "İnovasyon..... gibidir. Çünkü....." ve "Araştırma ve Geliştirme..... gibidir. Çünkü....." metaforları belirlenmiş ve bu metaforlar ortak özellikleri kategorize edilerek temalaştırılmıştır. Öğrencilerden alınan cevaplar içerik analizi ile kategorize edilmiştir. İki çalışma sonucunda öğrencilerin inovasyon araştırma ve geliştirme kavramları için oluşturdukları farklı metaforlar ve metaforlardaki değişimler kategorize edilmiştir. Bu kategoride ilk çalışmada 100 formda 44 metafor, ikinci çalışmada ise 100 formda 25 metafor yer almıştır. Oluşturulan metaforların tamamı olumludur. Bu metaforlar öğrencilerin inovasyon ve Ar-Ge kavramlarına bakış açılarının olumlu göstergeleridir. Birinci ve ikinci çalışmanın sonuçları, dersin işleniş yönteminin sonuçlarını da ortaya koymaktadır. Bu makale, metafor yöntemi ile inovasyon kavramına teorik katkılar sağlamaktadır. Çalışmadan elde edilen benzetmeler müfredata eklenerek dersin gelişimine katkı sağlamaktadır. Akademisyenlerin dersin girdi ve çıktılarını iyi analiz etmelerine katkı sağlamaktadır.

**Anahtar Kelimeler:** İnovasyon, Ar-Ge, Metaforik Analiz, Ar-Ge ve Proje Yönetimi

### INTRODUCTION

The analysis of metaphors is a classic research topic in linguistics but has so far received little attention in innovation research. Metaphor analysis, as conceptualised in cognitive linguistics, is proposed here as a quantitative method for innovation research for several reasons (Moser, 2000).

Innovation and R&D are the most frequently used concepts everywhere today. Organisations use the terms innovation and R&D in their mission, vision and goal statements and politicians use the term innovation in most of their statements. The education sector is also trying to open innovation centres in university campuses by completing all teaching processes in the field of innovation and R&D. Although this kind of prevalence attracts attention, it is also known that innovation is one of the most used keywords in Western countries.

On the other hand, a common misconception is that some individuals and organizations tend to casually use the terms innovation and innovativeness as synonyms. On the other hand, a common misconception is that the terms innovation

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and innovativeness are used synonymously. Innovation is a noun that defines the ability and capacity for innovation while innovativeness is an adjective. (Merriam-Webster, 2017).

Even though its ubiquity has led to overuse and misunderstanding, innovation deserves to be better understood as it is essential for longevity and important for all organisations. For innovation to become more understandable, a better definition of the necessary elements, ideas and local language framing of the term is required (Kahn, 2018).

Metaphor is recognised as an important way of thinking and using language, such as explaining abstract ideas or finding indirect but powerful ways of communicating emotions, creating analogies and making connections between ideas. Analysing people's use of metaphors provides a better understanding of emotions, attitudes and concepts as participants in individual and social life.

In general, metaphor analysis is researcher-friendly and makes a valuable theoretical and methodological contribution to metaphor research, particularly 'metaphor in discourse' (Sun, 2011). In addition, Saban (2006) identified various functions of metaphor teaching and educational research. In addition, the use of metaphor allows students to associate a concept with something familiar and make it more concrete (Singh, 2010).

Science, technology and innovation policies are explained by a historically positive set of concepts, models and metaphors. From about 1950 to 1980 they dominated as contractual metaphors for scientists and policymakers. R&D is a more recent metaphorical concept in science. It has been systematically researched and placed on the agenda of the European Commission by policymakers and academics working on technology evaluation and EU science policy (von Schomberg, 2011a, von Schomberg, 2011b, Sutcliffe, 2014; Owen et al., 2012, Stilgoe et al., 2020).

According to Merriam-Webster, 2017, innovation is the introduction of something new or a new idea, method or device.

In this context, the aim of this study is to analyse students' predispositions towards the concepts of "innovation and R&D" within the scope of the R&D and Project Management course, which is an elective course at the university. Studies investigating these concepts from a broad perspective are rare when the literature is examined. The study had the following aims: (1) to identify the metaphors that innovations students use to describe the concept of "innovation and R&D", (2) to explore the categories in which these metaphors are organised and the conception of "innovation and R&D" they represent, (3) to reveal the possible relationships between the dominant conceptual themes and the participants' gender, and programmes of study. With this research, a gap regarding the concepts will be filled, and how students perceive the concepts of "innovation" and "R&D" will be determined through metaphors. Thus, it is thought that the study will contribute to both the literature and the importance of the mentioned concepts. The findings of the study will provide a better understanding of the concepts of innovation and R&D.

## LITERATURE REVIEW

### Overview of Innovation and R&D Concepts

Although innovation and R&D are often used as common terms, most organisations today still perceive innovation as incomprehensible. One explanation for this is that innovation and R&D are not fully understood. In particular, innovation has many alternative definitions and is the creative way in which individuals apply ideas to capitalise on opportunities. Therefore, any discussion of innovation must first address the issue of how innovation is categorised (Christensen, 2013).

The European Commission (2013) put forward the concepts of research, development and innovation as "Science with and for Society", a concept that will be instrumental in addressing the societal challenges in Europe addressed by Horizon 2020, building capacity and developing innovative ways to link science with society. In this sense, they wanted to allow all societal actors to work together throughout the whole research and innovation process in order to make science more attractive, increase society's interest in innovation, open up research and innovation activities and to better align both the process and its results with the values, needs and expectations of European society.

Linguistically, the search for these concepts, which have evolved as "responsible research and innovation", "basic and applied research" or "basic and applied research" or "research and development", also appears as a project based on the search in various workshops of the "Conceptual Approaches to Science, Technology and Innovation" network ([www.casti.org](http://www.casti.org)) (Flink and Kaldewey, 2018).

A comprehensive study by Frankelius (2009) by searching databases such as EBSCO, ISI, JSTOR, ABI/Inform and LIBRIS is interesting. The meaning of "R" for "research" when referring to R&D is almost always characterised as technological and includes nanotechnology, optical technology and molecular technology. The meaning of "R" has never been, for example; business, economics, marketing or sociological research. Researchers use the term "research" to refer to technological research when discussing issues such as the "commercialisation of research".

Furthermore, non-technological fields are hardly pointed in the "R&D" literature, or even in the innovation literature in general (Fagerberg, Mowery and Nelson, 2005)).

Another study assumes that the high-level knowledge required for any innovation almost always comes from universities. This supposition appears, for example, in the literature on "commercialisation of research" or "technology transfer" Rothwell (1982), Hindle and Yencken (2004), Gulbranson & Audretsch (2008) and Speser (2012) are a few examples representing this view (as cited in Frankelius, 2009).

However, the technology bias in the innovation literature can also be questioned from an etymological perspective. The word innovation is partly rooted in the Latin "res novae" (Morwood, 2000). It is also known that this expression was frequently used in the Roman Empire in the first century BC (Wagenvoort, 1956). One of the first to use the more modern term "innovation" in the Oxford English Dictionary (2002) is noted as King Edward VI in 1548. It is stated in the dictionary that the meaning of the term is "something that comes into being".

According to Kahn (2018), to truly reap the benefits of innovation, organisations need to recognise that innovation is a process, an outcome and a mentality. As he suggests in Table 1, each factor handles a better understanding of the concept by addressing sharp dimensions. It is important to mention these elements as they also help us to understand the theoretical definitions of innovation.

**Table 1:** Understanding Innovation

Elements	Strategic Focus	Strategic Question	Thinking
Innovation is the result	Output	What do you want?	Product innovation -Process innovation -Marketing innovation -Business model innovation -Supply chain innovation -Organisational innovation
Innovation is a process	Ways and meanings	How to make it happen	-Innovation process -Product development process
Innovation is a mindset	Situation	What needs to be instilled and ingrained to prepare for what and how?	-Individual mindset -Organisational culture

Research and development is the set of innovative activities undertaken by companies or governments to develop new services or products and improve existing ones (Scientif, 2005). The benefits of categorising innovation and R&D will contribute to both academics and students in education.

In another study, Price (2007) argues that despite all the innovation rhetoric, there is no clear understanding of what innovation is. For many, innovation simply means increasing research and development (R&D) expenditure. The true definition of innovation is problem-solving. It is the ability to see a need and think creatively about how that need can be met in a better way.

## Metaphors in Education

Metaphor is pervasive in language and thought: in scientific discovery (Gentner, 1982; Gentner and Jeziorski, 1993; Gruber, 1995; Nersessian, 1992), in literature (Gibbs, 1994; Miller, 1993; Steen, 1989; Turner, 1987), and in everyday language (Fauconnier and Turner, 1998; Lakoff and Johnson, 1980). Not surprisingly, this richness has engendered a number of approaches to metaphor (Steen, 2007).

Metaphors serve as a tool for developing "perspective awareness" by reducing complex concepts to a single vivid image (Oxford *et al.*, 1998). In educational research, metaphors have sometimes been used to explain a teacher's self-defined professional identity (Thomas and Beauchamp, 2011). Metaphors provide a conceptual framework for thinking about something.

According to Allbritton (1995), metaphor has three main functions: 1) to support the connection between speaker and listener, as it is based on mutual knowledge in speech; 2) link the subject and tool fields; and 3) to understand a new concept and being socio-cultural support.

Furthermore, metaphors show promise in generating and mediating insights by analogy (Steen, 2007). In other words, metaphors create and endorse new meanings by utilising familiar, embodied reference points to develop sophisticated understandings of new, complex constructs. Metaphor generation is an innovative idea based on both linguistic and conceptual forms (Lynch and Fisher-Ari, 2017). Previous research has shown that collecting and analysing metaphors is a useful strategy in searching for data that are difficult to collect through verbal interviews or cannot be represented by statistics (Chan, Chien and Henderson, 2018). Gillis and Johnson (2002) state that "metaphors contain information necessary for our development as professionals because they reveal our educational values, beliefs, and principles".

Lakoff and Johnson (1980) argue that the essence of the "cognitive metaphor theory" is that metaphors are far from being merely a figurative or decorative device (i.e. substitution theory) or a simple analogy (i.e. comparison theory), they structure our perceptions, thoughts and actions. In terms of "cognitive theory", metaphors serve as powerful mental models that enable people to understand their world by relating complex phenomena to something previously experienced and concrete. Indeed, what makes a metaphor an effective metaphor is the process of making connections between two different ideas (concrete and abstract) or the reflection of one schema (source domain of the metaphor) to another schema (target domain of the metaphor) (Schnitzer and Pedreira, 2005).

The most common approach to the use of metaphors in educational science is to elicit metaphors by encouraging participants to produce their metaphors spontaneously (Seung, Park and Jung, 2015), verbally (e.g. Martinez, Saulea and Huber, 2001) and in writing (e.g. Inbar, 1996; Saban, Kocbeker and Saban, 2007),

According to Lynch and Fisher-Ari (2017), when some concepts in education are analysed metaphorically, the following benefits are provided to students:

- a- Metaphors help to illuminate students' interactions with their ideas in time.
- b- Metaphors inform when the learners need further assistance
- c- Metaphors help you get to know students better as individuals
- d- Metaphors create opportunities for aesthetic and personalised understandings.

Metaphors are important. They also need to be understood theoretically. A misunderstanding of what innovation means leads to wrong decisions being made by people and organisations and represents a probable reason why some organisations consider innovation difficult (Kuratko, Covin and Hornsby, 2014).

A similar study, by Massengill, *et al.* (2005) observed that in five teachers there were visible links between metaphors and behaviour in their teaching practice in the classroom, as indicated by a questionnaire with pre-selected metaphors. Similarly, Wegner and Nückles (2015b) asked 91 students about their learning metaphors and assessed their learning strategy use and epistemological beliefs and found four metaphor categories (metaphors related to knowledge acquisition, problem-solving, personal development and regulation).

## METHOD

### Participant Information

The participants consisted of 51 students enrolled in different education programmes at Kocaeli University. Logistics programme students constituted the largest group (n= 22; 43%). 33 males (64.7%) and 18 females (35.3%) participated in the study. The age of the participants ranged between 17 and 26.

### Methodology used to identify the participants

A questionnaire consisting of two parts was used in the study. In the first part, the demographic information of the participants such as education programme, gender and age were questioned. In the second part, the participants were asked to write a text by filling in the prompts "Innovation is like... because..." and "research and development are like... because ...." used by Saban (2008). This type of open-ended questioning was specifically chosen to allow the participants to freely reflect on their own in-depth feelings, ideas and beliefs about the concept of innovation and R&D. Furthermore, these data enabled the researcher to elicit as diverse understandings as possible and to analyse the data easily.

In the first data collection tool in the R&D and Project Management course, which is an elective course at the university in the 2021-2022 academic year, a blank sheet of paper with these prompts at the top of the page was distributed to the participants in the first week of the semester and they were asked to complete it by focusing only on these two metaphors. In the second data collection instrument, for reaching the opinions of students who could not come in the first weeks, these questions were sent electronically through the distance education centre (UZEM) via the survey link. In addition, 3 demographic data as gender, age and programme type were requested.

The participants were given approximately 15 minutes for metaphorical writing to represent their thoughts. One of the reasons for doing this at the beginning of the semester was to see the awareness of these concepts that will form the basis of the course and constitute the basis for the output to be formed at the end of the course. One of the reasons for doing this before the lesson was to see the awareness of these concepts that will form the basis of the lesson and to form the basis for the output to be formed at the end of the lesson. At the end of the semester, only the questions "Innovation is like ...." and "R&D is like ....." were asked in the question form coded in the first study (to the same student). In order not to increase the complexity of the data, the phrase because was not added to this second study.

The data were collected through a semi-structured questionnaire prepared by the researcher. A semi-structured questionnaire is a type of questionnaire that is a combination of an unstructured questionnaire with closed and open-ended questions that try to reveal purpose-based opinions (Sarantakos, 2005).

The data were analysed in detail and a meticulous study was conducted. The research, it was aimed to determine how university students perceive and conceptualise the concepts of "innovation and R&D" through metaphors.: In line with this aim, the following questions were sought to be answered:

- (1) What are university students' metaphors for the concepts of "innovation" and "R&D"?
- (2) How can the metaphors produced by university students for the concepts of "innovation" and "R&D" be conceptualised?

During the data analysis process, many articles were read for metaphorical research. According to Moser (2000), metaphor analysis is essentially a qualitative research methodology related to content analysis, but it also allows researchers to apply quantitative procedures to categorical data. Categorical eliminations were made for the answers given, and the answers given by 1 student were determined as "not well-expressed metaphors" and eliminated. Data analysis generally followed the traditional approach established by Cameron & Low (1999), which involves "collecting examples of linguistic metaphors, generalising from them to conceptual metaphors, and using the results to propose or construct understanding". The whole procedure involved four steps:

- (a) extraction/coding,
- (b) ranking (clarification and elimination),
- (c) categorisation (metaphor derivation) and
- (d) analysing data.

### **Extraction/Coding**

The data collected from the students were first analysed and subjected to a sorting process. Student (S), Female (F), Male (M). Coded as 1,2,3... The same codes were used for the same student in 2 studies. A statistical expert was asked to check the names to avoid confusion.

### **Ranking**

After the extraction process, the forms on which the "Because..." section explaining the reason for the preference of the metaphor is not explanatory will be excluded from the analysis. As a result of these analyses, the answers that did not have a connection between the subject of the metaphor and its source and that expressed inconsistency were meticulously examined and no erroneous data was found except for 1 student in the class. It was seen that the answer given by that student was far from the nature of the lesson. This student was not included in the research in the 2nd study conducted at the end of the semester.

### **Classification (metaphor derivation)**

In order to develop categories, the data were written one by one in an Excel environment, similar ones were classified and lists were created. Thus, the repetition of a metaphor in different categories was prevented. The metaphors developed as a result of the analysis are presented in the findings section.

### **Analysing the Data (Determining Validity and Reliability)**

At the stage of ensuring the validity and reliability of the study, the opinions and suggestions of two expert academicians who have studies on this subject were consulted in order to reveal whether the metaphors represent the conceptual categories. The categories created and the mappings made by the experts were compared. In the comparisons, the numbers of agreement and disagreement were tried to be analysed. Positive and negative distinctions were made. Participants' age, gender, and programme analyses were made through SPSS. Miles & Huberman's (1994) formula [ $\text{Reliability} = \text{Consensus} / (\text{Consensus} + \text{Disagreement}) * 100$ ], which is frequently used in the reliability calculations of the data collected in the content analyses of qualitative research, was used by the researcher. At the end of the calculation, the reliability of the research was found to be 100%, and it was accepted as reliable if it exceeded 70%. The reason for the 100% result was that the erroneous data was eliminated from the beginning.

## RESULTS

### First Study

Not every student may produce a valid metaphor that can be analysed. At this stage, a total of 1 article was eliminated despite the thought that there may be poorly structured examples. Table 2 shows the evaluation of 50 forms. Repeated metaphors are shown in the number of metaphors.

Not every student may produce a valid metaphor that can be analysed. At this stage, a total of 1 form was eliminated with the idea that there may be poorly structured examples. This metaphor collection was compiled from 51 students at the university, and even if the sample is seen as small, the fact that it is an elective course at the university can be seen as an advantage of diversity related to professions in different structures from different programmes.

It was observed that gender, age and programme had no effect on students' understanding of innovation and R&D. Students' views on the concept of innovation are presented in Table 2 and their views on the concept of R&D are presented in Table 3.

**Table 2** : Students Views on the Concept of "Innovation" (Beginning of the Term)

Metaphor Name	Number of Metaphors	Metaphor Name	Number of Metaphors
Future	2	Globalisation	2
Creativity	4	New product	3
Competition 4	4	The foundation of the business	1
Development	4	Research &Development	1
Finding a remedy	1	Solution	1
Child	1	Improvement	1
Human	1	Science	2
Idea	6	Technology	1
Living condition	2	Invention	2
Age	1	Industry	1
Draft	1		
Innovation	7		
Basis of life	1		
Total			23/ 50

When Table 2 is analysed, it is seen that 23 metaphors were produced out of 50 forms. When the metaphors were analysed, it was concluded that these analogies made before taking the course were aimed at the students' imagination.

**Table 3:** Students Views on the Concept of "R&D" (Beginning of the Term)

Metaphor Name	Number of Metaphors	Metaphor Name	Number of Metaphors
Change	3	Wikipedia	1
Knowledge repertoire	1	Research	4
Growing up	2	Curiosity and interest	1
Reading books	1	Invention	5
Renewal	4	Innovation	6
Technology	1	Pharmaceuticals	1
Book	1	Try	3
Repair	1	Test	2
Invention	5	Laboratory	2
Building Construction	1	Innovation	4
Culture, human and society	1		
Total			21/ 50

50 different metaphors belonging to 2 different concepts were categorised into three groups as single, two objects and semi-sentences. Table 4 represents this classification.

**Table 4: Classification of Metaphors (Beginning of the Term)**

Word Structure		
	Innovation/R&D	Metaphors
Single	Innovation	Future, Creativity, Competition, Development, Finding Solutions, Children Human, Idea, Age, Draft, Innovation, New Product, R&D, Solution Improvement, Science, Technology, Invention, Industry
	R&D	Change, Grow, Renewal, Technology, Book, Repairs
		Invention, Innovation, Wikipedia, Research, Invention, Innovation, Pharmaceuticals, Try, Test, Laboratory Finding a Solution, Condition of Life, Basis of Life, Basis of Business
Two	Innovation R&D	R&D Knowledge, Reading Books, Curiosity and Interest
Half Sentence	Innovation R&D	Culture, Man and Society- Building R&D - Culture, Human and Society

As a result of the study, three categories were formed. The 50 types of metaphors created by the students for the concepts of innovation and R&D were 23 and 21, respectively (Table 2-3). Since all of the categories created were positive, no separate calculation was made.

The positive views on innovation and R&D as a research theme in the eyes of most of the students are as follows;

*The main categories for innovation (innovation, idea, invention, invention, competition, development) and main categories for R&D are as follows (innovation, invention, invention, research, innovation). These categories are the most remarkable findings of the research.*

Some examples of the metaphors proposed by the students for "innovation..... because....." are as follows:

*1SM. It is like development. Because innovation produces new things to facilitate human needs. These things are an improved version of the previous ones. Therefore, innovation is like development.*

*3SF. It is like creativity. Because innovation means innovation as we know and for this, we need a lot of creative thinking.*

*5SF. It is like competition. Because new ideas and inventions need to be put forward in order to survive among companies in a competitive environment.*

*6SM. It is like the birth, growth and development of a child. Because innovation is the extraction and development of something new.*

*7SM. It is like finding a remedy for deficiencies. Because new ideas are in the idea of producing new things.*

*8SF. It is finding new ideas and inventions. Because inventions and inventions that will make our daily life easier, apart from our daily basic needs, make our lives easier.*

*10SF. It is like a human being because it develops and grows as it is renewed and passes to a higher level.*

*12SM. It is like an idea. Because no one comes up with a new innovation idea while making a good or bad comment about anything they experience without realising it.*

*22SF. It is like a life condition. Because innovations and inventions contribute to our lives.*

*24SF. It is like the age because it creates new products as it is renewed.*

*29SM. It is like innovation. Because it makes life easier by producing something that does not exist or by developing ideas on something that does not exist, it enables us to renew our lives in a more positive way more easily.*

*30SF. It is like the basis of life because it represents the innovation and future of the things we need everywhere in life.*

*34SF. It is like globalisation because the world needs innovation*

*41SM. It is a new product because innovation gives birth to a new product.*

*42SM. It is the foundation of the business because it cannot exist without innovation.*

*45SF. It is a science because there is no innovation without science.*

*50SF. It is technology, innovation represents technology.*

51SM. It is an invention because inventions teach innovation.

Some examples of the metaphors proposed by the students for "R&D..... because....." are given below:

1SM. R&D is like change. Because we research our ideas and thoughts on many subjects and we focus on the change of this.

2SF. R&D is like a repertoire of knowledge. Because they put forward ideas consisting of the knowledge of humans and society and put forward new products.

4SF. R&D is like growing up. Because people research and develop things and learn new things. The things they learn and gain enlarge their minds. This is how mankind grows and becomes dominant. That is why research and development are necessary for the growth of humanity.

9SM. R&D is like reading a book. Because you are interested in knowledge and innovations.

11SM. R&D is like renewal. Because every research renews our thoughts.

12SM. R&D is like technology. Because it is to develop new techniques to do a certain job.

15SF. R&D is like a book. Because as you get into it, as you research, as you read, you develop.

26SM. R&D is like repairs. Because everything can be improved to adapt to the time.

31SF. R&D is like an invention. Because every stage is important and should be developed.

33SM. R&D is like building a building. Because we contribute to innovations and inventions as we research and develop them.

46SF. R&D is like innovation. Because it is to gain and learn something new.

47SF. R&D is like curiosity and interest. Because people who are curious investigate, people who are interested strive to develop.

48SM. R&D is like Wikipedia. Because it is a way to reach unlimited information.

49SF. R&D is to do research. Because it develops research topics.

The findings in the research are the metaphors that are close to the definitions of innovation and R&D. In their research, Greeno, Collins & Resnick (1996), in order to learn from metaphors, at least an additional distinction between behavioural and cognitive perspectives is necessary and they based the categorisation of metaphors on three main dimensions in order to further differentiate the learning area. These are:

- 1- The behaviourist perspective interprets knowledge as an accumulation of associations resulting from experience, while the learning process is regarded as producing new connections between "sensory impressions" and "individual response" units.
- 2- From a scientific perspective, knowledge consists of interrelated metaphors that are individually and actively constructed by transforming old metaphors into new ones or inductively developing new metaphors from a series of different experiences. The mind is proactive, problem-orientated and interpretative.
- 3- Situational or socio-historical perspective comprehends knowledge as distributed among individuals in a social community and their artefacts, e.g. books, computers, etc.". The authors' categorisations are evaluated in Table 5 according to the findings.

**Table 5** :Categorisation of Metaphors (Beginning of Term) (Greeno, Collins & Resnick, 1996)

Word structure	Innovation/R&D	Metaphors
Behavioural	Innovation	Finding a Solution, Creativity, Competition, Development, Finding a Solution,
	R&D	Idea, Solution, Improvement Change, Grow, Regeneration, Renewal, Repair, Try, Building, Curiosity and Interest
Scientific	Innovation	Draft, Innovation, New Product, R&D, Science, Technology, Invention, Industry
	R&D	Knowledge, Reading Books, Testing, Innovation, Invention, Wikipedia, Research, Invention, Innovation, Medicine, Laboratory, Technology, Book,
Situational	Innovation	Future, Age, Culture, Human and Society, Human, Child
	R&D	Condition of Life, Basis of Life, Basis of Business Culture, Human and Society



When Table 5 is examined, it is seen that the metaphors created by the students' views from behaviourist, scientific and situational perspectives. When the intensities of the metaphors are examined, behavioural, scientific and situational metaphors about innovation are intense. In the study on R&D word structure, it can be said that the metaphors created as behavioural and scientific are intense and the least metaphor is attributed to the situational field. From the research findings, it is concluded that students' sensitivity to metaphors is high and positive.

### Second Study

When the same forms were distributed to the same coded students at the end of the term, the findings are shown in Tables 6, 7 and 8.

**Table 6 : Students Views on the Concept of "Innovation" (End of Term)**

Metaphor Name	Number of Metaphors	Metaphor Name	Number of Metaphors
Innovative Thinking	10	Creativity	5
Smart Product	5	Change	5
New product	4	New Idea	3
Entrepreneur	4	Idea	2
Technology	4	Digital	2
Artificial intelligence	2	Microsoft	2
Apple	1	Patent	1
Total			13/ 50

When Table 6 is analysed, it is seen that the student's ideas about the concept of innovation have changed and the concept has tended towards more scientific and current analogies.

**Table 7: Students Views on the Concept of "R&D" (End of Term)**

Metaphor Name	Number of Metaphors	Metaphor Name	Number of Metaphors
Trial and Error	10	Patience	4
Research	4	Need	5
Science	6	Problem-Solving	5
Quality	3	Development	5
Development	2	Project	4
Tübitak	1	OECD	2
Toplam			12 / 50

When Table 7 is analysed, it is concluded that students' metaphors of R&D concepts are more prone to scientific definitions. A total of 12 metaphors were produced and it is also seen that these metaphors consist of concepts representing course outputs.

**Table 8: Classification of Metaphors (End of Term)**

Word Structure	Innovation/R&D	Metaphors
Single	Innovation	The initiative, Technology Apple, Creativity, Change, New idea, Idea, Digital, Microsoft, Patent
	R&D	Science, Quality, Development, Tübitak, Patience, Need, Project, OECD
Two	Innovation	Innovative Thinking, Smart Products, New Products, Artificial Intelligence
	R&D	Trial and Error, Problem-Solving, Continuous Improvement
Half Sentence	Innovation	-----
	R&D	-----

When Table 8 is analysed, it is seen that metaphors consisting of one and two words were formed. These findings lead us to the opinion that students use more methodological knowledge formed as a result of learning.

**Table 9:** Categorisation of Metaphors (End of Term) (Greeno, Collins & Resnick, 1996)

Word structure	Innovation/R&D	Metaphors
Behavioural	Innovation R&D	Innovative Thinking, Creativity, New Idea, Attempt, Idea, Artificial Intelligence Trial and Error, Patience, Problem-Solving, Need,
Scientific	Innovation R&D	New Products, Technology, Digital, Microsoft, Apple, Smart Product, Patent Research, Science, Tübitak, OECD, Project
Situational	Innovation R&D	Change Quality

When Table 9 is examined, it is seen that metaphors formed by students' views in terms of behaviourist, scientific and situational. When the densities of metaphors are examined, it is seen that behavioural and scientific metaphors related to innovation are intense. In the study on R&D word structure, it can be said that behavioural and scientific metaphors are intense and the least metaphors are attributed to the situational field. From the research findings, it was concluded that the students' sensitivity to metaphors was high and positive.

## Discussion And Conclusion

In this study, many metaphors related to the R&D and Project Management course were identified. These metaphors reflect the participants' perceptions of the concepts of innovation and R&D. In the research in which the views of university students on the concepts of innovation and R&D were determined, the opinion was formed that they have knowledge about the basic features and analogies that should be known about these concepts. Various other factors may shape how students view the concepts of innovation and R&D. The findings are highly relevant to the teaching of R&D and Project Management courses in terms of behavioural, cognitive and situational metaphors. The results of the first and second studies also reveal the outcomes of the teaching method of the lesson.

The findings of the first study show that the concepts of innovation and R&D are intertwined. It is possible to see this mixture in the metaphors used for innovation (innovation, idea, invention, invention, competition, development) and R&D (innovation, invention, invention, research, renewal). However, abstract definitions are also interesting. The foundation of life, building a building, living conditions, and finding a remedy are positive and positive concepts and metaphorically positive thoughts.

In the findings of the second research, it is clearly noticeable that the concepts of innovation and R&D are learnt separately from each other. Especially for innovation, 23 different metaphors in the 1st research decreased to 13 in the 2nd research and a change in meaning occurred by turning towards the concept of the product. The reason for this can be said that OECD, Frascati Guide, Oslo Guide, R&D Law and Tübitak (Scientific and Technological Research Council of Turkey) training notes, which are included in the learning methods during the course process, also had an effect. The metaphors captured here are closer to scientific connotations.

Assuming that the basic function of metaphor is to provide space for ideas that cannot easily be wrapped around the language to which the thinker has access, this structure is especially useful for undeveloped and developing ideas and beliefs (Lynch and Fisher-Ari, 2017). These various metaphors reflect the wide range of perspectives that students bring to a discussion of the development of their professional identity and serve as a reminder that it is a dynamic, constantly evolving concept. The results of this study show that there are positive views towards the concepts of innovation and R&D. The metaphors identified help us to create meaning.

Asking students to create their own metaphors and share their perspectives with others allows them to consider their own and others' perceptions (Singh, 2010). Metaphors can indirectly elicit students' general understanding of learning.

The study also provides some methodological suggestions for those who want to adopt metaphor analysis in future studies. Metaphors should be collected together with their justifications. This way allows the respondents to reflect and explain their conceptual reasoning for the metaphors they have chosen and also helps the researcher in thematic analysis. Otherwise, the use of metaphors alone may not be sufficient both to reveal the concepts of the respondents and to distinguish the participants who attribute different meanings or analogies to the same metaphor (Koç, 2013).

The metaphor study in education also provides an opportunity for educators to improve a curriculum in terms of the aspects that students lack. In addition, it supports students to understand the importance of the concepts of the course. When the findings of the study are analysed, it is seen that the students' metaphors attribute important and positive meanings to the concepts of innovation and R&D.

In this paper, we develop several alternative perspectives. It is hoped that this study will contribute to the knowledge of the R&D and Project Management lesson. In particular, the results of the study will have several practical applications:

- 1) This study will contribute to the development of the course. Allowing students to express their views is important for the development of the course.
- 2) It will contribute to the development of the meanings of the concepts and will enable the concepts to reach large masses.

In summary, further research on metaphors is valuable because the impact of metaphors in the field of education is very high. In this paper, we also discuss critical problems in innovation theories, such as the evolving meaning of innovation based on defining innovation in the language of discovery/exploitation.

### **LIMITATIONS OF THE STUDY**

A metaphorical expression can be interpreted differently by people with different social experiences and different cultural backgrounds. For the research, various metaphors were collected by thematic analysis with themes chosen according to the study staff's self-interpretation. This collection of metaphors was collected from 51 students at the university and it would not be appropriate to generalise the results to other students. Nevertheless, in this small sample of students, it is clear that a variety of views exist. Therefore, it can be predicted that inconsistencies in metaphorical interpretation will arise depending on the socio-cultural background, personal experiences, professional training, languages are spoken and other characteristics of the team members. In addition, the same analysis can be conducted again at the end of the semester for the students who chose the R&D and Project Management course and the differences in metaphors can be re-evaluated.

### **SUGGESTIONS**

Metaphors can be used in a number of ways in educational innovation lessons. Through an analysis of their own and others' metaphors, students can be asked to describe what the innovation means for, what types of activities would be a priority, and compare them to other activities.

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