

## **An Analysis of the Relationship between the Metaphorical Perceptions of Classroom Teacher Candidates Towards Computer-Assisted Mathematics Instruction and Their Learning Approaches**

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### **Abstract**

This study aims to reveal the perceptions that classroom teacher candidates have regarding the concept of computer-assisted mathematics instruction (CAMI), with the help of metaphors. Furthermore, the another aim of the study of this study consists of an analysis of whether these metaphors differed based on the teacher candidates' learning approaches. The descriptive and relational survey model was employed in the study. The study group was comprised of 90 teacher candidates, who were first-year students at the Department of Primary Education of a Faculty of Education in the Aegean Region. In order to determine the metaphoric perceptions of the teacher candidates, they were initially asked to complete the sentence "Computer-assisted mathematics instruction is like ....., because ....." . The data were interpreted, using the content analysis technique. Moreover, they were subjected to a scale for the purpose of analyzing whether there were any differences between the metaphors at different levels of learning approaches. The metaphors were found to be included in the categories "CAMI with positive aspects", "CAMI with negative aspects", "CAMI in terms of structural aspects" and CAMI with neutral aspects". Upon the comparison of these categories to the learning approaches, it was found that teachers, who adopted the "deep" and "strategic" learning approach, had a much more positive perception, while those adopting the "surface" learning approach had a negative perception. Additionally, it was observed that teacher candidates, who rather put emphasis on the structural aspects and conditions of CAMI, were the ones to adopt the strategic learning approach. Thus, determination of the learning approaches adopted by teacher candidates and an analysis of their perceptions towards a number of concepts are considered to be significant as they could be effective in the course of their educational lives and in the processes of becoming role models when they start the profession.

**Keywords:** Computer-Assisted Mathematics Instruction, Learning Approach, Classroom Teacher Candidates, Metaphor.

**DOI:** 10.29329/ijpe.2021.346.11

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## INTRODUCTION

Even though it is challenging to wholly reveal the underlying reasons for human behaviour, human perceptions are known to be one of them (İnceoğlu, 2010). Therefore, it is very important to understand what affects the perception of the person and what they will cause. Senemoğlu (2011) considers past experiences and expectations as two important factors that affect perception. Being the initial factor of these two, past experiences are a topic that is probably required to be discussed more than numerous fields in the process of computer-assisted instruction (CAI).

The fact that the expressions "digital native" and "digital immigrant" have started to be used in line with the developments in technology (Prensky, 2001), manifests itself in the field of education as well. It is required to determine which experiences and opportunities borne by the teachers and teacher candidates put them into the digital native category and which ones put them into the digital immigrant category and to evaluate the respective results in terms of creating a positive perception in regards to CAI. Being another factor of importance, expectations are also a topic to be discussed with respect to CAI. CAI is considered an opportunity for the solution of several problems in the field of education. It is possible to say that expectations on this subject matter have appeared in terms of all stakeholders of the education process, as the studies show that CAI yields mainly positive outcomes. The use of CAI in the process of teaching mathematics is called "Computer-assisted mathematics instruction (CAMI)" (Baki, 2002), which is not a recent event. It is stated that the start of the general use of the computer technology in the field of education actually was simultaneous with the start of its use in the field of mathematics education (Dinçer & Doğanay, 2016). Studies conducted in the field of CAMI yield positive outcomes in terms of learners on one hand while causing increasing expectations with respect to providing more benefits on the other hand. When analyzed from this standpoint, the determination of the perceptions of teacher candidates in regard to CAMI is considered important both in terms of student achievements and in the processes of meeting the expectations created. In association with the results of the studies of similar types, it is important to conduct studies over the variables that might affect the perceptions of teacher candidates regarding CAI in the process of teaching mathematics and that therefore affect their practices.

Following the analysis of the literature, it is possible to find studies suggesting that the use of CAI in pre-undergraduate periods increases the students' achievements in mathematics, that it enables students to develop a positive attitude towards mathematics, and that these might differ based on personal variables (Aktümen Kaçar, 2003; Çeliköz, 1997). Of the studies conducted over teacher candidates, however, there are studies reporting that the participants had both positive and negative attitudes towards CAMI. For instance, in a study that they conducted with classroom teacher candidates and elementary school mathematics teacher candidates, Yenilmez and Sarier (2007) reported that teacher candidates preferred classic methods of teaching while stating that it was challenging to use computers in the teaching of mathematics. Keşan and Kaya (2007), on the other hand, put emphasis on the statements of classroom teacher candidates over the fact that it could be possible to make students more active through CAMI, that it enriched the teaching in audiovisual terms, and that it could increase the level of learning by eliminating the factor of boredom in the learning process. Thus, it is obvious that their CAMI-oriented perceptions could provide indicators with regards to the attitudes of teacher candidates and be effective both during their education lives and in their processes of teaching.

The learning approach adopted is another factor that is emphasized to be important in terms of teacher candidates' own learning processes and the learning processes at the beginning of their careers. The learning approach is defined as a variable that may differ based on a number of factors correlated with the intentions and thoughts of the individual (Ekinci, 2009) and that affects the quality of learning (Senemoğlu, 2011). There are studies that classify learning approaches as "deep", "surface" (Marton & Säljö, 1976), and additionally, as "strategic" learning approaches (Ramsden, 1979). Factors, such as being actively interested in the class, associating it with previous knowledge and experiences, and making research are defined as the keywords of deep learning; factors, such as making efforts for

studying, being successful in the management of time and effort, and making efforts to be successful by acting upon the criteria of evaluation, as the keywords of strategic learning; and factors, such as studying without any purpose or strategy, considering subjects to be disassociated with one another, and having a feeling of pressure-apprehension in regards to studying, as the keywords of surface learning strategy (Entwistle, McCune & Walker, 2001, c.f. Beyaztaş & Senemoğlu, 2015). Therefore, the learning approach adopted can be effective both in the processes of individuals, such as learning, doing research, acquiring information, succeeding, finding meaning and achieving results, and over the learning approaches of students particularly in the processes where teacher candidates practice the profession of teaching (Olpak, Arıcan & Baltacı, 2018). Accordingly, determining the learning approaches adopted by teacher candidates, who are at the beginning of their undergraduate studies, is important in terms of shedding light on the processes of learning of teacher candidates, interpreting their perceptions and attitudes in regards to different concepts, and even making inferences about their settings of learning.

It is stated that a stronger measurement tool is needed to analyze people's understanding of a phenomenon that is thought to be effective in learning processes and their perceptions towards certain concepts, since the quantitative data obtained from the scales used generally do not allow detailed examinations to shed light on the learning process (Yılmaz & Güven, 2015). The fact that this tool is based on the individual's own statements instead of interpreting it through certain defined options may provide the researcher with the opportunity to obtain in-depth information, no matter how abstract or complex the phenomenon is. When the ways of expressing their thoughts are examined, it is stated that individuals use concrete concepts to explain abstract concepts (Saban, 2008; Şahin, 2013).

Metaphors are among the data collection tools, through which individuals manifest their understandings, perceptions, or associations over a specific phenomenon (Schmitt, 2005). In metaphor studies, individuals are asked to liken any given concept to any specific thing and to write down the reasons for this specific metaphor. Metaphor is defined as a bridge for establishing a connection between phenomena (Cortazzi & Jin, 1999), as a tool of measurement through which something is interpreted and expressed based on another thing (Lakoff and Johnson, 2010, p. 27), or as "a mechanism of mental mapping and modelling" (Arslan and Bayrakçı, 2006, p.103). Metaphors establish connections between "new and extant knowledge" and "language and images" (Tobin & Tippins 1996, p. 716), therefore enabling researchers to enter the inner world of the perceptions, understandings, and experiences of the participants through metaphors (Jensen 2006, p. 41).

Russell and Hrycenko (2006) stated that metaphors played a significant part in determining the perceptions of teacher candidates and in observing the development in occupational learning processes. Based on an analysis of the literature, it is possible to come across a number of studies analyzing the metaphors created by teacher candidates in regards to numerous concepts particularly on science and education (teacher, teaching, student, school, knowledge, curricula, science, scientist, technology, mathematics etc.) (Ateş, 2019; Aydın & Pehlivan, 2010; Durukan, Hacıoğlu & Dönmez-Usta, 2016; Gültekin, 2013; Güveli, İpek, Atasoy & Güveli, 2011; Koç, 2014). Nevertheless, of those studies, not even one could be found that compared the metaphoric perceptions of individuals particularly to the CAMI-oriented data. Thus, this study differs from others as it compares the learning approaches adopted by teacher candidates to CAMI-oriented metaphors. Therefore, it is believed that this study will pave the way for studies that would have the objective to estimate/analyze the learning approaches through the metaphors created by individuals thanks to intra-class-based strategies, or to analyze the effects of these variables on one another.

Primary school years are the years where the curiosity and learning capacity of the students are at high levels (Kağıtçıbaşı, Sunar, & Bekman, 2001) and the roles of classroom teachers in this process are of paramount importance. It can be said that the teacher's role in the process of learning-teaching shifted from passing down information to the side where they teach students how to learn (Baki, 2001). Rapid advances in the field of technology and the fact that learning to learn has been increasingly emphasized, bring up the discussion of the learning approaches in the processes of

learning-teaching in terms of students, and the discussion of CAI with different aspects in terms of methods of teaching. Under the light of these data, this study primarily aimed to determine the perceptions of classroom teacher candidates regarding the concept of CAMI, as well as the learning approaches that they adopted. Furthermore, the another aim of the study of this study consists of an analysis of whether the metaphors created by teacher candidates about CAMI differed based on the learning approaches that they adopted. Accordingly, the study sought answers to the research questions below:

1. Which metaphors do teacher candidates use in order to explain the concept of CAMI?
2. Under which categories can the metaphors put forward by teacher candidates be grouped in terms of their common aspects?
3. Do the metaphors of teacher candidates regarding the concept of CAMI differ based on the learning approach they adopt?

## **METHOD**

This chapter explains the research design, study group, and data collection tools of the study, as well as the collection and analysis of the data.

### **Research Design**

The study aimed to analyze the perceptions of classroom teacher candidates in regard to the concept of CAMI, as well as the learning approaches they adopted, and whether the metaphors they created on CAMI differed from the learning approaches they adopted. Within the framework of this objective, the model of the study was set as the survey model because it attempted to explain the current situation as it was without any intervention (Karasar, 2002). Of the survey models, the descriptive and relational survey models were employed within this framework. The descriptive survey model was employed in order to determine the perception of classroom teacher candidates regarding the concept of CAMI, as well as the learning approaches that they adopted. On the other hand, the relational survey model was used in order to analyze whether the metaphors created by teacher candidates regarding CAMI differed based on the learning approaches that they adopted. Using the relational survey model, it was aimed to put forward the correlation between variables, without any intervention on the variables (Büyüköztürk, Akgün, Demirel, Karadeniz, & Çakmak, 2015).

### **Study Group**

The study was conducted on teacher candidates, who were first-year students at the Department of Primary Education. The data of the study were collected in the spring semester of the 2016-2017 academic year. The metaphor forms were administered to 90 teacher candidates in association with the fundamental problem of the study. Nonetheless, the second part of the study, which focused on its sub-problems, was conducted with 62 teacher candidates who voluntarily completed the scale of learning approaches in full.

While the first-grade teacher candidates participated in the study took the common compulsory courses (Foreign Language, Turkish Language, Computer, Atatürk's Principles and History of Revolution) through distance education in the first semester, they took Mathematics, Biology, History of Civilization and Introduction to Educational Science courses face to face. Thus, considering that teacher candidates at this grade level did not take any elective courses or courses such as field teaching and teaching methods, it is assumed that their views on CAMI are limited only to their first-term experiences and their perceptions of that period.

## **Data Collection Tools**

### **Metaphor Form**

A metaphor form was prepared in order to let the teacher candidates complete the sentence “*Computer-assisted mathematics instruction is like ....., because .....*”. Having been provided with a short explanation of the metaphors, the teacher candidates were asked to create a metaphor regarding a sample concept. Finally, emphasizing that they had to focus on a single metaphor for the designated concept and express the reasons, the teacher candidates were given time to complete the form given. Of the metaphors created by the teacher candidates regarding CAMI, 89 were deemed valid. The metaphor given by a teacher candidate, who did not provide a logical basis for their metaphor, was deemed invalid.

The steps of the study process were reported as elaborate as possible with respect to reliability and validity, and they were submitted to be assessed by an expert, whenever needed. Moreover, direct quotations of the teacher candidates were included with regards to specific examples of metaphors and their justification. An expert, who had previously conducted metaphor studies, was asked to match the metaphors with categories. This matching and another matching done by one of the authors were compared, using the reliability formula of Miles and Huberman (1994). The reliability was calculated as 94% due to the fact that five pieces of metaphors were evaluated in a different category by the expert. The metaphors were evaluated in the categories determined upon the unanimous decision of the researcher and the expert.

### **The Learning Approaches Scale**

“The Approaches and Study Skills Inventory for Students” was the data collection tool of choice for the purpose of determining the learning approaches of the teacher candidates. The scale was developed by Tait, Entwistle, and McCune (1998) and adapted to Turkish by Senemoğlu (2011). The entire scale consists of four parts and a total of 67 items, all of which are of the five-point Likert scale type. In the first study conducted, the reliability coefficient was found to be in the range of 0.71-0.81 for the whole of the scale and for the four parts. Whereas in the Turkish adaptation this value was found to be in the range of 0.71-0.91. This study used the first part of the scale, which consisted of three dimensions - deep, strategic, and surface learning approaches - and 52 items. The reliability coefficient of the part used was found as 0.88. Of these 52 items, sixteen measure the deep learning approach, twenty measure the strategic learning approach, while the remaining sixteen measure the surface learning approach.

### **Analysis of Data**

Descriptive and content analysis techniques were employed for the analysis of the qualitative data in the study. In this context, the "naming and elimination", "category development" and "ensuring validity and reliability" phases (Gültekin, 2013; Saban, 2008) were followed in the process of analyzing and interpreting the metaphors created by the teacher candidates. In the first phase, the scope of the study included the metaphors created by teacher candidates, who focused on a specific metaphor and provided a valid reason in regard to this metaphor. Subsequently, the metaphors listed alphabetically were given in the findings chapter in tables. At the category development phase, the metaphor expressions were analyzed in respect of the common aspects that they had regarding CAMI. Categories were created, considering the emphasis, justification, and perspectives of the teacher candidates on this concept. In addition to the categories and sub-categories given in the results chapter, examples of metaphors and explanations are provided in Appendix 1.

Regarding the learning approaches, total points of the relevant items are not comparable to one another as the 52 items available in the first part of the scale were not distributed equally among the learning approaches. Therefore, their average was calculated in order to make the points obtained from

relevant items suitable for comparison, and the points obtained by teacher candidates from each learning approach were arranged in a way that the highest point would be 5, and the lowest 1. Subsequent calculations were carried out over these values obtained. The learning approach preferred by the student was calculated for each learning approach and determined as per the highest point.

## FINDINGS

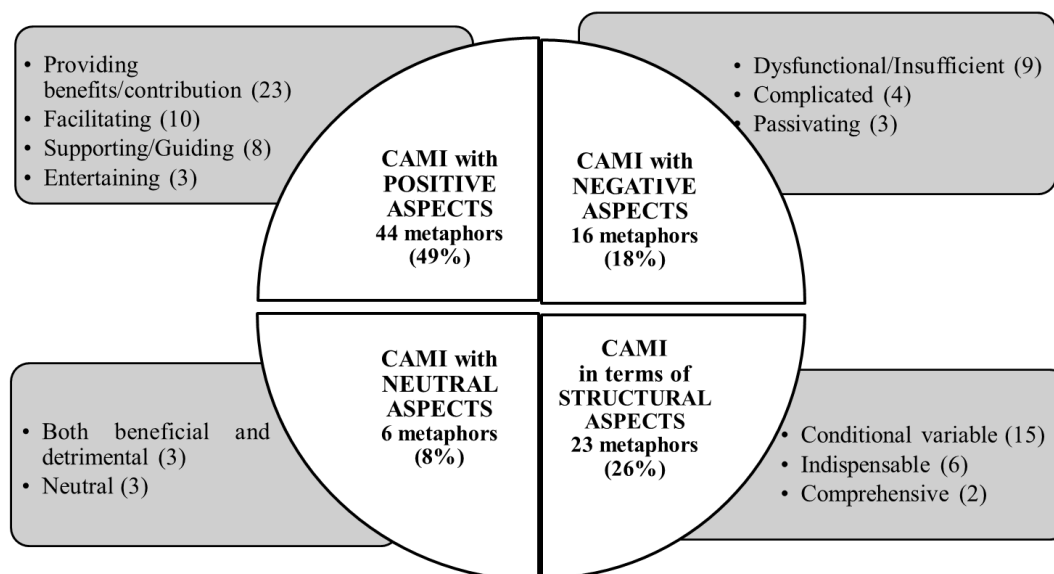
### Findings on Metaphors Regarding CAMI

The first research question of the study was determined as follows: "Which metaphors do teacher candidates use in order to explain the concept of CAMI?" In this context, the metaphors produced by the participants in line with CAMI are listed in Table 1 in alphabetical order.

**Table 1: Metaphors Created by Teacher Candidates Regarding CAMI**

|                              |                           |                       |                         |
|------------------------------|---------------------------|-----------------------|-------------------------|
| absorbing course             | Eating                    | machine (2)           | skeletonless human      |
| antibiotics                  | empty classroom           | main storage          | stone                   |
| assistant                    | Eyeglasses                | mascara               | sunbathing on the beach |
| ayran (local beverage)       | first aid kit             | mathematics itself    | rain in the desert      |
| baklava (dessert)            | flat coke                 | mixer                 | rainbow colours         |
| beneficial situation         | foreign tv series         | new book              | remote education        |
| book                         | Game                      | night vision camera   | tasteless bread         |
| broccoli                     | Gift                      | node                  | teacher                 |
| butterfly                    | going out to nature       | non-refereed football | telephone line          |
| cake                         | good example              | novel                 | thievery                |
| car                          | hectic life               | old lady's cane       | time machine            |
| catching harmony             | Hometown                  | part of life          | unconditional love      |
| chewing gum                  | hot dip                   | person losing weight  | unnecessary course      |
| child learning how to read   | infertile land            | pistachio baklava     | upcoming exams          |
| cloud                        | internet research         | playing games         | watching TV (2)         |
| communicating with a tourist | invigoration of the mind  | potato peeler         | water filling in a hole |
| crutch                       | keşkek (traditional meal) | preparation phase     | writing encyclopedia    |
| doctor                       | Lamp                      | process of addition   | vitamin pill            |
| dog                          | learning how to cook      | puzzle                | zucchini                |
| dream (3)                    | Life                      | salt                  |                         |
| drug                         | Lifeguard                 | sauce                 |                         |
| earphone                     | Love                      | seasonal flower       |                         |

Table 1 shows that teacher candidates created a total of 89 CAMI-oriented valid metaphors in alphabetical order and that metaphors "dream" (f=3), "machine" (f=2), and "watching TV" (f=2) were created by multiple teacher candidates. The second research question of the study was determined as follows: "Under which categories can the metaphors put forward by teacher candidates be grouped in terms of their common aspects?" As a result of the analysis of the metaphors, the CAMI-oriented metaphors created by the teacher candidates were collected under the categories "CAMI with positive aspects", "CAMI with negative aspects", "CAMI in terms of structural aspects" and "CAMI with neutral aspects". Each category and each subcategory are given in Figure 1.



**Figure 1: Categories and subcategories of metaphors regarding CAMI**

Figure 1 shows that the metaphors of the teacher candidates were discussed under 4 categories and 12 subcategories. Considering the category-based percentage of the metaphors, it can be seen that the teacher candidates mainly had a positive perception. Of the teacher candidates, nearly half (49%) were evaluated to have positive perceptions about CAMI as they put emphasis on the beneficial, facilitating, supportive or entertaining aspects of CAMI. A group of teacher candidates (18%) was found to have created negative metaphors, putting emphasis on the insufficient, complicated, or passivating aspects of CAMI. Nevertheless, a small portion of teacher candidates (8%) made justifications both on positive and negative aspects of CAMI, as well as on their perceptions being neutral. Following the analysis of the metaphors and justification by the teacher candidates, it was observed that some teacher candidates (26%) put emphasis on CAMI being conditional, comprehensive, or indispensable, rather than positive or negative aspects of CAMI. Each category, subcategories, examples of metaphors, and examples of explanations are given in Appendix 1.

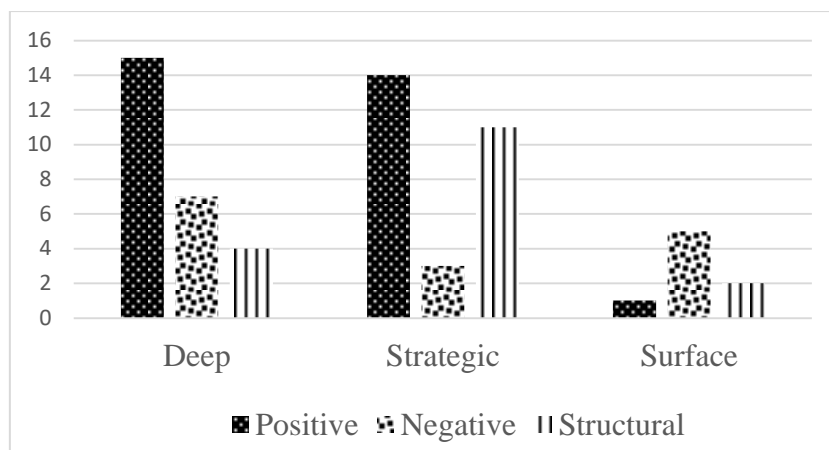
### Findings Concerning the Comparison of the Teacher Candidates' Metaphors with Their Learning Approaches

The third research question of the study was determined as follows: "Do the metaphors of teacher candidates regarding the concept of CAMI differ based on the learning approach that they prefer?" As this part of the study was conducted with 62 teacher candidates, Table 2 gives the results concerning the distribution of the metaphor categories of the teacher candidates and their dominant learning approaches.

**Table 2: Distribution of Metaphor Categories and Learning Approaches**

| Metaphor Categories | Learning Strategies (f) |           |         | Total |
|---------------------|-------------------------|-----------|---------|-------|
|                     | Deep                    | Strategic | Surface |       |
| Positive Aspects    | 15                      | 14        | 1       | 30    |
| Negative Aspects    | 7                       | 3         | 5       | 15    |
| Structural Aspects  | 4                       | 11        | 2       | 17    |
| Total               | 26                      | 28        | 8       | 62    |

Following the analysis of Table 2, it was determined that a great majority of the teacher candidates adopted the strategic (f=28) and deep (f=26) learning approaches, while a specific portion adopted the surface (f=8) learning approach. It can also be seen that nearly half of the metaphors were created to put emphasis on the positive aspects (f=30) of CAMI, while others emphasized the structural (f=17) and negative (f=15) aspects of it. No metaphors could be found among the participants of this group concerning the neutral aspect of CAMI. Figure 2 gives the distribution of the metaphor categories and the learning approaches of the participants.



**Figure 2: Distribution of the learning approaches and metaphor categories**

Following the analysis of Figure 2, it was found that teachers, who adopted the deep and strategic learning approach, had proportionally more positive approaches, while those adopting the surface learning approach had a negative perception. For instance, a teacher candidate, who adopted the deep learning approach, reflected their positive thoughts by using expressions, such as "it is similar to an old lady's stuff because it provides positive support as a third foot", and a teacher adopting the strategic learning approach did the same by using expressions, such as "it is similar to writing encyclopedias because numerous new information can be passed down to students through this type of teaching, enabling such information to be planted inside the brain of the students", while a teacher candidate adopting the surface learning approach expressed his negative opinions through expressions, such as "it is similar to a dream because you usually come across the opposite of what you see, which in turn disappoints you".

In addition to these opinions, it was observed that teacher candidates, who rather put emphasis on the structural aspects and conditions of CAMI, were the ones that had the strategic learning approach. For instance, one teacher candidate stated "it is similar to a puzzle because our skills improve to the extent of effort we put in", while another said, "it is similar to water filling into a hole because teaching can only occur by the completion of missing information, which solidifies the knowledge". Therefore, it is possible to say that the learning approaches adopted by teacher candidates were in concordance with the metaphors they created and with their justification.

The SPSS Exact Test was employed to determine whether there was a statistically significant correlation between the metaphors categories and learning approaches of the teacher candidates, and the results were given in Table 3.

**Table 3: Correlation between Learning Approaches and Metaphor Categories**

|                           | Value   | Df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) |
|---------------------------|---------|----|-----------------------|----------------------|
| Pearson's Chi-Square Test | 12,473* | 4  | ,014                  | ,013                 |

\*3 cells (33,3%) have expected count less than 5. The minimum expected count is 1,94.

The chi-square test dictates that no more than 20% of the values should be lower than five. As the subject matter of the study included a 3x3 table and because the proportion of the number of



observations with theoretical values lower than 5 was more than 20% (33.3%, see Table 3), it was decided to employ the SPSS Exact Test. As a result of the analysis, a statistically significant correlation was found between the metaphors and learning approaches ( $\chi^2= 12.47, p = .013$ ).

## DISCUSSION, CONCLUSION, AND RECOMMENDATION

This study was conducted in order to analyze whether the classroom teacher candidates' metaphors regarding CAMI differed from the learning approaches that they adopted. Of the study results, the first one was related to putting forward 85 different metaphors out of 89 valid metaphors in total (as some teacher candidates created similar metaphors). Considering the fact that the teacher candidates participating in the study took similar courses before and during the study, the resulting variability can be considered striking. This situation may indicate that there are individual differences between students and that the common course they take, similar course processes, or metaphors alone may not be functioning as a determinant in designating their perception.

As it was not possible to fully explain the CAMI-oriented perception by using the metaphor expression created, the justification of the metaphors was analyzed and the statements of the teacher candidates were grouped under specific categories. Of the results obtained as a consequence of the study, the second one shows that nearly half of the metaphors created by the teacher candidates were positive while one-fifth were negative in regard to CAMI. Approximately one-fourth, however, are observed to have rather focused on structural aspects of CAMI. Similarly, the results of the study conducted by Boz and Özerbaş (2020) put forward that the perception of classroom teachers concerning the use of technology in mathematics class was substantially positive. Even though these results seem to be positive at first sight, in order to interpret this situation, it is important to initially determine what teacher candidates make of the concept of CAI. When the metaphor-related statements are analyzed, it can be seen that some teacher candidates evaluated CAI mainly from its remote education aspect. Based on the statements made by some teacher candidates, such as "we cannot get efficiency as we can in a normal lesson", "it is proper that a teacher lectures the course", "it is at our disposal for those who cannot go to school", "remote education brings about lower quality, which makes it unnecessary", it is believed that they made negative comments on remote education, instead of CAI. This may be caused by the fact that the common compulsory courses started to be lectured remotely one year before the study took place, that this situation was a new experience for the freshmen, as well as the setbacks in the process. Some previous studies support this idea (Çivril, Aruğaslan, & Özkara, 2018; Fidan, 2017; Marsh, Mitchell & Adamczyk, 2010). For instance, in the study conducted by Yılmaz and Güven (2015), it is shown that the reasons for the negative perceptions are that the lessons are combined without a break, there is no opportunity to ask questions to the lecturer outside the lesson, and there may be technical problems from time to time.

Based on the research of Açıkgül and Aslaner (2014) on the studies conducted with pre-service teachers for the use of CAI in mathematics lessons, it can be said that pre-service teachers' computer anxiety levels, self-efficacy perceptions and attitudes also affect this result. Polat and Karakuş (2020), as a result of their study with pre-service teachers, revealed that pre-service teachers' attitudes towards CAI and their self-efficacy perceptions were generally positive and emphasized that there were other studies that yield parallel results. Another factor emerged in the study is that the higher the class level, the more positive the attitude and perception of self-efficacy. Considering that the participants of this study are first grade students, it can be concluded that if the quality of the education given increases in parallel with the increase in grade level, prospective teachers may have a better perception when they graduate. Moreover, it is reported that there is a highly negative relationship between computer self-efficacy perception and computer anxiety levels of students (Durndell & Zaag, 2002; Öztürk, 2013). For this reason, it can be thought that most of the students may not have high computer anxiety levels. Some researchers (Öztürk, 2013; Polat & Karakuş, 2020) also state that students owning a computer may also add to this result and therefore it would be beneficial to evaluate the working group from this point of view.

The third study result sets forth that teacher candidates adopting the deep and strategic learning approach had proportionally more positive perceptions while those with the surface learning approach had negative perceptions, and that there is a statistically significant correlation between the metaphor categories and learning approaches. This result seems to be in concordance with the aspects of the learning approaches. The fact that a method beyond traditional methods, such as CAI, is perceived positively and preferred by teacher candidates may be arising from the fact that the processes they have experienced and will experience are of better quality, as well as from their intentions to make use of different opportunities concerning high expectations of achievement. Even though no studies could be found that directly discussed the correlation between learning approaches and CAI, a study conducted by Doğruluk (2015) can be evaluated in terms of creating a perspective on this subject matter. In a study they conducted with teacher candidates, Doğruluk (2015) put forward that the level of surface learning approaches of teacher candidates increased in parallel with the duration of internet use. On the other hand, the same study concluded that the correlation between the self-sufficiency belief that the teacher candidates had regarding the use of the internet for educative purposes and the deep approach was more powerful, compared to the surface approach. When the study results are analyzed in this respect, it can be concluded that the proper use of technology in the field of education, beyond its usage in our daily lives, can pave the way for the creation of a quality learning-teaching process. In a study they conducted, Bozkurt and Cilavdaroğlu (2011) also set forth that even though classroom teachers used technology, they could not use it sufficiently and in a quality manner in the learning processes of the students. Classroom teachers use computer technology through interactive software and websites in order to attract attention or for visual aspects; nevertheless, they make only a little use of the software that supports different activities for creating and developing concepts in mathematics classes (Sarı & Akbaba-Altun, 2015).

The results of the study were evaluated in line with the objective of the study, and they revealed the need for different studies. There are studies in the literature that emphasize the fact that individual variables are important in terms of attitudes and that mainly those with past experiences in CAI have positive attitudes (Çeliköz, 1997). Therefore, it is also important to determine the CAI experiences of teacher candidates in the pre-undergraduate periods. Additionally, although the general CAMI-oriented perceptions of teacher candidates are not negative, it is required to elaborately research the causes of negative perceptions concerning CAMI.

The metaphors created by teacher candidates, their remarks on said metaphors, and the correlation between the metaphors and learning approaches are also significant in respect of giving an idea to the faculty members managing the program, and the outcomes should be taken into consideration. The way the teacher candidates explain specific concepts during the intra-class dialogs they had, may give some clues regarding the learning approaches that they adopt. As learning approaches are variables that can differ based on a number of factors, it is of utmost importance to elaborately analyze the underlying reasons why individuals adopt surface learning and under which circumstances they can develop deep and strategic approaches.

Rather than how densely it is used in the settings of teaching, it is significant to integrate technology into a pedagogical approach in line with educational purposes (Mumcu, Haşlaman, & Usluel, 2008). CAMI materials can be prepared that are in concordance with the programs and achievements of teacher candidates in order to effectively integrate technology into learning processes. Doing so, it could be possible to increase their awareness of this subject matter and to help them develop a positive attitude. Additionally, the prospective benefits of this teaching method in the deep and strategic learning process can be shown by preparing activities on how students can use CAMI in their own learning processes.

## REFERENCES

- Açıkgül, K., & Aslaner, R. (2014). Computer Based Instruction and Prospective Mathematics Teachers: A Literature Review *İnönü University Journal of Educational Sciences Institute*, 1(1), 41-51.
- Aktümen, M. & Kaçar. A. (2003). The Role of Computer Assisted Instruction in The Teaching of Expressions among Primary Education Eight Grade Students and Evaluation Students' Opinion about Computer Assisted Instruction. *Kastamonu Education Journal*, 11(2), 339-358.
- Arslan, M. M & Bayrakçı, M. (2006). Examining the Metaphorical Thinking and Learning Approach in terms of Education. *National Education Journal*. 34(171), ss.100-108.
- Ateş, Ö. (2019). Preservice Teachers' Views of Nature of Science and Their Metaphoric Perceptions of Science and Scientists, *International Online Journal of Educational Sciences*, 11 (4), 141-159.
- Aydın, İ. S. & Pehlivan, A. (2010). The Metaphors That Turkish Teacher Candidates Use Concerning "Teacher" and "Student" Concepts. *Turkish Studies-International Periodical for the Languages, Literature and History of Turkish or Turkic* Volume 5/3 Summer 2010, p. 818-842.
- Baki, A. (2001). Evaluation of Mathematics Education Under the Light of Information Technology. *National Education Journal*, 149, 26-31.
- Baki, A. (2002). *Computer-aided Mathematics for Learners and Teachers*. İstanbul: Ceren Publication.
- Beyaztaş, D. & Senemoğlu, N. (2015). Learning Approaches of Successful Students and Factors Affecting Their Learning Approaches. *Education and Science*. 40(179):193–216.
- Boz, İ., & Özerbaş, M. A. (2020). Opinions of Primary School Teachers about the Use of Technology in Mathematics Lesson. *Science, Education, Art and Technology Journal (SEAT Journal)*, 4(2), 56-66.
- Bozkurt, A. & Cilavdaroğlu, A. K. (2011) Mathematics and Classroom Teachers' Perceptions Of Technology Use And Integration Into Their Instruction. *Kastamonu Education Journal*, 19(3), 859-870.
- Büyükoztürk, Ş., Akgün, Ö. E., Demirel, F., Karadeniz, Ş., & Çakmak, E. K. (2015). *Scientific Research Methods*. Pegem Publishing.
- Cerit, Y. (2008). Students, Teachers and Administrators' Views on Metaphors about the Concept of Teacher. *The Journal of Turkish Educational Sciences*, 6(4), 693-712.
- Cortazzi, M. & Jin, L. (1999). Bridges to learning: Metaphors of Teaching, Learning and Language. In L. Cameron ve G. Low (Eds.). *Researching and Applying Metaphor* (pp.149-176). Cambridge: Cambridge University Press.
- Çeliköz, N., (1997). The Studies Relating to Computer-aided Teaching in Turkey. *Educational Administration Journal*, 3(4), 479-498.

- Çivril, H., Aruğaslan, E., & Özkara, B. Ö. (2018). Distance Education Perceptions of Distance Education Students: A Metaphor Analysis. *Educational Technology Theory and Practice*, 8(1), 39-59.
- Dinçer, S., & Doğanay, A. (2016). Computer Assisted Instruction Rating Scale Adaptation Study. *Ondokuz Mayıs University Journal of Faculty of Education*, 35(1), 45-62.
- Doğruluk, S. (2015). The Relationship between Pre-Service Teachers' Self-efficacy Beliefs Related to Educational Internet Usage and Their Learning Approaches. Unpublished Master Thesis. Institute of Science and Technology, Kahramanmaraş Sütçü İmam University
- Durndell, A., & Haag, Z. (2002). Computer Self-efficacy, Computer Anxiety, Attitude to the Internet and Reported Experience with the Internet, by Gender, in an East European Sample. *Computers in Human Behavior*, 18(5), 521-535.
- Durukan, Ü. G., Hacıoğlu, Y., & Dönmez Usta, N. (2016). Computer Education and Instructional Technology Prospective Teachers' Perceptions of Technology. *Journal of Computer and Education Research*, 4 (7), 24-46
- Ekinci, N. (2009). Learning Approaches of University Students. *Education and Science*, 34(151), 74-88
- Fidan, M. (2017). Metaphors of Blended Learning' Students Regarding the Concept of Distance Education. *International Online Journal of Educational Sciences*, 9(1), 276-291.
- Gültekin, M. (2013). The Metaphors that Primary Education Teacher Candidates use Regarding Curriculum. *Education and Science*, 38(169), 126-141.
- Güveli, E., İpek, A. S., Atasoy, E., & Güveli, H. (2011). Prospective Primary Teachers' Metaphorical Perceptions Towards Mathematics. *Turkish Journal of Computer and Mathematics Education*, 2(2).
- İnceoğlu, M. (2010). Attitude, Perception and Communication. İstanbul: Beykent University Publishing.
- Jensen, D. (2006). Metaphors as a Bridge to Understanding Educational and Social Contexts. *International Journal of Qualitative Methods*, 5(1), 36-54.
- Kağıtçıbaşı, Ç., Sunar, D., & Bekman, S. (2001). Long-term Effects of Early Intervention: Turkish Low- Income Mothers and Children. *Applied Developmental Psychology*, 22, 333-361.
- Karasar, N. (2002). Scientific Research Methods, Nobel Publishing, Ankara.
- Keşan, C. & Kaya, D. (2007). Primary School Teaching Students' Perspectives on Computer Aided Basic Mathematics Teaching. *Journal of Science, Education and Thought*, 7(1).
- Koç, E. S. (2014). The Metaphoric Perceptions of Classroom Teacher Candidates Regarding the Concepts of Teacher and Teaching Profession. *İnönü University Faculty of Education Journal*, 15(1), 47-72.
- Lakoff, G., ve Johnson, M. (2010). *Metaphors Life Meaning and Language*. İstanbul: İthaki Publishing.
- Marsh, B., Mitchell, N., & Adamczyk, P. (2010). Interactive Video Technology: Enhancing Professional Learning in Initial Teacher Education. *Computer & Education*, 54(3), 742-748.

- Marton F. Saljo R. (1976). On Qualitative Differences in Learning: I Outcome and Process. *The British Journal of Educational Psychology*, 46(1), 4–11. 10.1111/j.2044-8279.1976.tb02980.x
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative Data Analysis*. Thousand Oaks, CA: Sage.
- Mumcu, F. K., Haşlaman, T., & Usluel, Y. K. (2008). Indicators of Effective Technology Integration within the Framework of Technological Pedagogical Content Knowledge Model, 8th International Educational technology conference Eskişehir, Türkiye.
- Olpak, Y. Z., Arıcan, M., & Baltacı, S. (2018). The Effects of Preservice Teachers' Learning Approaches and Individual Innovativeness Characteristics on Their Satisfaction towards Peer Instruction. *Yüzüncü Yıl University Journal of Education Faculty*, 15(1), 525-551.
- Öztürk, E. (2013). An Investigation On Prospective Teacher's Computer Anxiety and Computer Self Efficacy Based on Several Variables. *Hacettepe University Journal Of Education*, (44), 275-286.
- Polat, K. & Karakuş, F. (2020). Examination of Pre-Service Teachers' Attitudes and Self-Efficacy Towards Computer-Aided Education . *Cumhuriyet International Journal of Education*, 9(2), 579-592.
- Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. *On the horizon*, 9(5), 1-6.
- Ramsden, P. (1979). Student Learning and Perceptions of the Academic Environment. *Higher Education*, 8, 411-427
- Russell, T. & Hrycenko, M. (2006). *The Role of Metaphor in a New Science Teacher's Learning from Experience*. In P. J. Aubusson, A. G. Harrison, and S. M. Ritchie (Eds.), *Metaphor and Analogy in Science Education* (pp. 131–142). Dordrecht: Springer Netherlands. doi:10.1007/1-4020-3830-5\_11.
- Saban, A. (2008). Metaphors about School. *Educational Administration: Theory and Practice*, 55, 459-496.
- Sarı, M. H. & Akbaba Altun, S. (2015). A Qualitative Research on Classroom Teachers' Technology Use in Mathematics Teaching. *International Journal of Eurasia Social Sciences*, 6(19), 24-49.
- Schmitt, R. (2005). Systematic Metaphor Analysis as a Method of Qualitative Research. *The Qualitative Report*, 10(2), 358–394. Retrieved from <http://nsuworks.nova.edu/tqr/vol10/iss2/10>
- Senemoğlu, N. (2011). *Development Learning and Teaching*. Pegem Publishing.
- Şahin, B. (2013). Teacher Candidates' Metaphoric Perceptions Related with “Mathematics Teacher”, “Mathematics” and “Math Lesson” Concepts. *Mersin University Faculty of Education Journal*, 9(1), 313-321.
- Tait, H., Entwistle, N. J., & McCune, V. (1998). ASSIST: a Re-Conceptualization of the Approaches to Studying Inventory. In C. Rust (Ed.), *Improving Students as Learners* (pp.262-271). Oxford: Oxford Brooks University.

- Tobin, K. & Tippins, D. J. (1996). Metaphors as Seeds for Conceptual Change and the Improvement of Science Teaching. *Science Education*, 80(6), 711–730. [https://doi.org/10.1002/\(SICI\)1098-237X\(199611\)80:6<711::AID-SCE5>3.0.CO;2-M](https://doi.org/10.1002/(SICI)1098-237X(199611)80:6<711::AID-SCE5>3.0.CO;2-M).
- Yenilmez, K. & Sarier, Y. (2007). Prospective Teachers' Opinions on Computer Aided Mathematics Teaching, Proc. 1st International Symposium on Computer and Instructional Technologies, Çanakkale, 1184-1204.
- Yılmaz, G. K., & Güven, B. (2015). Determining the Teacher Candidates' Perceptions on Distance Education by Metaphors. *Turkish Journal of Computer and Mathematics Education*, 6(2), 299-322.

APPENDIX 1

