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# THE CONVERGENCE OF PERCEIVED EFFICACY BELIEFS AND SCIENCING IN EARLY CHILDHOOD CLASSROOMS[1]

**Yrd. Doç. Dr. Evrim GENÇ KUMTEPE**
Anadolu University, College of Open Education, evrimgenc@gmail.com
**Yrd. Doç. Dr. Alper Tolga KUMTEPE**
Anadolu University, College of Open Education, atkumtepe@anadolu.edu.tr
**Öğr. Gör. Bülent BATMAZ**
Anadolu University, College of Open Education, bbatmaz@anadolu.edu.tr

## Abstract

*Like many other countries, Turkey is also suffering from the lack of science in early years. Considering the literature and previous experiences in Turkey's early childhood centers, it is obvious that science is the most neglected subject area in the curriculum. Furthermore, lack of science centers and materials in Turkey is also recognized by few available studies. This study employed survey research design with a sample of 242 in-service teachers from every region of Turkey. Results of the analyses support the reliability and construct validity of measuring science teaching efficacy with the SETAKIST instrument among early childhood teachers. Result of the correspondence analysis revealed that the higher levels of both teaching efficacy and knowledge efficacy are associated with more frequent science activities in classrooms. Another variable that was associated with more frequent science teaching was the year of teaching experience. Because the number of teachers who utilize science activities every day is relatively small, it is positioned apart from other components.*

**Keywords**: *Early childhood, science education, teacher self-efficacy, multiple correspondence analyses.*

## OKULÖNCESİ EĞİTİMDE ÖZYETERLİK ALGISI VE FEN UYGULAMALARI İLİŞKİSİNİN İNCELENMESİ

## Özet

*Pek çok ülkede olduğu gibi, Türkiye'de de erken çocukluk eğitiminde fen alanına yeterince yer verilmemektedir. Alanyazın ve Türkiye'deki erken çocukluk eğitimi kurumlarındaki deneyimler incelendiğinde öğretim programında en az çok göz ardı edilen alanın fen olduğu görülmektedir. Fen köşelerinin ve fen malzemelerinin eksikliği de var olan az sayıdaki araştırmada ortaya konulmuştur. Bu çalışmada anket araştırma yöntemiyle Türkiye'nin farklı bölgelerinden 242 okulöncesi eğitim öğretmeninden veri toplanmıştır. Sonuçlar SETAKIST ölçeğinin okulöncesi eğitim öğretmenlerinin özyeterliklerini ölçmede geçerli ve güvenilir bir seçenek olabileceği görüşünü desteklemektedir. Çoklu uyum analizi sonuçları hem öğretme özyeterliğinin hem de bilgi özyeterliğinin sınıfta gerçekleştirilen fen etkinliklerinin sıklığıyla ilişkili olduğunu göstermiştir. Fen etkinlikleri ile ilişkili bulunan bir diğer değişken de öğretmenlerin deneyim yılıdır. Fen etkinliklerini her gün kullanan öğretmenlerin diğer katılımcılardan ayrıştıkları gözlenmiştir.*

**Anahtar Kelimeler**: *Okulöncesi eğitim, fen eğitimi, öğretmen özyeterliği, çoklu uyum analizi*

[1] This study was presented at the 5th World Conference on Educational Sciences at Sapienza University of Rome, Italy.

## Introduction

Like many other countries, Turkey is also suffering from the lack of science in early years. According to the results of 2009 Programme for International Student Assessment (PISA) study, Turkey is ranked 31st among all 33 OECD countries in term of science literacy (OECD, 2010). Although PISA scores are affected by many other variables, early experiences are thought to be essential for later academic success in science (Eshach, 2006; French, 2004; Ginsburg & Golbeck, 2004; Lind, 1999; Samarapungavan, Mantzicopoulos & Patrick, 2008) even more than some quick remedies like reducing the class size. Considering the literature and previous experiences in Turkey's early childhood centers, it is obvious that science is the most neglected subject area in the curriculum. Furthermore, lack of science centers and materials in Turkey is also recognized by few available studies (e.g., Erden & Sönmez, 2011; Özbey & Alisinanoğlu, 2008; Uyanık-Balat, 2009).

### *Literature Review*

Certain knowledge and skills about science and technology in today's Information Age society is considered as a must. Contrary to traditional schooling experiences, this is an emphasis on what our students can do with knowledge rather than what units of knowledge and skills they have, that best reflects 21st century skills and requirements. It is believed that this core notion would ensure that children not only pursue science and technology for their careers but also become literate citizens in those areas (Yager, 2012). It is, therefore, argued commonly that this need should be mimicked in education in these disciplines as early as preschool and kindergarten even though science is considered as the most neglected area in these periods (Moomaw & Davis, 2010).

Previous research in science, mathematics and technology has found a new channel to develop in recent years as STEM has emerged as an umbrella term. STEM is an acronym for fields of science, technology, engineering and mathematics. It was coined by the National Science Foundation (NSF) in the early 2000s and until today numerous projects have been funded by the organization.

The literature provides ample evidence illustrating the importance of early years in a child's future success. For instance, recent research findings emphasize the importance of science education in early years and assert that it is necessary to incorporate science in early childhood education (Eshach, 2006; French, 2004; Ginsburg & Golbeck, 2004; Lind, 1999; Samarapungavan, Mantzicopoulos & Patrick, 2008) because basic understanding and skills in science as early as infancy have lasting effects in a child's future learning experiences. Early childhood STEM literature provides sufficient evidence illustrating children who "start behind, stay behind" (National Academies of Sciences and Engineering [NASE], 2010, p. 6) not only in STEM disciplines but also in other academic areas like reading (Blachman, 2000) as "it turns out that early math skills are just as predictive of later reading achievement as early reading achievement is" (NASE, 2010, p. 15). Recent research depicts that children involved in developmentally appropriate science (Eshach & Fried, 2005; Kumtepe, Kaya, & Kumtepe, 2009) and math (NASE, 2010) activities at the preschool, kindergarten, and early elementary school outperform their uninvolved peers at consequent years.

However, design and use of the early science experiences and environments is heavily dependent on the abilities of teachers. As it is the case in other subject areas and grade levels, the teacher and the environment in early childhood institutions play key roles on successful applications of science learning. However, "we know almost nothing about the early teaching of mathematics and science, partly because they have seldom been taught to young children" (Ginsburg & Golbeck, 2004, p. 196). Teachers' reluctance to teach science is considered to be associated with many variables like self-efficacy (Bandura, 1977), lack of knowledge (Wenner, 1993), attitude towards science, and misconceptions about science being difficult to teach (Seefeldt & Galper, 2002). Research has shown that the level of science knowledge is linked to increase positive attitudes towards science and in turn, positive attitudes linked to more frequent and effective science teaching practices (Eshach, 2006; Faulkner-Schneider, 2005; Garbett, 2003). When teachers are not equipped with adequate science knowledge, they tend to stay away from science activities in early childhood classrooms (Cullen, 2000; Garbett, 2003; Hedges & Cullen, 2005). Avoidance of teaching science is strongly tied to the low levels of perceived self-efficacy and attitudes of teachers (Kobolla & Crawley, 1985).

Since Bandura (1977) first introduced the construct of self-efficacy, the construct been viewed as a central facet of social cognitive theory. According to Bandura (1997) "self-efficacy refers to beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p.3) and such beliefs are the most central mechanism of personal agency. Bandura (1997) further states that self-efficacy is specific to a particular set of behaviors and comprises two components; self-efficacy and outcome expectations which respectively relate to belief in personal capacity to effect a behavior and the belief that the behavior will result in a particular outcome.

Teacher efficacy has been tentatively identified as an important variable in accounting for differences in effectiveness (Saklofske, Michayluk, & Randhawa, 1988; Seefeldt & Galper, 2002). Teachers' efficacy is conceptualized as the belief teachers have about their skills and abilities to achieve desirable learning outcomes by students. The construct of teacher efficacy has been conceptualized in a number of ways, but the most pervasive is derived from two Rand Corporation evaluations of innovative educational programs funded by the Federal Elementary and Secondary Education Act. In these studies, teachers' level of efficacy was identified by computing a total score for their responses to two 5-point Likert scale items. Gibson and Dembo (1984) developed a 30-item scale that yields two factors consistent with the Rand items. They relied on Bandura's cognitive social learning theory of self-efficacy to interpret the two factors that are derived from a factor analysis. Gibson and Dembo named the first factor *personal teaching efficacy* (PTE) that contributes to self-efficacy. *Teaching efficacy* was the second factor assumed to capture outcome expectancy. Woolfolk, Rossoff and Hoy (1990) changed the name of the second factor “teaching efficacy” in the instrument with *General Teaching Efficacy (*GTE). They believe that GTE should reflect a teacher’s personal belief about the general relationship between teaching and learning. On the other hand, PTE is a teacher’s general sense of his or her own effectiveness. Riggs and Enochs (1990) developed another instrument to assess elementary teacher’s science teaching efficacy belief (STEBI) using the same components of efficacy expectations in Gibson and Dembo’s instrument.

Continued research with the Gibson and Dembo items began to identify inconsistencies. Factor analysis of the 30-item instrument indicated that several items loaded on both factors. Consequently, some researchers have used a shortened version, selecting only 16 items that load uniquely on one factor or the other (Soodak & Podell, 1993). Tschannen-Moran (2000) even instigated a discussion on a one-factor solution for the original 36-item instrument. Hoy and Woolfolk (1993) have modified the Gibson and Dembo’s instrument and developed a scale with just 10 items: five personal and five general teaching efficacy items. Furthermore, “the reliability of the two-factor solution that cannot explain more than 60%of the overall variance” (Roberts, Henson, Tharp, & Moreno, 2001, p. 201) was argued. Based on the issue of poor construct validity, Roberts and Henson (2000) designed a new instrument called Self-efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST) that revised the second factor of outcome expectancy.

The current research study was set out to examine early childhood teachers’ self-efficacy beliefs about science teaching and also to explore the effect of teaching practices, classroom environment, and personal traits and experiences on efficacy evaluation in a country context. To address this aim, a quantitative cross-sectional, analytical study was designed for the current study. Concurrently, we planned to build another confirmatory factor analysis to validate the structure of Self-Efficacy Teaching and Knowledge Instrument (SETAKIST) with in-service early childhood teachers in Turkey as a potential instrument to be utilized in future research. Therefore, the main purpose of the current study was twofold: (a) to examine early childhood teachers’ self-efficacy beliefs about science teaching; and (b) to investigate the factor structure of the SETAKIST with in-service early childhood teachers in Turkey.

## Method

This section discusses the nature of participants, instruments, and methods of data analyses utilized in the study.

***Instrument and Participants***

The English version of the science teaching efficacy instrument (SETAKIST) developed by Roberts and Henson in 2000 was translated into Turkish by a team of content experts including one faculty from the field of science education, one from early childhood education, and one from statistics and psychometrics. The team established content validity and wording clarity processes to ensure that the instrument had semantic and conceptual equivalence across languages and cultures, respectively (Cha, Kim, & Erlen, 2007). The SETAKIST contains 16 items on a five-point Likert scale ranging responses from strongly disagree (1) through strongly agree (5) (see Appendix). Originally two-factor model was hypothesized for the instrument as *Teaching Efficacy* (TE) and *Knowledge Efficacy* (KE). The first construct "teaching efficacy" consists of eight items measuring self-efficacy for teaching in science. The second construct "knowledge efficacy" also consists of eight items measuring self- efficacy for pedagogical content knowledge herein knowledge in science teaching.

Online Turkish version of the SETAKIST was administered to early childhood in-service teachers working in a kindergarten and also serving as practicum teachers via a Learning Management System in a distance early childhood teacher education program in Turkey. Two hundred and forty two teachers completed online questionnaire. All respondents were female.

***Data Analysis***

In the current study, both exploration and confirmation are accomplished by examining explained variance, testing for additivity of items in the subscales and also comparing the computed covariance matrix implied by the hypothesized model to the actual covariance matrix derived from the empirical data. Subsequently, the total scores of all components were classified as low, middle, and high by K-means cluster analysis. Finally, multiple correspondence analysis (MCA) was used for studying their relationships with the demographic characteristics of the individuals in other clusters.

More specifically, exploratory factor analysis, with varimax rotation, was initially performed and factor loadings, alpha reliability, and descriptive statistics were examined as well. The exploratory factor analysis was considered necessary before moving to a confirmatory factor analysis because of the previous arguments of the teacher self-efficacy either being a one-factor or a two-factor concept. Items with factor loadings were checked whether they are above 0.40 or not, regarding their respective subscale. The criterion for factor loadings was set at 0.40 as it is the most commonly accepted cut-off value in the field of social sciences (Jöreskog & Sorbom, 1993). Cronbach alpha coefficient was calculated to indicate internal consistency evidence for the subscales hypothesized. Further, confirmatory factor analysis, was employed to verify the hypothesized factorial structure of the SETAKIST. Certain absolute and incremental fit indices were applied to evaluate the acceptability of the model: High chi square ($\chi^2$) and $\chi^2$/ df ratio, Root Mean Square

Error of Approximation (RMSEA), Normed Fit Index (NFI), and Comparative Fit Index (CFI).

In the current study, variables are also grouped based on certain criteria and then utilized in a cluster analysis. Cluster analysis is used to place units of measures into homogeneous groups based on similarities and differences (Özdamar, 2004). In an appropriate clustering effort, units in a cluster are positioned close to each other, while clusters are far from each other (Hair et al., 1998). When interpreting relations among more than two categorical variables, MCA is used. It is a method that illustrates interactions among sub-categories that are cross-tabulated (r*c*m) (Özdamar, 2004). This is actually an extension of correspondence analysis (CA) that allows one to analyze the pattern of relationships of several categorical dependent variables (Abdi & Valentin, 2007). In MCA, herein, Teachers' efficacy scores were explained relative to teacher level variables. Initially, the total factor scores on the KE and TE scales were clustered and coded as an ordinal variable as low, medium and high efficacy scores. Teachers' efficacy scores on these two factors were then explained using two categorical variables as "frequency of science teaching in each week" and "teaching experience". Frequency distributions of the variables were presented in Table 1. More than 50% of the teachers reported that they teach science one or two times a week and have more than 10 years of teaching experience.

**Table 1:** Frequency Distributions of Teacher Level Variables (n=242 teachers).

| ***How often do you teach science related activities in class?*** | | **%** | ***Experience (year)*** | **n** | **%** |
|---|---|---|---|---|---|
| Less than a week | 1 | 12.8 | Less than 3 | 35 | 14.5 |
| 1-2 times a week | 37 | 56.6 | 4 - 10 | 109 | 45.0 |
| 3-4 times a week | 7 | 27.7 | 11 - 16 | 57 | 23.6 |
| Every day | | 2.9 | More than 16 (17+) | 41 | 16.9 |

**Results**

The data set consists of 242 completed response sets and no missing values were observed. Kaiser-Myer-Olkin measure of sampling adequacy (KMO=0.894) presented that the dataset was appropriate for a factor analysis. It also refers to evidence that correlations between pairs of items can be explained by the other items in the dataset. Further, Barlett's test of sphericity is used to test the hypothesis that the correlation matrix is an identity matrix[2]. In other words, we

[2] *All diagonal terms are one and all off-diagonal terms are zero.*

checked whether all items are perfectly correlated with themselves (one), and have some level of correlation with the other items in the scale. This result, $\chi^2$=1456.91, *p*<0.001, refers to a good indication to continue with the factor analysis. Therefore, the responses were subjected to exploratory factor analysis, with varimax rotation, hypothesized for a two-subscale solution (Robert & Henson, 2000).

Two-subscale solution (latent factors TE and KE) explained 48.13% of total variability in the factorial structure of the scale ($R^2$=0.4813). Further examination of factor loadings, presented in Table 2, revealed that all the items are loading properly on their intended factors with reasonably high loadings (>0.40). Overall, as hypothesized, the teaching efficacy subscale grouped the eight items, 1, 3, 5, 7, 9, 11, 13, and 14 with a Cronbach $\alpha$=0.886 and the knowledge efficacy subscale also grouped the eight items, 2, 4, 6, 8, 10, 12, 15, and 16 with a Cronbach $\alpha$=0.738. Both Cronbach alpha coefficients were greater than 0.70 referring to the fact that preliminary analyses support the reliability of the instrument. The respective mean and standard deviation scores of teachers' responses in two subscales may be examined in Table 2.

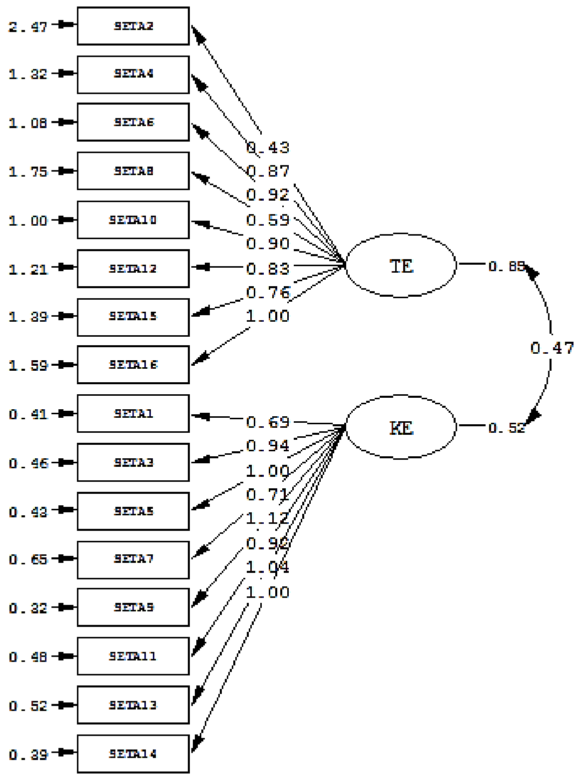
**Table 2:** *Results of Exploratory Factor Analysis and Descriptive Statistics of SETAKIST.*

| ***Item*** | ***Subscale*** | | ***Mean (sd)*** |
|---|---|---|---|
| | ***TE*** | ***KE*** | |
| SETA 2 | 0.410 | | 3.24 (1.62) |
| SETA 4 | 0.579 | | 3.96 (1.40) |
| SETA 6 | 0.659 | | 4.07 (1.34) |
| SETA 8 | 0.472 | | 3.58 (1.43) |
| SETA 10 | 0.578 | | 4.12 (1.30) |
| SETA 12 | 0.517 | | 4.10 (1.34) |
| SETA 15 | 0.677 | | 3.51 (1.37) |
| SETA 16 | 0.607 | | 3.33 (1.56) |
| SETA 1 | | 0.777 | 4.79 (0.81) |
| SETA 3 | | 0.803 | 4.43 (0.96) |
| SETA 5 | | 0.778 | 4.40 (0.98) |
| SETA 7 | | 0.736 | 4.64 (0.96) |
| SETA 9 | | 0.707 | 4.14 (0.99) |
| SETA 12 | | 0.620 | 4.01 (0.96) |
| SETA 13 | | 0.613 | 4.02 (1.43) |
| SETA 14 | | 0.601 | 4.18 (0.96) |

*TE=Teaching Efficacy*
*KE=Knowledge Efficacy*
*Reversed items: 2, 4 ,6, 8, 10, 12, 15, 16*
*Sd=Standard Deviation*

As mentioned earlier, CFA model was performed to test the hypothesized model of two correlated factors (TE & KE). The model identification values (regression weights, standard errors), goodness-of-fit indices and internal consistency coefficient values for the model were summarized in Table 3 and Figure 1. The items were loaded highly on the knowledge efficacy factor ($\lambda > 0.60$) whereas the loadings on teaching efficacy factor were relatively low ($\lambda > 0.40$) comparing to the TE scale.

**Figure 1:** *Path Diagram for SETAKIST Containing the* Unstandardized Solution.




The squared standardized weights ($R^2$) also are provided in Table 3 and indicate explained variance of the each item in the respective subscales. An interpretation of the example is that the item 6 is the most significant contributor among other items and accounts for 40% of the variance ($R^2$=0.40) in teaching efficacy scale. Similarly, the item 9 accounts for 67% of the variance ($R^2$=0.67) in the knowledge efficacy scale.

The chi-square value was found to be large (262.04) and statistically significant ($p$<0.001). However, this should not necessarily mean that the model is rejected since the large sample size increases the power of the test. The results displays good model fitness: The $\chi^2$/df ratio (2.54) is lower than the criterion value of 3.0; RMSEA (0.08) is at the acceptable level; NFI (0.92) is very close to criterion (NFI≥0.95) and CFI (0.95) is at the criterion level (CFI≥0.95)(Hu & Bentler, 1999). Those values indicate a good fit between the model and the observed data. Besides, no post-hoc modifications were indicated from the CFA analysis due to the good-fit indexes.

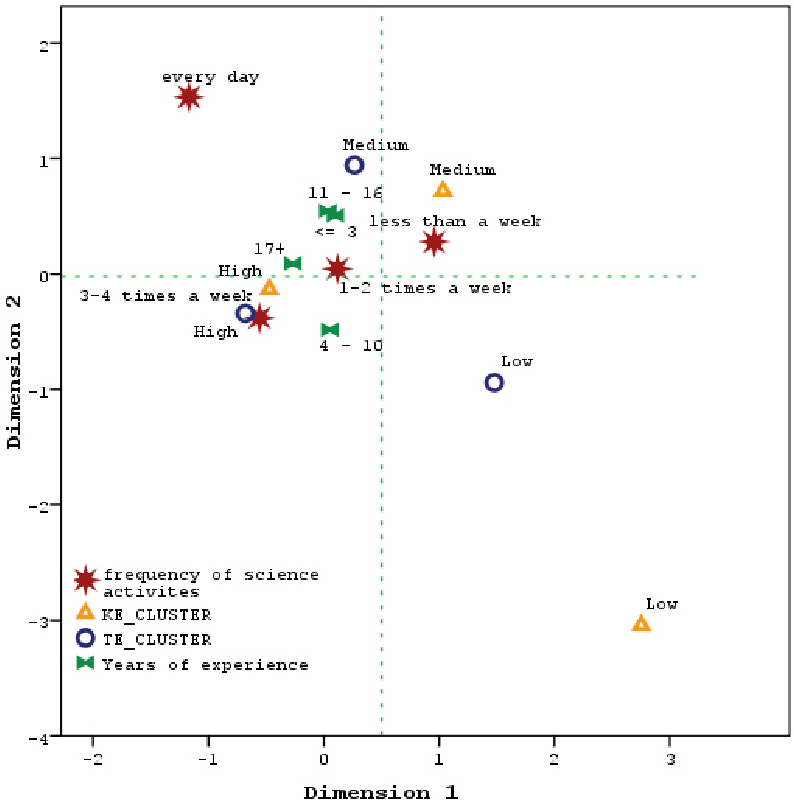
**Table 3:** *Model Identification and goodness of fit indices for the two-factor model of SETAKIST (n=242)*

| **Subscale** | **Item** | **λ (se)** | ***t* statistics** | $R^2$ |
|---|---|---|---|---|
| TE | SETA 2 | 0.24 (0.94) | 3.28* | 0.06 |
| | SETA 4 | 0.57 (0.67) | 6.83* | 0.32 |
| | SETA 6 | 0.63 (0.60) | 7.35* | 0.40 |
| | SETA 8 | 0.38 (0.86) | 4.93* | 0.14 |
| | SETA 10 | 0.64 (0.59) | 7.39* | 0.41 |
| | SETA 12 | 0.57 (0.67) | 6.84* | 0.32 |
| | SETA 15 | 0.51 (0.74) | 6.29* | 0.26 |
| | SETA 16 | 0.59 (0.65) | | 0.35 |
| KE | SETA 1 | 0.62 (0.62) | 9.50* | 0.38 |
| | SETA 3 | 0.71 (0.50) | 11.01* | 0.50 |
| | SETA 5 | 0.74 (0.45) | 11.62* | 0.55 |
| | SETA 7 | 0.54 (0.71) | 8.22* | 0.29 |
| | SETA 9 | 0.82 (0.33) | 12.98* | 0.67 |
| | SETA 12 | 0.69 (0.52) | 10.72* | 0.48 |
| | SETA 13 | 0.72 (0.48) | 11.28* | 0.52 |
| | SETA 14 | 0.76 (0.43) | | 0.58 |
| **Covariance $s_{TE\text{-}KE}$** | **0.47 (0.08)** | | | |
| | df | 103 | | |
| | $\chi^2$ | 262.04 ($p$ < 0.001) | | |
| | $\chi^2$/df | 2.54 | | |
| | RMSEA | 0.08 | | |
| | NFI | 0.92 | | |
| | CFI | 0.95 | | |

** $p < 0.05$*
*(λ) - Standardized Weights; (se)- Standard Error*
*(df)- Degrees of Freedom; ( $\chi^2$)- Chi Square*

Result of the correspondence analysis, as can be seen in the ScatterPlot graph, revealed that the higher levels of both teaching efficacy and knowledge efficacy are associated with more frequent science activities in classrooms. Because the number of teachers who utilize science activities every day is relatively small, it is positioned apart from other components. However, the second highest level of science activity frequency, that is 3-4 times a week, is clustered around high levels of both types of efficacy.

**Figure 2:** Scatter plot for multiple correspondence analysis




High levels of efficacy were also associated with 1-2 times a week of science activities. Another point of interest was that the high levels of efficacy was associated with teaching experiences of 17 years and more, indicating that the more experience teachers have the higher the levels of efficacy are. On the other hand, teachers who have medium levels of efficacy utilize science activities less than once a week.

**Discussion**

The current study examined early childhood teachers' self-efficacy beliefs about science teaching and their effects on science teaching practices in the classroom. Concurrently, a confirmatory factor analysis was carried out to validate the commonly argued structure of (SETAKIST) with in-service early childhood teachers. Results revealed that the two-factor solution for SETAKIST is also supported on a different sample as proposed by Roberts and Henson (2000).

Result of the correspondence analysis showed that the higher levels of both teaching efficacy and knowledge efficacy are associated with more frequent science activities in classrooms. This finding is in line with previous arguments that teachers who are not equipped with adequate science knowledge and have low self-efficacy in teaching science tend to stay away from science activities in early childhood classrooms (Cullen, 2000; Garbett, 2003; Hedges & Cullen, 2005). In ensuring that children benefit from early science activities, teachers play a crucial role, as they are the representatives of a coherent, developmentally appropriate, and hands-on curriculum in the classroom. In addition to organizing a rich learning environment and resources, teacher's knowledge, efficacy, and attitude towards science are considered as significant factors that affect science education in early childhood, as well as other STEM areas. Results of previous research reveal that teachers' attitude towards science and mathematics is directly related to teaching scientific concepts in early years (Eshach, 2006; Faulkner-Schneider, 2005; Garbett, 2003). This finding of the current study was also supported by the fact that high levels of efficacy were also associated with teaching experiences of 17 years and more. It can be argued that teachers become more competent and feel more comfortable in teaching science as they become more experienced in the profession of teaching. However, this finding also raises questions about the quality of teacher education programs in the country. Apparently, new graduates of teacher education programs, namely teachers with less experience, do not have the required levels of self-efficacy to effectively teach science in early childhood classrooms. Policy makers should take this into account in designing new higher education curriculum for teacher education programs.

Depending on the result, it can be argued that higher education institutions should focus their efforts more on preparing recent graduates of teacher education programs in terms of science knowledge, which in turn is highly associated with the science teaching self-efficacy. Future research efforts and grants, therefore, should be directed to examine possible remedies for revising teacher education programs in general. Furthermore, researchers should remain focused on validating SETAKIST with different populations and examine other factors that might be tied to the lack of science in early childhood classrooms. Finally, the SETAKIST may be used in different countries and cultures as we showed herein, in order to support its factorial structure and offer the scientific community with a solid measuring instrument for the detection of science related self-efficacy for teachers.

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**APPENDIX**

SETAKIST

Please indicate the degree to which you agree or disagree with each of the following statements by circling the appropriate number to the right of each statement.

| | Strongly Disagree | Disagree | Uncertain | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 1. When teaching science, I usually welcome student questions. | 1 | 2 | 3 | 4 | 5 |
| 2. I do not feel I have the necessary skills to teach science. | 1 | 2 | 3 | 4 | 5 |
| 3. I am typically able to answer students' science questions. | 1 | 2 | 3 | 4 | 5 |
| 4. Given a choice, I would not invite the principal to evaluate my science teaching. | 1 | 2 | 3 | 4 | 5 |
| 5. I feel comfortable improvising during science lab experiments. | 1 | 2 | 3 | 4 | 5 |
| 6. Even when I try very hard, I do not teach science as well as I teach most other subjects | 1 | 2 | 3 | 4 | 5 |
| 7. After I have taught a science concept once, I feel confident teaching it again. | 1 | 2 | 3 | 4 | 5 |
| 8. I find science a difficult subject to teach. | 1 | 2 | 3 | 4 | 5 |
| 9. I know the steps necessary to teach science concepts effectively. | 1 | 2 | 3 | 4 | 5 |
| 10. I find it difficult to explain to students why science experiments work. | 1 | 2 | 3 | 4 | 5 |
| 11. I am continually finding better ways to teach science. | 1 | 2 | 3 | 4 | 5 |
| 12. I generally teach science ineffectively. | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 13. I understand science concepts well enough to teach science effectively. | 1 | 2 | 3 | 4 | 5 |
| 14. I know how to make students interested in science. | 1 | 2 | 3 | 4 | 5 |
| 15. I feel anxious when teaching science content that I have not taught before. | 1 | 2 | 3 | 4 | 5 |
| 16. I wish I had a better understanding of the science concepts I teach. | 1 | 2 | 3 | 4 | 5 |