Educational Sciences: Theory & Practice - 12(1) • Winter • 168-174

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Developing a Scale for Innovation Management at Schools: A Study of Validity and Reliability

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Abstract

The purpose of this study is to develop a valid and reliable assessment tool for use in determining the competency beliefs of school administrators about innovation management. The scale applied to a study group of 216 school administrators, after work Centered on assessing intelligibility and specialized opinion. Exploratory and confirmatory factor analysis has been applied to determine the construct validity of the scale. Cronbach Alpha inner consistency coefficient was calculated to determine the reliability of the scale. The corrected item-total correlations were initially calculated to determine how efficient the items covered by the scale are in distinguishing between people by the aspect they measure and t-test was conducted to determine whether there exists any significant difference between the item average scores of top 27% and bottom 27% groups. As a result of exploratory factor analysis of the scale, the scale was identified to consist of four sub-dimensions, including Project Management, Organizational Culture and 32 5-point Likert items. The factor value loads of items covered by the scale vary in a range of 0.51 to 0.77. The four-factor structure of the scale is also affirmed by the confirmatory factor analysis. The corrected item-total correlations of the scale items ranged from 0.77 to 0.39. Based on result of t test performed between the item average scores of top 27% and bottom 27% groups, it was observed that differences had been significant for all items and factors. The inner consistency factor for the entire scale was calculated as 96. The inner consistency coefficients of the scale's sub-dimensions varied between 85 and 94. The findings of this study reveal that Innovation Management Scale at Schools is a valid and reliable measuring tool that can be used to determine the competence beliefs of school administrators on innovation management.

Key Words

Innovation, Innovation Management at Schools, School Administrator, Scale Development.

We live in a World of radical changes occurring in many areas and where scientific and technological advancements keep a fast stance, and global competition comes up to the forefront. The changes occurring deeply influence not only all societies and individuals but also all organizations no matter what their main areas of engagement are. In this process of change, only those organizations which adopt the innovative culture and successfully achieving the innovative structure in them get enormous gains in terms of environmental fitness and adaptation to developments. In this sense, innovation poses vital importance for the success and sustenance of organizations (Bülbül, 2010). However, innovation, which is vital for organizations as prescribed, doesn't occur suddenly, but requires a lot of work and efforts pursued according to a plan. Since organizations can neither inherit innovation as part of their legacy nor purchase it. Therefore, innovation should be created and sustained within the organization (Dobni, 2006). The objective of creating innovation within the organization requires vision, deliberation and a strong belief. In addition, for a successful organization, the right conditions, structure, culture and climate should be created, as well

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as proper directions for the organization and innovation should encompass all areas and aspects of the organization. More importantly, the organization should be filled with right people who possess the required skills, attitudes and behaviors towards innovation (Watt, 2002).

Measuring innovation is difficult like measuring creativity or art. Who exactly makes innovation and why does s/he make it? What is the created value, how is it noticed and by whom? Describing and calculating the clear measurements of these activities are difficult. However, it is possible to collect data from inputs and outputs of innovation (Kingsland, 2007). Although it is possible to witness difficulties while describing innovation, it can be said that there is still an agreement on the description of innovation in the literature (Goffin & Mitchell, 2005; Scott & Bruce, 1994)

When innovation is considered as creating and implementing new, useful and creative ideas (Amabile, Conti, Coon, Lazenby, & Herron 1996; Matthews; 2003; Oslo Kılavuzu, 2005; Woodman, Sawyer, & Griffin, 1993), it is possible to describe educational innovation as a process and a result that directs innovativeness and creativity in the system, improves creativity, implements modern innovations and developments in the management and supervision of the education institution and learning-teaching processes, turns practical information into the practice, controls its outputs by considering all the elements of the education process (Özkan, 2009). Within the context of innovativeness, educational organizations, e.g. schools, universities, and training Centers, introduce new products and service, e.g. new curricula, new processes for delivering its services, use of ICT in e-learning services, new ways of organizing their activities, e.g. ICT to communicate with students, parents, and new marketing techniques, e.g. pricing of postgraduate courses. These new practices are intended to improve the education service, in one way or another, and therefore, innovations in education should be regarded as "improvements" (Organisation for Economic Co-operation and Development [OECD], 2009). Shortly, educational innovation is a way to the better performance. Hence, most of the schools need to have innovation management skills in order to get more benefits from the innovation (Bubner, 2009).

The organizational form of the innovation process is large and rarely follows a straight line. It involves many departments and people within the organization and has a fairly complicated development process. Therefore, it is not only hard but also complicated to manage innovation (Barker, 2001; Liao & Wu, 2010). How to manage innovation has been the major concern of discussion among many researchers in the literature (Adams, Bessant, & Phelps, 2006; Cormican & O'Sullivan, 2004; Goffin & Pfeiffer, 1999; Martensen & Dahlgaard, 1999; Smith, Busi, Ball, & Van der Meer, 2008) and requires a good understanding of how new product and service development processes are managed by organizations. Therefore, it is important to lay out the various dimensions of innovation management.

Tidd, Bessant & Pavitt (2005) have listed the basic dimensions of innovation management as leadership and vision, organizational structure, key individuals, effective teamwork, individual development, comprehensive communication, high rate of participation in innovation, customer focus, a creative environment, and a learning organization. Goffin and Pfeiffer (1999) advocate that a successful innovation management requires demonstration of good performance in five dimensions and interrelations between efforts rendered in these areas. These five areas include the innovation strategy, creativeness and management of ideas, selection and portfolio management, implementation management, and human resources management. Adams et al. (2006) have described innovation management in seven dimensions, based on an area-specific literature scan. These seven dimensions are: Input management, information management, strategic management, organizational culture and structure, portfolio management, project management, and commercialization. Cormican and O'Sullivan (2004) have grouped innovation management under five basic dimensions: strategy and leadership, culture and climate, planning and selection, structure and performance, communication and cooperation. In the meanwhile, Smith et al. (2008) indicate that there are nine basic dimensions that influence innovation management in organizations, which have sub-dimensions, based on a literature scan they performed. These dimensions can be listed as management style and leadership, technology, innovation process, innovation strategy, organizational structure, organizational culture, employees, resources, and information management. Watt (2002) denotes that innovation occurring at schools has four dimensions. These are innovative individuals, culture and climate, structures and processes and leadership.

Mainly, driven by these discussions in area-specific literature, the innovation management competence areas of school administrators were treated as input management, innovation strategy, organizational

Table 1.
Theoretical Infrastructure of Innovation Management Scale for Schools (IMSS)

Competence Areas for Innovation Management	Input management (Adams et al., 2006; Goffin & Pfeiffer, 1999; Smith et al., 2008; Watt, 2002).	Human resource management (Adams et al., 2006; Goffin & Pfeiffer, 1999; Munshi et al., 2005; Oke, 2007), Physical and Financial resource management (Adams et al., 2006; Smith et al., 2008).
	Innovation strategy (Adams et al., 2006; Cormican & O'Sullivan, 2004; Goffin & Pfeiffer, 1999; Smith et al., 2008).	Information management, Organizational learning and Personal development, Strategic guidance, Strategic management, Innovation vision and mission (Adams et al., 2006; Matthews, 2003; Patterson, Kerrin, & Gatto-Roissard, 2009; Tidd et al., 2005), Organizational strategy, strategic decision-making (Cormican & O'Sullivan, 2004; Goffin & Pfeiffer, 1999; Smith et al., 2008).
	Organizational culture and structure (Adams et al., 2006; Cormican & O'Sullivan, 2004; Smith et al., 2008; Watt, 2002).	Culture, Climate, Organizational structure and processes, organizational communication (Adair, 2008; Adams et al., 2006; Cormican & O'Sullivan, 2004; Gadot, Shoham, Ruvio, & Schwabsky, 2005; Pervaiz, 1998; Pollock, 2008; Tidd et al., 2005; Watt, 2002), Attitude of innovation, high participation to innovation (Smith et al., 2008)
	Project management (Adams et al., 2006; Cormican & O'Sullivan, 2004; Goffin & Pfeiffer, 1999).	Project selection, portfolio management (Goffin & Pfeiffer, 1999), Project efficiency, team work, (Tidd et al., 2005; Cormican & O'Sullivan, 2004), Cooperation, risk management, cost-benefit balance, optimization of resource use, (Adams et al., 2006; Hernández, Noruzi, & Sariolghalam, 2010; Smith et al., 2008; Tidd, 2001).

culture and structure, and project management and the scale was structured on these foundations. Accordingly, the theoretical infrastructure of Innovation Management Scale for Schools (IMSS) thus formed is given under Table 1, below.

There is very few research reportedly conducted on innovation process and management in both international literature and educational schemes of Turkey. While there are some studies on innovation process in education, in international literature (Lindsey, 2008; Pollock, 2008; Watt, 2002) and on measurement of innovation in education (OECD, 2009), other studies have been performed in Turkey on the concept of innovation in education (Varış, 1982), organizational innovation (Özdemir, 1995, Özdemir & Cemaloğlu, 1999, 2000) and on barriers to innovation in education (Cemaloğlu, 1999; Gülşen & Gökyer, 2010; Karip, 1997; Taş, 2007). However, among these studies, there is not a study which has been performed towards determining the competences among school administrators as well as innovation management in education. Based on these discussions, this study aims to develop a valid and reliable measurement tool for determining competences of school administrators' innovation management.

Method

Study Group

The study group consisted of 216 school administrators working in a total of 140 primary schools in Edirne city, its administrative districts (i.e. Enez, Havsa, İpsala, Lalapaşa, Meriç, Keşan, Süloğlu, Uzunköprü) and villages, during the first semester of 2010–2011 academic year. By the time this study was performed, the total number of school administrators in Edirne city Center, districts and villages was counted as 253. Of the 216 school administrators taken to the study group, 16, 7% (n=36) were females and 83,3% (n=180), males. 55, 6% (n=120) of the school administrators in the study group were school principals and 44.4 (n=96) were school vice principals. Of the school administrators, 81,5% (n=176) hold graduate degrees, while 7,4% (n=16) hold post graduate degrees and 11,1% (n=24) degrees issued by other educational institutions. When investigated for distribution according to length of professional service, the school administrators forming the test group were found to be professionals with experience between "1 to 10 years" by 14.8% (n=32), between "11 to 20 years" by 30.6% (n=66) and "at or above 21 years" by 54,6% (n=118).

Data Collection Instrument

When the items of Innovation Management Scale for Schools were created, previous research studies both in international literature and Turkey were examined and as a result, some scales were found to exist for innovation management developed for educational organizations, if not for innovation management at schools in particular (Acaray, 2007; Arıkan, 2008; Cornican & Sullivan 2004; Çeliktaş, 2008; Dobni, 2008; Gilbertson, 2004; Gökçek, 2007; Öztürk, 2009; Scott & Bruce, 1994). In this study, based on these scales and other theoretical information, a comprehensive pool that consists of 120 items was created by the author. The draft form that was created with the items selected from the pool was presented to a group of ten people that included educational management, assessment and evaluation, and language experts. The purpose of this presentation was to discuss the scope validity and

linguistic comprehensibility of the form. Necessary revisions were then made based on feedback provided by these experts. Subsequently, the scale was presented to the views of a group of 15 school administrators, for further evaluation of aspects such as intelligibility, rate of responsiveness, and expedience. The feedback provided by this group also contributed to final structuring of the scale, which was then made ready to use.

The scale was organized so that it could be answered in the 5-points Likert-type rating scale format. Rating took place with scoring based on a grade designed with five options such as: "1-Strongly Disagree," "2-Agree a Little," "3-Fairly Agree," "4-Strongly Agree," "5-Totally Agree." The test questionnaire which consisted of 51 items was applied to 250 school administrators by the author of this study. Of the scales received from the respondents, incomplete and incorrectly filled questionnaires were eliminated, resulting in 216 remaining scales, which were then used for analysis. In order to investigate the construct validity of the scale, firstly, the exploratory factor analysis was made and then the fitness of the factor structure obtained was tested using the confirmatory factor analysis. Factor analysis can be used to state the theoretical structures that form the basis of a data group and how much these structures reflect real values (Henson & Roberts, 2006).

In this study, the criterion factor load value to form the basis for the selection and decision-making on fitness of an item during the exploratory factor analysis was taken as 0.40 and above, and item eigen value was taken as 1 and above (Büyüköztürk, 2006; Tavşancıl, 2005). Tabachnick & Fidell (2007) indicate that, as a basic rule, the load value of each variable should be assessed at and above 0.32. For exploratory factor analysis, SPSS 17.0 was employed. As a result of the confirmatory factor analysis of the Innovation Management Scale for Schools, the ratio /sd was evaluated with consideration of GFI, AGFI, RMSEA, RMR, SRMR, CFI, NFI, NNFI and PGFI fitness indexes. In this study, Lisrel 8.70 was employed for confirmatory factor analysis.

During the study, initially the corrected item-total correlations were calculated, with a view to determine how effective the items included in the scale were in distinguishing between people as per the aspects they measure and then t-test was performed to determine whether a significant different exists between the item average scores of top 27% and bottom 27% groups or not. Next, the Cronbach Alpha inner consistency coefficient was calculated to assess reliability of the Innovation Management Scale for Schools.

Results

In the study, Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were conducted initially, to determine the fitness of data for factor analysis. KMO is a test for measuring the adequacy of data structure for factor analyses in terms of sampling size. Kaiser states that a value found in approximation to 1 gets perfect while a value below 0.50 is unacceptable (perfect in 0.90 range, very good in 0.80 range, average in 0.70 and 0.60 ranges and bad at 0.50 range) (Tavşancıl, 2005). In this study, the KMO value of scale was found to be 0.95. This demonstrates that data supplied by the scale are "perfect" fits for factor analysis. By employing Bartlett's Spherical Test, the study revealed that the data were from a multivariate normal distribution. The obstructiveness of the chi-square test statistic obtained at the end of this test is an indication of the fact that data were originated from a multivariate normal distribution (Şencan, 2005; Tavşancıl, 2005). As a result of analysis performed, the Barlett Test of Sphericity of the data set of the scale was found significant ($\chi 2=5117.925$ $p<0.01$). Findings retrieved from KMO and Bartlett Spherical Tests have revealed the adequacy of data set for factor analysis.

Findings on Exploratory Factor Analysis

In the study, considering the hypothesis that the factors in the scale are unrelated, the Varimax technique which is one of the most preferred orthogonal approaches in the exploratory factor analysis (Akbulut, 2010; Özdamar, 1999; Tavşancıl, 2005) is used. The exploratory factor analysis was started with 51 items in total. The 19 items originally included in the test form of the scale were subsequently removed either for bearing low factor loading values or high factor loading values in multiple factors and etc.

The total amount of variance revealed by this structure of the scale, which was summed up in 32 items and four factors as a result of exploratory analysis is 62.99%. There are 15 items in the "Project Management" dimension, which is the first dimension of the scale and the value of factor loadings of items rotated using the Varimax vertical rotation method vary in a range of 0.51 to 0.68. The attribute of this factor is 16.0 and the variance it explains singly is 50.0%. The "Organizational Culture and Structure" which is the second dimension of the scale, incorporates 6 items and the individual values of factor loadings rotated by Varimax vertical rotation method varies

in a range of 0.54 to 0.77. The attribute of this factor is 1.6 and the variance it explains singly, 4.9. The third dimension of the scale, "Innovation Strategy" encompasses 6 items, the values of factor loadings as rotated by Varimax vertical rotation method varies in a range of 0.55 and 0.64. The attribute of this factor is 1.4 and the variance it individually explains is 4.4%. In the fourth dimension of the scale identified as "Input Management," there are 5 items, and the individual factor loading values rotated by Varimax vertical rotation method varies in a range of 0.59 to 0.77. The attribute and variance of this item individually explain are 1.2 and 3.7%, respectively.

Findings on Confirmatory Factor Analysis

The confirmatory factor analysis was then applied to the structure of the scale, which consisted of 32 items grouped into four factors. An assessment made over findings obtained as a result of confirmatory factor analysis resulted in a finding of 2.27 for /sd (/sd=1042.95/458). Tabachnick & Fidell (2007) maintains that a model can be considered as perfect when its /sd ratio retains below 2, while Kline (2011) indicates that the same ratio being ≤ 2.5 would correspond to perfect adequacy.

The GFI and AGFI indexes, among the criteria used when examining a model's adequacy, can take values between 0 and 1. Both GFI and AGFI values equaling to 1 are generally considered as an indication of a perfect fit (Sümer, 2000; Tabachnick & Fidell, 2007). The GFI AND AGFI indexes, among the criteria used when examining a model's adequacy can take values between 0 and 1. Both GFI and AGFI values equaling to 1 are generally considered as an indication of a perfect fit. This study revealed findings as GFI = 0.77 and AGFI = 0.73. Sümer (2000) indicates that a RMSEA value of ≤ 0.08 corresponds to good adequacy. In this study, the resultant finding was RMSEA=0.077, and this value was considered as good adequacy. Brown (2006 as cited in Çokluk, Şekercioğlu, & Büyüköztürk, 2010) states that an RMR value of ≤ 0.05 translates as perfect adequacy. This study revealed a result of RMR= 0.026, which was considered as an indication of perfect fit, accordingly. The condition of SRMR's being less than or equal to 0.10, where SRMR is one of the criteria used when investigating the model adequacy is considered as sufficient grounds for the model to be accepted (Worthington & Whittaker, 2006). This study resulted in a finding of SRMR=0.049, which was considered as an indication of good adequacy. Sümer (2000) states that, of the criteria employed for assessing model adequacy, CFI, NFI and NNFI values above or equal to 0.95 can be admitted as an indication of a perfect fit. This study resulted in the findings of CFI= 0.98, NFI=0.96 and NNFI=0.98, which were considered as perfect. A value of 1 taken by PGFI, being one of the criteria to be used when assessing the Model usually denotes perfect adequacy (Sümer, 2000). This study yielded the finding of PGFI= 0.67, which was considered sufficient. The path diagram obtained through confirmatory factor analysis of the Innovation Management Scale for Schools is given in Appendix 1.

The corrected item-total correlation values of items covered by Innovation Management Scale for Schools vary between 0.39 and 0.77. As the results of t test conducted between item average scores of top 27% and bottom 27% groups had shown, the differences were observed to be significant for all items and factors. This finding indicates that all items and factors included in the scale are distinctive.

Findings on Reliability of Innovation Management Scale for Schools

The Cronbach Alpha inner consistency coefficient for the "Project Management" dimension, which is the first dimension of the Innovation Management Scale for Schools, is 0.94. This coefficient is 0.90 for the second dimension "Organizational Culture and Structure," 0.85 for the third dimension "Innovation Strategy," and 0.85 for the fourth dimension "Input Management." On the other hand, the Cronbach Alpha inner consistency coefficient for the scale as a whole is 0.96. Thus, the calculated inner consistency coefficients demonstrate that the scale has a high level of reliability.

Discussion

This study mainly aims to develop a valid and reliable data collection tool that can be used to determine the personal beliefs of school administrators on innovation management. For this purpose, a scale initially consisting of 51 items was applied to a group of 216 individuals who included school administrators and the performance of validity and reliability analyses of the scale was conducted on the collected data. As a result of the exploratory factor analysis, it was determined that the items covered by the scale were loaded on a total of four factors, which are built upon Project Management, Organizational Culture and Structure, Innovation Strategy and Input Management dimensions. The 19 items which were originally included in the scale were removed later, for such reasons as bearing low

factor loading values or high factor loading values in multiple factors and etc. The confirmatory factor analysis was then applied to the structure of the scale, which consisted of 32 items grouped into four factors. At the end of confirmatory factor analysis of Innovation Management Scale for Schools, the ratio /sd has been evaluated along with GFI, AGFI, RMSEA, RMR, SRMR, CFI, NFI, NNFI and PGFI adequacy indexes, which were concluded at the sufficient level for fitness with the model as a whole. Then, it was concluded that the relevant structure had been confirmed.

According to the results of item-total correlations made to determine the reliability of dimensions covered by the established scale, the corrected item-total correlations of items vary between 0.39 and 0.77. From the results of t-test performed between the item average scores of top 27% and bottom 27% groups, it was observed that the differences were significant for all items and factors. The inner consistency coefficient for the whole scale was calculated as 0.96. The inner consistency coefficients of individual dimensions of the scale, on the other hand, varied in a range of .85 to .94. These results demonstrate that the scale has high level of reliability.

In the final form of Innovation Management Scale for Schools, obtained as a result of validity and reliability tests, as consisting of 32 items and four dimensions, all items are scored according to the following grading scale: "1- Strongly Disagreed," "2- A Little Agree," "3- Fairly Agree," "4- Strongly Agree," "5- Totally Agree." The scale has no item which is scored inversely. The scale is a measuring tool that determines the competences of the innovation management of school administrators based on their own responses. It is possible to get a total score from the scale. Higher scores that can be obtained from the entire scale with its sub-dimensions will demonstrate high levels of beliefs among school administrators related to the competence of an innovation management process.

The findings obtained as a result of validity and reliability tests of the Innovation Management Scale for Schools show that the scale has a structure that can be comfortably used in determining beliefs of school administrators on competence of the innovation management. The scale can further be used to assess and evaluate the innovation management competences of school administrators based on perceptions of teaching staff and educational inspectors. It will also be useful to produce proof of validity and reliability for groups when creating forms of the scale for different groups.

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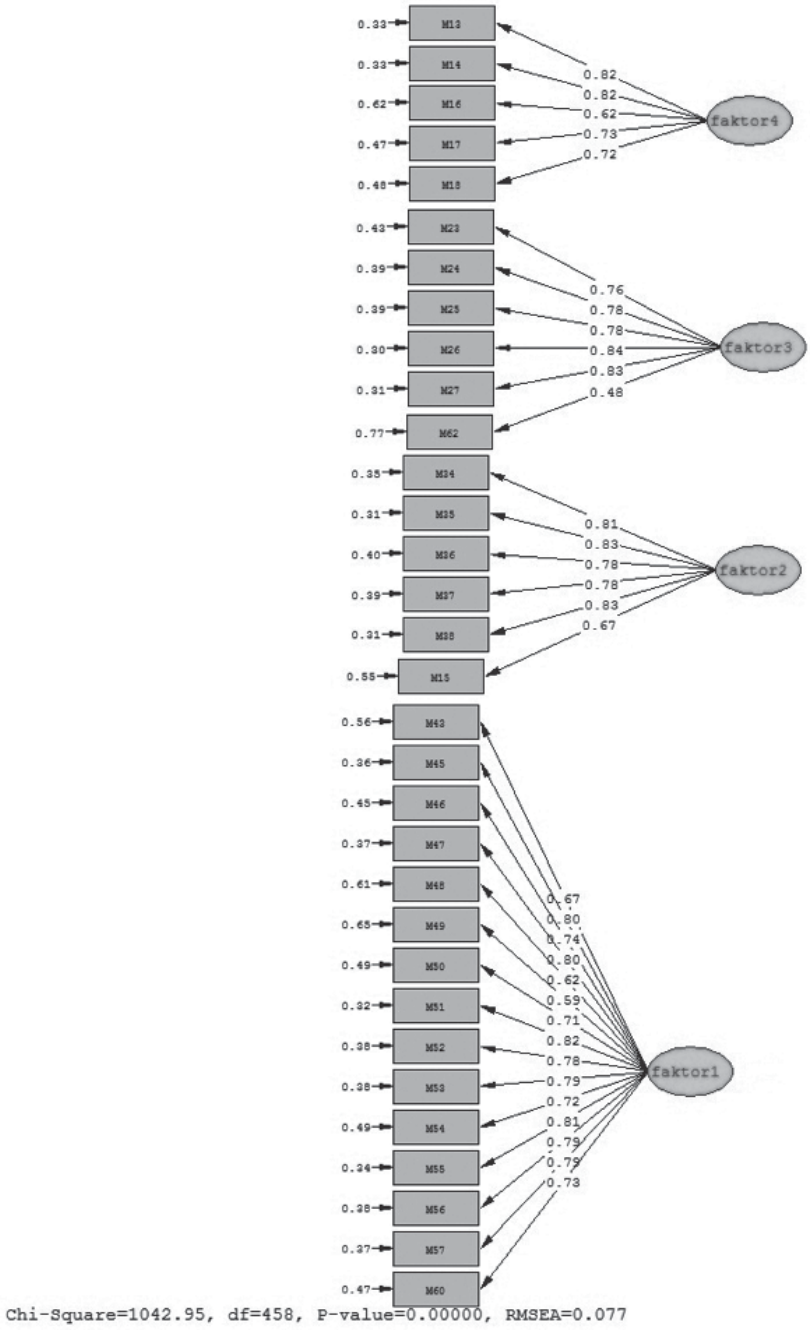
Ek 1.



Şekil 1.

Okullarda Yenilik Yönetimi Ölçeğinin Doğrulayıcı Faktör Analizi İle Elde Edilen Yol Şeması (Path Diagram)