The Determination of the Performance Degree of Education and Training Acquisitions in Chemistry Lessons with an Analytic Hierarchy Process

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Abstract

This study determines the performance level of acquisitions anticipated for 9th grade chemistry lesson within the secondary education curriculum. In the first stage of this study, educational and training acquisitions of the curriculum were analyzed and grouped. In the second stage, the Analytic Hierarchy Process (AHP) model, which presents the pattern of acquisitions, was created. In the third stage, pair-wise comparisons were made and the relative importance of acquisitions was calculated in accordance with the AHP method. Finally, in the last stage of the study, the education and training acquisitions performance degree was determined. The proposed method in this study not only assesses education and training acquisitions in curriculum at the macro level but also determines the performance degree of each acquisition in a detailed manner.

Key Words*:* Curriculum, Chemistry Education, Acquisitions, Analytic Hierarchy Process

INTRODUCTION

Curriculums lead the way for educational institutions to perform their targets. As for the practical function, a curriculum consists of skills, information, abilities, attitudes and values that students are expected to acquire during the education process (Aşkar & Altun, 2011). In curriculums, targeted outputs to be acquired by students differ according to the objectives of the society at-large, and the quality and nature of the lessons. In the literature, studies conducted on education and training acquisition at different levels (Taşar, Temiz,& Tan, 2002; Dökme, 2004; Koray, Bahadır, & Geçgin, 2006; Kılıç, Haymana, & Bozyılmaz, 2008; Şimşekli & Çalış, 2008; Yalçın, 2011; Erduran Avcı & Önal, 2013; Yağmur, 2011) investigate how acquisitions can be improved, and according to students and teachers, how curriculums and course books on scientific process skills affects learning acquisition In addition, scientific process skills and student attitudes towards lessons (Dönmez & Azizoğlu, 2010), student success based on scientific process skills (Germann & Aram, 1996; Walters & Soyıbo, 2001) and the effects of the cooperative learning method on scientific process skills (Bozdoğan, Taşdemir, & Demirbaş, 2006) were examined. Throughout the literature, studies were conducted on the effect of the scientific process skills-based learning approach on the attitudes of students towards science (Duran & Özdemir, 2009), the relationship between this approach and scientific creativity (Aktamış & Ergin, 2007) and the effect of this approach on student success (Temiz,2010). In the studies mentioned, acquisitions was the research subject generally discussed with a functional approach in the scope of scientific process skills. In other words, in the literature, acquisitions were investigated as a predictor variable or dependant variable on the basis of different issues (Walters,& Soyıbo, 2001; Aydoğdu, 2006; Bozdoğan et al., 2006; Şimşekli & Çalış, 2008). However, no study is found in the literature that determines the performance degree of acquisitions in the scope of each lesson with an integrated approach. As for education institutions, the performance degree of acquisitions in the curriculum is an indicator that should be known for its effectiveness in the educational context. Although different criteria are used to assess the educational effectiveness (Balkan & Arıkan, 2010; Yüksel, 2012), the inclusion of acquisitions in the curriculum, by students (Karacaoğlu, 2009), is regarded as an important criterion. In addition, the recognition of the performance degree of acquisitions in planning and practices related to educational and training processes) is important for decision-makers.

In the literature analysis, it is evident that acquisitions are classified in different respects (Çepni, Ayas, Johnson, & Turgut,1997; Dönmez & Azizoğlu, 2010). The first classification is content

acquisitions which are directly associated with the syllabus (Yüksel, 2011). The performance level of content acquisitions was generally conducted with measurement and evaluation examinations in the classroom environment. Apart from content acquisitions, the performance level of anticipated education and training acquisitions in a lesson is also important. However, other educational and training acquisitions cannot be as easily measured and evaluated as content acquisitions. For this reason, there are some important issues to take into consideration during the measurement and evaluation process of the performance level of education and training acquisitions. An issue that results from the acquisitions' features is the high number of acquisitions. This feature requires an approach and methodology which is multi-dimensional in order to determine performance levels of education and training acquisitions. Hence, multi-criteria approaches are used throughout the literature with the purpose of minimizing the challenges before case evaluation and measurement, containing more than one element, is performed (Dağdeviren & Yüksel, 2010; Yüksel & Dağdeviren, 2010).

Another relevant approach that determines the performance degree of acquisitions at the macro level is the holistic approach in measurement and evaluation. Furthermore, the literature shows that a holistic approach is used in the evaluation of multi-dimensional cases (Yüksel, 2012). The main reason for this is that it provides an opportunity to measure all elements in each case. In this scope, the separate evaluation of each acquisition, independent of other educational and training acquisitions, cannot be regarded as a sufficient indicator for macro-level targets anticipated from a curriculum. Moreover, targets anticipated from a curriculum are possible only through the performance of all acquisitions stated in the curriculum. However, anticipated acquisitions set forth in a curriculum can have different relative importance according to lessons. For this reason, the relative importance should be taken into account while determining the acquisitions' performance degree. According to the literature, this problem encountered in the measurement and evaluation of cases containing many elements is solved by integrated measurement and evaluation approaches (Yang & Huang, 2000; Gibney & Shang, 2007; Yüksel, 2012).

This study proposes a method for the measurement and evaluation of acquisitions by considering the issues mentioned above. The proposed method aims to determine the performance degree of acquisitions in the curriculum at macro level. This determination is detailed and measured on the basis of each acquisition. In this way, it is assumed that the performance level of anticipated acquisitions in curriculum, or deviations, can be observed. This study was conducted within the scope of educational and training acquisitions in the curriculum (Ministry of National Education, 2007) of a 9th grade chemistry lesson in Turkey. Apart from content acquisitions of the chemistry lesson, this study contains other educational and training acquisitions such as science process skills, acquisitions of chemistry-technology-society-environment relationship and communication, and attitude and value acquisitions. This is because the contents of chemistry lessons are generally measured and evaluated by examinations. In this study, acquisitions in the chemistry curriculum is the research subject and because science teaching in primary and secondary schools in Turkey is more problematic than other lessons. As a matter of fact, at the national level, success in science lessons, which is calculated by the measurement and evaluation examinations made with academic content, is quite low (ÖSYM, 2012) The results are similar for measurement and evaluation examinations conducted at the international level such as Trends in Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) (Yayan & Berberoglu, 2004; Karadağ, Deniz, Korkmaz, & Deniz, 2008; Erarslan, 2009; Uzun, Bütüner, & Yiğit, 2010). Studies report that the majority of students having science education in Turkey reach only few of the targeted acquisitions due to the challenges in academic evaluations (Gürses, Açıkyıldız, Bayrak, & Yalçın, 2004). The information above shows that studies focused on science education in primary and secondary school in Turkey are necessary and important.

The other chapters of this study are designed as follow: The second chapter explains the method of the study. In the third chapter, models created to determine the performance degree of acquisitions and results are presented. Discussion and recommendations are presented in the fourth chapter.

METHOD

The method followed to determine the performance degree of educational and training acquisitions with the Analytic Hierarchy Process (AHP) consists of three steps. In the first step of the study, the educational and training acquisitions for chemistry lessons were hierarchically grouped in accordance with the anticipation standards of AHP method. The 9th grade chemistry curriculum educational-training outputs for secondary school, which are prepared by the Ministry of National Education in Turkey, were defined as acquisitions (Ministry of National Education, 2007). Apart from the chemistry content acquisitions, other educational and training acquisitions are defined under three groups: There are 11 items under the title of science process skills (SPS), 10 items under the acquisitions of chemistry-technology-society-environment relationship (CTSE) and 7 items under the communication, attitude and value acquisitions (CAV) (Ministry of National Education, 2007). However, as some items of acquisitions have multiple meanings, items are re-classified with content analysis. Based on the classification made by Çepni et al. (1997), science process skills in the curriculum are collected under 15 items. Accordingly, the basic process consists of 6 items, and causal process and experimental process consist of 5 and 4 items respectively. Consisting of 10 items in the curriculum, acquisitions of chemistry-technology-society-environment relationship are collected under 18 items and four groups at the end of the content analysis. These groups are created as follow: Technologic acquisitions consist of two items, social acquisitions consist of eight items, economic acquisitions consist of three items and environmental acquisitions consist of five items. Similarly, consisting of seven items, communication, attitude and value acquisitions are classified under three groups and 12 items with content analysis. Communication acquisition consists of four items, value and attitude consist of three and five items, respectively. The classification of the acquisitions mentioned above was evaluated by a specialist in education sciences and the classification is significant. Accordingly, the classification of acquisitions in the study is as follows:

- Scientific Process Skills (SPS)
  - Basic Processes (BP)
    - Recognition of coding system used in chemistry (BP1)
    - Use of coding system and chemistry terminology in communication (BP2)
    - To express measurable sizes with suitable units (BP3)
    - To express the results of experiments with charts and graphics (BP4)
    - To make distinction between qualitative and qualitative scientific information (BP5)
    - To comprehend the importance of the difference between qualitative and qualitative information (BP6)
  - Causative Processes (CP)
    - To express the results of observation, experiment and research mathematically and verbally (CP1)
    - To make cause-effect relationship while interpreting natural events on the basis of chemistry (CP2)
    - The interpretation of charts and graphics (CP3)
    - To generalize by interpreting available data of experiments (CP4)
    - The use of theory and models to define and anticipate physical events (CP5)
  - Experimental Processes (EP)
    - To comprehend the importance of observation and experiment in accurate interpretation of the universe (EP1)
    - The recognition of devices and instruments used in observation and experiments (EP2)
    - To obey security rules during experiments (EP3)
    - To obtain the skill of carrying out experiments (EP4)
- Acquisitions of Chemistry-Technology-Society-Environment Relationship (CTSE)
  - Technologic (TC)
    - The recognition of technologic effects of chemistry (TC1)
    - To question the importance of conducting studies on science and technology (TC2)

- Social (SC)
    - The recognition of social effects of chemistry (SC1)
    - To question the adoptability of chemistry in social fields (SC2)
    - The recognition of chemistry practices in social life (SC3)
    - The interpretation of the effects of developments in chemistry on moral values (SC4)
    - To question the social cost of scientific developments (SC5)
    - The interpretation of the effects of developments in chemistry on social values (SC6)
    - To use the knowledge obtained from chemistry lessons in the resolution of daily problems (SC7)
    - The interpretation of the effects of developments in chemistry on political values (SC8)
- Economic (EC)
    - The recognition of economic effects of chemistry (EC1)
    - To question the adoptability of chemistry in economic fields (EC2)
    - The interpretation of the effects of developments in chemistry on economic values (EC3)
- Environmental (EV)
    - To give examples about the adverse effects of scientific and technologic developments on people (EV1)
    - To use knowledge obtained from lessons in the explanation of physical events (EV2)
    - To comprehend the importance of the scientific approach and interrogatory thinking on the interpretation of the world (EV3)
    - To use the knowledge obtained from the chemistry lesson in the resolution of problems related to chemistry (EV4)
    - To give examples about the adverse effects of scientific and technologic developments on nature (EV5)
- Communication, Attitude and Value Acquisitions (CAV)
    - Communication (CM)
        - To volunteer to work in cooperation (CM1)
        - To listen quietly (CM2)
        - To express one-self (CM3)
        - To assert demands and claims based on general acceptance (CM4)
    - Attitude (AT)
        - The interest towards science and chemistry as a part of science (AT1)
        - The acceptance (belief) that there is not an award for learning (AT2)
        - To consider learning itself as an award (AT3)
        - The willingness to participate in life-long learning (AT4)
        - To be careful to discuss unknown issues (AT5)
    - Value (VL)
        - The sensitivity towards environmental problems (VL1)
        - To internalize the leading role of science in the comprehension of the universe and life (VL2)
        - To make a distinction between prior issues of sciences and prior issues of democracy (VL3)

In the second step of the study, the AHP model was created on the basis of the classification mentioned above and local weights, global weights and the consistency ratio of acquisitions were calculated. The Analytic Hierarchy Process, which is one of the multi-criteria decision techniques, is used in this study as it helps to determine the performance degree of education and training acquisitions. Developed by Saaty (1980), the AHP technique is used for the resolution of complex and hierarchical problems. In the literature, there are many studies that use the AHP technique in solving various problems (Ho, 2008). The superiority of the AHP technique above other multi-criteria decision techniques is its capability to evaluate a problem with an integrated approach and to determine the

evaluation inconsistencies (Saaty, 1980). With the AHP technique, the problem is decomposed hierarchically from top to bottom. In this way, all elements constituting the problem can be presented in one model. Pair-wise comparisons matrixes are created based on the grouping of elements in the AHP model (Saaty, 1980; Saaty, 1986). Furthermore, in the AHP technique the pairwise comparison of *i*. and *j*. is presented with a_{ij} and the comparison of *j*. and *i*. is presented with a_{ji}. In AHP, $a_{ji} = 1/a_{ij}$ presents the equation. The transition of the pairwise comparison of groups constituted by elements in the AHP model is conducted with the scale (Table 1) proposed by Saaty (1980). Finally, in the AHP technique, pairwise comparisons are made to *n (n-1)/2*.

Table 1. Saaty's 1-9 scale for pair-wise comparisons (Saaty, 1980)

Comparative judgment	Intensity of importance
a_i and a_j are equally important	1
a_i is weakly more important than a_j	3
a_i is strongly more important than a_j	5
a_i is demonstrably or very strongly more important than a_j	7
a_i is absolutely more important than a_j	9
Intermediate values between adjacent scale values	2, 4, 6, 8

The priority vector in the AHP technique is found with the solution of the $(A-\lambda_{max}I)W=0$ equation. In this equation, A refers to the pairwise comparison matrix. W refers to eigenvector and λ_{max} is the highest eigenvalue of the A matrix. In the AHP technique, consistency of pairwise comparisons is also calculated (Saaty, 1980; Saaty, 1991). The inconsistency ratio (CR) is determined according to consistency index (CI) and random index (RI) values. First of all, the consistency index (CI) is determined with the eigenvalue (λ_{max}) of pairwise comparison matrix. The consistency index is found in this equation: $CI=(\lambda_{max}-n)/(n-1)$. In this equation, n refers to the size of the matrix. The random index is determined according to the size of the matrix (Table 2). The consistency ratio is determined with the $CR=CI/RI$ equation. If the value of CR is less than 0.10, the pairwise comparisons are regarded as consistent. Otherwise, the pairwise comparisons are repeated.

Table 2. Values of random index (RI) (Saaty, 1980)

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

In this step, the AHP model (Figure 1), created according to the classification of education and training acquisitions, consists of four levels: The first level of the AHP model consists of objective function and the second level consists of basic acquisition groups. Third and fourth levels consist of sub-acquisition groups and types.

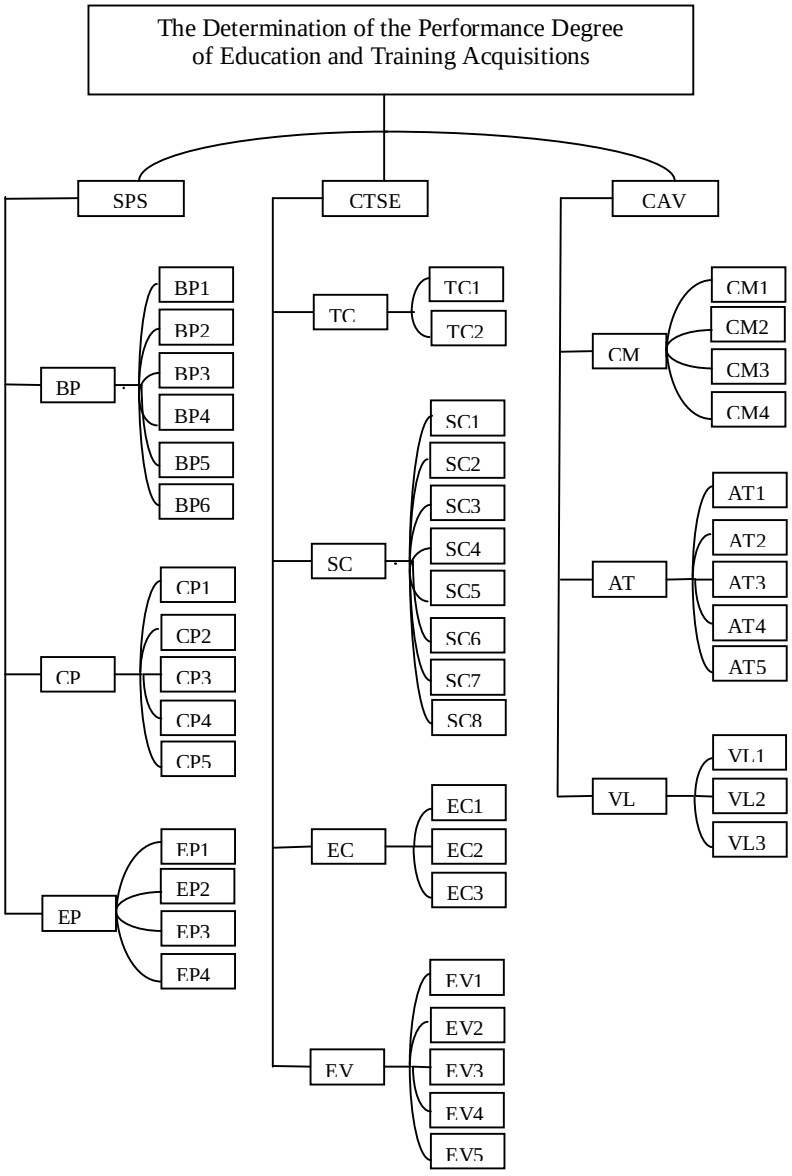

Figure 1: AHP model for the acquisitions

The pairwise comparisons in this study were made by a group including three chemistry teachers at head teacher, specialist teacher and teacher levels. Accordingly, pairwise comparisons of acquisitions in the AHP model (a_{ij}) were made according to the 1-9 scale (Table 1) proposed by Saaty (1980). Weights and consistency ratios were calculated with the Expert Choice (2000) program.

In the last stage of the study, the performance degree of acquisitions was determined. In this step, the performance degree of acquisitions was determined in the scope of approaches used in multi-criteria studies (Dağdeviren & Yüksel, 2010; Yüksel & Dağdeviren, 2010) from the literature. The evaluation of the performance degree of acquisitions was made according to the views of the lesson teacher with the scale presented in Table 3 (Yüksel, 2012). The values of the evaluation scale consist of six levels between 0.0 and 1.0.

Table 3. Evaluation scale

Levels	Value of level
Very good (VG)	1.0
Good (G)	0.8
Moderate (M)	0.6
Negative (N)	0.4
Very negative (VN)	0.2
Not evaluation (NE)	0.0

RESULTS

Pairwise comparisons were made related to the acquisitions in the AHP model (Figure 1) created in the first step of the study and weights and consistency ratios of matrixes were calculated. Accordingly, pairwise comparisons, local weights and consistency ratios of basic acquisitions in the second level of the AHP model are presented in Table 4. According to the evaluation made with the AHP technique, the local weight of each acquisition within a group refers to the relative importance of the acquisition. According to the local weights of basic acquisitions (Table 4), it is evident that the weight of scientific process skills is more than two other acquisition groups. In the ranking of basic acquisitions, it is evident that the acquisitions of chemistry-technology-society-environment relationship are at the second rank and communication, attitude and value acquisitions take place at the last rank.

Table 4. The pairwise comparison matrix and local weights of the main acquisitions

Basic acquisitions	SPS	CTSE	CAV	Local weights
Scientific Process Skills (SPS)	1	3	3	0.594
Acquisitions of Chemistry-Technology-Society-Environment Relationship (CTSE)		1	2	0.249
Communication, Attitude and Value Acquisitions (CAV)			1	0.157
CR:0.05				

Pairwise comparisons, local weights and consistency ratios of the acquisitions in the third and fourth level of the AHP model, are presented in Table 5-17. General weights of acquisitions are presented in the second column of Table 18.

Table 5. The pairwise comparison matrix and local weights for scientific process skills

Scientific Process Skills	BP	CP	EP	Local weights
Basic Processes (BP)	1	2	2	0.500
Causative Processes (CP)		1	1	0.250
Experimental Processes (EP)			1	0.250
CR:0.05				

Table 6. The pairwise comparison matrix and local weights for basic processes

Basic Processes	BP1	BP2	BP3	BP4	BP5	BP6	Local weights
Recognition of coding system used in chemistry (BP1)	1	3	3	2	1	2	0.269
Use of coding system and chemistry terminology in communication (BP2)		1	1	1/2	1/2	1/2	0.086
To express measurable sizes with suitable units (BP3)			1	1/3	1/3	1/3	0.071
To express the results of experiments with charts and graphics (BP4)				1	1/2	1/3	0.135
To make distinction between qualitative and qualitative scientific information (BP5)					1	1	0.220
To comprehend the importance of the difference between qualitative and qualitative information (BP6)						1	0.220
CR:0.03							

Table 7. The pairwise comparison matrix and local weights for causative processes

Causative Processes	CP1	CP2	CP3	CP4	CP5	Local weights
To express the results of observation, experiment and research mathematically and verbally (CP1)	1	2	3	3	2	0.366
To make cause-effect relationship while interpreting natural events on the basis of chemistry (CP2)		1	2	3	1	0.225
The interpretation of charts and graphics (CP3)			1	1	1	0.126
To generalize by interpreting available data of experiments (CP4)				1	1/2	0.101
The use of theory and models to define and anticipate physical events (CP5)					1	0.181
CR:0.02						

Table 8. The pairwise comparison matrix and local weights for experimental processes

Experimental Processes	EP1	EP2	EP3	EP4	Local weights
To comprehend the importance of observation and experiment in accurate interpretation of the universe (EP1)	1	3	3	3	0.483
The recognition of devices and instruments used in observation and experiments (EP2)		1	2	2	0.229
To obey security rules during experiments (EP3)			1	1/3	0.105
To obtain the skill of carrying out experiments (EP4)				1	0.183
CR:0.08					

Table 9. The pairwise comparison matrix and local weights for CTSE

Acquisitions of CTSE	TC	SC	EC	EV	Local weights
Technologic (TC)	1	2	2	1/3	0.260
Social (SC)		1	2	1/2	0.179
Economic (EC)			1	1/3	0.104
Environmental (EV)				1	0.458
CR:0.06					

Table 10. The pairwise comparison matrix and local weights for technologic acquisitions

Technologic Acquisitions	TC1	TC2	Local weights
The recognition of technologic effects of chemistry (TC1)	1	3	0.750
To question the importance of conducting studies on science and technology (TC2)		1	0.250
CR: 0.00			

Table 11. The pairwise comparison matrix and local weights for social acquisitions

Social Acquisitions	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	Local weights
The recognition of social effects of chemistry (SC1)	1	3	3	2	2	2	1/3	2	0.187
To question the adoptability of chemistry in social fields (SC2)		1	1/3	1	1	1	1/3	2	0.077
The recognition of chemistry practices in social life (SC3)			1	3	3	1	1/3	3	0.146
The interpretation of the effects of developments in chemistry on moral values (SC4)				1	1	1	1/3	2	0.081
To question the social cost of scientific developments (SC5)					1	1/3	1/3	1	0.064
The interpretation of the effects of developments in chemistry on social values (SC6)						1	1	3	0.133

To use the knowledge obtained from chemistry lessons in the resolution of daily problems (SC7)					1	3	0.258
The interpretation of the effects of developments in chemistry on political values (SC8)						1	0.055
CR:0.06							

Table 12. The pairwise comparison matrix and local weights for economic acquisitions

Economic acquisitions	EC1	EC2	EC3	Local weights
The recognition of economic effects of chemistry (EC1)	1	3	3	0.594
To question the adoptability of chemistry in economic fields (EC2)		1	2	0.249
The interpretation of the effects of developments in chemistry on economic values (EC3)			1	0.157
CR:0.05				

Table 13. The pairwise comparison matrix and local weights for environmental acquisitions

Environmental	EV1	EV2	EV3	EV4	EV5	Local weights
To give examples about the adverse effects of scientific and technologic developments on people (EV1)	1	3	1	3	1	0.272
To use knowledge obtained from lessons in the explanation of physical events (EV2)		1	1/3	1/3	1/3	0.073
To comprehend the importance of the scientific approach and interrogatory thinking on the interpretation of the world (EV3)			1	3	3	0.339
To use the knowledge obtained from the chemistry lesson in the resolution of problems related to chemistry (EV4)				1	1	0.141
To give examples about the adverse effects of scientific and technologic developments on nature (EV5)					1	0.175
CR:0.06						

Table 14. The pairwise comparison matrix and local weights for communication, attitude and value Acquisitions

CAV acquisitions	CM	AT	VL	Local weights
Communication (CM)	1	1/3	1/3	0.143
Attitude (AT)		1	1	0.429
Value (VL)			1	0.429
CR:0.00				

Table 15. The pairwise comparison matrix and local weights for communication acquisitions

Communication Acquisitions	CM1	CM2	CM3	CM4	Local weights
To volunteer to work in cooperation (CM1)	1	2	3	2	0.402
To listen quietly (CM2)		1	3	1/3	0.183
To express one-self (CM3)			1	1/3	0.094
To assert demands and claims based on general acceptance (CM4)				1	0.321
CR:0.08					

Table 16. The pairwise comparison matrix and local weights for attitude acquisitions

Attitude acquisitions	AT1	AT2	AT3	AT4	AT5	Local weights
The interest towards science and chemistry as a part of science (AT1)	1	1	3	1	3	0.269
The acceptance (belief) that there is not an award for learning (AT2)		1	3	1	3	0.269
To consider learning itself as an award (AT3)			1	1/3	3	0.119
The willingness to participate in life-long learning (AT4)				1	3	0.269
To be careful to discuss unknown issues (AT5)					1	0.074
CR:0.03						

Table 17. The pairwise comparison matrix and local weights for value acquisitions

Value acquisitions	VL1	VL2	VL3	Local weights
The sensitivity towards environmental problems (VL1)	1	1	2	0.413
To internalize the leading role of science in the comprehension of the universe and life (VL2)		1	1	0.327
To make a distinction between prior issues of sciences and prior issues of democracy (VL3)			1	0.260
CR:0.05				

In this study, following the determination of local and general weights of education and training acquisitions, the performance degree of acquisitions is calculated (Table 18). Accordingly, acquisitions are presented in the first column of Table 18. General weights of acquisitions are presented in the second column. General weight refers to the relative importance of each acquisition out of all acquisitions. The total of relative importance of acquisitions equals to 1. For example, as for this study, the weight of the "BP1" acquisition is 8% out of all acquisitions. The obtained level of each acquisition after the lesson is presented in the third column. The evaluations in this column are made in accordance with the explanations in the third step of the method chapter of this study. For example, the "BP1" acquisition is evaluated as "very good (VG)" according to the evaluation made with the scale in Table 3. The numerical value corresponding to the evaluation level in the third column is presented in the fourth column, (Table 3). In the fifth column, the performance degree of each acquisition is presented. The values in this column consist of the multiplication of general weights in the second column and level values in the fourth column. The expected value of the performance degree of each acquisition is between zero and the general weight of the acquisition. In the last column of Table 18, the total value of the performance degree of acquisitions is presented. Accordingly, as for this study, the performance degree of education and training acquisitions is 74.9%.

Table 18. Performance Degree of Education and Training Acquisitions

Acquisitions	Global weights of the acquisitions (gw)	Levels of evaluation of acquisitions	Value of level (vl)	Performance Degree of acquisitions (GA x DD)
BP1	0.080	VG	1.00	0.080
BP2	0.026	G	0.80	0.021
BP3	0.021	G	0.80	0.017
BP4	0.040	G	0.80	0.032
BP5	0.065	G	0.80	0.052
BP6	0.065	M	0.60	0.039
CP1	0.054	G	0.80	0.043
CP2	0.033	M	0.60	0.020
CP3	0.019	G	0.80	0.015
CP4	0.015	G	0.80	0.012
CP5	0.027	M	0.60	0.016
EP1	0.072	M	0.60	0.043
EP2	0.034	VG	1.00	0.034
EP3	0.016	VG	1.00	0.016
EP4	0.027	G	0.80	0.022
TC1	0.049	G	0.80	0.039
TC2	0.016	M	0.60	0.010
SC1	0.008	M	0.60	0.006
SC2	0.003	M	0.60	0.002
SC3	0.007	G	0.80	0.006
SC4	0.004	M	060	0.002
SC5	0.003	M	0.60	0.002
SC6	0.006	M	0.60	0.004
SC7	0.012	M	0.60	0.007
SC8	0.002	N	0.40	0.001
EC1	0.015	M	0.60	0.009
EC2	0.006	M	0.60	0.004
EC3	0.004	M	0.60	0.002
EV1	0.031	G	0.80	0.025
EV2	0.008	G	0.80	0.006
EV3	0.039	M	0.60	0.023
EV4	0.016	G	0.80	0.013
EV5	0.020	G	0.80	0.016
CM1	0.009	G	0.80	0.007
CM2	0.004	G	0.80	0.003
CM3	0.002	G	0.80	0.002
CM4	0.007	M	0.60	0.004
AT1	0.018	G	0.80	0.014
AT2	0.018	G	0.80	0.014
AT3	0.008	M	0.60	0.006
AT4	0.018	M	0.60	0.011
AT5	0.005	VG	1.00	0.005
VL1	0.028	G	0.80	0.022
VL2	0.022	G	0.80	0.018
VL3	0.017	N	0.40	0.007
Total	1.000			0.749

CONCLUSION AND DISCUSSION

This study proposes a method to determine the performance degree of education and training acquisitions in 9th grade chemistry lesson. As education and training acquisitions are various and have different qualities, the AHP technique, which is one of the multi-criteria decision techniques, is used in the proposed method. In this study, scientific process skills, acquisitions of chemistry-technology-society-environment relationship and communication, and attitude and value acquisitions are re-classified. According to the created AHP model, pairwise comparisons of acquisitions were made and the weights and consistency ratios of acquisitions were calculated. In the last stage of the study, the performance degree of education and training acquisitions was determined.

According to the results of the study, it is seen that the proposed method can be used to determine the performance degree of education and training acquisitions. In addition, the proposed method obtains detailed information about acquisitions. The first part of this method is to calculate the local weights indicating the importance level of each acquisition within a group by means of the AHP technique. This information is important for decision makers and teachers. The recognition of the importance of anticipated student acquisitions is vital for the future preparation of lessons and programs. Furthermore the same information is important for teachers. A teacher's recognition of the importance levels of acquisitions in a lesson is necessary information for effective teaching. Another issue that makes the results of this study important is the determination of consistency ratios of pairwise comparisons. It is evident that the possible inconsistencies in pairwise comparisons, which is a basis for the local weights of acquisitions, can be determined with the AHP technique. In addition, the level of an acquisition out of all acquisitions could be determined with the calculated global weights. The recognition of the importance level of each acquisition is vital for the preparation and evaluation of curriculum contents. On the other hand, the current situation of each acquisition can be evaluated. Accordingly, the performance degree of each acquisition can be determined. Another important result of the proposed method is the value of the difference between expected and realized levels of each acquisition. This value indicates which acquisitions can not be performed at its expected level by decision makers and teachers as well as calculates the deviation from the expected level.

When considering the results of this study, this method offers the possibility of generating the data required in the evaluation of the education process in order to determine the performance degree of education and training acquisition in the chemistry lesson in secondary school curriculum. The method followed in this study can help determine the performance degree of the anticipated education and training acquisitions in curriculums of other science fields.

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