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A Quantitative Research for Students' Knowledge Area Skills of Project Management

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Özet

Students should learn project management (PM) because of different achievements as some professional groups must learn it such as university members, teachers, engineers, ICT experts etc. PM has different skill sets called by PM skills. One of them is a knowledge area skill set. So, students must achieve the knowledge area skills in order to complete the project on time, on budget and within scope. The research aims to determine levels of knowledge area skills of PM for students with different variables. Quantitative research was used in the research and survey techniques performed to meet the purpose. The findings show that students have high-level KAS of PM for each knowledge area and KAS of PM of students can differ with grade level, number of completed project, academic achievement and enjoying project based learning (PBL) but not gender according to their opinions. Finally, a couple of suggestions were shared.

Anahtar Kelimeler: Project management, knowledge areas, skills, project based learning.

Proje Yönetimi Bilgi Alanları Becerilerine Yönelik Bir Nicel Araştırma

Abstract

Öğretim üyeleri, öğretmenler, mühendisler, ICT uzmanları gibi öğrenciler de yaşama yönelik farklı becerileri kazandırabildiği için proje yönetimini öğrenmelidir. Proje yönetimi içinde farklı beceri setlerini barındırmaktadır. Bu setlerden biri de bilgi alanları becerileridir. Öğrenciler, hazırlamakta oldukları projeleri kapsamında, zamanında ve varolan bütçe ile tamamlayabilmeleri için bilgi alanı becerilerine sahip olması gerekmektedir. Bu araştırma, farklı değişkenler açısından öğrencilerin proje yönetimi bilgi alanları becerilerinin düzeylerini belirlemeyi amaçlamaktadır. Araştırma amaçlarına ulaşabilmek için nicel araştırma modeli ve anket tekniği kullanılmıştır. Araştırma bulguları genel olarak öğrencilerin yüksek düzeyde proje yönetimi bilgi alanları becerilerine sahip olduğunu ve öğrencilerin bilgi alanları beceri seviyelerinin eğitim düzeyi, bitirilen proje sayısı, akademik başarı ve proje tabanlı öğrenmeyi sevme durumu ile değişebildiği ancak cinsiyet değişkeni ile değişmeyebildiği sonucunu ortaya çıkarmıştır. Son olarak araştırmaya yönelik birkaç öneri paylaşılmıştır.

Keywords: Proje yönetimi, bilgi alanları, beceriler, proje tabanlı öğrenme.

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INTROUCTION

Development and improvement are strategic purposes of all humanity. Production and making value-added innovation emerge in order to meet strategic purposes. Project management (PM) is an effective and efficient method to achieve these kinds of strategic purposes. Partnership for 21st century skills (P21) shows PM as one of the 21st century skills (2009). Educational Foundation of Project Management Institute (PMI-EF, 2013; PMI-EF, 2011) also explains how important PM skills are. Uysal and Lepcha (2016) stated that PM includes skill sets that contain most of the 21st century skills such as communication, collaboration, critical thinking problem solving and creativity etc. as well as PM is one of the 21st century skills. Many papers, books support the vision (PMI, 2013; Nijhuis, 2012; Gillard, 2009; Byrne et al., 2008; Pant and Baroudi, 2008; Turner and Müller, 2005; Edum-Fotwe and Mccaffer, 2000).

Project based learning (PBL) has been mostly used in recent years in education. While students are getting the PBL course they are learning some parts of PM indirectly at the same time. Because PBL needs a project so a project is the most crucial and central part of PBL. Calis and Ergul (2012) emphasized that managing projects lead to understanding the PBL method according to % 52.1 participants' responses. Institutions and experts suggest that PBL and PM should be integrated to increase the quality of the learning process (Fioravanti et al., 2018; Amaral et al., 2015; De Los Ríos et al., 2015; Hutchison, 2015; PMI-EF and P21, 2014; P21 and PMI-EF, 2015) to acquire learning outcomes and to achieve PM skills and 21st century skills those are very similar.

After graduation from educational institutions, people want to have a good career. To do this they must acquire work skills. Project management is one of the work skills (Byrne et al., 2008; Pant and Baroudi, 2007; Kinkus, 2007; Jugdev and Müller, 2005; Edum-Fotwe and Mccaffer, 2000). So, students should acquire the formation of PM before graduation. PM is a large topic consists of some knowledge areas and process groups. The Project Management Body of Knowledge (PMBOK®) Guide explains knowledge areas and process groups of PM and all the works required to complete the project successfully (PMI, 2013). PM needs integration of knowledge areas to operate effectively. PM also can provide many skills. PM skills contain more than one skill set. There are several skill sets in the literature such as technical skills (hard, professional), interpersonal skills (soft), managerial skills, conceptual skills, human skills, people skills, organizational skills, leadership skills, political skills, behavioral skills, legal skills, technological skills, ethical skills etc. (PMI, 2013; Chandra, 2017; Awan et al., 2015; Sunindijo, 2015; Nijhuis, 2012; Kinkus, 2007; Lei and Skitmore, 2004; Mantel et al., 2001; El-Sabaa, 2001; Edum-Fotwe and Mccaffer, 2000; Kloppenborg and Petrick, 1999; Jiang et al., 1998; Munns and Bjeirmi, 1996; Katz, 1974). So, PM really deserves credit for including various skill sets that are reflected by different names.

Lei and Skitmore (2004, p.15) conducted a survey to identify the important issues and skills of PM for the foreseeable future. Time management, cost management, and risk management etc. emerged according to survey results at the end of the research. Zadeh et al. (2016) and Sunindijo (2015) added quality management and procurement management

as other skill sets of PM. Panuwatwanich et al. (2011, p.571) and Kopečková and Máchal (2016) used all the knowledge areas as skill sets of PM. Chandra (2017, p.18) indicated the summary of knowledge area skills derived from the various authors from literature as hard skills. In this respect, the researcher intended to suggest a new classification for PM skills those may compose of knowledge areas skills (KAS) related to management of the project, technical skills related to profession or subject matter of the project, interpersonal skills related to relations of people to people or people to institutions, technological skills related to technology usage for PM and ethical skills related to value, moral and legal kind of considerations in where the project takes place and project partners are from. In the research, students' knowledge area skills (KAS) of PM were focused on to reveal the findings through the research questions except other skill sets for a restriction of the research.

Purpose of the Study

This study aims to determine students' KAS of PM. While analyzing data to achieve the aim, following research questions will be examined:

1. What are the frequencies, percentages, and means of students' KAS of PM for each process groups and each knowledge areas with related items?
2. Do students' opinions regarding KAS of PM differ with independent variables of the research such as;
    a. Gender?
    b. Grade Level: Middle or High School?
    c. The Number of Completed Projects?
    d. Academic Achievement?
    e. Enjoying PBL?

METHOD

Research Model

The purpose of this study is to determine the KAS of PM for middle and high school students and compare the results in terms of independent variables of the research stated above. Quantitative research was used in the research and survey techniques performed to meet the purpose (Gay, Mills and Airasian, 2006).

Sample and Population

The participants of the research were composed of middle school and high school students in the city of Denton and Southlake, TX. The reference population of the current study consisted of five schools in Denton and Southlake (Denton High School, Denton Technology Complex, McMath Middle School, Calhoun Middle School, and Clariden

School). In this study, convenience sampling which provides an opportunity for researchers to collect data from their environment, according to Balcı (2001, p.100) was used. The data was collected in between 2015 and 2016 by the researchers, a total of 867 students participated in the study. Table 1 presents the demographic information of the participants.

Table 1. Demographic information of the participants

	Frequency	Percent (%)
Gender		
Male	398	45.9
Female	469	54.1
Grade Level		
Middle School	537	61.9
High School	330	38.1
Number of Completed Project		
None	28	3.2
1-4	596	68.8
5-12	221	25.5
13 and more	22	2.5
Academic Achievement		
Low	19	2.2
Average	384	44.3
High	464	53.5
Enjoying PBL		
Yes	656	75.7
No	211	24.3
Total	867	100

Data Collection Tools, Reliability and Validity Studies

In order to collect data addressing the research questions, a survey was administered to students in permitted schools by Denton ISD. The survey consisted of two parts as demographic information and KAS of PM. The demographic information part included 5 independent variables. This part provides to conduct some comparisons in terms of gender, grade level, number of completed project, enjoying PBL and academic achievement of the students.

The second part of the survey consisted of 38 items those belong to KAS of PM which was adapted from PMBOK® Guide (PMI, 2013) according to the cognitive, affective and psychomotor domain of the target group by the researcher. Expert opinions were obtained to sustain content and face validity. After content and face validity, 36 close-ended

questions were determined which were directly relevant with students. The scale consists of 36 items and 5 dimensions. "Initiating Process" consists of 4 items, "Planning Process" consists of 13 items, "Executing Process" consists of 5 items, "Monitoring- Controlling Process" consists of 7 items and "Closing Process" consists of 7 items as shown in Table 2 below.

Table 2. Project Management Process Groups and Knowledge Areas

(Adapted from Table A1-1. Project Management Process Groups and Knowledge Areas, PMI, 2013, p.423)

Knowledge Areas	**Process Groups**				
	Initiating	Planning	Executing	Monitoring-Controlling	Closing
Integration Management (I)	1, 2, 3, 4		18	24	36
Scope Management (S)		5, 6, 7, 8, 9, 10, 11		25	
Time Management (T)		12, 13		26	32
Budget Management (B)		16		27	30
Quality Management (Q)			21	23	
Human Resource Management (HR)		14	19		
Communication Management (C)			20		33, 34, 35
Risk Management (R)		17		28	
Procurement Management (P)		15	22	29	31

A five-point Likert scale was used in order to determine KAS of PM which ranged from 'Very Low (1)', 'Low (2)', 'Average (3)', 'High (4)' to 'Very High (5)'. The internal reliability coefficient of Cronbach's Alpha was calculated and a high-reliability coefficient was found (0.974). Cronbach Alpha reliability values for the dimensions of the scale are; .832 for "Initiating Process", (.937) for "Planning Process", (.872) for "Executing Process", (.925) for "Monitoring-Controlling Process" and (.889) for "Closing Process".

Data Analysis

A couple of data removed from the dataset because of the answers all 1 or all 5. After control the dataset, totally 867 students responded to the survey with no missing values. The highest score of each KAS can be the top score five (5) and the lowest score one (1). Five evaluation intervals and criteria were determined in order to interpret and evaluate students' KAS of PM (Table 3).

Table 3. Evaluation Criteria for KAS of PM

Evaluation Criteria	Very Low	Low	Average	High	Very High
Evaluation Intervals	1.00 – 1.79	1.80 – 2.59	2.60 – 3.39	3.40 – 4.19	4.20 – 5.00

Arithmetic average, percentage, and frequency were used in the analysis of the collected data as descriptive statistics. On the other hand, independent sample t-test and analysis of variance (ANOVA) were used to determine whether KAS of PM differ according to gender, grade level, number of completed projects, enjoying PBL and academic achievement of the students. The significance level was taken as .05 in the analyses of the data. SPSS 17.0 (Statistical Package for the Social Sciences) package program was used in statistical analyses.

FINDINGS

There are three research questions in the research. The items belong to knowledge areas were identified in the relevant tables with descriptive statistics shown below.

Findings for Reseach Question 1

The answer to the first research question is shown in Table 4, Table 5, Table 6, Table 7 and Table 8 below. Each table indicates information about one of the process groups.

Table 4. Students' KAS of PM for Initiating Process

Initiating Process	**Knowledge Areas**	**Very Low**		**Low**		**Average**		**High**		**Very High**		$\overline{X}$
I can ……. for/of/about a project		**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	
1. come up with an idea	I	31	3.6	77	8.9	237	27.3	322	37.1	200	23.1	3.67
2. describe what a project is about	I	14	1.6	89	10.3	222	25.6	304	35.1	238	27.5	3.76
3. write a project proposal (project charter)	I	57	6.6	160	18.5	277	31.9	245	28.3	128	14.8	3.26
4. explain the benefits	I	34	3.9	123	14.2	219	25.3	286	33	205	23.6	3.58

As seen in Table 4, three items (1, 2, 4) of Initiating Process are high-level ($3.4< \overline{X} <4.2$) but one item (3) is average-level ($2.6< \overline{X} <3.4$). Teachers should add project proposal writing activity in the PBL courses to increase the level of item 3.

Table 5. Students' KAS of PM for Planning Process

Planning Process	Knowledge Areas	Very Low		Low		Average		High		Very High		$\overline{X}$
I can…… for/of/about a project		f	%	f	%	f	%	f	%	f	%	
5. conduct a needs analysis	S	34	3.9	115	13.3	281	32.4	289	33.3	148	17.1	3.46
6. define the objectives (goals, purposes)	S	14	1.6	66	7.6	193	22.3	298	34.4	296	34.1	3.92
7. identify the assumptions of a project	S	28	3.2	100	11.5	248	28.6	329	37.9	162	18.7	3.57
8. define the deliverables (products)	S	29	3.3	88	10.1	251	29	325	37.5	174	20.1	3.61
9. describe the constraints (limitations)	S	35	4	88	10.1	254	29.3	312	36	178	20.5	3.59
10.describe the tasks and the activities	S	17	2	52	6	201	23.2	312	36	285	32.9	3.92
11.determine the milestones	S	33	3.8	90	10.4	264	30.4	305	35.2	175	20.2	3.58
12.prepare a schedule	T	40	4.6	89	10.3	250	28.8	262	30.2	226	26.1	3.63
13.determine the proper duration to complete	T	27	3.1	101	11.6	234	27	305	35.2	200	23.1	3.63
14.build a project team	HR	25	2.9	59	6.8	220	25.4	284	32.8	279	32.2	3.85
15.describe the resources (materials, tools, people etc.) that are needed	P	14	1.6	49	5.7	168	19.4	271	31.3	365	42.1	4.07
16.determine the approximate budget	B	37	4.3	98	11.3	260	30	285	32.9	187	21.6	3.56
17.make risk analysis to plan how to overcome	R	30	3.5	94	10.8	273	31.5	296	34.1	174	20.1	3.57

As seen in Table 5, all the items (5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17) of Planning Process are high-level ($3.4< \overline{X} <4.2$).

Table 6. Students' KAS of PM for Executing Process

Executing Process	Knowledge Areas	Very Low		Low		Average		High		Very High		$\overline{X}$
I can…… for/of/about a project		f	%	f	%	f	%	f	%	f	%	
18.manage the tasks and the activities	I	18	2.1	64	7.4	221	25.5	311	35.9	253	29.2	3.83
19.manage a project team	HR	26	3	70	8.1	202	23.3	299	34.5	270	31.1	3.83
20.manage communication	C	28	3.2	56	6.5	213	24.6	304	35.1	266	30.7	3.84
21.correct the mistakes in a project if any	Q	12	1.4	58	6.7	211	24.3	292	33.7	294	33.9	3.92
22.procure materials, tools and other needs	P	23	2.7	66	7.6	229	26.4	303	34.9	246	28.4	3.79

As seen in Table 6, all the items (18, 19, 20, 21, 22) of Executing Process are high-level ($3.4< \overline{X} <4.2$).

Table 7. Students' KAS of PM for Monitoring-Controlling Process

Monitoring-Controlling Process	Knowledge Areas	Very Low		Low		Average		High		Very High		$\overline{X}$
I can…… for/of/about a project		f	%	f	%	f	%	f	%	f	%	
23.control the quality	Q	23	2.7	66	7.6	221	25.5	330	38.1	227	26.2	3.78
24.monitor the tasks and the activities	I	16	1.8	56	6.5	225	26	321	37	249	28.7	3.84
25.control the scope	S	28	3.2	82	9.5	271	31.3	316	36.4	170	19.6	3.60
26.monitor the schedule	T	23	2.7	100	11.5	217	25	319	36.8	208	24	3.68
27.control the budget	B	47	5.4	115	13.3	247	28.5	281	32.4	177	20.4	3.49
28.control risks and manage possible risks	R	34	3.9	85	9.8	250	28.8	320	36.9	178	20.5	3.60
29.control procurements	P	28	3.2	77	8.9	261	30.1	332	38.3	169	19.5	3.62

As seen in Table 7, all the items (23, 24, 25, 26, 27, 28, 29) of Monitoring-Controlling Process are high-level ($3.4< \overline{X} <4.2$).

Table 8. Students' KAS of PM for Closing Process

Closing Process	Knowledge Areas	Very Low		Low		Average		High		Very High		$\overline{X}$
I can…… for/of/about a project		f	%	f	%	f	%	f	%	f	%	
30.complete and close the budget	B	36	4.2	96	11.1	240	27.7	313	36.1	182	21	3.59
31.finalize and close procurements	P	26	3	94	10.8	270	31.1	313	36.1	164	18.9	3.57
32.complete a project on time	T	26	3	70	8.1	173	20	266	30.7	332	38.3	3.93
33.write a project essay (project report)	C	54	6.2	100	11.5	198	22.8	252	29.1	263	30.3	3.66
34.give a presentation	C	54	6.2	74	8.5	207	23.9	232	26.8	300	34.6	3.75
35.spread project results	C	25	2.9	88	10.1	237	27.3	296	34.1	221	25.5	3.69
36.evaluate a project to make it better in the future	I	17	2	66	7.6	195	22.5	296	34.1	293	33.8	3.90

As seen in Table 8, all the items (30, 31, 32, 33, 34, 35, 36) of Closing Process are high-level ($3.4< \overline{X} <4.2$).

Table 9. KAS of PM for Each Process Group

Process Group	$\overline{X}$	**sd**
Initiating Process	3.57	0.87
Planning Process	3.68	0.78
Executing Process	3.83	0.82
Monitoring-Controlling Process	3.65	0.85
Closing Process	3.72	0.84
General Means of KAS of PM	3.69	0.75

As seen in Table 9, the means of students' KAS of PM are $\overline{X}$ = 3.57 for Initiating Process, $\overline{X}$ = 3.68 for Planning Process, $\overline{X}$ = 3.83 for Executing Process, $\overline{X}$ = 3.65 for Monitoring-Controlling Process and $\overline{X}$ = 3.72 for Closing Process. This finding shows that students have high-level KAS of PM for each process group according to their opinions.

Table 10: KAS of PM for Each Knowledge Area

Process Group	$\overline{X}$	**sd**
Integration Management (I)	3.69	0.79
Scope Management (S)	3.65	0.80
Time Management (T)	3.71	0.88
Budget Management (B)	3.54	0.94
Quality Management (Q)	3.84	0.89
Human Resource Management (HR)	3.83	0.94
Communication Management (C)	3.73	0.90
Risk Management (R)	3.58	0.93
Procurement Management (P)	3.76	0.82
General Means of KAS of PM	3.69	0.75

As seen in Table 10, the means of students' KAS of PM are $\overline{X}$ = 3.69 for Integration Management, $\overline{X}$ = 3.65 for Scope Management, $\overline{X}$ = 3.71 for Time Management, $\overline{X}$ = 3.54 for Budget Management, $\overline{X}$ = 3.84 for Quality Management, $\overline{X}$ = 3.83 for Human Resource Management, $\overline{X}$ = 3.73 for Communication Management, $\overline{X}$ = 3.58 for Risk Management and $\overline{X}$ = 3.76 for Procurement Management. This finding shows that students have high-level KAS of PM for each knowledge area according to their opinions as well as each process group.

Findings for Reseach Question 2

Gender Difference: An independent sample t-test was conducted to examine whether there was any significant difference between female and male students in their KAS of PM (Table 11). The means of male students' KAS ($\overline{X}$ = 3.69) and the means of female students' KAS ($\overline{X}$ = 3.70) are very similar. According to independent t-test result [t(865)= -.123, p=0.90 > 0.05], there is no significant difference between male and female students for KAS of PM.

Table 11. Gender Difference for KAS of PM

Gender	Groups	N	$\overline{X}$	Sd	df	t	p
KAS of PM	Male	398	3.69	.76	865	-.123	.902
	Female	469	3.70	.75			

Grade Level Difference: An independent sample t-test was conducted to examine whether there was any significant difference between grade level (middle school - high school) of students in their KAS of PM (Table 12). The means of middle school students' KAS ($\overline{X}$ = 3.64) and the means of high school students' KAS ($\overline{X}$ = 3.77) are slightly different. According to independent t-test result [t(865)= -2.45, p=0.01 < 0.05], there is a significant difference between middle school and high school students for KAS of PM. Effect size was calculated d=0.171 which means it can be a small effect on KAS of PM by grade level.

Table 12. Grade Level Difference for KAS of PM

Grade Level	Groups	N	$\overline{X}$	Sd	df	t	p
KAS of PM	Middle	537	3.64	.75	865	-2.45	.014
	High School	330	3.77	.76			

Number of Completed Projects Difference: As seen in Table 13, the means of students' KAS of PM are $\overline{X}$ = 3.31 for None choice, $\overline{X}$ = 3.63 for 1-4 choice, $\overline{X}$ = 3.88 for 5-12 choice and $\overline{X}$ = 4.11 for 13 and more choice according to the number of completed projects variable. It was found that when the number of completed projects increased then the means of KAS of PM increased. This finding shows that the students' KAS of PM can be improved according to the number of completed projects variable.

Table 13: The Means for Number of Completed Projects Variable-1

Number of Completed Projects	$\overline{X}$	sd	N
1= None	3.31	0.89	28
2= 1-4	3.63	0.76	596
3= 5-12	3.88	0.67	221
4= 13 and more	4.11	0.69	22
Total	3.69	0.75	867

5-12 choice and 13 and more choices were merged in order to see the significant difference between None choice and others. A new formation for the number of completed projects variable was seen in Table 14.

Table 14: The Means for Number of Completed Project Variable-2

Number of Completed Projects	$\overline{X}$	sd	N
1= None	3.31	0.89	28
2= 1-4	3.63	0.76	596
3= 5 and more	3.90	0.67	243
Total	3.69	0.75	867

One Way ANOVA test was used to determine if there was a significant difference in students' KAS of PM, related to number of completed projects variable. As can be seen from the results given in Table 15, there is a significant difference in students' KAS of PM for the number of completed projects variable [F(2-864)=15.81; p<0.05]. Effect size was calculated η^2 = .035 which means it can be a small effect on KAS of PM by number of completed projects.

Table 15: Number of Completed Projects Difference for KAS of PM

Number of Completed Projects	Source of Variance	S.S.	df	M.S.	F	p	Significant Difference
KAS of PM	Between Groups	17.66	2	8.83	15.81	0.00	1-2, 1-3, 2-3
	Within Groups	482.47	864	.55			
	Total	500.14	866				

LSD multiple comparison methods were used to determine specifically which groups are significantly different related to the number of completed projects variable. It was found that all three groups are significantly different between each other.

As seen in the Table 14, None choice group ($\overline{X}$ = 3.31) is average level and lower level than 1-4 choice group ($\overline{X}$ = 3.63) and 5 and more choice group ($\overline{X}$ = 3.90) that they are high-level. This can be an explanation of the significant difference between None choice group and other groups. None choice group has the potential to increase KAS of PM by giving chance and providing proper learning environment them to carry out projects. There is also another significance different between 1-4 choice group ($\overline{X}$ = 3.63) and 5 and more choice group ($\overline{X}$ = 3.90) because of doing more projects briefly. The result shows that doing more projects with increasing experience about PM strengthens KAS of PM. Also, the number of completed projects variable correlates with students' KAS of PM directly proportional.

Academic Achievement Difference: As seen in Table 16, the low academic achievement group ($\overline{X}$ = 2.68) and the average academic achievement group ($\overline{X}$ = 3.39) are average-level for KAS of PM. Also, the high academic achievement group ($\overline{X}$ = 3.99) are

high-level for KAS of PM. PBL and PM are kinds of learning by doing activities. Therefore, the low academic achievement group can be average-level for KAS of PM-related to doing projects as the finding and Honestly, the finding can be questionable because of merely 19 students in the group. Generally, it was found that when academic achievement increased then means of KAS of PM increased.

Table 16: Means for Academic Achievement Variables

Academic Achievement	$\overline{X}$	sd	N
Low	2.68	1.15	19
Average	3.39	0.69	384
High	3.99	0.65	464
Total	3.69	0.75	867

One Way ANOVA test was used to determine if there was a significant difference in students' KAS of PM-related to academic achievement variable. As can be seen from the results given in Table 17, there is a significant difference in students' KAS of PM for academic achievement variable [F(2-864)=100.74; p<0.05]. Effect size was calculated η^2 = .189 which means it can be a large effect on KAS of PM by academic achievement.

Table 17: Academic Achievement Difference for KAS of PM

Academic Achievement	Source of Variance	S.S.	df	M.S.	F	p	Significant Difference
KAS of PM	Between Groups	94.57	2	47.28	100.74	0.00	1-2, 1-3, 2-3
	Within Groups	405.56	864	.46			
	Total	500.14	866				

LSD multiple comparison methods were used to determine specifically which groups are significantly different related to the academic achievement variable. It was found that all three groups are significantly different between each other.

As seen in Table 17, the high academic achievement group ($\overline{X}$ = 3.99) is high-level for KAS of PM and higher level than the average academic achievement group ($\overline{X}$ = 3.39) and the low academic achievement group ($\overline{X}$ = 2.68) that they are both average-level for KAS of PM. This can be an explanation of the significant difference between the high academic achievement group and other groups. The average academic achievement group has a mean ($\overline{X}$ = 3.39) that is very close to high- level for KAS of PM. Also, the low academic achievement group has a mean ($\overline{X}$ = 2.68) that is very close to low-level for KAS of PM. The mean difference between average academic achievement group and low academic achievement group can be the reason for significant difference. The finding shows that the academic achievement variable correlates with students' KAS of PM directly proportional by comparing the means of each group.

Enjoying PBL Difference: An independent sample t-test was conducted to determine whether there was a significant difference between Yes – No choices for enjoying PBL of students in their KAS of PM (Table 18). The means of students' KAS ($\overline{X}$ = 3.78) who enjoy PBL and means of students' KAS ($\overline{X}$ = 3.43) who do not enjoy PBL seem different. According to the independent t-test result [t(865)= 5.96, p=0.00 < 0.05], there is a significant difference between Yes – No choices for enjoying PBL related to students' KAS of PM. Effect size was calculated d=0.471 which means it can be a medium effect on KAS of PM by enjoying PBL.

Table 18: Enjoying PBL Difference for KAS of PM

Enjoying PBL	Groups	N	$\overline{X}$	Sd	df	t	p
KAS of PM	Yes	656	3.78	.73	865	5.96	.000
	No	211	3.43	.76			

CONCLUSION DISSCUSSION AND RECOMMENDATIONS

Interestingly, all the items belong to KAS of PM are not very high-level but high-level for all process groups and knowledge areas except item 3: "write a project proposal (project charter)". Mean of item 3 for high school students is ($\overline{X}$ = 3.43) and mean of item 3 for middle school students is ($\overline{X}$ = 3.16). According to independent t-test result [t(865)= -3.49, p=0.00 < 0.05], there is a significant difference between middle school and high school students for writing project proposal. High school students can write a project proposal better than middle school students because high school students do more projects and write more project proposals than middle school students. It is observed that writing is difficult than reading and speaking most of the time. Writing project needs experience such as thinking all the knowledge areas, designing all the process groups all in one.

Fernandes, Ward, and Araújo (2013) expressed that particular relevance is given to tools and techniques from planning process about top most useful PM Practices. Their research also revealed that the areas of knowledge, scope, time, risk, communication and integration, assume a high relevance, each with at least three PM practices on the top of the list. In the research of Besner and Hobbs (2006), respondents were specifically asked to indicate the phase(s) of projects during which they are most often involved. Many respondents indicated involvement in more than one phase: Initiation/Concept 52%, Planning/Development 83%, Execution/Implementation 77%, Finalization/Commissioning/Handover 54%.

Panuwatwanich et al. (2011, p.572) notified that scope management, time management, and cost management were the three most critical areas and perceived as the areas where graduate engineers may require more improvement according to survey result. They also informed that the all KAS of PM of the graduate engineers are totally average-level (2.6< $\overline{X}$ <3.4), with the two best areas; quality and communication management. The profession of the participants may be the reason of the average-level because of the difficulties in their project types. Awan et al. (2015) stated that the project

manager's communication skills positively affect the project success. Lei and Skitmore (2004, p.6) expressed that the level of project managers' ability for communication is high-level ($\overline{X}$ = 4.15) same level as the current research.

Students who participated the research have high-level KAS of PM for each process group and each knowledge area according to their opinions. This means they are ready to carry out projects, they are good at KAS of PM and the preliminary readiness status of students can be adequate to be a candidate for the project manager. Students should proceed to conduct new projects for social good in the framework of sustainable development at school because of their high potential.

Students' KAS of PM generally do not differ by gender variable includes males and females. Mulenburg (2002) stated that there are many similarities among men and women project managers in NASA and each group was substantially the same in terms of their civil service grade level, leadership scores, ego resilience, and personality type. Rodríguez et al (2017) found that men and women make the same decisions in 48 of 53 situations about PM as well as making different decisions in 5 of 53 situations. In the research, similarities seem more than differences. Aretoulis (2018) expressed that statistically, significance differences exist among male and female participants regarding the required competencies. The reason for the difference can be the scope of the two researches. Aretoulis (2018) examined interpersonal and ethical skills as well as KAS of PM. Henderson and Stackman (2010) confirmed the importance of gender in project management and its interrelationships with the role, location, technology, and cost.

Students' KAS of PM differ by grade level variable includes middle school and high school and the number of completed projects variable. Grade level can have a small effect on KAS of PM according to effect size (d=0.171) in the research. High school students carried out more projects then middle school students because of the period of study. Zadeh et al. (2016, p.15) reflected that the level of education is a variable that can affect PM skills. Both grade level and the number of completed projects variables are relevant to experience as with years of experience in projects. The results show that doing more projects with increasing experience strengthens the KAS of PM. The number of completed projects variable correlates with students' KAS of PM directly proportional in the research. Number of completed projects can have a small effect on KAS of PM according to effect size (η^2 = .035). None choice group has the potential to increase KAS of PM by giving chance and providing proper learning environment them to carry out projects.

Aretoulis (2018) suggested that "experience" is a key attribute in project management, directly related to project success. Many researches revealed that PM skills can be improved by experience by doing projects more or working on PM (Aretoulis, 2018; Chandra, 2017; Zadeh et al., 2016; Fung, 2015; Singh and Hofmann, 2012; Aitken and Crawford, 2007; Lei and Skitmore, 2004; Edum-Fotwe and Mccaffer, 2000; Anderson, 1992). Students can improve KAS of PM by doing more projects in PBL based courses whether they enjoy doing projects or not according to the number of completed projects and enjoying PBL variables.

Students' KAS of PM differs by for academic achievement variable. The result shows that the academic achievement variable correlates with students' KAS of PM directly proportional by comparing the means of each group. Academic achievement can have a large effect on KAS of PM according to effect size ($\eta^2 = .189$).

Enjoying PBL is a kind of attitude variables and attitudes can have an effect on our behaviors and skills. It is seen that PBL can affect the KAS of PM in schools. There is a significant difference between Yes – No choices for enjoying PBL related to students' KAS of PM. Enjoying PBL can have a medium effect on KAS of PM according to effect size (d=0.471) in the research. The result reveals that enjoying PBL can give a chance to improve students' KAS of PM because of PBL effect on PM. Moura et al. (2018) resulted that there is empirical evidence that not only attitudes of project managers but also skills of project managers can affect project performance.

As a conclusion, this study contributes to determining KAS of PM at schools. The students achieved high-level KAS of PM according to survey results. KAS of PM can be affected by some variables such as grade level, number of completed projects, academic achievement and enjoying PBL except gender variable.

Recommendations

A couple of recommendations can be shared related to the current research shown below:

- Writing project proposal activities can be implemented more in PBL based courses. More practices can be carried out for writing a project proposal.
- The students' KAS of PM can be improved when the number of completed projects increase. So, PBL method should be used in learning/teaching process.
- PMI (2018) declared that champions-high performing organizations are making the investment: 81% prioritize the development of technical skills which also includes KAS. Schools and learning institutions can implement a similar strategy like champions.
- Education and training can improve KAS of PM according to research results. In order to improve KAS of PM, students or learners should carry out more projects considering doing the right projects right as Cooke-Davis (2004) informed after working on several noteworthy studies over the last 30 years.

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