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The assessment of teamwork competencies for students focuses on dimensionality and mixed-method assessment

The challenges of assessing teamwork competency, which internal structures can be multidimensional and complex. It is necessary to assess of the teamwork competency as unidimensional or multidimensional structures and perform assessments in a variety of ways to ensure accuracy and accuracy from the assessment. The research objectives were to assess the dimension of students' teamwork competencies and to assess students' teamwork competencies using mixed methods assessment.

Participants were 385 students in advanced professional innovation scholarship undergoing empowerment process for dimensional and quantitative assessment, 10 experts panel for setting cut-off score of assessment criteria, and 40 students for qualitative assessment. Research instrumentations were teamwork competency self-assessment digital form, the setting questionnaire of the cut-off score of assessment criteria for expert judgment, and an interview form for qualitative assessment. Data were analysed by mean, standard deviation, Eigen value, one-way multivariate analysis of variance (one-way MANOVA), thematic analysis.

Research results found that: The teamwork competencies were appropriate for multi-dimension assessment, the ratio between the Eigen value of factor 1 toward the Eigen value of factor 2 was equal to 1.078. Quantitative assessment of teamwork competencies, Building a team relationship (BTR) at high to a very high level, participation in a team exchange (PTE) at a high level, adapting and creating a team atmosphere (ACT) at a very high level, and supporting a team (STE) high to a very high level. In addition, the main effect (region) on BTR and STE, the results showed that there were statistically significant region differences with small to moderate effect size, but on PTE and ACT, the results showed that there were no statistically significant region differences. Qualitative assessment of students' perspective reflects the reasons for the teamwork competencies found that significant of building a team relationship comprised nineteen-theme (Priority three: Make a success of the team, good working friendship, and it's easy to build harmony and grouping with friends) and significant of supporting a team comprised six-theme Priority three: Reduce conflicts, Strengthen teamwork, and Make it work better).

The quantitative assessment of teamwork competencies reflects to appropriate for multi-dimension assessment, and the qualitative assessments also support the explanation of teamwork competencies with multidimensional characteristics of students.

Keywords: teamwork competencies, dimensionality assessment, mixed-method assessment

For Reference:

Chianchana, C., & Swangjang, S. (2021). The assessment of teamwork competencies for students focuses on dimensionality and mixed-method assessment. *Perspektivy nauki i obrazovania – Perspectives of Science and Education*, 54 (6), 126-140. doi: 10.32744/pse.2021.6.9

Introduction

The competency that is essential for today's learning is teamwork competency. Teamwork is one ability that today is of high value in the professional arena with great importance for various personal and interpersonal skills associated with it [1], Teamwork is a set of interrelated thoughts, actions, and feelings of each team member that are needed to function as a team and that combine to facilitate coordinated adaptive performance and task objectives resulting in value-added outcomes [2], and is a recognized competence present in both curricular activities and professional educational endeavors [3]. Besides education, it extends to other professions as concept Anderson et al. [4] teamwork is essential to delivering high-quality care and is central to nursing. Therefore, teamwork is now important in both education and other professions.

The importance of teamwork competency is also critical to the student level. Teamwork activities have become highly relevant, fundamentally because of the need for the development of teamwork competency, and particularly to guarantee the future teamwork performance of the student [5] and teamwork is a learning outcome that is required for all engineering programs [6]. Tonso [7] has laid down a framework for building teamwork in a classroom that emphasizes explicit teaching about teamwork theories, especially about how to respect each other and manage conflict. The model also includes trust-building and incorporation of formative feedback throughout the duration of the team. For teams to succeed, students need to possess various teamwork skills including trust-building, communication, and conflict management. Zou and Ko [8] said that based on the above information, teamwork performance is necessary to study and develop with learners.

The internal structure of teamwork competency is a multidimensional potential according to McEwan and Beauchamp [9] refers to teamwork as a multidimensional construct comprised of collaborative behaviors that take place before, during, and after team tasks, and Nadal, et al. [10] refers to teamwork competence is a multidimensional construct, the definition of teamwork competence may depend on the perspective from which it is studied. Teamwork is therefore a great assessment challenge [11]. Despite the importance of teamwork in education in general and in eLearning settings in particular, just 20% of the students have never been evaluated in teamwork [12], in addition, assessment of teamwork is critical in improving patient safety during endovascular procedures. Assessment may encourage teams to reflect on their performance, identify deficiencies in teamwork, highlight training needs, and inform further development of teamwork training interventions [13].

As a study of the challenges of assessing teamwork competency, which internal structures can be multidimensional and complex. It is necessary to assess of the teamwork competency as unidimensional or multidimensional structures and perform assessments in a variety of ways to ensure accuracy and accuracy from the assessment. This will lead to the development of students' teamwork that aims to develop students to succeed.

The research objectives were to assess the dimension of students' teamwork competencies and to assess students' teamwork competencies using mixed methods assessment.

1. Teamwork competencies

The term of team competencies, educators have said: allows organizations to establish the appropriate requirements for their teams and strategies to enhance teamwork and performance. Teamwork competencies can be characterized as resources that team members draw from to function. As noted, they include knowledge, skills, and attitude-based factors [14]. Carmenado, Rodríguez, and Gajardo [1] said that teamwork competence refers to a set of actions, strategies, procedures, and methodologies used by a group of people to achieve objectives and/or goals, sharing responsibilities. UN [15] refers to the combination of skills, attributes, and behaviour required of all staff, regardless of their level of function. In addition, Torrelles [16] said that understood teamwork competence as “the set of knowledge, skills, and attitudes required to work with others in carrying out tasks and achieving common goals, sharing information, distributing tasks, taking responsibility, solving problems, and contributing to the improvement and collective development.”

In the term dimension of teamwork competence Nadal, et al. [10] refers to teamwork competence as a multidimensional construct; the definition of teamwork competence may depend on the perspective from which it was studied, and the main tool used to measure teamwork competency was self and peer evaluation [6].

2. Assessment approach

In the education field, the assessment refers to the methods or tools that educators used to test, measure, and evaluate learning readiness, learning progress, learning outcome. The term assessment was often used to describe the measurement of what an individual knows and can do [17]. Brown [18] refers to a related series of measures used to determine a complex attribute of an individual or group of individuals. This involves gathering and interpreting information about student level of attainment of learning goals, Apple [19] assessment was a process of measuring and analyzing performance or product to provide quality, timely feedback for improvement, and Banta [20] provides this succinct definition that includes the concept of assessment as a process or cycle: “Assessment was a multi-stage, multi-dimensional process—a vehicle—for bringing clarity and balance to an individual activity or set of activities.”

From the above data, teamwork competence was a multidimensional construct; the study should first assess the construct dimension to lead to accurate interpretation. Chianchana and Na Wichian [21] refer to a dimensionality assessment as studied the dimension of variable as primary to get the answer of interpretation of assessment that it should be interpreted in terms of unidimensionality or multidimensionality. In addition, the assessment of teamwork competencies should support both quantitative and qualitative data for a better explanation of complex data related to mixed-method approach according to Tashakkori and Creswell [22] said that mixed methods refer to research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches or methods in a single study. In addition, Creswell and Creswell [23] said that writings in this area had sought to develop an understanding of the importance of complete integration of the two approaches.

Teamwork competence was the set of knowledge, skills, and attitudes required to work with others in carrying out tasks and achieving common goals and was a multidimensional construct, and the main tool used to measure teamwork competency was self, the study should first assess the construct dimension to lead to accurate interpretation, the dimensionality assessment was applied. As well as complex data, it is possible both quantitatively and qualitatively, mixed methods assessment was applied as well. The data lead to research conceptual framework as figure 1.

Figure 1 Research conceptual framework

Research methodology

The research design in this research was a mixed-method explanatory Sequential Design (Two-phase design) [23]. Which it was sequential method by the first quantitative method and followed explanation by qualitative method. The details of the research method were as follows:

1. Participants

1) 1,106 population in advanced professional innovation scholarship undergoing empowerment process for dimensional and quantitative assessment gained at stratified random sampling, strata were regions, sampling unit was student, a minimal sample should be 157 (confidence interval=99%, margin of error 0.03) [24]. Therefore, this research has a sample of 385 students.

2) 10 experts panel for setting cut-off score of assessment criteria. They were experts in educational measurement and evaluation, and experience greater than 10 years, for appropriateness of sample size according to Patil [25] recommend 6-12 participants discuss a specific research topic.

3) 40 students for qualitative assessment gained mixed purposeful sampling consisted of two steps were the first step, critical case sampling with high and outstanding teamwork competencies each a region. In the second step, quota sampling there are four regions with each a region of 10 people, for appropriateness of sample size according to Patil [25] recommend 6-12 participants discuss a specific research topic.

2. Research instruments

Research instrumentations: 1) Teamwork competency self-assessment digital form (forty-four items) consisted of four factors: building a team relationship (BTR), participation in a team exchanges (PTE), adapting and creating a team atmosphere (ACT), and supporting a team (STE). The examine of instrumentation quality appear item-total correlation between 0.67-0.77, reliability by Cronbach's alpha coefficient equal 0.98 and construct validity by

confirmatory factor analysis appear teamwork competencies factors fit the empirical data. 2) The setting questionnaire of a cut-off score of assessment criteria for expert judgment, and 3) Interview form for qualitative assessment, which it was examined face validity by the five experts prove language.

3. Analysis

The data were analysed by mean, standard deviation, Eigen value, one-way multivariate analysis of variance (one-way MANOVA), and thematic analysis.

4. Research steps

The research was three steps: the first, assess of teamwork competencies dimensions. Second, assess teamwork competencies follow first step (dimensional assessment) with create assessment criteria of teamwork competencies and assess teamwork competencies in quantitative data. Finally, assess teamwork competencies in qualitative data.

Research results

1. Assessment of teamwork competencies dimensions

The analysis results of teamwork competencies dimensions by factors analysis were found that the ratio between the Eigen value of factor 1 toward the Eigen value of factor 2 was equal to 1.078. The values were less than the criteria, which would be concluded the multidimensionality. Morizot et al. [26] proposed to consider the unidimensionality from the ratio between Eigen value of factor1 toward the Eigen value of factor 2. If the value was more than or equal to 3.00, it showed the unidimensionality. With all evidence mentioned above, it can be concluded that the teamwork competencies were appropriate for multidimensionality assessment as shown in Table 1.

Table 1

Assessment of teamwork competencies dimensions

Factors (F)	Eigen values	% of Variance
1	9.662	24.154
2	8.966	22.415
3	7.944	19.859
Eigen value F1 / Eigen value F2 =1.078		

2. Assessment criteria of teamwork competencies

From the data above, teamwork competencies dimensions were appropriate for multidimensionality assessment, therefore, assessment criteria of teamwork competencies based on multidimensional criteria on each dimension by ten expert judgments in educational measurement and educational management fields shown in figure 2.

Teamwork competencies assessment results found that the dimensions: Building a team relationship (BTR) at high to a very high level, participation in a team exchange (PTE) at a high level, adapting and creating a team atmosphere (ACT) at a very high level, and supporting a team (STE) high to a very high level.

Figure 2 Assessment criteria of teamwork competency

Table 2

Assessment of teamwork competencies

Dimension	area	Mean	Std. Deviation	n
BTR	center	66.1758	7.87908	91
	north	64.4519	8.67188	104
	north east	66.7647	6.96188	85
	east	68.9905	5.91201	105
	Total	66.6078	7.59279	385
PTE	center	51.9890	5.85471	91
	north	50.7500	5.98015	104
	north east	52.5647	5.64726	85
	east	52.8095	5.83935	105
	Total	52.0052	5.87455	385
ACT	center	34.9780	4.47953	91
	north	34.1058	4.52805	104
	north east	35.4824	4.13928	85
	east	35.6000	3.82954	105
	Total	35.0234	4.27651	385
STE	center	21.8791	2.75211	91
	north	20.8077	3.03083	104
	north east	22.1059	2.45930	85
	east	21.8952	2.67080	105
	Total	21.6442	2.78587	385

The Box' M test for equality of the covariance matrices shows a significant value of.000, showing a significant difference between the four groups on four variables not equal. Therefore, should be used F and p values generated by Pillai's Trace criterion [27; 28].

The assumption concerns the homogeneity of the variance-covariance matrices across the four groups, univariate tests (Levene's test) for three variables comprised PTE, ACT, and STE were nonsignificant or equal variance, but for BTR significant or not equal variance.

To check multicollinearity, the circled correlation (between the dependent variables), Tabachnick & Fidell [29] suggest that no correlation should be above $r = .90$, from data correlation among the dependent variables between 0.82-0.87. Therefore, non-multicollinearity.

The correlation among all dependent variables, value Bartlett's Test of Sphericity (Chi-Square=14080.181, df=780, p=.000), showing enough correlation. As shown in Table 3.

Table 3

Multivariate and univariate measures for testing homoscedasticity and testing multicollinearity

Multivariate tests of homoscedasticity				
Box's Test of Equality of Covariance Matrices				
Box's M		111.552		
F		3.648		
df1		30		
df2		376682.984		
p-value		.000		
Univariate tests of homoscedasticity				
Levene's Test of Equality of Error Variances				
Variable	F	df1	df2	p-value
BTR	2.691	3	381	.046
PTE	.321	3	381	.810
ACT	.652	3	381	.582
STE	.565	3	381	.639
Testing correlation among the dependent variables				
Dimension	BTR	PTE	ACT	STE
BTR	1			
PTE	0.83	1		
ACT	0.88	0.83	1	
STE	0.83	0.82	0.87	1
Bartlett's Test of Sphericity Approx. Chi-Square=14080.181, df=780, p=.000				

3. Testing outliers

Cook's distance (D_i) was considered the single most representative measure of influence on the overall fit and it can also detect outlier [30]. In addition, it was a summary measure of the influence of a single case (observation) based on the total changes in all other residuals when the case is deleted from the estimation process. Cook's distances > 1.00 were removed from the analysis [31]. Data were verified a value less than 1 was found no data was found outlier shown in Figure 3.

Figure 3 Testing outliers of data

The Box's M test was statistically significant, showing that the assumption of equal dependent variables covariance matrices was violated, thus, the Pillai's trace was used to assessing the multivariate effect, Pillai's trace criterion should be used because more robust to departures from assumptions [27; 28]. Pillai's trace was argued to be the most robust statistic for general protection against departures from the multivariate normality and homogeneity of variance-covariance matrices [29]. With the use of Pillai's trace criterion, the linear combined dependent variables were statistically significant (Pillai's Trace=.125, $F(12,1140)=4.141$, $p=.000$), with small to moderate effect size (partial $h^2=.042$) and The power for the statistical tests was 1.000, indicating that the sample sizes and effect size were sufficient to ensure that the significant differences would be detected [32].

The main effect (area) on BTR, the results showed that there were statistically significant area differences with small to moderate effect size ($F(3,381)=6.631$, $p=.000$, partial $h^2=.05$) showed as Table 4. The Levene's test was significant ($F=2.691$, $df_1=3$, $df_2=381$, $p=.046$), therefore, not equal variance, for multiple comparisons used Dunnett T3 method found that area differences on center and east, and north and east showed as Table 5.

The main effect (area) on PTE and ACT, the results, showed that there were no statistically significant area differences.

The main effect (area) on STE, the results showed that there were statistically significant area differences with small to moderate effect size ($F(3,381)=4.525$, $p=.000$, partial $h^2=.034$) showed as Table 4. Levene's test was not significant ($F=.565$, $df_1=3$, $df_2=381$, $p=.639$), therefore, equal variance, for multiple comparisons used Bonferroni method found that area differences on center and north, north and east, and north and northeast showed as Table 5.

Table 4

Multivariate and univariate tests for area differences in teamwork competencies

Variables	Sum of Squares	df	Mean Square	F	p-value	Eta Squared	Observed Power
BTR	1098.546	3	366.182	6.631*	.000	.050	.973
PTE	258.416	3	86.139	2.526	.057	.020	.623
ACT	140.573	3	46.858	2.594	.052	.020	.636
STE	102.530	3	34.177	4.525*	.004	.034	.882
BTR $R^2=.050$ (Adjusted $R^2=.042$), PTE $R^2=.020$ (Adjusted $R^2=.012$), ACT $R^2=.020$ (Adjusted $R^2=.012$), STE $R^2=.034$ (Adjusted $R^2=.027$), Observed power computed using $\alpha=.05$, * $p<.05$							

Table 5

Multiple comparison for BTR and STE

BTR not equal variance used Dunnett T3 method					STE equal variance used Bonferroni method				
	Center	North	North east	East		Center	North	North east	East
Center	-				Center	-			
North	1.72	-			North	1.07*	-		
North east	0.59	2.31	-		North east	0.23	1.30*	-	
East	2.81*	4.54*	2.23	-	East	0.02	1.09*	.21	-
* $p<.05$									

4. The qualitative assessment of teamwork competencies

According to the quantitative assessment results, building a team relationship (BTR) and supporting a team (STE) was different. Therefore, we have been working to find an explanation of the importance of each factor through the student's perspective. The information that has been a qualitative assessment through interview, which data were analysed using thematic analysis. There were assessment criteria was the first priority of the student perspective reflects the reasons for the teamwork competencies factors shown in text below and Figure 4-5.

Reason support in building a team relationship:

"...Encouraging appreciation will give you more confidence to choose to appreciate because teamwork, no matter how it works, is unique and supports team members. For the next job, our friendship will not go away and will continue to do better..."

"...To be appreciated because teamwork, no matter what the outcome, shared responsibility is unique and supports our team friends. For the next job, our friendship will not go away and will continue to do better..."

"...When commenting on more opinions, we encourage you to collaborate with teammates, help each other, and work as a team..."

"...It's a good thing to talk to your friends in a group because you have to create a three-pliers and get along easily with your friends. If there's a good relationship, it's easier for everything to work out..."

"...Because of work, you have to know the people who work with us, which way they're good at it..."

"...Get to know your colleagues friendly. We have good knowledge and enjoy activities together..."

"...Building relationships is important for working in groups so that you can get to know your friends at different colleges and get to collaborate on the team because we can have better friendships..."

"...I'm going to make more friends. Because if we build, we should relate to each other to make us work well as a team..."

"...Everyone comes from different colleges, we all want to make friendships with other people easy to get into with friends..."

"...Cooperate with friends Cooperation is our first priority..."

"...Whether it's in a leadership role or a follow-up. Everyone has to listen to the opinions of their teammates to make different decisions, to be unanimous in the team..."

"...Cooperating may also create relationships where all team cooperation will form unity in the team, choosing to cooperate with our teammates because working together will make it easier to work..."

"...We should listen to our friends in the group, and they must be good listeners. Listen to your teammates' opinions..."

"...You should be open to listening to others because your friends' opinions are the right thing to do. We have to listen to the thoughts of the team, so we can get it done..."

"...Build relationships with team members before we get close because teamwork understands each other, helps each other through obstacles, we have to help each other, so team relationships are part of teamwork. Teamwork. We have to listen to each other's opinions. If you don't listen to your opinions, others don't call it teamwork..."

"...Listening to teammates creates harmony for the team so that they know what other

people think and help brainstorm ideas together so that they know what their teammates think because each person thinks differently..."

"...Let's get to know teamwork, help friends in everything. Make activities easier..."

"...I want to educate my friends and the benefits of living as we must be close when doing team activities. The atmosphere will be friendly..."

"...It is to dissolve the behavior with friends in order to do activities together, good relations with team members, good relations and good human relations..."

"...I believe it's important to encourage your friends or to yourself because we're going to do something full. With the power of us and our friends. That thing will be more efficient..."

"...Encourage teammates to cheer each other up during the event, so they can continue to be encouraged and fight..."

"...Give everyone power because we don't know what everyone's been through. It's not a counterweight..."

"...Help each other get the job done, cooperate with teammates..."

"...We probably can't do much unless there's anything we can do, we can help with what we can do..."

"...Because if we don't love each other, teamwork is impossible. Maintain good friendships so you can work as a team effectively..."

"...Like the way we know and be kind to each other, have good friendships. Maintain friendship, be kind and make sacrifices with friends. If we have a good friendship with the group, it will get the job done and go well..."

"...Because if we have good friendships, teamwork follows love, harmony. Loving each other is more fessy, because if we have a good friendship, teamwork follows a love of unity. More love..."

"...If we have unity in our team, we will succeed. Teamwork unity If unity is born within the portfolio, it will be a great success..."

"...Unity leads to success. It's important to work with unity. If you work together, the first thing you need is unity within the team, helping and solving problems..."

"...Teamwork requires cooperation. Listen to the team's comments and collaborate on important activities..."

"...Focus on activities with the people in the group. If we stay in the team and provide assistance, we can go through everything..."

"...Teamwork, because people are different. Working with people in different ways is therefore inevitable and there should be a good way to cope..."

"...Think teamwork. Even if you don't like each other, even if you just know each other, you have to be able to distinguish your work. When there is a job, it must be done together to get it done..."

"...It has to be done. The goal is the most important thing, so everyone in the team needs to look at the goals and do their best together..."

"...In order for that goal to be achieved, it must be targeted to know what we are doing..."

"...Be a good member of teamwork, cooperate fully with your teammates. Working with others requires the cooperation of colleagues. Is to coexist with others..."

"...Participate in activities to the fullest, teamwork to get the job done faster..."

"...Join us to support your teammates. If we behave as good members, express our opinions and beard, the opinions of others will make our team successful..."

"...Be a good listener and commentator. Take responsibility for the job, do what you do, do it, do it, do it all the time. If you behave badly, the team won't have peace of mind..."

"...The encouragement of the compliments gives confidence in teamwork..."

"...Collective responsibility creates support for the team and the next working friendship..."

"...Collaborating on teams, helping each other to succeed in the team..."

"...Talking to your friends in a group can help create harmony and grouping with friends. Having a good relationship will make it easier to work..."

"...Teamwork understands which team members are adept at working. Work known to bring joy and joy..."

"...Creating Working Relationships It's important to make the team successful. Make good friendships with each other..."

"...Cooperating is important, everyone needs to hear from fellow members for decision making. Cooperating will create harmony in the group, making work easier..."

"...Being open to listening to friends in the group, because people have different ideas, different ideas, knowledge, abilities, listening to the opinions of friends in the group can be successful..."

"...Building relationships with team members leads to success. Listening to teammates to build harmony and brainstorm ideas together..."

"...Know teamwork and be able to perform activities more easily..."

"...Building relationships makes team activities. A friendly atmosphere creates a melting behavior..."

"...Encouraging each other to do activities will be encouraging and strong..."

"...Helping each other will make it a success..."

"...Good friendships can make teamwork effective. It brings harmony, and love..."

"...Collaboration Mutual Assistance It will be able to get the job done well..."

"...Helping each other to do the tasks they have assigned will make it a success..."

"...Sharing goals will know what to do..."

"...Be a good member to support the team in time. If you don't have a team, you'll not have peace of mind..."

Reason support in supporting a team:

"...Teamwork support reduces conflicts..."

"...Supporting teamwork to strengthen teamwork..."

"...Teamwork helps to recognize self-role, help each other, make work better..."

"...Being open to listening to friends in the group, as there are many different ideas, knowledge and abilities, which support teamwork, will help reduce conflicts..."

"...The goal is the most important thing, so everyone in the team needs to look at the goal and do their best to achieve it. We have to set goals to know what we're doing. Supports reciprocal work..."

"...Supporting teamwork makes for smooth operation. No conflicts later..."

"...Supporting teamwork to be able to adapt as much as the situation..."

"...Supporting teamwork is teamwork, achieving goals..."

"...Team support is especially important because people have different ideas, different ideas, knowledge, abilities, and listening to the opinions of friends in the group can be successful. Building relationships with team members leads to success..."

"...To work with others requires the cooperation of colleagues, it is to coexist with others. Participate in activities to the fullest, teamwork to get the job done faster. Be a good member, join us to support your teammates..."

"...Teamwork Support within the team is very important, it requires cooperation, listening

to the team's comments and cooperating in activities that are important, behaving with potential before joining the event. If we stay in the team and provide assistance, we can go through everything..."

"...To strengthen teamwork from new teammates, introduce ways that friends don't know before work, goals need to be laid out. Always listen to friends, solve problems, help each other and review their work..."

"...Help us work as a team, let us know our roles and help each other. Reduce conflicts..."

Figure 4 Significant of building a team relationship (BTR)

Figure 5 Significant of supporting a team (STE)

Discussion

The teamwork competencies were appropriate for multi-dimension assessment, the findings may be due to teamwork performance, diverse factors, and deep correlations related with Nadal [10] said that teamwork competence is a multidimensional construct, McEwan & Beauchamp [9] said that teamwork is a multidimensional construct comprised of collaborative behaviors that take place before, during, and after team tasks, McEwan and Beauchamp [33] conceptualized the component of teamwork is complex, multidimensional, in addition, McEwan et al. [34] study in the development and psychometric properties of the multidimensional Assessment of teamwork in sport.

Building a team relationship and supporting a team were statistically significant area differences, this may be because the context of the area affects the building of relationships within the team, the culture in each area is different with the team as well as the distribution of points from high to very high level make a difference related to Lansdell [35] the working in teams with people of different nationalities and Backgrounds and Vakil [36] the various perspectives towards teamwork and leadership training across different regions.

Based on the qualitative assessment results, it is evident that the additional teamwork that has been studied will see teamwork performance as important. It has a broad, rather varied impact, building a team relationship comprised of nineteen-theme and supporting a team comprised six-theme. This may be because of the significant performance of teamwork to achieve the goals related to Zou and Ko [8]. For teams to succeed, students need to possess various teamwork skills including trust-building, communication, and conflict management, the Organisation for Economic Cooperation and Development [37] defines competence as "the ability to respond to the demands or carry out tasks successfully, and Carmenado, Rodríguez, and Gajardo [1] defines teamwork competence refers to a set of actions, strategies, procedures, and methodologies used by a group of people to achieve objectives and/or goals, and valuable for productivity and highly valued by organizations that need cooperation between their members to achieve their objectives [38].

For practical recommendation, the assessment of teamwork competencies should be design about indicators, criteria, and interpretation for teamwork competencies assessment that looks like multidimensionality and characteristics should be promoted consist of building a team relationship and supporting a team for students to lead to the success of work. For next research recommendation, teamwork competencies development programs should be created digitally and experimental research variables that influence teamwork competencies.

Conclusion

The quantitative assessment of teamwork competencies reflects to appropriate for multi-dimension assessment, and the qualitative assessments also support the explanation of teamwork competencies with multidimensional characteristics of students. The teamwork competencies were appropriate for multi-dimension assessment, the ratio between the Eigen value of factor 1 toward the Eigen value of factor 2 was equal to 1.078.

Teamwork competencies assessment results found that the dimensions: Building a team relationship (BTR) at high to a very high level, participation in a team exchange (PTE)

at a high level, adapting and creating a team atmosphere (ACT) at a very high level, and supporting a team (STE) high to a very high level. The main effect (area) on BTR and STE, the results showed that there were statistically significant area differences with small to moderate effect size, but on PTE and ACT, the results showed that there were no statistically significant area differences.

The student perspective reflects the reasons for the teamwork competencies found that significance of building a team relationship comprised nineteen-theme (Priority three: Make a success of the team, good working friendship, and it's easy to build harmony and grouping with friends) and significance of supporting a team comprised six-theme Priority three: Reduce conflicts, Strengthen teamwork, and Make it work better).

Acknowledgements

This research was supported the data by the students of high-level professional innovation scholarship. The authors thank for support for this research.

REFERENCES

1. Carmenado, I.D.L.R., Rodríguez, F.B., & Gajardo, F.G. (2012). Methodological proposal for teamwork evaluation in the field of project management training. *Procedia – Social and Behavioral Sciences*, 46, 1664–1672. doi: 10.1016/j.sbspro.2012.05.358
2. Salas, E., Sims, D.E., & Burke, C.S. (2005). Is there a “Big Five” in teamwork? *Small Group Research*, 36, 555–599.
3. Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., García-Peñalvo, F.J., Tovar-Caro, E., 2013. Competence gaps in software personnel: a multiorganizational study. *Computers in Human Behavior*, 29, 456–461.
4. Anderson, J.E., Ross, A.J., Lim, R., Kodate, N., Thompson, K., Jensen, H., & Cooney, K. (2019). Nursing teamwork in the care of older people: A mixed methods study. *Applied Ergonomics*, 80, 119–129. doi: 10.1016/j.apergo.2019.05.012
5. Fidalgo-Blanco, A., Sein-Echaluce, M.L., Francisco J. García-Peñalvo, F.J., & Conde, M.A. (2015). Using Learning Analytics to improve teamwork assessment. *Computers in Human Behavior*, 47, 149–156. doi: 10.1016/j.chb.2014.11.050
6. Rhee, J., Parent, D., & Basu, A. (2013). The influence of personality and ability on undergraduate teamwork and team performance. *Springer Plus*, 2:16. 1-14.
7. Tonso, K.L., (2006). Teams that work: campus culture, engineer identity, and social interactions. *Journal English Education*. 95 (1), 25–37.
8. Zou, T.X.P., and Ko, E.I. (2012). Teamwork development across the curriculum for chemical engineering students in Hong Kong: Processes, outcomes and lessons learned. *Education for Chemical Engineers*. 7, e105–e117. doi: 10.1016/j.ece.2012.04.003
9. McEwan, D., & Beauchamp, M. R. (2020). The Power of Groups In Youth Sport. Elsevier doi: 10.1016/B978-0-12-816336-8.00011-1
10. Nadal, C.T., Mañas, G.P., Bernadó, B.S., & Mora, C.A. (2015). Assessing teamwork competence. *Psicothema*. 27(4), 354-361. doi: 10.7334/psicothema2014.284
11. Olupeliyawa, A.M., Hughes, C., & Balasooriya, C.D. (2009). A review of the literature on teamwork competencies in healthcare practice and training: Implications for undergraduate medical education. *South East Asian Journal of Medical Education*. 3(2), 61-72.
12. Fidalgo-Blanco, A., Sein-Echaluce, M.L., Francisco J. García-Peñalvo, F.J., & Conde, M.A. (2015). Using Learning Analytics to improve teamwork assessment. *Computers in Human Behavior*, 47, 149–156. doi: 10.1016/j.chb.2014.11.050
13. Hull, L., Bicknell, C., Patel, K., Vyas, R., Herzeele, I.V., Sevdalis, N., & Rudarakanchana, N. (2016). Content Validation and Evaluation of an Endovascular Teamwork Assessment Tool. *European journal Vascular Endovascular Surgery*, 52, 11-20. doi: 10.1016/j.ejvs.2015.12.044
14. Salas, E. & Cannon-Bowers, J.A. (2001). Teamwork and Team Training. *International Encyclopedia of the Social & Behavioral Sciences*. Elsevier Science Ltd.
15. UN (2014). United Nations Learning and development. DM/OHRM. Available at: <http://www.un.org/staffdevelopment/viewPage.asp?selMenu=unc.asp> (accessed 20 October 2021).
16. Torrelles, C. (2011). *Eina d'avaluació de la competència de treball en equip* [Teamwork competence assessment tool]. Tesis doctoral, Facultat de Ciències de l'Educació, Universitat de Lleida, Lleida, España.

17. Banta, T.W., & Palomba, C.A. (2015). *Assessment essentials: Planning, implementing, and improving assessment in higher education*. San Francisco, CA: John Wiley & Sons, Inc.
18. Brown, D. H. (1990). *Language assessment: Principles and classroom practices*. London: Longman.
19. Apple, D.K. (2003). Assessment Methodology. *Pacific Crest*. (630), 737-1067.
20. Banta, T.W. (2002). Characteristics of effective outcomes assessment: Foundations and examples. In T.W. Banta & Associates (Eds.), *Building scholarship of assessment* (pp. 261 – 283). San Francisco, CA: Jossey-Bass.
21. Chianchana, C., & Na Wichian, S. (2016). Assessment of Performance Competency in the Organization: Dimensionality Oriented Assessment. *Polish Journal of Management Studies*. 13(2), 27-35.
22. Tashakkori, A, & Creswell, J.W. (2007) Editorial: the new era of mixed methods. *Journal Mixed Methods Research*. 1, 3–7.
23. Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
24. Bartlett, J.E., Kotrlik, J.W., & Higgins, C.C. (2001). Organizational research: Determining appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal*. 19(1), 43-50.
25. Patil, R. (2018). *Community Medicine: Practical Manual*. Relx: Elsevier.
26. Morizot J., Ainsworth A.T., Reise S. 2007, Toward modern psychometrics: Application of item response theory models. [in:] *Handbook of research methods in personality psychology*, New York, Guilford Press.
27. Herzallah, M.M., Khodour, H.Y., Taha, A.B., Elmashala, A.M., Mousa, H.N., Taha, M.B, Ghanim, Z., Sehwal, M.M., Misk, A.J., Balsdon, T., Moustafa, A.A., Myers, C.E., & Gluck, M.A. (2017). Depression Reduces Accuracy While Parkinsonism Slows Response Time for Processing Positive Feedback in Patients with Parkinson's Disease with Comorbid Major Depressive Disorder Tested on a Probabilistic Category-Learning Task. *Frontiers in Psychiatry*. 8, 1-12. doi: 10.3389/fpsy.2017.00084
28. Sywelem, M., Dahawy, B., and Wang, C.H. (2010). An Examination of Learning Style Preferences among Egyptian University Students. *Institute for Learning Styles Journal*, 1 (Spring), 16-23.
29. Tabachnick, B. G., & Fidell, L. S. (2012). *Using Multivariate Statistics* (6th ed.). New York Allyn and Bacon.
30. Cook, R. D. (1977). Detection of influential observations in linear regression. *Technometrics*, 19, 15-18.
31. Cook, R. D., & Weisberg, S. (1982). *Residuals and influence in regression*. New York: Chapman and Hall.
32. Hair, J.F., Anderson, R.E., Tatham, R.L., & Black, W.C. (2010). *Multivariate data analysis: A global perspective*. (7th ed.). Pearson education.
33. McEwan, D., & Beauchamp, M. R. (2014). Teamwork in sport: A theoretical and integrative review. *International Review of Sport and Exercise Psychology*, 7, 229-250. doi: 10.1080/1750984X.2014.932423
34. McEwan, D., Zumbo, B.D., Eys, M.A., & Beauchamp, M.R. (2018). The development and psychometric properties of the multidimensional Assessment of teamwork in sport (MATS). *Journal of Sport & Exercise Psychology*. 40(2), 1-13. doi: 10.1123/jsep.2017-0193
35. Lansdell, S. (2016). *Teamwork across cultures*. CSc. 238 Spring. Available at: <http://athena.ecs.csus.edu/~buckley/CSc238/Teamwork%20across%20cultures.pdf> (accessed 20 October 2021)
36. Vakil, K.S. (2019). Approaches to Teamwork and Leadership Training in Maritime Education and Training institutions: A comparative analysis of the perspectives of seafarers towards teamwork and leadership across different regions. Dissertation Master of Science: MARITIME AFFAIRS. Available at: https://commons.wmu.se/all_dissertations (accessed 20 October 2021)
37. Organisation for Economic Cooperation and Development. (2005). The definition and selection of key competencies. Executive Summary. Paris: OECD.
38. Iglesias-Pradas, S., Ruiz-de-Azcárate, C., & Agudo-Peregrina, Á. F. (2015). Assessing the suitability of student interactions from Moodle data logs as predictors of cross-curricular competencies. *Computers in Human Behavior*, 47, 81–89.

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