The Efficacy of Employing Problem-Based Learning (PBL) Approach as a Method of Facilitating Students' Achievement

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ABSTRACT The goal of this study to expand a version to develop a model to examine the effectiveness of using a problem based learning (PBL) approach as a method of facilitating students' achievement, and incorporating the literature of PBL approach for educational purpose. Therefore, this research hypothesizes that use PBL approach effect on students' learning motivation, students 'thinking, students' learning difficulties on learning, students' learning style, and students' learning skills that in turn, affect students' achievements. To achieve the research goal, the research employed a questionnaire as the main data collection method and dispensed it to 88 university students all of whom use PBL approach. The findings were obtained via a quantitative research method, Structural Equation Modeling (SEM). This research found a significant relationship between PBL approach with students' learning motivation, students 'thinking, students' learning difficulties on learning, students' learning style, and students' learning skills that in turn, affect students' achievements. Hence, the research indicates that PBL approach enhances the students' achievements, and allows to sharing knowledge, information and discussions, and therefore, we recommend students to utilize PBL approach for education purpose and should have encouraged them through lecturers at universities.

INDEX TERMS Problem based learning approach, structural equation modeling (SEM), students' achievements.

I. INTRODUCTION

Despite the role teacher plays in conventional classrooms, his/her function in problem based learning (PBL) method classes is to facilitate pupils. That is, teachers are not supposed to prepare actual information for students, neither should they guide them towards thinking correctly. They should encourage students' thinking by asking questions, which helps them to handle the problem consciously, instead. PBL, as a learner-centered approach, is distinctly advantageous in comparison with traditional teacher-centered didactic technique as a matter of the fact that it promotes a long-time information retention, which results in contextual learning as well as skills and tendencies development generically [1]. According to several studies, using online equipment in teaching and learning processes provides only technical support, rather than educational one [2], [3] and [4]. Technical support is essential for an effective learning

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environment [5], [6]. However, it is also crucial to integrate active learning methods, for instance problem based learning, into these mixed learning conditions to derive greater benefits [7], [8]. Therefore, as this research aims at, providing a clear vision of the necessity of applying active approaches in interactive learning conditions, the use of problem based learning method in blended learning environments is scrutinized. In addition, problem based learning is capable of providing a convenient learning space with blending application of problem based learning and technology of information communication [7]. Nevertheless, experimental study on favorable outcome of problem based learning is in the preliminary stage yet, and revealing more clear evidence demands further researches [9]. Hence, the purpose of this research is to investigate the influence of the problem based learning technique on improvement of students' achievements. Opportunity understanding of Students for developing their skills as well as thinking within the problem based learning method has also been explored.
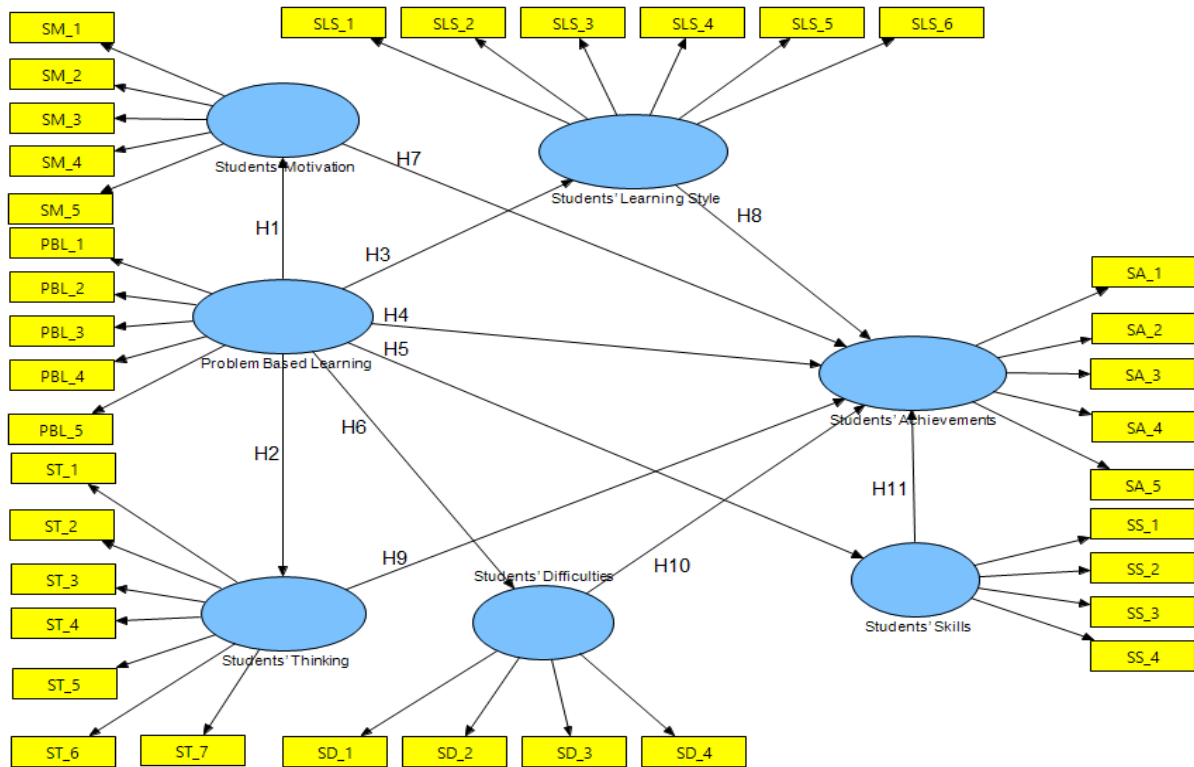
FIGURE 1. Research model.

A. THE PROBLEM BASED LEARNING CONCEPT

There is a background for problem based learning in education. Its bases back to John Dewey's beliefs at the early twentieth century. According to Delisle [10] Dewey opined that 'teachers should ask students to explore and create using their natural instincts' (p. 1). An afterward, Barrows and Tamblyn [11] used problem based learning in medical education in the late 1960's for the first time to be substituted for traditional methods, as a successful strategy in instructing medical students. Since then, it has been employed worldwide in countries such as Australia, Canada, the USA, and also many countries in the Middle East [12]. Furthermore, as Schwartz, Mennin and Webb stated [13], many branches of knowledge, such as education, health sciences, business, mathematics and law has implemented problem based learning in higher education. This approach has been defined several times. As far as experiential [8] and meaningful learning [14] is concerned, problem based learning is defined as 'the learning resulting from trying to perceive or resolve a problem' [11]. Additionally, Russell [15] described it as 'an educational technique which tries to solve complex problems that students would face in the future by asking them to cope with complicated and ill-structured difficulties of real world'(p. 175). In other authors' definition, on the contrary, the method of problem based learning is considered as both a model and a learning idea [12]. Problem based learning based on his experience as one of the problem based learning originators at McMaster University Medical School in Canada [16].

The precious strength point of problem based learning environment is assisting students to peruse and possess several learning, cognitive, social and personal abilities. Problem based learning role by teachers and practitioners receives International recognition [17]. There would be no classroom improvement without appropriate trainings and practices by a teacher even if computer exposure is provided [18]. Thus, according to [7], [19], high satisfaction level in students' learning through integrating proper learning methods such as problem based learning, with blended learning environments can be achieved. Therefore, desired learning results are obtained using problem based learning supporting the learning environment. Moreover, applying active learning approaches with web-based gadgets is supported by theories and practices [12], [16], [20].

II. THEORETICAL MODEL

Seven major dimensions of problem based learning (PBL) have been identified in this research, which are: students' learning motivation (SM); students' learning thinking (ST); students' learning style (SLS); students' learning difficulties (SD); students' learning skills (SS); and students' achievements (SA). See figure 1.

A. PROBLEM BASED LEARNING (PBL)

Problem based learning is a comprehensive approach in education, instead of an ordinary method of teaching and learning, which includes four essential constituents:

design of curriculum, tutorials, compatible evaluations and the philosophical principles, which are the cornerstone of problem based learning [21]. Barrows [16] believed that problem based learning has six key dimensions, including: hypothetical deductive reasoning; growing cognitive flexibility; creating permanent self-directed learning skills; developing skills of cooperation; student-centred; fostering habits of self-reflection and self-appraisal. It could be perceived from aforementioned dimensions that the approach is comprehensive [21], [22], involving several learning methods, such as collaboration-based and self-directed learning. This holistic approach aids individuals to improve their capabilities to foster new lifetime skills, such as critical thinking, problem solving and independent learning [20]. Based on the above discussion, following hypotheses were proposed:

H1: PBL is positively related to SM.
H2: PBL is positively related to ST.
H3: PBL is positively related to SLS.
H4: PBL is positively related to SD.
H5: PBL is positively related to SS.
H6: PBL is positively related to SA.

B. STUDENTS' LEARNING MOTIVATION (SM)

Motivation is defined as energizing, directing and sustaining behavior element which makes it possible for students to participate, put themselves in a specific direction, and continue exploring themselves [23], [24]. Intrinsic motivation is of utmost importance in students' learning in blended learning, and students who are motivated intrinsically are more prone to finish tasks, and perform better in comparison with the extrinsically motivated pupils. Significance of motivation has been emphasised in several studies owing to its influences on learning performance [25], [26]. Every learner has motivation inside as a deep-rooted intention which has a purpose or direction. Bandura [27] proposed that students are proactive in dealing with the environment because of their achievement. Pupil's awareness of their goals and values would lead to a rise in students' learning motivation [28]. Intrinsic motivation is related to academic achievement and achievement aims positively [29].hence, one hypothesis is proposed to study the students' learning motivation with students' achievements: *H7: SM is positively related to SA.*

C. STUDENTS' LEARNING THINKING (ST)

Students' thinking was defined by Ennis [30] as "the logical and reflexive thinking which concentrates on deciding upon beliefs and actions" (p. 179). Strategies of teaching which develop students thinking skills, especially logic skills, which are reflective, deliberative, analytical, and procedural, are connected to the development of intellectual problem based learning and students' thinking skills [31]. Moreover, influence of students' thinking on the students' academic performance has resulted in research improvement on the topic [32]. A considerable number of studies has done on critical thinking skills owing to students' critical thinking importance [33]. Therefore, to examine the students' learning

thinking with students' achievement, one hypothesis is developed: *H8: ST is undoubtedly related to SA.*

D. STUDENTS' LEARNING STYLE (SLS)

The way students interact with others, obtain knowledge, or respond to motives in the learning environments is described by learning styles [34]. Several theories have been suggested by educational field researchers on students' learning style variety [35]. There are plenty of students with academic achievement who are ready to change their skills of study and gain the benefits of their learning strategies [36]. Generally, a learning style indicates the preferred learning method of a person [37], which is often connected to one's performances of learning and therefore is capable of predicting academic success. Hence, understanding students' learning styles is indispensable for instructors, especially with new technologies gadgets advent. Despite many studies have done on social media tools application in education [38]–[41], the impact of learning styles on students' who are instructed using problem based learning has not been studied yet. Several factors affect students' learning styles. For example, gender, age, academic achievement, and culture [42]. Thus, to examine the students learning style with students' achievement, one hypothesis is proposed: *H9: SLS is positively related to SA.*

E. STUDENTS' LEARNING DIFFICULTIES (SD)

Students' learning difficulties are related to a major portion of students who have different educational requirements [43]. Having mediocre or more than average intelligence with deficiency in the cognitive processing which affects their learning and achievement, recognises Students' learning difficulties [44], [45]. Identifying these difficulties, which can be lifetime, usually takes place after disappointing academic performance and following the eradication of other potential reasons of underachievement, such as vision, hearing or intellectual disorders, or factors related to the student's environment [44]. For many kinds of students leaving high school and going to university is a challenge, especially for those with learning difficulties [46]. Similarly, first- and second-year university students who had learning disabilities showed a unique variance in their goal of persisting at university [47]. Students' psychological development is affected by learning difficulties which can form academic motivation in plenty of ways [48]. Hence, to examine the students' learning difficulties with students' achievement, one hypothesis is developed: *H10: SD is positively related to SA.*

F. STUDENTS' LEARNING SKILLS (SS)

Several different replaceable terms associated with students' skills, such as "transferable skills" [49], and "generic skills" [50], have been investigated in former studies. Generally, "personality features, purposes, character, incentives, and priorities, which are credited in the universities, schools, and other areas" describe these skills [51]. Moreover, skills in the Information Communication Technology (ICT) system

include "interplay, articulation and interpersonal skills" [52]. Understanding the necessity of relation between learning content and skills, which must be clearly embedded in the curriculum disciplines, by teachers and tutorial designers is important [53]. afterwards, students need social skills to learn cooperatively instead of competitively in a self-directed and valid online learning environment [54] as a matter of the fact that students might never meet each other face to face but only through online communications such as emails and the Learning Management System (LMS) and social media [55], [56]. Recently, it is found by a study from Norway that even the frequency of using technology in schools negatively correlates with the self-reported digital skills of students [57]. Thus, to examine the students' learning skills with students' achievement, one hypothesis is developed: *H11: SS is positively related to SA.*

G. STUDENTS' ACHIEVEMENTS

Based on several experiential studies, problem based learning is an efficient learning method which helps improving academic achievement [58], provides long-term information keeping [14], [58], develops problem solving skills [59] and fosters critical thinking [60], [61]. This approach also has a positive influence on motivation towards the course, compared to conventional method [62]. The impacts of problem based learning on outcome of the students, such as cognitive and affective skills, were inspected by various meta-analysis or synthesis studies [63], [64]. On the other hand, facing difficulties in hypothesizing and dealing with obstacles or getting bored with long-term problem based learning activities is likely for students and especially pupils with disappointing results may have a difficulty in internalizing the problem cases [14]. Therefore, overcoming these difficulties and enhancing students' achievements could be achieved by supporting problem based learning with technology. The academic achievement of pupils taught by using conventional methods and problem based learning technique were compared by Syafii and Yasin's [65]. Alignment of the problem based learning module with the structure and essence of the problem based learning model was not clear, which is explained by Barrows and Tamblyn [11], [66]. In particular, they found out that significant higher academic results were achieved by the students who were taught physics concepts through problem based learning in compare to their peers who were taught by using lecture based approach. Secondary economics education and a potential effect of problem based learning on student achievement were studied by Finkelstein and Hanson [67] and Maxwell *et al.* [68]. They concluded that the problem based learning approach to teaching was generally more effective in comparison with traditional methods as far as developing students' content knowledge and their problem-solving skills are concerned.

III. RESEARCH METHODOLOGY

The use the problem based learning has been encouraged by many universities including King Faisal University (KFU).

Therefore, the research aims at developing a model of measurement students' achievements through an empirical investigation on problem based learning. The problem based learning was measure via five factors which are: students' learning motivation; students' learning thinking; students' learning style; students' learning difficulties; and students' learning skills. Hence, the questionnaires involved were distributed among students using problem based learning as a quantitative approach. The participants of the current study were undergraduate students who were users of problem based learning. Likert scale of 5- point was utilized in the current study to measure students' rating of the different items "strongly disagree (1), disagree (2), undecided (3), agree (4), strongly agree (5)". The questionnaire comprises of two main sets of factors. One of these sets comprises the factors of independent factors that include problem based learning; students' learning motivation; students' learning thinking; students' learning style; students' learning difficulties; and students' learning skills, the second the dependent factor of model is students' achievements. 88 questionnaires were entered and tabulated to Statistical Package for the Social Sciences (SPSS), SPSS was the main tool used to analyse the responses of the students to the different questionnaire items. In particular, this study utilized the Structural Equation Modeling (SEM- Smart-PLS) for the purpose of analysis. Based on the recommendation by Hair *et al.* [69], SEM- Smart-PLS was conducted in two main phases. The first phase aimed at calculating the construct, converge and discriminate the validities of the measurement model while the second aimed at examining of the structure model.

A. MEASUREMENT INSTRUMENTS

The main purpose of adapting the constructs items was to achieve a satisfactory result regarding content validity. The survey comprises of two main sections. The first section was designed to collect the students' demographic information such as gender and age as well as information about the respondents' frequency of using problem based learning to enhance students' achievements. The second part adapted the factors as following: problem based learning considered five items was adapted from [70], students' learning motivation considered five items was adapted from [71]; students' learning thinking considered seven items was adapted from [72]; students' learning style considered six items was adapted from [73]; students' learning difficulties considered four items was adapted from [71]; students' learning skills considered four items was adapted from [74], and students' achievements considered five items was adapted from [75], [76].

IV. RESULT AND ANALYSIS

The reliability of Cronbach's Alpha was analysed the factors as following: problem based learning (0.913), students' learning motivation (0.817); students' learning thinking (0.921); students' learning style (0.892); students' learning difficulties (0.907); students' learning skills (0.898), and students'

achievements (0.931). Three criteria were used for the purpose of evaluating the discriminant validity (DV). In particular, these criteria were index among variables, the average variance extracted (AVE) value of each construct and square of (AVE) of every single construct. The resulting value first should be under 0.80 based on the recommendations by [69], the value of the second must be 0.50 or above and the value of the third criteria should be above the inter construct correlations (IC) connected with the factor [69]. According to [69], the resulting values of Cronbach's Alpha (CA) and composite reliability (CR) are expected and should be ≥ 0.70 while both of the factor loading (FL) and crematory factor analysis (CFA) values should be equal to or above 0.70.

A. MEASUREMENT MODEL AND INSTRUMENTATION
The use of Partial Least Square was the first step in the model's legitimacy and dependability assertion. Through the use of Basic Equations Modeling (PLS-SEM) and Smart PLS 3.0, previous related theories were examined and the integrity fitness of the current model was checked. Similarly, a number of things were determined such as the legitimacy build that ranges the loadings of components; the composite unwavering quality, Cronbach's alpha, and the merging legitimacy. At this point, the study also utilized standard test in order to affirm discriminant legitimacy following the recommendations by [77].

B. CONSTRUCT VALIDITY OF THE MEASUREMENTS
The level to which the things used to measure components is defined as Develop legitimacy. It can suitably calculate the idea they were meant to quantify [69]. All of the things used to measure the develops should pile essentially to their individual develops rather than different builds. This was certain by having an orderly audit of writing in the mission to deliver things that have as of now been set up and tried by earlier writers. As for component analysis, it was ensured that things get to be named to their develops as they expressed high loadings on them which stood out from several develops (See Table 1).

C. CONVERGENT VALIDITY OF THE MEASUREMENTS
The composite reliability values differed from 0.982181 to 0.967698 and they are everywhere throughout the prescribed cut-off estimation of 0.70, with Cronbach Alpha values contrasting from 0.978733 to 0.957515, over the prescribed cut-off estimation of 0.60. In addition, the normal change removed (AVE) values contrasted from 0.909484 to 0.857072 (all surpassed the cut-off estimation of 0.5), with critical element loadings surpassing 0.50. These qualities all went over the prescribed an incentive by Hair *et al.* [69] and Fornell and Larcker [77]. The CFA results of the measurement model are presented in Table 2 below.

D. DISCRIMINANT VALIDITY OF MEASURES
The calculation of discriminant legitimacy aims at measuring how a certain idea along with its markers can be

different from another idea along with its pointers [78]. The discriminant legitimacy for the builds is supported by the results of this study as the AVE is found to be above 0.50 which is critical at p = 0.001 [77]. In such manner, Hair *et al.* [69] stated that the relationships between things in two develop should not exceed the square base of the normal fluctuation shared by solitary developed things (See Table 3).

E. ANALYSIS OF THE STRUCTURAL MODEL
Taking after the assurance of the integrity of the demonstrated estimation, the following stride illustrates the testing of the estimated relations among the figures. Smart PLS 3.0 was used at this point where the model was examined through calculation using the PLS. then; the coefficient figures were calculated and then illustrated in Figure 2. Figures 3 what's more, show the theories on table 4.

Regarding the first hypothesis, the relationship between problem based learning and students' learning motivation ($\beta = 0.979$, t = 259.26, p < 0.001). So, first hypothesis was significant and supported. The second proposition is positive too, significant and supported, as the analysis indicates a relationship between problem based learning and students' learning thinking ($\beta = 0.887$, t = 36.55, p < 0.001). The next hypothesis is relationship between problem based learning and students' learning style ($\beta = 0.972$, t = 217.25, p < 0.001). Thus, third hypothesis was significant and supported. The next hypothesis number four is a positive and supported, as the analysis also indicates a relationship between problem based learning and students' achievements ($\beta = 0.396$, t = 57.88, p < 0.001). Moreover, next hypothesis five is also positive and supported, as a relationship exists between problem based learning and students' learning skills ($\beta = 0.941$, t = 96.65, p < 0.001). Nonetheless, based to the relationship problem based learning and students' learning difficulties ($\beta = 0.954$, t = 114.56, p < 0.001). Hence, the results a positive as well as a significant relation as stated in the 6th hypothesis. Also, the 7th hypothesis is also supported as the relation between students' learning motivation and students' achievements ($\beta = 0.296$, t = 2.705, p < 0.001). In addition, the positive and significant relation found between students' learning style and students' achievements provides a strong support for the 8th hypothesis as the results came out as ($\beta = 0.237$, t = 1.756, p < 0.001). Students' learning thinking and students' achievements appeared to be closely and significantly at ($\beta = 0.361$, t = 3.640, p < 0.001). This provides a strong support for the 9th hypothesis. Similarly, the 10th hypothesis was also supported as the relations between students' learning difficulties and students' achievements at ($\beta = 0.276$, t = 3.006, p < 0.001). Finally, the 11th hypothesis tested the relationship between students' learning skills and students' achievements was significant and supported at ($\beta = 0.229$, t = 1.675, p < 0.001). All hypotheses goes in line with some of the previous related research [22], [26], [31], [57]–[59].

TABLE 1. Loading and cross-loadings of the items.

Factors	Code	PBL	SA	SD	SLS	SM	SS	ST
Problem Based Learning	PBL1	0.946346	0.874951	0.903571	0.896631	0.898456	0.886434	0.881792
	PBL2	0.924238	0.837021	0.852064	0.886356	0.926241	0.843625	0.757612
	PBL3	0.944842	0.865051	0.880771	0.927006	0.936632	0.890431	0.813260
	PBL4	0.947792	0.904209	0.928536	0.934236	0.918340	0.924508	0.902410
	PBL5	0.963179	0.894425	0.942259	0.951538	0.950221	0.905007	0.836161
Students' Achievements	SA1	0.923394	0.936446	0.921014	0.941403	0.928782	0.914456	0.849079
	SA2	0.840773	0.952586	0.901377	0.895797	0.866414	0.907317	0.885319
	SA3	0.779546	0.918132	0.811264	0.814653	0.811542	0.891101	0.908493
	SA4	0.884722	0.954134	0.910382	0.887022	0.890295	0.918166	0.905171
	SA5	0.917227	0.933514	0.916051	0.938347	0.907297	0.933689	0.911398
Students' learning difficulties	SD1	0.920353	0.932071	0.973403	0.957324	0.924011	0.917797	0.853741
	SD2	0.908856	0.898834	0.966155	0.924225	0.891874	0.891117	0.859163
	SD3	0.908357	0.879581	0.937013	0.927656	0.919454	0.844124	0.745562
	SD4	0.902221	0.914274	0.937538	0.921223	0.894056	0.938013	0.931223
Students' Learning Style	SLS1	0.914620	0.939812	0.929864	0.950885	0.931219	0.944380	0.910634
	SLS2	0.895489	0.842827	0.870231	0.906010	0.928450	0.849092	0.743374
	SLS3	0.881551	0.929996	0.910548	0.925917	0.911359	0.917617	0.859570
	SLS4	0.914592	0.884530	0.913553	0.931884	0.888370	0.885078	0.862357
	SLS5	0.935562	0.914029	0.924868	0.963265	0.925389	0.905262	0.847693
	SLS6	0.900454	0.822084	0.923306	0.916018	0.875462	0.834739	0.769003
Students' learning motivation	SM1	0.908547	0.839419	0.838044	0.894862	0.919632	0.857744	0.783908
	SM2	0.929810	0.934671	0.926752	0.953602	0.966616	0.937747	0.872481
	SM3	0.827032	0.845533	0.848099	0.850370	0.884862	0.808005	0.754440
	SM4	0.924793	0.906745	0.901762	0.908829	0.920522	0.934570	0.893532
	SM5	0.939482	0.812985	0.886458	0.906211	0.935388	0.836169	0.757076
Students' learning skills	SS1	0.935563	0.924891	0.919906	0.928806	0.938530	0.960948	0.915720
	SS2	0.911836	0.913232	0.899476	0.926555	0.909731	0.920630	0.866776
	SS3	0.814520	0.884146	0.807976	0.814765	0.801952	0.928431	0.934103
	SS4	0.881766	0.939576	0.915248	0.920293	0.909759	0.957018	0.914394
Students' learning thinking	ST1	0.931834	0.933091	0.891678	0.917410	0.928416	0.955140	0.940409
	ST2	0.763826	0.877997	0.832864	0.796750	0.757481	0.837588	0.901081
	ST3	0.838657	0.900161	0.832499	0.829823	0.815034	0.914052	0.970428
	ST4	0.745882	0.834742	0.767360	0.778276	0.753140	0.860305	0.907596
	ST5	0.898474	0.933734	0.883926	0.903298	0.898698	0.957702	0.961135
	ST6	0.809599	0.864221	0.775195	0.793990	0.786352	0.882632	0.947896
	ST7	0.845199	0.910050	0.866652	0.857410	0.838075	0.931826	0.963142

F. DESCRIPTIVE AND ANALYSIS OF FACTORS

The result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' learning motivation for learning. Therefore, "this research defines problem based learning approach as the degree where a students' learning motivation for learning that in turn, effect students' achievements". These results are consistent with [24]–[26], who argued that problem based learning approach was useful on students' learning motivation for learning. See Figure 4.

Also, the result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' learning thinking for learning. Therefore, "this research defines problem based learning approach as the degree where a students' learning thinking for learning that in turn, effect students' achievements". These results are consistent with [31], [32], who argued that problem based learning approach was useful on students' learning thinking for learning. See Figure 5.

Moreover, the result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' learning style. Therefore, "this research defines problem based learning approach as the degree where a students' learning style that in turn, effect students' achievements". These results are consistent with [36], [38], [79], [80], who argued that problem based

TABLE 2. Convergent validity.

Factors	Code	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE	R Square
Problem Based Learning	PBL1	0.946346	0.970225	0.976762	0.893707	0.000000
	PBL2	0.924238				
	PBL3	0.944842				
	PBL4	0.947792				
	PBL5	0.963179				
Students' Achievements	SA1	0.936446	0.966443	0.973893	0.881828	0.967382
	SA2	0.952586				
	SA3	0.918132				
	SA4	0.954134				
	SA5	0.933514				
Students' learning difficulties	SD1	0.973403	0.966718	0.975716	0.909484	0.910516
	SD2	0.966155				
	SD3	0.937013				
	SD4	0.937538				
Students' Learning Style	SLS1	0.950885	0.969919	0.975611	0.869622	0.946024
	SLS2	0.906010				
	SLS3	0.925917				
	SLS4	0.931884				
	SLS5	0.963265				
	SLS6	0.916018				
Students' learning motivation	SM1	0.919632	0.958087	0.967698	0.857072	0.959129
	SM2	0.966616				
	SM3	0.884862				
	SM4	0.920522				
	SM5	0.935388				
Students' learning skills	SS1	0.960948	0.957515	0.969187	0.887212	0.887306
	SS2	0.920630				
	SS3	0.928431				
	SS4	0.957018				
Students' learning thinking	ST1	0.940409	0.978733	0.982181	0.887387	0.787964
	ST2	0.901081				
	ST3	0.970428				
	ST4	0.907596				
	ST5	0.961135				
	ST6	0.947896				
	ST7	0.963142				

learning approach was useful on students' learning style. See Figure 6.

Furthermore, the result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' learning difficulties for learning. Therefore, ''this research defines problem based learning approach as the degree where a students' learning difficulties for learning that in turn, effect students' achievements''. These results are consistent with [44], [45], [48], who argued that problem based learning approach was useful on students' learning difficulties for learning. See Figure 7.

Additionally, the result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' learning skills for learning. Therefore, ''this research defines problem based learning approach as the degree where a students' learning skills for learning that in turn, effect students' achievements''. These results are consistent with [49], [53], who argued that problem based learning approach was useful on students' learning skills for learning. See Figure 8.

As well, the result shows that the majority of students somewhat agree and strongly agree that problem based

TABLE 3. Latent variable correlations.

|	PBL	SA	SD	SLS	SM	SS	ST
Problem Based Learning	1.000000						
Students' Achievements	0.926165	1.000000					
Students' learning difficulties	0.954210	0.950462	1.000000				
Students' Learning Style	0.972637	0.954125	0.978068	1.000000			
Students' learning motivation	0.979351	0.938467	0.951480	0.975920	1.000000		
Students' learning skills	0.941969	0.972365	0.941705	0.954475	0.946583	1.000000	
Students' learning thinking	0.887673	0.949758	0.889023	0.893578	0.879124	0.963114	1.000000
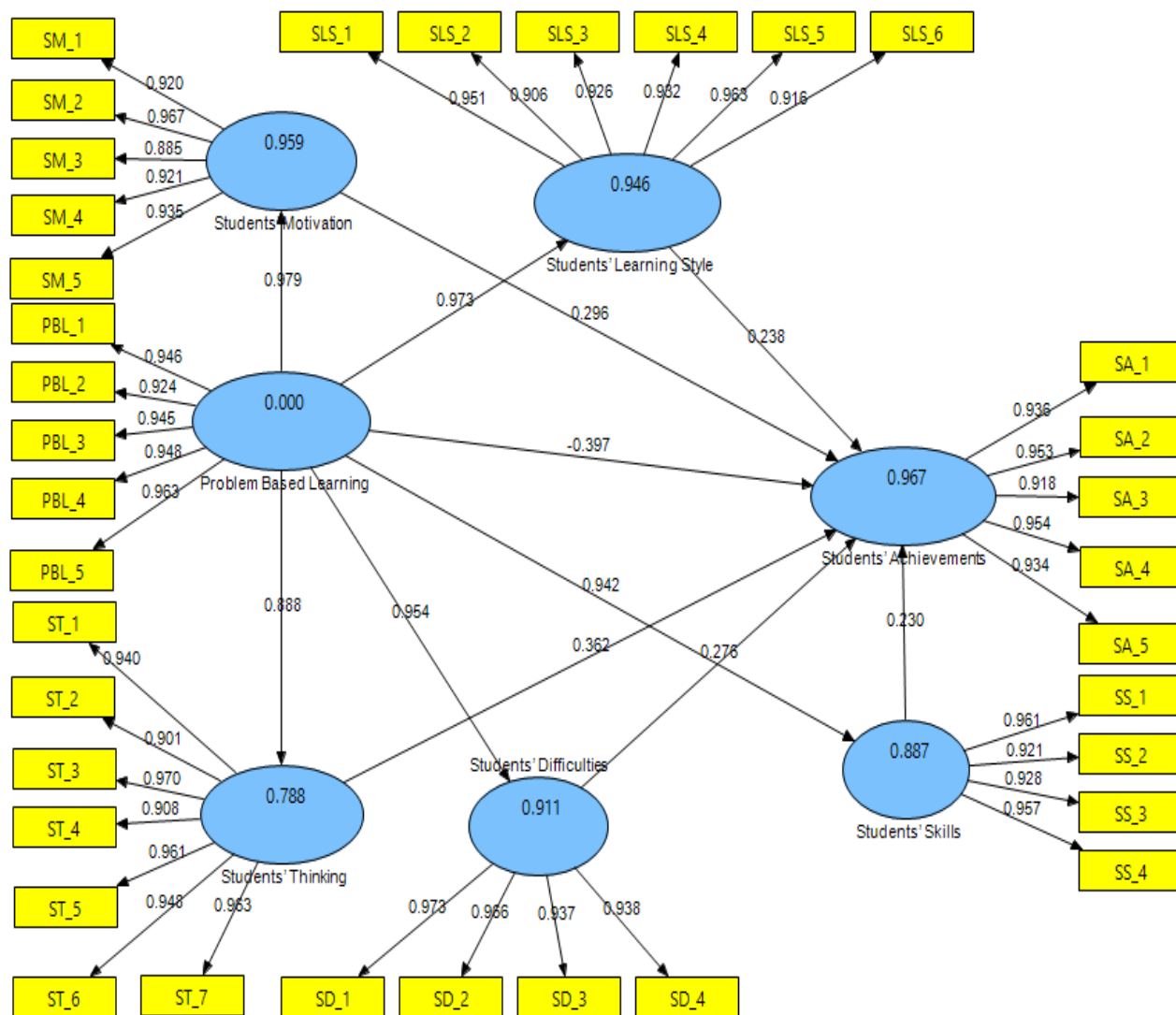
FIGURE 2. Path Coefficients Results

FIGURE 2. Path coefficients results.

learning approach was useful for learning. Therefore, "this research defines problem based learning approach as the degree where a students' learning in the classroom that in turn, effect students' achievements". These results are consistent with [14], [21], [22], who argued that problem based learning approach was useful for learning. See Figure 9.
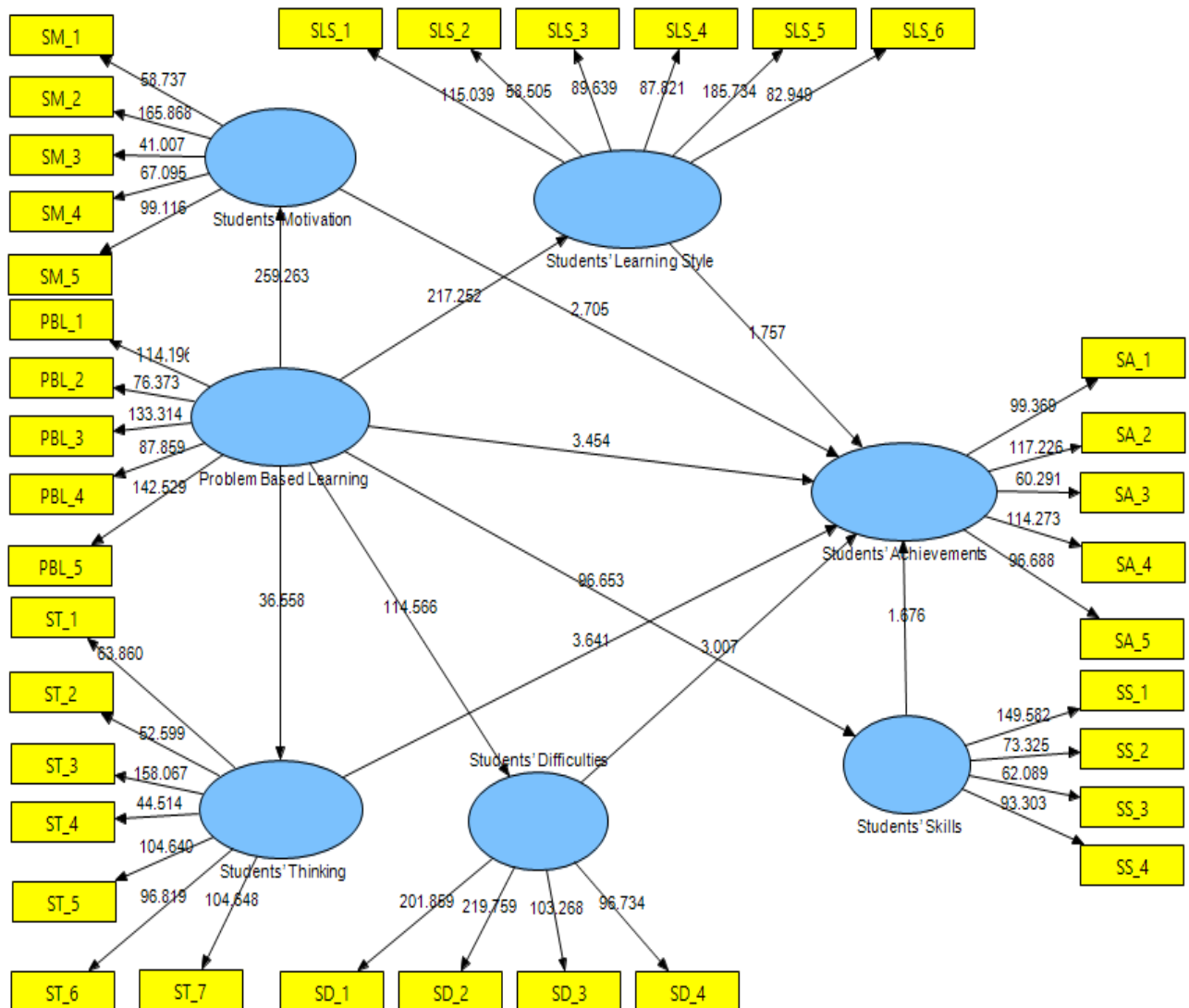
FIGURE 3. Path coefficients T values.

TABLE 4. Hypotheses testing.

H	Independent	Relationship	Dependent	Path coefficient	Standard. E	T Value	Result
1	PBL	⟶	MO	0.979	0.0037	259.26	Acceptable
2	PBL	⟶	ST	0.887	0.0242	36.55	Acceptable
3	PBL	⟶	SLS	0.972	0.0044	217.25	Acceptable
4	PBL	⟶	SA	0.396	0.1149	57.88	Acceptable
5	PBL	⟶	SS	0.941	0.0097	96.65	Acceptable
6	PBL	⟶	SD	0.954	0.0083	114.56	Acceptable
7	MO	⟶	SA	0.296	0.1094	2.705	Acceptable
8	SLS	⟶	SA	0.237	0.1354	1.756	Acceptable
9	ST	⟶	SA	0.361	0.0994	3.640	Acceptable
10	SD	⟶	SA	0.276	0.0919	3.006	Acceptable
11	SS	⟶	SA	0.229	0.1372	1.675	Acceptable

Finally, the result shows that the majority of students somewhat agree and strongly agree that problem based learning approach was useful on students' achievements. Therefore, "this research defines problem based learning approach as the
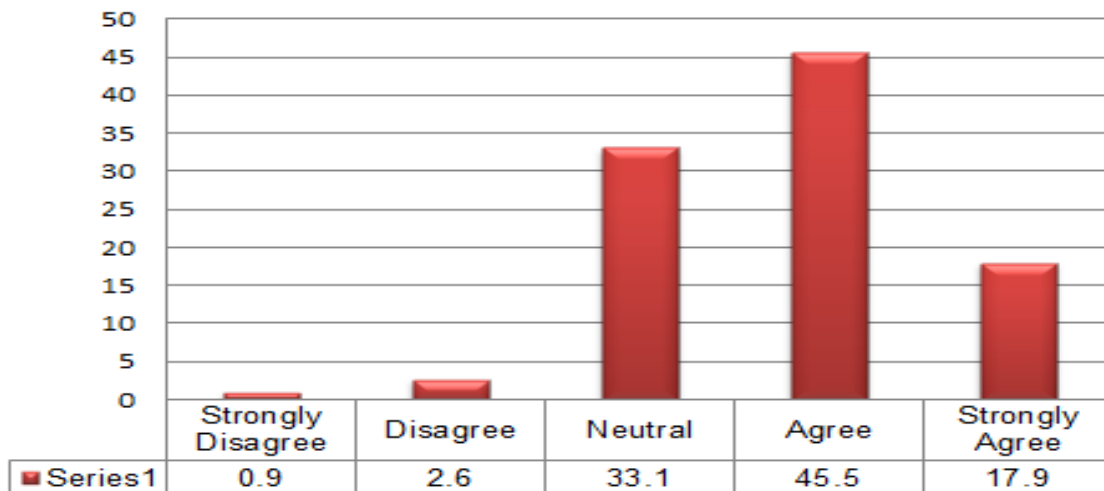
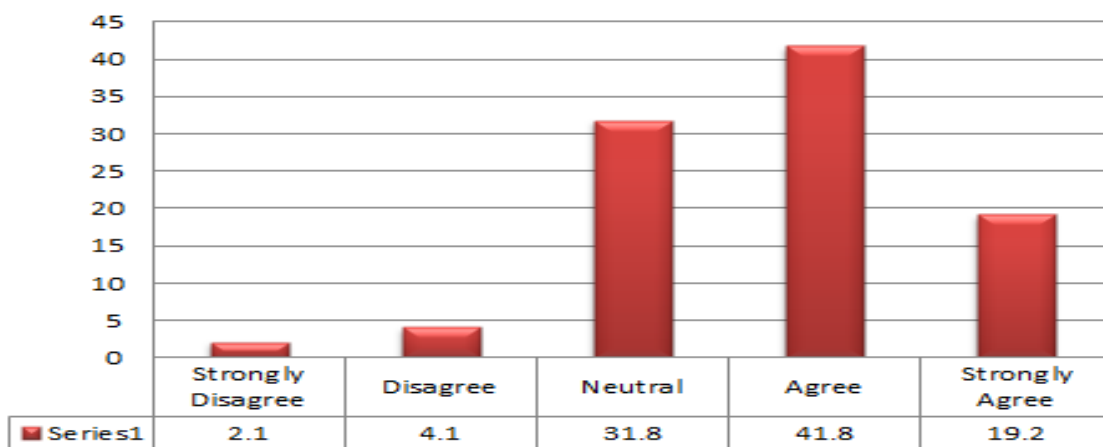**FIGURE 4.** Measuring students' learning motivation for learning.

Series1	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	0.9	2.6	33.1	45.5	17.9

FIGURE 5. Measuring students' learning thinking for learning.

Series1	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	2.1	4.1	31.8	41.8	19.2
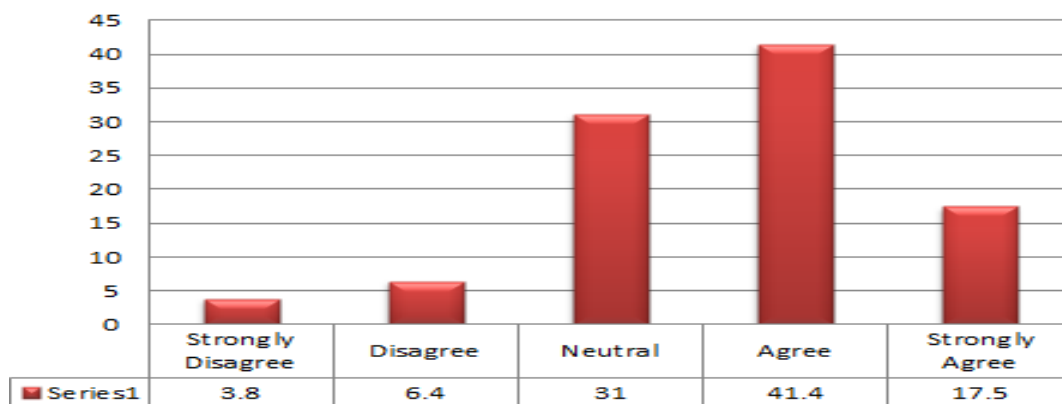
FIGURE 6. Measuring students' learning style.

Series1	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	3.8	6.4	31	41.4	17.5

degree where a students' learning in classroom that in turn, effect students' achievements''. These results are consistent with [14], [58], [62]–[64], who argued that problem based learning approach was useful on students' achievements. See Figure 10.

G. DISCUSSION AND IMPLICATIONS
The current research aims at cultivating a new model on how problem based learning through students' learning difficulties, students' learning style, students' learning motivation, students' learning skills, students' learning thinking
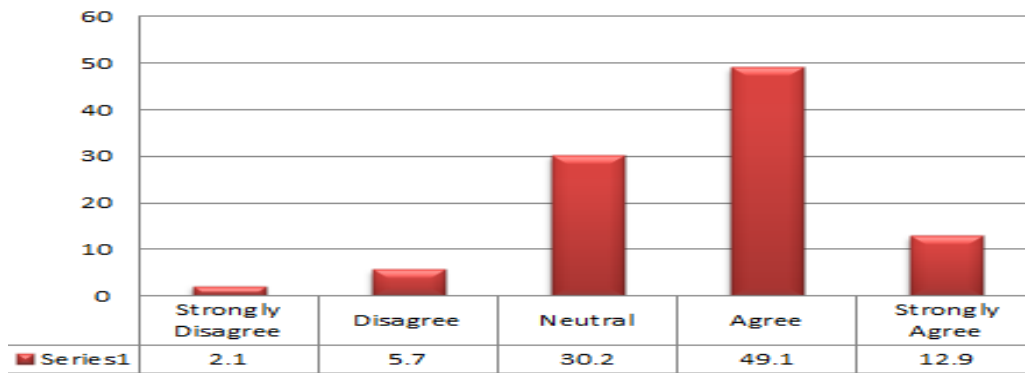
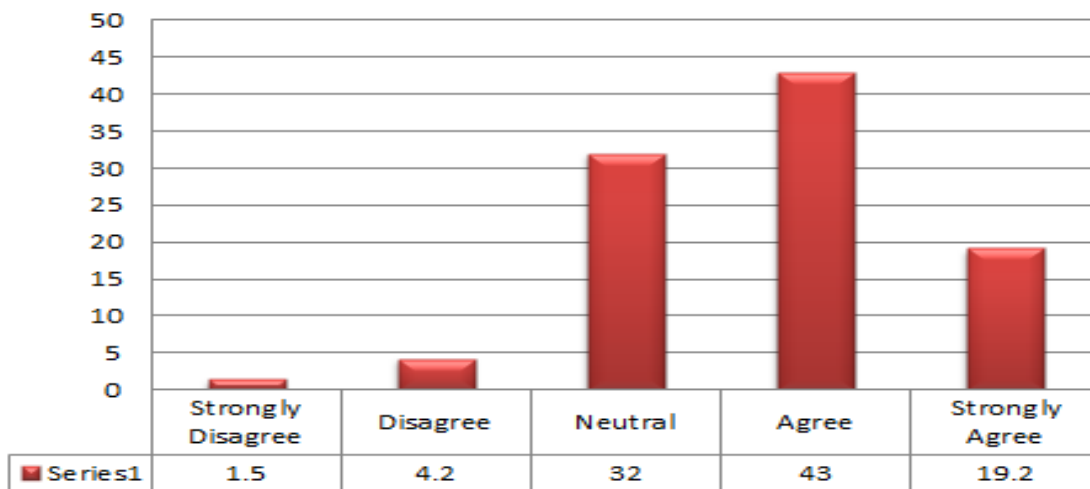**FIGURE 7.** Measuring students' learning difficulties.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Series1	2.1	5.7	30.2	49.1	12.9

FIGURE 8. Measuring students' learning skills.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Series1	1.5	4.2	32	43	19.2
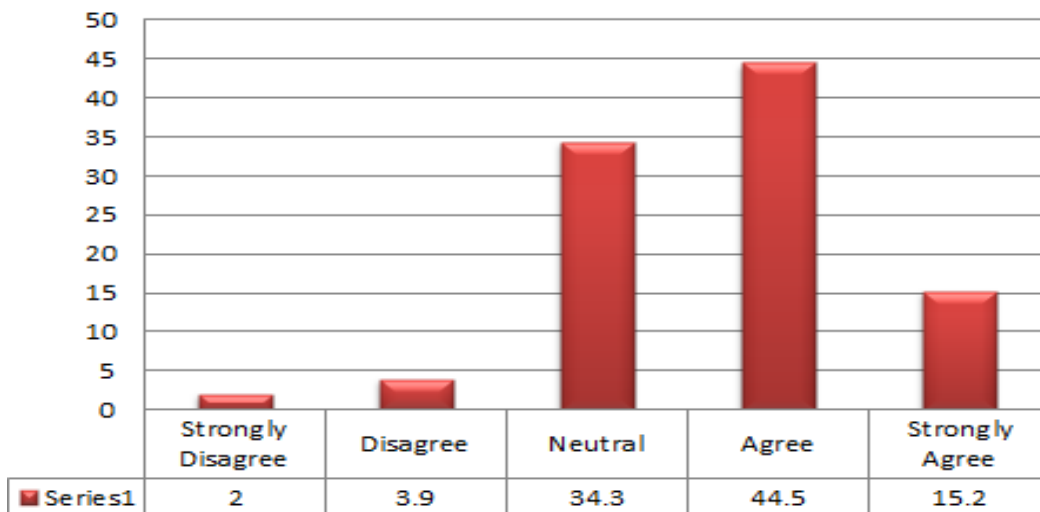
FIGURE 9. Measuring problem based learning approach.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Series1	2	3.9	34.3	44.5	15.2

to improve students' achievements in the institution of higher education. This research was an innovative effort in applying problem based learning among university students.

based on the model proposed, the relationships between six hypotheses were explored the problem based learning with the following factors: students' learning difficulties,
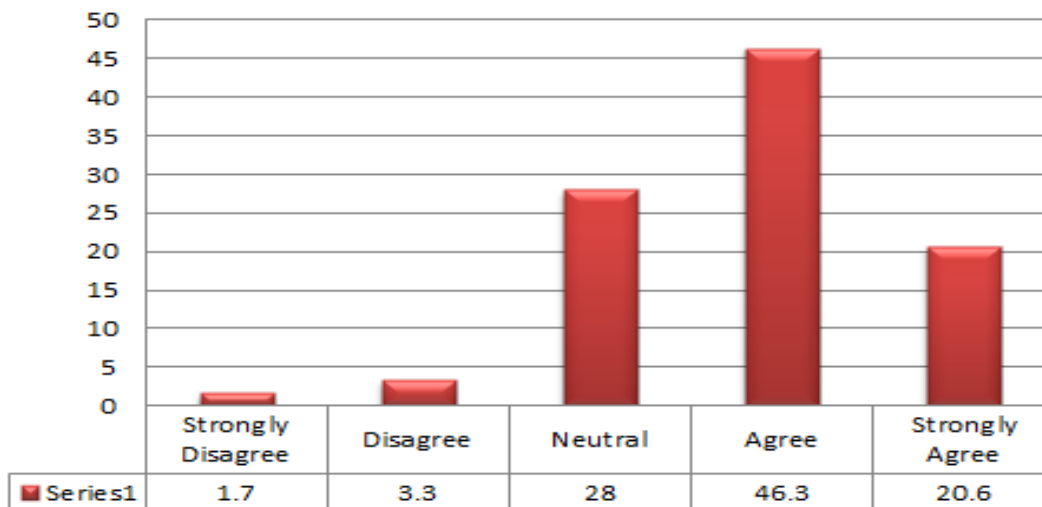
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Series1	1.7	3.3	28	46.3	20.6

FIGURE 10. Measuring students' achievements.

students' learning style, students' learning motivation, students' learning skills, students' learning thinking and students' achievements. Also, the relationships between five hypotheses were explored on the following factors: students' learning difficulties, students' learning style, students' learning motivation, students' learning skills, and students 'thinking with students' achievements (see Figure 2). According to the purpose of this research, using problem based learning among university students is highlighted and discussed to provide a clear vision of the importance of employing such students' learning skills, students' learning thinking, students' learning difficulties, students' learning style, students' learning motivation, and improves students' achievements in learning environments. Thus, the problem based learning approach provides rich daily life situations and problems that can be discussed to attain this target [81], [82].

The finding of this research shows there is a growing perception on teaches students through the problem based learning approach could positively impact the academic achievements. Therefore, the students get the opportunity to utilize problem based learning approach to bring new academic information into learning. Thus, the findings revealed that problem based learning has a positive impact on student academic achievements. Besides, the problem based learning approach helped the university students to foster information exploration and information sharing [58]. Thus, the perception that problem based learning approach yields beneficial results as an academic environment prompt several students to have a high inclination towards improve their academic achievements [59]. Moreover, the findings of this research revealed that problem based learning approach acts as an integral element in the lives of several students and teachers drawn from the younger generation. For instance, problem based learning approach improves the learning environment for the students by ensuring that they can effectively manage

their studies efficiently. The interactive nature of problem based learning approach helps to accomplish educational purposes, and sustaining connection with between the learners and students.

From a different perspective the problem based learning approach encourages learners to engage actively and deeply in authentic activities and tasks [83], and create new solutions by using a much wider number and range of resources and knowledge about the problem [12]. It also gives learners the ability to formulate their learning needs and ultimately become self-directed with the desire to learn and solve a problem [10]. Therefore, the problem based learning approach creates a feeling of connection to the course content and classmates. For that reason, designing problem based learning approach that are linked to the student assignments and previous course activities would improve the learning in the contemporary academic environment.

The statistical analyses in this study provide a clear-cut support to all of the hypotheses proposed in this study. Thus, both of the research model and the hypotheses are confirmed. Many fruitful insights on problem based learning approach through students' learning difficulties, students' learning style, students' learning motivation, students' learning skills, and students 'thinking and their impacts on their achievements.

Moreover, the problem based learning was examined via following factors: students' learning difficulties, students' learning style, students' learning motivation, students' learning skills, students 'thinking and students' achievements. The adoption of problem based learning approach in the processes teaching and learning was also found to be strongly influenced by students' learning motivation, students' learning skills, and students 'thinking, in turn improve students' achievements. Furthermore, the factors of students' learning difficulties, students' learning style,

students' learning motivation, students' learning skills, students 'thinking and students' achievements on problem based learning were also validated according to the findings of this study. Therefore, the findings of the current research go in line with the results of previous related research supporting the claim that the problem based learning approach in teaching and learning can be strongly influenced via students' learning difficulties, students' learning style, students' learning motivation, students' learning skills and students 'thinking that in turn improve students' achievements [21], [22], [26], [31], [36], [45], [57]–[59].

Besides, the findings of this research go in line with the results of previous discussion, it can be seen that constructivism, including its propositions and practices, is consistent with the principles of the problem based learning approach. This conclusion is documented by many specialists in the field [15], [83]–[86]. The problem based learning approach is described as 'constructivist'. For instance, Savery and Duffy [83] clearly emphasise that it is 'one of the best exemplars of a constructivist learning environment' (p. 135). Further, understanding the importance of designing higher education courses, tasks and practices, based on constructivist theory and the principals' of problem based learning, is a crucial and productive trend in many disciplines [15], [87].

Through results of current research model on problem based learning approach to improve students' academic achievements. Thus, encourages the students' to use problem based learning approach should be emphasized by faculties and universities. Also, through the problem based learning approach, universities should explain to the students the many facts that they can get by using this approach and integrating it in their learning. The fact that students understand the various benefits that they can get through the use of problem based learning approach on their academic achievements which will be considerably improved.

This research provides three empirical pieces of evidence. First empirical evidence of problem based learning use through students' learning style, students' learning motivation, students' learning skills, students 'thinking and difficulties on learning. Second empirical evidence of problem based learning with students' learning motivation, students' learning difficulties on learning, students' learning style, students' learning skills, and students 'thinking that in turn, affect students' achievements (refer to hypotheses number 1, 2, 3, 4, 5, and 6). The third empirical evidence of problem based learning with students' learning motivation, students' learning style, students 'thinking, students' learning difficulties on learning, and students' learning skills that in turn, affect students' achievements (refer to hypotheses number 7, 8, 9, 10 and 11). Based on the results of the current research, three implications were generated follows:

Employing problem based learning approach in the process of teaching and learning, this includes the role played by lecturers and instructors in supporting students through attending to their questions. Also, the easy process of sharing knowledge will enable the students to enhance their skills, thinking and motivation that in turn, affect students' achievements.

Encouraging universities and tertiary educational institutions to teach the students how to make use of problem based learning approach.

Realizing that students' learning style, students' learning motivation, students' learning skills, students 'thinking and difficulties on learning are considered significant for problem based learning approach that in turn, affect students' achievements.

V. CONCLUSION AND FUTURE WORK
The findings of this research support the problem based learning approach that in turn, affect students' achievements. The findings also showed that students' learning motivation, students 'thinking, students' learning difficulties on learning, students' learning style, and students' learning skills that in turn, affect students' achievements. Therefore, the results of this study show all hypotheses were acceptable. Regarding at the results of all hypotheses were significance and positively that mean the students has a positive attitude toward use problem based learning approach for teaching and learning, thus future work should take into consideration the creation of teachers' guidelines of how to combine problem based learning approach in various fields in the processes of teaching and learning. Future attempts should also consider the views of teachers and other higher education stakeholders in relation to the use of problem based learning approach in educational settings. The limitations and facilitating factors should be investigated in future research, having different view and perspectives from different countries and cultures would definitely enrich the research in this field. This also can provide more insights on how to handle this topic within higher education in different educational environments.

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