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An Interpretive Structural Modeling of Teamwork Training in Higher Education

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Abstract: In the past decade, the importance of teamwork training in higher education and employers' enthusiasm for recruiting team players have been widely discussed in the literature. Yet, the process through which effective teamwork training is developed in a higher education setting has not yet been properly discussed. The present study aims to map the precedence relationships among the key determinants of teamwork training effectiveness and explain the process through which an effective teamwork training program can be developed. The study first conducted an extensive review of the literature to highlight the key determinants of effective teamwork training. Next, the study benefitted from an interpretive structural modeling technique and captured the opinions of a group of teamwork training experts to further map the interrelationships among the potential determinants that were identified. By listing the key determinants of effective teamwork training, mapping their interrelationships, and identifying their driving and dependence power, the present study is expected to help practitioners and academicians through providing a detailed understanding of the process through which an effective teamwork training program can be developed in a higher education context.

Keywords: teamwork; higher education; determinants; interpretive structural modeling

1. Introduction

In today's competitive employment market, possessing good teamwork skills is an essential requirement for most jobs, ranging from academic jobs to industrial, healthcare, and so forth [1]. Nowadays, it is hard to find a job advertisement where teamwork capability is not a requirement. From the employers' perspective, university graduates are expected to effectively work in teams and multi-cultural environments [2]. In such circumstances, higher education has a significant responsibility and obligation to provide the students with the right education/training that increases their employability and satisfies the market requirements [3,4]. Teamwork training is mainly concerned with developing personal skills such as collaborative problem solving, open discussion, and responsibility [5]. In general, teamwork has its focus on working relationships between people who have different social and educational backgrounds [6]. A variety of definitions for teamwork, depending on the aspects studied, can be found in the literature (e.g., [7]). In this study, teamwork in the context of the higher education is defined as any process that involves more than one student who work together to fulfill a common goal through interdependent behavior, while each student also has his/her own individual responsibility.

Improving teamwork skills has received considerable attention by academia and within medical education in particular [8]. A comprehensive review of advancements in teamwork training within a medical education context can be found in Chakraborti et al. [9] and Barton et al., [10]. The higher education context has been no exception, and the issue of teamwork training has been the topic of interest within this context for decades [2]. However, achieving teamwork training effectiveness is indeed a challenging task, as it depends on several key determinants [11]. A review of the teamwork training literature reveals several key determinants that can contribute to teamwork training in higher education, either as facilitators or as barriers. Yet, none has empirically shown how these potential factors interact with each other in implementing and progressing teamwork training in higher education. The review of the literature also implies that a clear understanding of the precedence relationships among the potential determinants of teamwork training effectiveness is indeed missing, which is a research gap that might impede the strategic planning regarding the efficient and progressive implementation of teamwork training in higher education. To properly address this research gap, this study first conducts an extensive review of the literature through analyzing the academic articles published in scientific journals within the context of teamwork training, and further analyzing their content to identify potential determinates of teamwork training. The study further adopts the interpretive structural modeling (ISM) technique to map the interrelationships among the potential determinates of teamwork training that were identified. In doing so, the study benefits from the opinions of a group of teamwork training experts. Therefore, the overall aim of this research is to provide instructors and higher education institutions with a better understanding of the mechanism through which effective teamwork training policies can be developed.

The rest of the paper is organized as follows. The literature review is presented in section 2. The review results and finding including the key determinants of teamwork training effectiveness are presented in section 3. The ISM model is provided in section 4. The discussion on the results and conclusion of the study are given in section 5, which is followed by a discussion on the limitations of the study and future research directions.

2. Literature Review

To identify the key determinants of teamwork training effectiveness in higher education, this study benefited from a content-centric review of the literature based on a multiple stage approach. This review was performed during the summer of 2018. To conduct a reliable review and identify the most relevant studies, this study took advantage of the guidelines proposed by Pickering and Byrne [12] and Liberati et al. [13] wherever applicable. The main stages of the review process that follows are explained in Figure 1. After reviewing several academic papers and getting better insight on the topic, a few keywords were selected with the core theme of "teamwork". At stage one, and to obtain a comprehensive set of related papers, an initial advanced search was constructed using the keywords listed in Table 1. The initial search used major electronic databases—namely Taylor and Francis, SAGE, Emerald Insight, Wiley, Science Direct, and Springer—to identify the key academic papers. The present study merely focused on journal articles to ensure scientific integrity and reliability. Since the initial search of the keywords selected returned an enormous number of papers, the search was refined by introducing three filtering levels. The first level ensured that the articles found are within the teamwork context by including only the papers that have the defined keywords in their title and abstract. The search was further narrowed down in the second level by merely including the studies that have their focus on student teamwork in the context of education and the classroom. The third level adjusted the finding to the aim of the review by only including the studies targeted at teamwork in higher education. This initial search policy resulted in the identification of 95 documents that might explain the determinants of teamwork training effectiveness in higher education. Next, each of the 95 documents was carefully reviewed and the exclusion criteria listed in Table 1 were utilized while handpicking the most related documents. This procedure resulted in the removal of 61 documents from the initial pool of 95 documents.

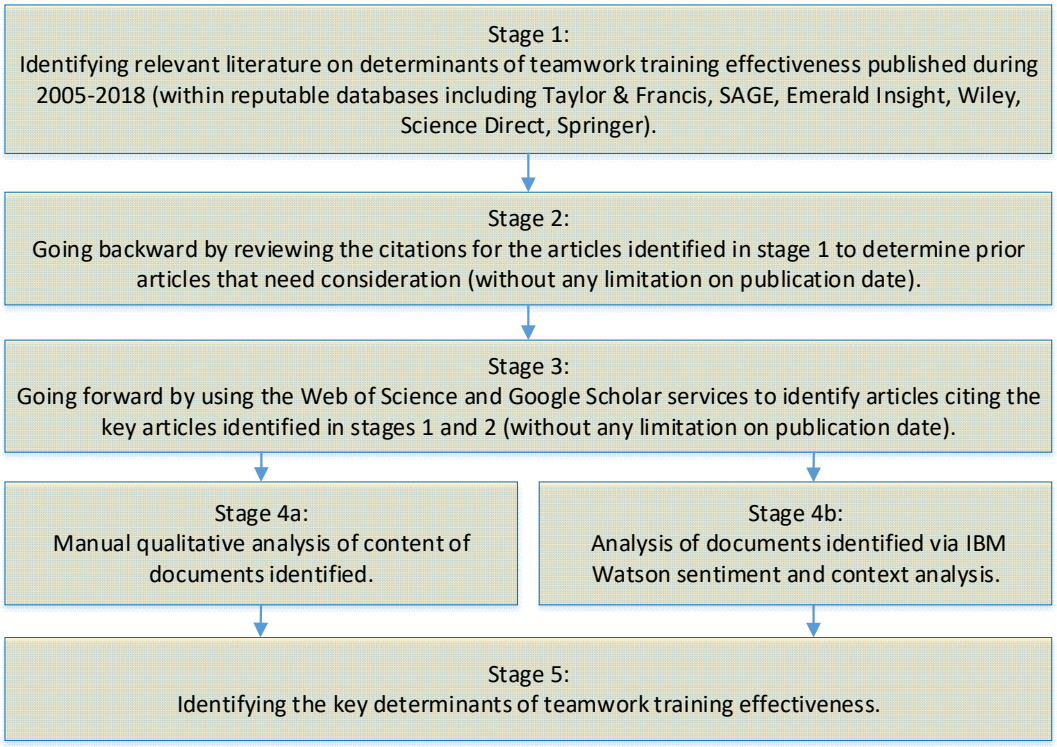

Figure 1. Steps undertaken for the content-driven review of the literature.

Table 1. Search terms and exclusion criteria.

Keywords (level 1)	"cooperative learning" OR "student role-playing" OR "team-based learning" OR "group working skills" OR "student teams" OR "group work" OR "team-working skills" OR "assessment of team work" OR "student teamwork" OR "team work" OR "teamwork" OR "teamwork skills" OR "teaching teamwork" OR "group project" OR "team activities" OR "team projects"
Keywords (level 2)	"education" OR "class" OR "pedagogy" OR "lectures" OR "learn" OR "teach" OR "study" OR "classroom" OR "train" OR "student"
Keywords (level 3)	"higher education" OR "university" OR "graduate" OR "undergraduate" OR "college" OR "faculty"
Exclusion criteria	A paper has only its title, abstract, and keywords in English, but not its full-text. A paper uses teamwork training only as a cited expression in the title, and does not focus on the review, survey, discussion, or problem solving of teamwork training. A paper does not fall within the higher education context.

In stage two, the backward review of citations for the documents identified in stage one was conducted. This means that the reference section of each of the 34 documents identified in stage one was carefully reviewed, and 16 new documents that seemed related to the context of the present study were identified. The content of these 16 newly identified documents was carefully reviewed, and the exclusion criteria introduced in Table 1 were applied to them, resulting in the removal of eight documents at this stage. Accordingly, eight new documents were identified as highly related to the context of the present study.

In stage three, Google Scholar and Web of Science services were used with the aim of recognizing the documents that cited the 42 (34 + eight) research articles identified in stage one and stage two. To do so, the full title of each of the 42 identified documents was used as the search term in Google Scholar and Web of Science, and the list of papers that cited each of them was identified. This resulted in a list of 292 unique papers that had not been identified in previous stages. The titles of these 292 papers were carefully reviewed, and the papers that had the notion of keywords of interest were

identified, which resulted in the identification of 36 new documents. The content of these 36 remaining papers was assessed based on the exclusion criteria defined in Table 1. As a result, 13 more documents were identified as highly related to the context of the study, and were further added to the final pool of related documents, leading to the final pool of 55 documents.

In stage four, two of the authors carefully reviewed each of the 55 articles that had been identified independently. In this stage, the authors benefited from IBM Watson natural language processing to better identify the potential determinants within selected documents.

In stage five and over a series of three meetings, two of the authors collaboratively extracted the determinant(s) that were explicitly or tacitly discussed in each of the selected papers. In this stage, 21 out of the 55 articles that had been identified were categorized as not related to the context of determinants of teamwork training effectiveness. This led to the final pool of 34 related journal articles. Figure 2 offers an information flow diagram of the document selection process. Table A1 in the appendix lists the characteristics of the 34 selected papers and the ways they have addressed the determinants of teamwork training effectiveness.

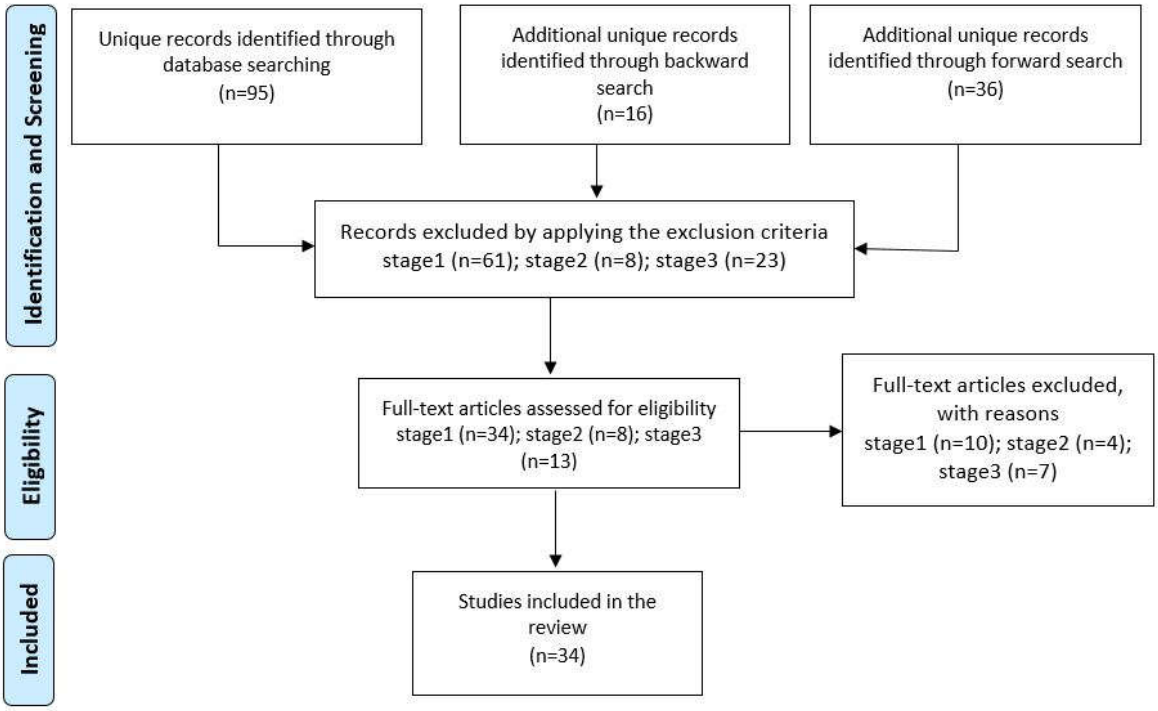

Figure 2. Information flow diagram on document selection process (adapted from Moher et al. [14]).

3. Review Results and Findings

The review of the literature revealed that the potential determinants of teamwork training effectiveness fall within the four main clusters of educational strategies, curriculum design, team/group arrangement, and work assessment. Since understanding these clusters is crucial to the identification of the key determinants of teamwork training effectiveness, each of these clusters are first explained briefly.

Educational Strategies: This factor is mainly concerned with identifying and implementing the possible strategies for successful teamwork. The three most important elements of the teamwork educational strategy are as follows. Preparing students with teamwork skills training and collaborative activities in teams is very important in higher education, as it leads to the higher students' achievement [15–17]. Different *teamwork training methods* are introduced and used in the literature for students' teamwork training. The two most important methods are self and peer assessment simulations, and role-play [16–19]. *Teamwork processes* can be divided into three parts, namely: interpersonal, transition, and action [20]. The transition part is concerned with creating teams and planning the team goal(s), as well as deciding on the roles and responsibilities of team members

[15,16]. The action part is mainly related to choosing communication means and establishing efficient communication skills such as direct or asynchronous communication within the team. The feedback system, including the strategies for giving and receiving feedback, also falls within the action part [19,21,22]. The last part is the interpersonal relationship, which focuses on conflicts between team members and possible solutions [23–26].

Curriculum Design: Another important element that highly affects the teamwork skill training is the effective design of the curriculum. In all of the courses where improving teamwork skills is an objective, the curriculum should be properly designed and structured to include all of the relevant teamwork activities required for learning teamwork skills. Therefore, defining the outcomes can be considered the first step in curriculum design, because it influences the course content, activities, and even the course assessment. Moreover, a good understanding of curriculum design techniques and knowing different teaching strategies (e.g., experiential, cooperative, or collaborative) that can lead to the expected learning outcome, i.e., teamwork skills, are indeed crucial [27,28]. It is obvious that curriculum design is a time-consuming and demanding task that needs substantial investment by both institutions and curriculum designers in the form of money and brainwork, respectively.

Team Composition: Arrangement of the team is another important element of teamwork. There are three important aspects that should be carefully considered for a successful team arrangement: size, diversity, and formation. One of the main criticisms that instructors receive in teamwork implementation is related to team formation. Critics believe that instructors form the teams and assign tasks to them without providing the team members with a proper lesson on how they should work in teams [21,25]. Moreover, the diversity of team members in terms of age, nationality, gender, and so on can sometimes be considered a disadvantage for some members of the team. Some students find it challenging to work in diverse and multi-cultural teams, which can result in a negative attitude toward teamwork.

Assessment: One of the most challenging tasks in teamwork is the work assessment. Different factors may be discussed in relation to teamwork assessment such as giving and receiving feedback (peer assessment), and social loafing. *Social loafing* is one of the main concerns of team members in any type of teamwork that puts the distributive justice of tasks into question. It is often seen in teams in which one or more members do not fairly contribute to tasks for different reasons and try to benefit from other members' work, which can cause dissatisfaction in teams. When grading is made based on the whole team product, team members may not feel fully satisfied if they perceive that not all of the members equally contributed to the final product. Therefore, effective strategies for the individual assessment and grading of each member of the team is also an important topic that should be properly addressed [29,30]. *Giving and receiving feedback* to/from other teams or students is an efficient method that is widely used by instructors to engage the students in the assessment and grading process [31]. However, the literature does not clearly define what aspects of teamwork (e.g., final product, teamwork quality, the contribution of each individual in the team) should be assessed, nor to what extent it should influence the overall grading.

Having the four main clusters of educational strategies, curriculum design, team/group arrangement, and work assessment as consideration, the literature review that was performed in this study identified 10 key determinants of teamwork training effectiveness in higher education, as explained in Figure 3.

Figure 3. Key determinants of teamwork training effectiveness in higher education.

Financial Resources: The cost of including teamwork in education can be considered one of the most important determinants of teamwork training effectiveness policies. There are several costs associated with teamwork, such as the cost of design, development, and maintenance. Moreover, including teamwork in education is highly affected by the benefits and costs related to developing, monitoring, coordinating, and evaluating the teamwork. In fact, markets/potential employers delegate most of these costs to higher education centers, as they expect to have work-ready graduates [32]. This means that an effective teamwork training program would significantly rely on financial supports from educational institutions.

Instructors' Qualification: One of the main shortcomings of teamwork training in higher education is that many instructors do not have a clear understanding of how teamwork skills should be taught, and therefore they are not well prepared [19]. The root of this issue can be traced back to the education of instructors themselves, because many higher education teachers are discipline-based researchers, and therefore they have little to no formal teaching education and are not familiar with the available methods and approaches for developing cooperative learning and improving students' teamwork skills [21,33]. Moreover, some of the instructors have not even experienced teamwork during their own education. Therefore, benefiting from competent instructors is one of the key elements of teamwork program effectiveness.

Institutional Support: Effective teamwork training programs heavily depend on institutional support, and the lack of support from the institution has long been regarded as a barrier toward teamwork training. Universities and colleges sometimes do not show adequate interest in providing the instructors with enough time to attend professional teamwork pedagogy courses, because it enforces them to reduce their teaching or/and research time, which consequently imposes some costs on the institute [2].

Teamwork Practice Timespan: The time required by students for practicing teamwork skills and cooperative learning strategies obviously takes away a part of the teaching time that can be used for

subject-specific and technical content in a course [33,34]. Therefore, some instructors prefer not to include the teamwork in their teaching, and spend more time on the subject-specific content.

Instruction Complexity: Complex instruction is inherently required for a successful teamwork training implementation strategy. The literature explains that the teamwork skill is not merely improved by dividing the students into groups, as clear teamwork instruction should be included in the course curriculum, which requires more time and effort [35].

Teamwork Assessment: In reality, instructors usually do not have enough experience in assessing the teamwork process. Providing good instruction for the assessment of each element of a teamwork process is crucial for having a fair evaluation. In other words, not only the outputs of the teamwork should be assessed, but the inputs need to be evaluated also [17]. Thus, teamwork assessment is a challenging task that might make prepared instructors less afraid of including teamwork in their education scheme.

Curriculum Design: Some instructors are introducing teamwork into their courses without considering proper curriculum design and defining the expected outcomes, having only the aim of reducing the assessment and grading load. Of course, teamwork may help reduce the marking load, but it may also bring about some costs related to students' dissatisfaction with this type of assessment, which is mainly caused by the inequity of the workload, social loafing, and so on [36,37]. Therefore, a properly designed curriculum is vital to the effective implementation of teamwork training programs in higher education.

Redesigning the Courses: The fiscal and human resources that higher education institutions need to invest in redesigning the courses and programs to include teamwork are another determinant that significantly affects the deployment of teamwork training [12]. Moreover, other requirements associated with providing a proper teamwork environment such as labs, virtual learning tools, and adjustable classrooms might be considered constraints for educational institutions to incorporate teamwork in their programs.

Planning and Implementation: If instructors are not provided with the required time, resources, and training by the institution for learning the teamwork strategies before implementing them, there might be a risk that the students miss the chance of experiencing teamwork because of poor planning and implementation [34]. Therefore, an effective teamwork-training program entails detailed planning and implementation strategies to be supported by higher education institutions.

Student Workload: The literature introduces the student workload as another important determinant of teamwork implementation in higher education. Students generally resist teamwork training because they feel that extra time must be spent at meetings after the class time, which affects the students' daily life [25]. Thus, optimizing the students' academic workload with respect to efforts that the teamwork requires of students should be a priority for higher education institutions.

4. Methodology

After identifying the key determinants of teamwork training effectiveness in higher education, and in order to understand the precedence relationships between these determinants, the present study benefits from the interpretive structural modeling (ISM) technique. ISM is generally used for enabling a small group of experts to develop graphical representations of complex systems [38]. The technique is structuring since it creates, based on the existing relations, a comprehensive structure of all the complex elements by considering all of the possible pairwise interactions of the elements. Alternatively, the method is categorized as a modeling technique given that it maps and illustrates the complete structure and the individual relationships of the elements in the form of digraphs [39]. ISM has been widely used by scholars of various research disciplines for establishing the prominent relations among factors of interests [40], particularly with the aim of analyzing the causal relationships for the determinants of a particular phenomenon, such as the adoption, failure, or success of a system [41–43]. Examples regarding the application of ISM in academia include the assessment of barriers of total productive maintenance [44], determinants of lean manufacturing success [45], determinants of knowledge management implementation [46], and determinants of the quality of management education [47].

ISM principally relies on the opinion of experts. Following the standard procedure for the application of ISM (e.g., [42,48]), the present study benefited from the opinion of four academics who have had practical experience in the development of teamwork training in the higher education setting, and are well-known for their on-the-field experience and scientific research and publications, in order to obtain the precedence relationships among the determinants of teamwork training effectiveness. Figure 4 illustrates the steps undertaken for the implementation of ISM methodology in the present study.

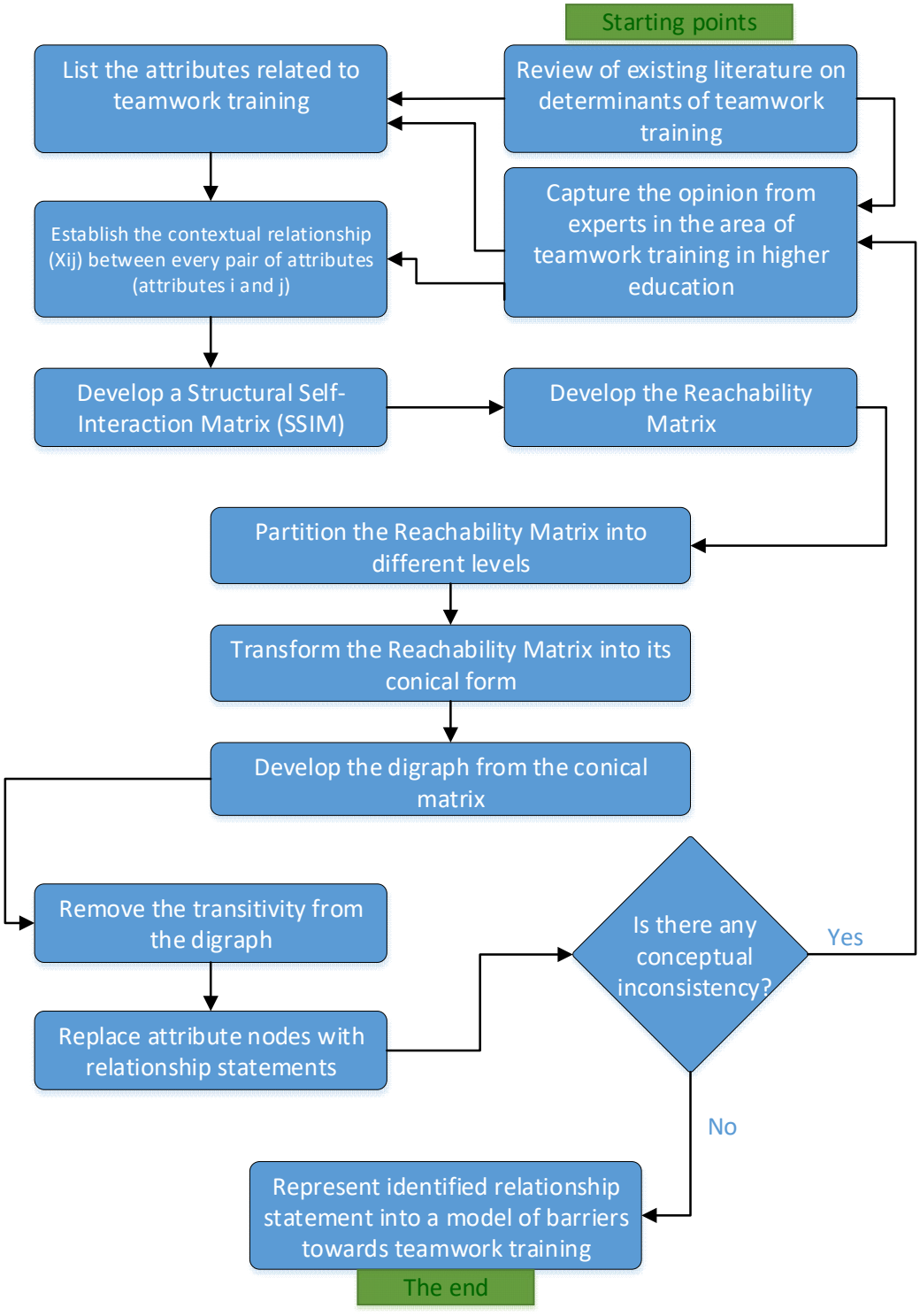

Figure 4. Framework for obtaining the interpretive structural modeling (ISM) decision model (adapted from Ghobakhloo et al. [45]).

Listing Determinants of Teamwork in Higher Education:

The structured and content-driven review of the literature in this study, as explained in the literature review section, identified 10 key determinants of teamwork training effectiveness (see Figure 3). Next, a session with the expert group, through the use of the nominal group technique (NGT), was organized in which the creditability of the 10 potential determinants were discussed. NGT is a learning and development tool that facilitates effective group decision making [49]. This technique generates information in response to an issue, which can be further prioritized by a group of experts [50]. In doing so, the experts ensured that no key barrier is missing from the list of barriers identified in the present study.

Creating the Contextual Relationships:

To establish the contextual relationships among the elements/variables of interest, the opinion of experts are captured via different opinion management techniques such as brainstorming or the nominal technique [48]. The ISM approach benefits from four different symbols (V, A, X, and O) to categorize the relationship among each pair of the variables of interest [51,52]:

V: attribute *i* determines attribute *j*;

A: attribute *i* is determined by attribute *j*;

X: attributes *i* and j determine each other;

O: attributes *i* and *j* are unrelated.

Establishing the contextual relationships among the variables of interest results in the development of the structural self-interaction matrix (SSIM). The SSIM matrix in this study is consistently established and presented as Table 2 by capturing the opinion of experts who participated in the NGT session. For example, the symbol O for the financial resource–student workload relationship explains that these two variables are independent of each other.

Table 2. Structural self-interaction matrix (SSIM) for the chosen attributes.

	i \ *j*	SW	PI	RC	CD	TA	IC	TPT	IS	IQ	FR
i	1. Financial resources (FR)	O	V	V	O	O	O	V	X	V	-
	2. Instructors' qualification (IQ)	V	V	V	V	V	O	V	A	-	
	3. Institutional support (IS)	X	V	V	O	O	O	V	-		
	4. Teamwork practice timespan (TPT)	V	A	A	A	O	A	-			
	5. Instruction complexity (IC)	O	A	A	A	V	-				
	6. Teamwork assessment (TA)	O	A	X	X	-					
	7. Curriculum design (CD)	O	X	O	-						
	8. Redesigning the courses (RC)	V	V	-							
	9. Planning and implementation (PI)	V	-								
	10. Student workload (SW)	-									

Developing the Initial Reachability Matrix:

The next step after the establishment of the SSIM is the development of an initial reachability matrix (Table 3). This matrix is a binary matrix that is developed by substituting V, A, X, or O by one or zero, based on the following standard rules that exist within the ISM literature [45,53]:

—If the (*i*, *j*) entry in the SSIM is V, then entry (*i*, *j*) in the reachability matrix is set to one, while entry (*j*, *i*) is set to zero.

—If the (*i*, *j*) entry in the SSIM is A, then entry (*i*, *j*) in the reachability matrix is set to zero, while entry (*j*, *i*) is set to one.

—If the (*i*, *j*) entry in the SSIM is X, then both the (*i*, *j*) and (*j*, *i*) entries in the reachability matrix are set to one.

—If the (*i*, *j*) entry in the SSIM is O, then in the reachability matrix, both entry (*i*, *j*) and (*j*, *i*) are set to zero.

Table 3. Initial reachability matrix for the key attributes.

i		*j*									
		FR	IQ	IS	TPT	IC	TA	CD	RC	PI	SW
i	1. Financial resources (FR)	1	0	1	1	0	0	0	1	1	0
	2. Instructors' qualification (IQ)	0	1	0	1	0	1	1	1	1	1
	3. Institutional support (IS)	1	1	1	1	0	0	0	1	1	1
	4. Teamwork practice timespan (TPT)	0	0	0	1	0	0	0	0	0	1
	5. Instruction complexity (IC)	0	0	0	1	1	1	0	0	0	0
	6. Teamwork assessment (TA)	0	0	0	0	0	1	1	1	0	0
	7. Curriculum design (CD)	0	0	0	0	1	1	1	0	1	0
	8. Redesigning the courses (RC)	0	0	0	1	1	1	0	1	1	1
	9. Planning and implementation (PI)	0	0	0	1	1	1	1	0	1	1
	10. Student workload (SW)	0	0	1	0	0	0	0	0	0	1

Developing the Final Reachability Matrix:

The final reachability matrix is developed by applying the transitivity property based on the previously established relationships. Table 4 offers the final reachability matrix. The transitivity of the contextual relation, as a basic assumption in ISM methodology, states that if attribute X is related to attribute Y and attribute Y is related to attribute Z, then attribute X is necessarily related to attribute Z [41]. Since the direction of the relationship is not used, the (*X*, *Z*) entry in the final reachability matrix becomes one.

Table 4. Final reachability matrix with driving power and dependence.

i		*j*										**Driving power**	**Rank**
		FR	IQ	IS	TPT	IC	TA	CD	RC	PI	SW		
i	1. Financial resources (FR)	1	1*	1	1	1*	1*	1*	1	1	1*	**10**	**1**
	2. Instructors' qualification (IQ)	0	1	1*	1	1*	1	1	1	1	1	**9**	**2**
	3. Institutional support (IS)	1	1	1	1	1*	1*	1*	1	1	1	**10**	**1**
	4. Teamwork practice timespan (TPT)	0	0	1*	1	0	0	0	0	0	1	**3**	**7**
	5. Instruction complexity (IC)	0	0	0	1	1	1	1*	1*	0	1*	**6**	**5**
	6. Teamwork assessment (TA)	0	0	0	0	0	1	1	1	0	0	**3**	**7**
	7. Curriculum design (CD)	0	0	0	1*	1	1	1	1*	1	1*	**7**	**4**
	8. Redesigning the courses (RC)	0	0	1*	1	1	1	1*	1	1	1	**8**	**3**
	9. Planning and implementation (PI)	0	0	1*	1	1	1	1	1*	1	1	**8**	**3**
	10. Student workload (SW)	0	0	1	1*	0	0	0	1*	1*	1	**5**	**6**
	Dependence	**2**	**3**	**7**	**9**	**7**	**8**	**8**	**9**	**7**	**9**		
	Rank	**5**	**4**	**3**	**1**	**3**	**2**	**2**	**1**	**3**	**1**		

Partitioning the Reachability Matrix:

The reachability and antecedent set for each attribute is further developed as the next logical step in the application of ISM based on the values from the final reachability matrix [52]. The reachability set for a particular attribute includes the attribute itself and all of the other attributes that it determines [48]. Alternatively, the antecedent set for a particular attribute comprises the attribute itself and all of the other attributes that determine it [41]. The intersection set for each attribute is further extracted as the intersection of the reachability and the antecedent sets [43]. After extracting the intersection sets, the attributes are hierarchized, and the top position(s) is given to the attribute(s) for which the intersection between the reachability set and the antecedent set equals the reachability set itself [54]. By repeating this procedure (while disregarding the attributes identified in the previous iteration), the hierarchic level of remaining attributes is iteratively acquired. Table 5 demonstrates the hierarchy levels of the attributes of interest in the present study.

Table 5. Attributes' hierarchy level.

Factors	Reachability set	Antecedent set	Intersection set	Level
Iteration 1				
FR	FR, IQ, IS, TPT, IC, TA, CD, RC, PI, SW	FR, IS	FR, IS	
IQ	IQ, IS, TPT, IC, TA, CD, RC, PI, SW	FR, IQ, IS	IQ, IS	
IS	FR, IQ, IS, TPT, IC, TA, CD, RC, PI, SW	FR, IQ, IS, TPT, RC, PI, SW	FR, IQ, IS, TPT, RC, PI, SW	
TPT	**IS, TPT, SW**	**FR, IQ, IS, TPT, IC, CD, RC, PI, SW**	**IS, TPT, SW**	**I**
IC	TPT, IC, TA, CD, RC, SW	FR, IQ, IS, IC, CD, RC, PI	IC, CD, RC	
TA	**TA, CD, RC**	**FR, IQ, IS, IC, TA, CD, RC, PI**	**TA, CD, RC**	**I**
CD	TPT, IC, TA, CD, RC, PI, SW	FR, IQ, IS, IC, TA, CD, RC, PI	IC, TA, CD, RC, PI	
RC	IS, TPT, IC, TA, CD, RC, PI, SW	FR, IQ, IS, IC, TA, CD, RC, PI, SW	IS, IC, TA, CD, RC, PI, SW	
PI	IS, TPT, IC, TA, CD, RC, PI, SW	FR, IQ, IS, CD, RC, PI, SW	IS, CD, RC, PI, SW	
SW	**IS, TPT, RC, PI, SW**	**FR, IQ, IS, TPT, IC, CD, RC, PI, SW**	**IS, TPT, RC, PI, SW**	**I**
Iteration 2				
FR	FR, IQ, IS, IC, CD, RC, PI	FR, IS	FR, IS	
IQ	IQ, IS, IC, CD, RC, PI,	FR, IQ, IS	IQ, IS	
IS	FR, IQ, IS, IC, CD, RC, PI	FR, IQ, IS, RC, PI	FR, IQ, IS, RC, PI	
IC	**IC, CD, RC**	**FR, IQ, IS, IC, CD, RC, PI**	**IC, CD, RC**	**II**
CD	**IC, CD, RC, PI**	**FR, IQ, IS, IC, CD, RC, PI**	**IC, CD, RC, PI**	**II**
RC	**IS, IC, CD, RC, PI**	**FR, IQ, IS, IC, CD, RC, PI**	**IS, IC, CD, RC, PI**	**II**
PI	IS, IC, CD, RC, PI	FR, IQ, IS, CD, RC, PI	IS, CD, RC, PI	
Iteration 3				
FR	FR, IQ, IS, PI	FR, IS	FR, IS	
IQ	IQ, IS, PI,	FR, IQ, IS	IQ, IS	
IS	**FR, IQ, IS, PI**	**FR, IQ, IS, PI**	**FR, IQ, IS, PI**	**III**
PI	**IS, PI**	**FR, IQ, IS, PI**	**IS, PI**	**III**
Iteration 4				
FR	FR, IQ	FR	FR	
IQ	**IQ**	**FR, IQ**	**IQ**	**IV**
Iteration 5				
FR	**FR**	**FR**	**FR**	**V**

Modeling the Precedence Relationships:

The extraction levels identified in Table 5 were further used to develop the precedence model in order to ascertain the determinants of teamwork implementation in higher education. Table 5 explains that teamwork practice timespan, teamwork assessment, and student workload have been extracted in iteration one; thus, they are positioned at the top of the precedence model for the determinants of effective teamwork training implementation. By positioning all of the determinants based on the hierarchical properties that had been identified in iterations one to five, depicting the interrelationships among the identified determinants via direct arrows, and removing the transitivities between the determinants of teamwork [42,45], the ISM-based model for the determinants of effective teamwork training in higher induction is introduced in Figure 5.

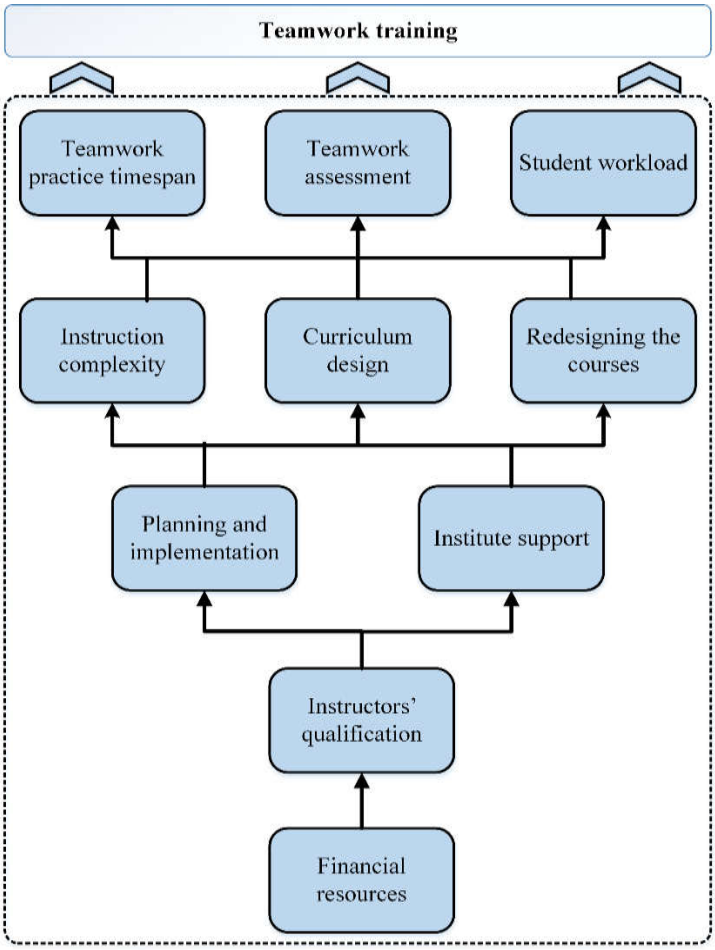

Figure 5. ISM-based model for determinants of effective teamwork training in higher education.

The next step in the application of ISM methodology involves the identification and assessment of the driving and dependence powers of each determinant (attribute) of interest based on the "Matrice d'Impacts Croisés Multiplication Appliquée àun Classement" (MICMAC) analysis [55,56]. The MICMAC analysis categorizes the determinant into four clusters [45], including:

1. Autonomous cluster that includes attributes with weak driving power and weak dependence;
2. Dependent cluster that includes attributes with weak driving power but strong dependence;
3. Linkage cluster that consists of attributes with strong driving power and strong dependence;
4. Driver cluster that includes attributes with strong driving power but weak dependence.

Following the MICMAC analysis procedure, the driving power and dependence diagram for the determinants of effective teamwork training in higher education is depicted in Figure 6, in which the

identified determinants have been placed into the appropriate quadrants based on the driving power and dependence values available in the final reachability matrix.

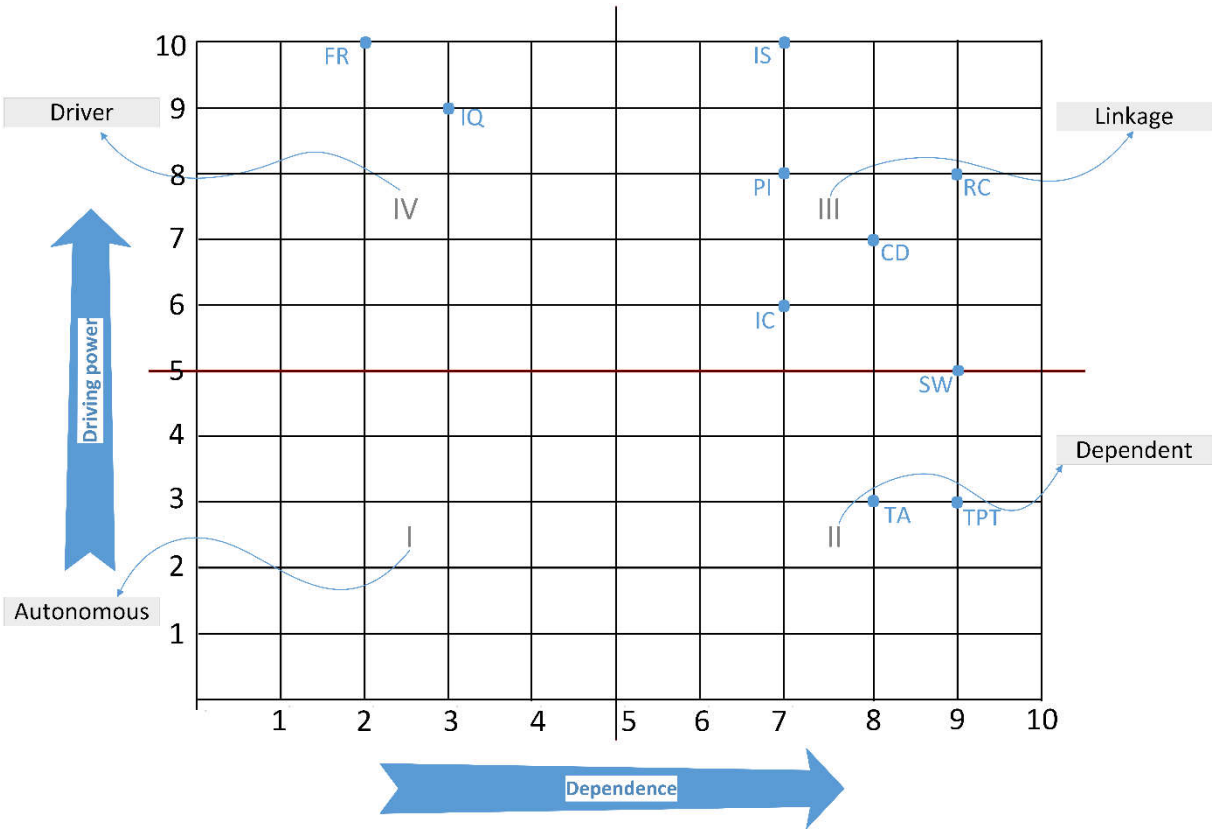

Figure 6. Driving power and dependence diagram for determinants of effective teamwork training.

5. Discussion and Conclusion

Teamwork training is an important and challenging topic in the context of higher education. Many organizations directly or indirectly push higher education centers toward the development of teamwork and collaborative skills in their programs through introducing some employment standards where teamwork skill is a main criterion [32,33,57]. Despite the advantages of teamwork and its importance, there are several determinants that may limit or promote the use of teamwork in higher education. Reviewing the literature revealed that although the teamwork pedagogy has been a hot topic that has received considerable attention by scholars during the past decades, there has been no comprehensive study that has identified the main determinants of teamwork training effectiveness in higher education. Therefore, this study primarily provided an overview of the main factors that influence the teamwork training in higher education, as well as challenges and barriers that may constrain the development of teamwork training. More importantly, our results showed that there are complex precedence relationships among different determinants of teamwork training effectiveness, and managing every single identified determinant is crucial to the success of teamwork training programs in higher education. The MICMAC analysis procedure, and the driving power and dependence analysis, provided valuable insights into the relative importance and the interdependencies among the determinants of teamwork training effectiveness. The journey toward teamwork training success in higher education starts with providing the necessary financial supports and ensuring the instructors' competencies in developing teamwork skills among students. These two determinants, which are considered *drivers*, are stepping stones that enable the development of other facilitators of teamwork training. A driving power and dependence diagram also reveals that institutional support, planning and implementation, instruction complexity, redesigning the courses,

and curriculum design are regarded as *linkage* determinants. Therefore, addressing the determinants characterized by strong driving power and strong dependence are the next logical steps, after ensuring financial support and instructor qualification, in facilitating the success of teamwork training in higher education. There are no *autonomous* determinants in this study, and teamwork assessment and the teamwork practice timespan fall within the *dependent* category. Hence, institutions need to address the *driver* determinants before planning the optimization of teamwork assessment procedures and the teamwork practice timespan. Finally, yet importantly, student workload includes the particularities of both the *driver* and *dependent* categories, meaning that this determinant should be addressed before focusing on the determinants that belong to the *dependent* category.

The results of the present study showed that instructor confidence and willingness to implement teamwork cannot solely guarantee successful teamwork; rather, students and an intuitive perception of teamwork can also significantly influence the implementation of teamwork. In fact, the determinants identified indicated that students have a very important role in the successful achievement of teamwork learning outcomes. In addition, merely dividing the students into groups will not necessarily enable them to become team players and better at teamwork. Therefore, a clear teamwork instruction should be included in the course curriculum [35,58], which highlights the importance of purposeful curriculum design, planning, and implementation.

Having the key determinants identified and their roles studied, it is also safe to conclude that there are multilevel interactions and interrelated relations between institutions, students, and instructors that can influence the teamwork pedagogy, meaning that instructors and institutions should carefully consider the curriculum design, team arrangement, instruction, and assessment strategies when including teamwork in their courses/programs. Moreover, it has also been found that the implementation of teamwork and willingness to include this form of teaching and learning in education is highly dependent on the return of investment. Therefore, all of the costs involved in the planning and implementation of teamwork, such as the design, development, maintenance, coordination, and evaluation costs, as well as human and physical resources expenses, highly affect the application of teamwork in higher education.

5.1. Limitations and Future Research Directions

This study has two potential limitations. The first limitation concerns the scope of the study that is purposefully limited to the context of higher education. Although limiting the scope of the review to higher education serves the objectives of the study, it cannot be ignored that the findings cannot be freely generalized to other research contexts. The second limitation of the study concerns a particular characteristic of ISM methodology. Although ISM enables scholars to develop the linkage among various determinants of a particular phenomenon by providing a single systemic framework, it is rather limited in statistically validating the obtained hypothetical framework [45]. The application of ISM in the present study has fulfilled the research objective of identifying the precedence relationships among the key determinants of effective teamwork training. However, using structural equation modeling and a cross-sectional survey procedure for understanding the significance of relationships among the determinants of teamwork training effectiveness would be an interesting avenue of future research.

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Appendix

Table A1. Results of content analysis of reviewed journal articles

	Financial resources	Instructors' qualification	Institute support	Teamwork practice timespan	Instruction complexity	Teamwork assessment	Curriculum design	Redesigning the courses	Planning and implementation	Student workload
Aggarwal & O'Brien [29]						X				
Ahern [59]		X				X		X		
Bacon [34]	X			X					X	
Clarke & Blissenden [60]						X				X
Crumbley et al. [61]							X			
D'Alessandro & Volet [62]					X					X
David et al. [63]								X		
Delaney et al., [17]				X		X				
Ding & Ding [5]									X	
Fraser & Bosqanquet [27]							X			
Frederick [64]	X			X						
Freeman & McKenzie [65]						X				
Goldfinch et al. [66]						X				
Gueldenzoph-Snyder [67]		X	X	X						
Hansen [21]	X	X				X				X
Hrynchak & Batty [68]		X					X			
Hughes et al. [31]						X				
Jackson et al. [26]						X		X		
Jassawalla [36]						X	X			
Kemery & Stickney [32]	X					X				

(continued)

	Financial resources	**Instructors' qualification**	**Institute support**	**Teamwork practice timespan**	**Instruction complexity**	**Teamwork assessment**	**Curriculum design**	**Redesigning the courses**	**Planning and implementation**	**Student workload**
Kliegl & Weaver [33]	X	X		X						
Kouliavtsev [69]						X				
Loughry et al. [70]		X	X			X				
Maiden & Perry [37]						X	X			
McCorkle et al. [71]	X	X		X						
Myers & Goodboy [35]					X					
Page & Donelan [72]	X			X		X				X
Pieterse & Thompson [73]						X				
Pineda & Lerner [15]				X						
Rafferty [25]					X					X
Rapp & Mathieu [16]				X						
Reinig et al. [57]									X	
Riebe et al. [2]			X						X	
Shaw [74]	X			X	X					
Strom & Strom [75]				X		X	X			
Trigwell & Prosser [28]							X			

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