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Collaborative Skill Assessment of During a Problem-Solving Task: Application of the Hesse Et Al Matrix on the Case of Students of Mohammed V University in Rabat

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Abstract

Collaboration is an essential 21-century skill that must be included in teaching and learning. This requires that measuring instruments be available to help evaluate and monitor the development of student performance. Our research study aims to apply the framework of the ATC21S project to assess the level of collaborative skill among students of Mohammed V University of Rabat (M5U-Rabat). In addition, we have sought to identify the determining factors of this skill in the Moroccan university through three comparison parameters: the type of high school diploma, the type of training and the type of university course. The method used in this study is a comprehensive quantitative research method. We applied the assessment framework of Hesse et al (2015) to assess collaborative skill in a fictitious problem-solving task, by taking a sample of 404 undergraduate students from the Mohammed V University of Rabat (M5U-Rabat). The data collection instrument is the questionnaire. The findings showed that the weak collaborative sub-skills among M5U-Rabat students are mainly social and relate to "interaction", "self-assessment" and "transactive memory". Also, differences in mastering these collaborative sub-skills are verified between students according to the type of their high school diploma; however, the type of training and university course chosen has no effect on the level of these skills.

Keywords: *Assessment, Collaborative Skill, Collaborative Problem Solving, Higher Education.*

1. INTRODUCTION

The end of the 20th century was marked by a shift in work patterns, leading people to collaborate more frequently within groups. This development of collective work was evident in various sectors, ranging from the industrial sector to training and education (Devine et al., 1999; Yan and Louis, 1999).

In this regard, several researchers (Autor et al., 2003; Deming, 2015) It has been subsequently observed that, during the final decades of the 20th century, the most significant surge in demand was for non-routine analytical abilities and interpersonal skills.

In the 21st century, these changes and transformations in the labor market have continued to evolve significantly, especially with technological advancements and innovation creating new jobs and work modes.

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Beginning in 2002, several initiatives have been introduced, notably the "Partnership for 21st Century Skills" (P21) and the "Assessment and Teaching of 21st Century Skills" (ATC21S), which concentrate on critical skills for the 21st century. Consequently, collaboration has been recognized as a pivotal skill for the 21st century in all frameworks that have examined the new competencies necessitated by major shifts in the labor market, as noted by Voogt and Roblin (2012) and Binkley et al. (2012).

A recent investigation in Morocco (Khaouja et al., 2019) identified collaborative ability as the most sought-after "soft skill" in the nation's job market. Similar to practices in other countries, the development of collaboration skills in Morocco is not directly taught but is rather implicitly cultivated through group-based learning activities and extracurricular engagements.

In an era where the significance of collaborative skills is escalating in both global and national job markets, and considering the Moroccan educational system's lack of dedicated instruction in this area, there arises a question about the proficiency levels of these skills among university freshmen. This inquiry revolves around whether new university entrants possess an adequate level of collaborative competence and whether the measured performance levels in students are influenced by specific variables.

In response to these queries, our approach involved a quantitative investigation, structured around the ATC21S measurement framework. This study was conducted using a carefully crafted questionnaire, which was distributed to students at Moroccan universities.

2. THEORETICAL FRAMEWORK

2.1 Concept of Collaborative Skill

The analysis of global scientific production in the Scopus, Web of Science, and Springer databases regarding the term "collaborative skill" revealed a significant increase in publications in all three databases during the period 2000-2020 (El Hassani and Elomari, 2022). Furthermore, the term "collaborative skill" is used in various fields, primarily in education, computer science, management, medicine, and engineering.

Despite the burgeoning and multidisciplinary expansion of global scientific literature on the concept of "collaborative skill," there remains a diversity of definitions and interpretations of this term. The challenge in delineating collaborative skill stems from the multiple meanings associated with its constituent terms, "skill" and "collaboration." The interpretation of "skill" varies across different approaches and disciplinary domains, as highlighted by Jonnaert (2009). Similarly, the term "collaboration" is subject to varying understandings, as discussed by Thomson and Perry (2007) and Henri and Lundgren-Cayrol (2001).

Given the intricate nuances and multidisciplinary complexity surrounding the concept of collaborative skill, it is essential to craft a definition that encapsulates its essence, the actions it entails, the context in which it is applied, its outcomes, and its objectives. This approach aligns with Tardif's (2006) definition of skill as "a complex know-how rooted in the effective mobilization and integration of a diverse array of internal and external resources across a range of situations." Additionally, it resonates with Bedewell et al.'s (2012) interpretation of collaboration as "an evolving process where multiple social entities actively and mutually participate in joint activities to achieve at least one shared objective." Building on these perspectives, we articulate collaborative skill as "the knowledge of voluntary interaction in a group context, focused on addressing a common issue or attaining a mutual objective" (El Hassani and Elomari, 2022).

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2.2 Assessment of Collaborative Skill

In the educational research domain, the strategy of Collaborative Problem Solving (CPS) has been pinpointed as a crucial technique for the assessment of collaborative skills. Subsequently, a number of theoretical frameworks for evaluating CPS proficiency have been formulated. Prominently, the ATC21S (Assessment and Teaching of 21st Century Skills) and the PISA (Programme for International Student Assessment) frameworks were conceptualized in a parallel timeline, setting a precedent in this field. These frameworks have significantly influenced subsequent models, as evidenced by the referential works in later frameworks that draw upon the pioneering efforts of the ATC21S and PISA 2013 initiatives, a point elaborated by Dingler et al. (2017). The ensuing section is dedicated to explicating the ATC21S framework and its implementation in the context of our study as is it shall be detailed in Table 1.

Building upon the ATC21S framework's application in our study, as previously discussed, it's notable that the framework categorizes Collaborative Problem Solving (CPS) skills into five distinct groups. Within these, three categories fall under the social dimension: 'Participation', 'Perspective Taking', and 'Social Regulation'. These categories collectively encapsulate the interpersonal aspects of CPS. Participation refers to the willingness and individuals be available to externalize and share information and thoughts. Perspective taking refers to the ability to see a problem through the eyes of a collaborator. Social Regulation refers to the ability of an employee to use their acquaintance with the strengths and weaknesses of other employees to coordinate and resolve differences in views, interests and strategies.

Additionally, the ATC21S framework delineates two categories within the cognitive domain: 'Task Regulation' and 'Learning and Knowledge Building. Task Regulation refers to the way the problem solver handles the task, whereas learning and knowledge building refers to the reasoning ability used.

For each category of skills (social and cognitive) sub-skills were identified to reach to a framework of eighteen sub-skills. These were then linked to observable behavioral indicators that constitute skill evidence. Finally, the behavioural indicators for each sub-skill were ordered into performance levels, which could be used as scoring items to classify observed performance into three levels: low, medium and high (Hesse et al, 2015).

3. RESEARCH OBJECTIVES

Our research study aims to assess the level of collaborative skill among students of M5U-Rabat. In addition, we sought to identify the factors that determine the level of this skill in the Moroccan university through three comparison parameters: the type of high school diploma, the type of training and the type of university course. Thus, the research questions that this study attempted to answer are as follows:

QR1: What is the level of collaborative skill among first-year students?

QR2: What are the determinants of collaborative skill performance among students at Mohammed V University in Rabat?

To answer our second question, we formulated three null hypotheses as follows:

H1: The type of high school diploma has no significant impact on the level of collaborative skill of the students of Mohamed V University of Rabat.

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H2: The type of training (fundamental or professional) has no significant impact on the level of collaborative skill among the students of Mohamed V University of Rabat.

H3: The type of university course has no significant impact on the level of collaborative skill among the students of Mohamed V University of Rabat.

4. METHODOLOGY

The methodology recommended in this study is based on an empirical quantitative survey carried out among students at the Mohammed V University of Rabat. The sample is constituted using the non-proportional stratified sampling method, where each university sector represents a stratum. In each stratum, simple random sampling is carried out. The measurement instrument used is a questionnaire developed based on the ATC21S framework to assess collaborative competence in a problem-solving task. The questionnaire is distributed in electronic and paper format. Student's T test and ANOVA test were used to analyze the collected data.

4.1 Research instruments:

In our quantitative study, we adopted the conceptual framework developed by Hesse, Care, Buder, Sassenberg, and Griffin (2015), which is an extension of the ATC21S project. We selected this model specifically for its focus on the instruction of collaborative skills. The framework's performance indicators categorize Moroccan university students into three proficiency levels: high, medium, and low. The ATC21S model is instrumental for formative assessment, facilitating monitoring of students' progress in collaborative skills throughout their university education. This is particularly relevant when integrating these skills into academic modules. We posit that this framework, with its comprehensive measurement of eighteen sub-skills, effectively encompasses all aspects of collaborative abilities that should be cultivated in students. (Table I)

Table I: Reference framework for collaborative skills according to Hesse et al. (2015).

Element	Indicator	Low level	Medium level	High level
Social Skills				
Participation				
Action	Acting in the environment			
Interaction	Interacting with others, encouraging them and responding to their contributions			
Task completion/ perseverance	Committing to and individually complete a task (or a part of it)			
Perspective taking				
Adaptive responsiveness	Ignoring, accepting or adopting the contributions of others			
Audience consideration	Bing aware of how to adapt one's behaviour to others in order to increase convenience			
Social regulation				
Negotiation	Reaching a solution or compromise			
Self-assessment (metamemory)	Knowing one's strengths and weaknesses			
Transactive memory	Knowing one's strengths and weaknesses			
Sens of responsibility	Assuming responsibility for ensuring that certain parts of the task are completed by the team			
Cognitive skills				
Task regulation				

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Organization (problem analysis)	Analyzing and describing a problem in a familiar language			
Goal setting	Setting a clear goal for a task			
Resource management	Managing resources or the persons for task completion			
Flexibility and ambiguity	Accepting ambiguous situations			
Necessary data collection	Examining and understanding the task elements			
Systematic approach (follow-up)	Applying possible solutions to a problem and monitor the progress			
Learning and knowledge building				
Relationships (outlining and elaborating)	Identifying the links and models "between" and "among" the elements of knowledge			
Rules "if…then"	Availing of the understanding of factors and impacts to devise a plan			
Hypothesis "and if…"	Accommodate reasoning or action plan according to data or circumstances change			

Based on this framework, we elaborated a questionnaire to collect data on the level of student collaborative skill. At the beginning of the questionnaire, a simulation of a simple, real and recurrent problem in class is proposed to the students. It is as follows:

"*Imagine that you have a class lesson in which you are going to outline your presentation made in a group. When you proceed to display your power point presentation on a screen using the data show, the screen is empty with a blue background.*

This technical problem often arises in class. Therefore, the teacher asked you to go back to your seats and required that your group and the other groups to find a solution to this technical problem".

Then, the student must choose an answer that corresponds to his decision, his words or his action in a given situation. Each question is supposed to reflect an indicator of the Hessian matrix while the proposed answers respectively represent the three levels of collaborative skill assessment, namely: low level, medium level, high level. The questions were presented according to a logical chronology of the process of solving the stated problem and cover the eighteen indicators mentioned in the framework of Hesse et al (2015).

In total, the questionnaire includes twenty-seven questions: the first eight questions concern socio-demographic information while the remaining nineteen are about the indicators for assessing collaborative skill, except that indicator thirteen relating to "ambiguity" and "flexibility " was handled in two questions, one assessing "ambiguity" and the other "flexibility".

4.2 Methodological approach

The questionnaire administration is carried out in two phases:

The initial phase of our methodology involved a preliminary test of the questionnaire in November 2021 with a select group of students who were not part of the main sample. This step aimed to ensure the questions were clear and understandable. Following this, in December 2021, the questionnaire was further reviewed by two experts to confirm its consistency with the specified measurement indicators.

In the subsequent phase, the questionnaire was distributed online via Google Forms over a period of nearly three months, from March 11 to May 25, 2022. To inform potential participants about the survey, an explanatory message detailing its purpose, along with a link

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to the questionnaire, was shared with contacts such as professors and class delegates. These individuals were tasked with spreading the word among students to promote participation in the study. Despite several reminders, the response rate from students pursuing fundamental degrees remained notably low. In response to this, a more direct approach was adopted. Professors teaching fundamental degree courses (in business and management, physical and chemical sciences, and French studies) were asked to dedicate the last 15 minutes of their classes for students to complete paper versions of the questionnaire. This method proved effective, yielding a total of 404 responses. Out of these, 377 were deemed suitable for statistical analysis.

To address the research questions and test the hypotheses, we employed statistical methods tailored to each hypothesis. Specifically, the Anova test was utilized for hypotheses 1 and 3, while the Student's t-test was applied to hypothesis 2. This approach ensured that each hypothesis was analyzed using the most appropriate statistical tool, providing robust and reliable results.

4.3 Sample:

The sampling strategy implemented in this study was carefully designed to enable extrapolation of the sample results. This approach aims to assess the level of collaborative skill among first-year university students at Mohammed V University of Rabat. Thus, the sample composition is carried out according to the non-proportional stratified sampling method. Indeed, each course represents a stratum; in each stratum, a random and simple sampling is carried out. Four faculties of M5U-Rabat in different scientific fields were chosen for this assessment study, namely Faculty of Law, Economics and Social Sciences (FSJES), Faculty of Sciences (FS), Faculty of Letters and Human Sciences (FSLH), and Faculty of Education Sciences (FSE). In each faculty, two training courses have been targeted: a professional degree course and a similar course for a fundamental degree.

The table below explains in detail the distribution of participating students by university course: (Table II)

Table II: Distribution of participating students according to university course

Course	% of participating students	Number of participating students	Number of enrolled students
Fundamental bachelor's degree	**80%**	**301**	**5533**
bachelor's degree in Education	6,63%	25	40
French studies	14,59	55	837
Economics and Management	26,26%	99	2958
Sciences of Physical-Chemical Matter (SPCM)	32,36%	122	1698
Professional bachelor's degree	**20%**	**76**	**202**
Bachelor's degree of Excellence in Education Science	6,63%	25	40
Communication	3,49%	13	17
Business management and administration	5,87%	22	106
Promotion of local products	4,24%	16	39
Total	**100%**	**377**	**5735**

In the sample selected for this study, females represent a significant majority, comprising 74% of the student population. Within this group of first-year university students, who began their studies in 2021, there is a clear dominance of those who have pursued scientific disciplines

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in secondary education, making up 85.67% of the sample. Additionally, students from literary backgrounds account for 10.87%, while those from technical fields constitute 3.45%. A substantial 83% of these students have completed their baccalaureate in public institutions. In terms of academic program selection, 80% of the students are enrolled in fundamental degree programs, with the remaining 20% undertaking professional degrees.

4.4 Questionnaire Validity and Reliability:

The construct validity of the questionnaire was examined using Exploratory Factor Analysis (EFA). The results of the Kaiser-Meyer-Olkin (KMO) test and the Bartlett test indicate the appropriateness of Exploratory Factor Analysis (EFA) for our questionnaire dataset. (See Table II)

Table III: KMO and Bartlett Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.768
Bartlett's Test of Sphericity	Approximate Chi-Square	740.798
	Degrees of Freedom	171
	Significance	0.000

The KMO value is 0.768, suggesting that the sample is adequate for conducting EFA. The Bartlett test shows an approximate chi-square of 740.798 with 171 degrees of freedom, and the p-value is 0.000. This indicates significant correlations among variables, justifying the use of EFA. Additionally, reliability results for all questions, as determined by Cronbach's alpha coefficient, is significant (0.709): (Table IV)

Table IV: Questionnaire Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.709	0.713	19

The outcomes of the Exploratory Factor Analysis (EFA) and the Cronbach's alpha calculations substantiate both the validity and reliability of the questionnaire for evaluating collaborative skill across its social and cognitive dimensions. This evidence bolsters the psychometric robustness of our measurement instrument, confirming its capacity to assess collaborative skill in a reliable and valid manner within the specified target population.

5. FINDINGS:

5.1 Level of collaborative skill among the students of Mohamed V University of Rabat M5U–Rabat (QR1):

To present the performance levels of students based on the obtained averages, we consider the following interpretation of average values: [1; 1.49] corresponds to a very low level, [1.5; 1.99] corresponds to a low level, [2; 2.49] corresponds to a medium level, and [2.5; 3] corresponds to a high level. Thus, the results of assessing collaborative skill among students show that students have average performance in six social sub-skills: “adaptive reactivity” (mean =2.15), “negotiation” (mean =2.18), “action” (mean =2.26), “Task completion / perseverance” (mean =2.21), “consideration of the audience” (mean =2.37) and “sense of responsibility” (mean =2.43). Regarding cognitive abilities, students have average performance in nine cognitive sub-skills: “ambiguity” (mean =2.03), “goal setting” (mean =2.19), “relationships” (mean=2.19), “systematic approach” (mean=2.21), “resource management” (mean =2.25), “what if…” hypothesis” (mean =2.26), “rules” if. .. then" (mean =2.28)", "necessary data collection" (mean =2.35) and "flexibility" (mean=2.45).

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However, students have low performance in three social skills: "interaction" (X=1.78), "self-assessment" (mean =1.87), "transactive memory" (mean =1.93) and a single cognitive skill: “organization” (mean=1.75). (Table V)

Table V: Level of collaborative skill among the students of Mohamed V University of Rabat M5U–Rabat

Variable\ Statistics	Average	Standard deviation
Participation		
Action	2,26	0.911
Interaction	**1.78**	**0,633**
Task completion / perseverance	2,21	0,706
Perspective taking		
Adaptive reactivity	2,15	0,601
Audience consideration	2,37	0,594
Social regulation		
Negotiation	2,18	0,809
Self-assessment (Meta-memory)	**1,87**	**0,829**
Transactive memory	**1,93**	**0,823**
Sense of responsibility	2,43	0,722
Task regulation		
Organization (problem analysis)	**1,75**	**0,745**
Goal setting	2,19	0,845
Resource management	2,25	0,737
Flexibility	2,45	0,755
Ambiguity	2,03	0,891
Necessary data collection	2,35	0,796
Systematic approach (follow-up)	2,21	0,701
Learning and knowledge building		
Relationships (outlining and elaborating)	2,19	0,838
Rules« if ... then »	2,28	0,773
Hypothesis " and if …"	2,26	0,81

5.2 Factors of collaborative skill among M5U–Rabat students (QR2):

The second question of the study aims to reveal the differences that may exist in terms of collaborative skill between students according to factors that characterize them; it is estimated that may have an effect on the level of command of this skill. We opted for verifying the impacts of three factors: type of high school diploma, type of university education and type of course.

5.2.1 Impact of the factor: Type of high school diploma

Findings of the level of collaborative skill according to the type of High School Diploma of the students are as follows: (Table VI)

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Table VI: Level of collaborative skill of M5U-Rabat students according to the type of High School Diploma

	Literary high school diploma		Scientific high school diploma		Technical high school diploma	
Variable\ Statistics	**Average**	**Standard deviation**	**Average**	**Standard deviation**	**Average**	**Standard deviation**
Participation						
Action	2,26	0,939	2,25	0,916	2,62	0,650
Interaction	1,74	0,665	1,79	0,630	1,62	0,650
Task completion / perseverance	2,29	0,742	2,21	0,707	2,23	0,599
Perspective taking						
Adaptive reactivity	2	0,625	2,17	0,599	2,15	0,555
Audience consideration	2,29	0,544	2,37	0,600	2,62	0,506
Social regulation						
Negotiation	2,07	0,745	2,20	0,818	2,15	0,801
Self-assessment (Meta-memory)	1,57	0,831	1,91	0,827	1,92	0,760
Transactive Memory	1,66	0,762	1,97	0,835	1,69	0,751
Sense of responsibility	2,29	0,708	2,43	0,729	2,69	0,48
Task regulation						
Organization (problem analysis)	1,76	0,759	1,75	0,744	1,92	0,760
Goal setting	1,76	0,850	2,24	0,830	2,15	0,899
Resource management	2,26	0,665	2,25	0,745	2,38	0,768
Flexibility	2,31	0,841	2,47	0,748	2,38	0,650
Ambiguity	2,07	0,894	2,04	0,895	1,69	0,751
Necessary data collection	2,24	0,821	2,36	0,791	2,46	0,877
Systematic approach (follow-up)	2,14	0,783	2,21	0,695	2,31	0,630
Learning and knowledge building						
Relationships (outlining and elaboration)	2,31	0,841	2,17	0,840	2,38	0,768
Rules« if...then»	2,19	0,773	2,28	0,773	2,46	0,776
Hypothesis " And if …"	2,26	0,857	2,26	0,806	2,23	0,832

The comparative analysis of students based on their high school diploma types yielded two distinct outcomes. Firstly, the null hypothesis H1 was rejected at a 5% significance level for the social sub-skills 'Self-Assessment' ($p = 0.045$) and 'Transactive Memory' ($p = 0.045$), as well as for the cognitive sub-skills 'Goal Setting' ($p = 0.002$) and 'What If Hypothesis' ($p = 0.011$). Secondly, for all other collaborative sub-skills assessed, the null hypothesis H1 was accepted, indicating no significant differences based on the type of high school diploma. (Table VII)

Table VII: Impact of the factor: type of high school diploma

Variable\ Statistics	**p**
Participation	
Action	0,37
Interaction	0,542
Task completion / perseverance	0,782
Perspective taking	
Adaptive reactivity	0,211
Audience consideration	0,217
Social regulation	
Negotiation	0,635
Self-assessment (Meta-memory)	**0,045**
Transactive memory	**0,045**

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Sense of responsibility	0,185
Task regulation	
Organization (problem analysis)	0,702
Goal setting	**0,002**
Resource management	0,804
Flexibility	0,391
Ambiguity	0,372
Necessary data collection	0,577
Systematic approach (Follow-up)	0,728
Learning and knowledge building	
Relationships (outlining and elaborating)	0,442
Rules« if ... then »	0,405
Hypothesis " and if …"	**0,011**

5.2.2 Impact of the factor: type of university education (open access/ limited- access)

Mohammed V University of Rabat provides two distinct educational pathways: a fundamental degree program, which is open-access for recent high school graduates, and a professional and excellence degree program that is available to new high school graduates who have successfully cleared the admission exams, thus offering limited-access.

The averages obtained for the two types of training are as follows: (Table VIII)

Table VIII: Level of collaborative skill among M5U–Rabat students according to type of training

	Open access		*Limited- access*	
Variable\ Statistics	**Average**	**Standard deviation**	**Average**	**Standard deviation**
Participation				
Action	2,21	0,929	2,5	0,792
Interaction	1,77	0,607	1,83	0,737
Task completion / perseverance	2,20	0,721	2,26	0,64
Perspective taking				
Adaptive reactivity	2,16	0,611	2,14	0,559
Audience consideration	2,37	0,608	2,36	0,534
Social regulation				
negotiation	2,16	0,812	2,28	0,793
Self-assessment (Meta-memory)	1,85	0,828	1,27	0,832
Transactive memory	1,91	0,837	2.00	0,8
Sense of responsibility	2,38	0,734	2,63	0,629
Task regulation				
Organization (problem analysis)	1,78	0,753	1,64	0,706
Goal setting	2,12	0,845	2,47	0,791
Resource management	2,25	0,752	2,29	0,67
Flexibility	2,44	0,759	2,53	0,739
Ambiguity	2,02	0,897	2,07	0,869
Necessary data collection	2,31	0,815	2,53	0,683
Systematic approach (follow-up)	2,17	0,686	2,37	0,746
Learning and knowledge building				
Relationships (outlining and elaborating)	2,17	0,846	2,26	0,806
Rules« if ... then »	2,26	0,782	2,37	0,727
Hypothesis "And if…"	2,27	0,822	2,24	0,764

The analysis comparing students based on their type of university education results in two distinct scenarios. Firstly, the null hypothesis H2 is rejected at a 5% level of significance

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for certain collaborative sub-skills: 'Action' (p = 0.006), 'Sense of Responsibility' (p = 0.003), 'Goal Setting', 'Collection of Necessary Information' (p = 0.016), and 'Systematicity' (p = 0.037). Secondly, for all other collaborative sub-skills, the null hypothesis H2 is accepted, indicating no significant differences are observed between the groups in these areas. (Table IX)

Table IX: Impact of the factor: type of training

Variable \ Statistics	p
Participation	
Action	**0,006**
Interaction	0,478
Task completion / perseverance	0,505
Perspective taking	
adaptive reactivity	0,874
Audience consideration	0,854
Social regulation	
Negotiation	0,26
Self-assessment (Meta-memory)	0,238
Transactive memory	0,398
Sense of responsibility	**0,003**
Task regulation	
Organization (problem analysis)	0,157
Goal setting	**0,001**
Resource management	0,639
Flexibility	0,352
Ambiguity	0,697
Necessary data collection	**0,016**
Systematic approach (follow-up)	**0,037**
Learning and knowledge building	
Relationships (outlining and elaborating)	0,393
Rules« if... then »	0,264
Hypothesis " And if …"	0,752

5.2.3 Impact of the factor: type of university course

The findings regarding the level of collaborative skill of students according to their university courses are outlined in the following table: (Table X)

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Table X: Level of collaborative skill of M5U-Rabat students according to the type of university course

	Average (Economics)		Average (Education Science)		Average (Sciences of the Physical-Chemical Matter)		Average (French Literature)	
Variable	**Economics & Management**	**Business Management & administration**	**Bachelor's Degree in Education**	**Bachelor's Degree of excellence in Education Science**	**Sciences Physical-Chemical Matter (SPCM)**	**Promotion of Local Products**	**French Literature**	**Communication**
Participation								
Action	2,27	2,32	2,48	2,80	2,13	2,19	2,19	2,62
Interaction	1,82	1,95	1,88	1,76	1,74	1,62	1,72	2,00
Task completion / perseverance	2,25	2,09	2,20	2,40	2,17	2,31	2,21	2,23
Perspective taking								
Adaptative Raactivity	2,21	2,05	2,20	2,32	2,17	2,25	2,00	1,85
Audience consideration	2,36	2,41	2,52	2,32	2,35	2,31	2,36	2,38
Social regulation								
Negotiation	2,14	2,09	2,28	2,44	2,13	2,31	2,21	2,23
Self-assessment (Meta-memory)	1,93	1,95	1,84	2,08	1,87	2,00	1,67	1,77
Transactive memory	1,92	2,23	1,80	1,80	1,95	2,19	1,84	1,77
Sense of responsability	2,45	2,55	2,60	2,64	2,28	2,69	2,39	2,69
Task regulation								
Organization (problem analysis)	1,96	1,41	2,00	1,88	1,62	1,56	1,75	1,69
Goal setting	2,13	2,55	2,40	2,36	2,17	2,56	1,87	2,46
Resource management	2,32	2,09	2,48	2,40	2,16	2,19	2,21	2,54
Flexibility	2,43	2,5	2,68	2,60	2,38	2,56	2,49	2,38
Ambiguity	1,93	2,05	2,32	2,12	2,05	2,06	1,98	2,00
Necessary data collection	2,21	2,77	2,36	2,64	2,35	2,31	2,33	2,15
Systematic approach (follow-up)	2,12	2,23	2,44	2,64	2,15	2,31	2,19	2,15
Learning and knowledge building								
Relationships (outlining and elaborating)	2,21	2,41	2,28	2,28	2,06	2,19	2,33	2,08
Rules« if ... then »	2,24	2,36	2,20	2,48	2,28	2,37	2,27	2,15
Hypothesis " And if …"	2,18	2,27	2,56	2,24	2,20	2,31	2,46	2,08

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The comparison of the four university training courses (educational sciences, economics, chemical and physical sciences and French literature) shows that students have a different level of collaborative skill in the two social and cognitive dimensions (p=0.006) and (p=0.00). This result is due to the difference existing in one social sub-skill: "sense of responsibility"(p=0.037) and in three cognitive sub-skills: "organization" (p=0.013), "resource management" (p=0.024) and "systematic approach" (p=0,00).

Consequently, the comparison of students based on their type of university course reveals two distinct outcomes: the null hypothesis H3 is rejected at a 5% significance level for specific collaborative sub-skills, namely 'Sense of Responsibility' (p = 0.037), 'Organization' (p = 0.013), 'Resource Management' (p = 0.024), and 'Systematic Approach' (p = 0.00). Conversely, for all other collaborative sub-skills, the null hypothesis H3 is accepted, indicating no significant differences are found in these areas. (Table XI)

Table XI: Impact of the factor: type of university course

Variable\ Statistics	p
Participation	
Action	0,05
Interaction	0,279
Task completion / perseverance	0,865
Perspective taking	
Adaptative reactivity	0,105
Audience consideration	0,768
Social regulation	
Negotiation	0,129
Self-assessment (Meta-memory)	0,145
Transactive memory	0,056
Sense of responsibility	**0,037**
Task regulation	
Organization (problem analysis)	**0,013**
Goal setting	0,172
Resource management	**0,024**
Flexibility	0,379
Ambiguity	0,312
Necessary data collection	0,715
Systematic approach (follow-up)	**0,000**
Learning and knowledge building	
Relationships (outlining and elaborating)	0,124
Rules« if ... then »	0,99

In summary, the results of this study made it possible to identify the initial level of collaborative competence among students at UM5-Rabat. It appears that the collaborative sub-skills presenting weaknesses among those students are mainly of a social nature, namely “Interaction”, “Self-assessment” and “Transactive Memory”. In addition, disparities were observed in the mastery of these collaborative sub-skills depending on the type of baccalaureate of the students, while the choice of training and university sector did not have a significant impact on the level of these sub-skills.

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6. DISCUSSION

Assessing collaborative skill in a problem-solving task can be challenging given the complexity of this concept and the diversity of social and cognitive sub-skills within CPS. One way to reduce the complexity of assessing qualities in CPS has been to greatly restrict the problem, environment, or collaborative approach (Andrews-Todd, J., & Forsyth, C. M., 2018).

In the present study, we examined collaborative problem solving in a classic classroom environment that uses human-to-human collaboration. A fictitious simulation of a simple and recurrent problem was proposed to the groups of students supposed to present a collective work in class. This scenario to solve a simple but real and inter human problem will allow the student to choose the answer that corresponds to his behavior (action or communication) in this simulation of collective work.

The findings from this evaluative study provide significant insights in response to the initial research question, which aimed to measure the initial level of collaborative skill among students, covering both social and cognitive dimensions. At the beginning of their university education, students generally exhibit moderate levels of collaborative skill. However, lower proficiency is noted in three social sub-skills: "Interaction", "Self-Assessment", and "Transactive Memory", as well as in one cognitive sub-skill: "Organization". These outcomes, indicative of an overall moderate skill level, align with some aspects of previous research (Mashuri et al., 2020). Yet, a deviation is observed in this context where the social sub-skills, contrary to the findings of Mashuri et al. (2020) who highlighted cognitive sub-skills, require more focused improvement.

In addressing the second research question regarding factors influencing collaborative skill levels among students at Mohammed V University of Rabat (M5U-Rabat), the study reveals that collaborative sub-skills vary depending on the type of high school diploma held by the students. However, these skills do not seem to be influenced by the type of university education or the chosen academic major.

This research highlights the necessity of enhancing collaborative skills in university students, irrespective of their education type (open or regulated access) and university major. This development is crucial for equipping them to meet the job market's demands regarding this skill.

Intervention strategies should focus primarily on bolstering the identified weaker sub-skills. "Interaction" is crucial, as it involves responsive and coordinated behavior with others, a vital component of collaboration. Effective interaction enables members to better comprehend each other's viewpoints, define objectives, discuss challenges, resolve conflicts, and share knowledge and strategies. According to Crowston et al. (2006), "Interaction" is fundamental for successful coordination and occurs through verbal and non-verbal means (Clark, 1996). Likewise, "Self-assessment" and "Transactive Memory," which facilitate social regulation, are essential in recognizing group diversity. "Self-assessment" relates to self-awareness (Flavell, 1976), while "Transactive Memory" involves understanding collaborators' strengths and weaknesses (Wegner, 1986).

"Organization", a key component of task-related regulation, involves analyzing problems and breaking down tasks into sub-tasks with specific sub-objectives. A deficiency in "Organization" can lead to a less structured and efficient problem-solving process, hindering goal attainment.

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Therefore, further research is warranted to monitor the progression of collaborative skills into the second year of university and through to the completion of the bachelor's degree. Such studies will ascertain whether the current educational approaches positively impact the development of collaborative skills or if there is a need to integrate specific programs for enhancing these skills in Moroccan universities.

This research, while providing valuable insights, is subject to certain limitations that merit consideration. Firstly, its execution at a single Moroccan university introduces a limitation in terms of generalizability. The findings, thus, predominantly reflect the context of this specific institution and may not be extrapolatable to other universities within Morocco, potentially limiting their broader applicability.

Furthermore, the methodological approach of this study, grounded in quantitative analysis and primarily reliant on a questionnaire for assessing students' collaborative skills, presents another limitation. Given the dynamic and multifaceted nature of collaborative skills, a more robust evaluation would benefit from employing a diverse array of assessment tools and methodologies. This would enhance both the reliability and validity of the results. The reliance on a single assessment tool, particularly one based on self-reporting, is prone to inherent biases. These biases, especially prevalent in self-assessment, can potentially skew the outcomes. As noted in the literature, students often face challenges in accurately evaluating metacognitive processes (Dunlosky and Metcalfe, 2008), a phenomenon that could similarly impact the assessment of collaborative skills.

The study's focus on "self-assessment" as an integral aspect of collaborative skills and the subsequent identification of weaknesses in this area among students further underscore the need for a more nuanced and comprehensive methodological approach. Future research endeavors in this domain could benefit significantly from adopting mixed-methods approaches, integrating quantitative findings with qualitative insights, and utilizing a range of assessment tools. Such an approach would allow for a more holistic and detailed understanding of collaborative skills in educational settings, thereby contributing more effectively to the field of educational research.

7. CONCLUSION

This investigation, centered on assessing collaborative skill, facilitated both the practical application and validation of the conceptual framework devised by Hesse et al. (2015) within the Moroccan university context. The study unveiled a moderate overall level of collaborative skill among Moroccan university students and identified specific social sub-skills, such as interaction, self-assessment, transactive memory, and organization that necessitate enhancement. Additionally, it established that neither the mode of education (open access vs. regulated access) nor the chosen university major significantly influences students' collaborative skills. However, the type of baccalaureate has a significant effect on the mastery levels of collaborative skills among students.

Qualitative studies are necessary to be able to explain the weakness of social skills among students before entering university. Does the Moroccan school system (primary and secondary) not sufficiently develop social sub-skills among students? And why does the type of baccalaureate have a significant effect on "self-assessment" and "transactive memory"?

Moreover, this exploration into collaborative skill, particularly within the context of a problem-solving activity, presented notable evaluation challenges. These challenges stem

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primarily from the multifaceted nature of collaborative problem-solving (CPS) and the intricate interdependence of its various sub-skills. This complexity raises a pertinent question regarding the pedagogical aspect: Do these evaluation challenges in CPS also mirror difficulties in its instruction? The implication here is the need to critically examine and possibly refine the teaching methodologies of CPS to ensure they are as effective and comprehensive as the evaluation strategies employed.

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