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Main Gaps in the Training and Assessment of Teamwork Competency in the University Context

María Luisa Sein-Echaluce[1](✉), Ángel Fidalgo-Blanco[2], and Francisco José García-Peñalvo[3]

[1] Departamento de Matemática Aplicada, Escuela de Ingeniería y Arquitectura, Universidad de Zaragoza, Zaragoza, Spain
mlsein@unizar.es

[2] LITI Laboratorio, Universidad Politécnica de Madrid, Madrid, Spain
angel.fidalgo@upm.es

[3] Grupo de Investigación GRIAL, Departamento de Informática y Automática, Instituto, Universitario de Ciencias de la Educación, Universidad de Salamanca, Salamanca, Spain
fgarcia@usal.es

Abstract. Individual competencies associated with teamwork are highly demanded in all productive and scientific sectors. International accreditation agencies have defined a set of indicators to identify the individual competencies associated with teamwork competence. Practically all universities address the challenge for graduates to acquire teamwork skills in groups and individually. In this context, it is essential to know whether students have acquired teamwork skills before entering the university and what training method they have followed to acquire them. In this research work, a tool has been developed to determine if they have followed procedures that generate evidence of these individual competencies throughout the development of teamwork, as well as the evaluation method used by the teachers who have trained them in this competency. The study was carried out on 171 students from two different subjects, degrees, and universities. The results confirm the central hypothesis of the work that the training method used before entering the university is of the "black box" type, where the faculty does not follow the evidence continuously and evaluates only the final result of the work.

Keywords: assessment · shared leadership · teamwork competence · university

1 Introduction

Teamwork is a highly demanded skill in all fields of knowledge since any work, service, or product requires collaborative actions between people. International organizations [1] have focused on the importance of teamwork for decades, and this interest has only grown.

In the academic field, great attention is paid to training in teamwork skills, not only because of its high demand in society. This Teamwork Competence (TC) enhances

learning, creativity, social skills, and communication among students [2, 3]. Likewise, it favors another set of competencies, called soft skills, which significantly impact the new Industry 4.0 [4].

Most students already perform teamwork during their pre-university academic training, and it is assumed that they have acquired the TC by the time they reach university. Nevertheless, in many cases, this supposed acquisition affects the training and evaluation of TC at the university.

The main hypothesis of this work is that most of the students have carried out the teamwork under a "black box" model. That is, teachers do not intervene or act during the development of teamwork and only evaluate the final product, giving the same grade to all members of the same team. This method makes it difficult for teachers to obtain evidence to assess both group (acquired by the team) and individual (acquired by its members) acquisition of TC.

The present work has the following objectives:

- To identify students' level of acquisition of TC when they begin their studies at the university.
- To know the degree of knowledge of techniques and tools for developing teamwork.
- To know the evaluation process of the TC, together with the evidence used by the teaching staff to evaluate it.

Based on the teamwork model of the International Project Management Association (IPMA) [5–7], one of the most important in project management accreditation, a survey has been developed to find out if the students have received training on teamwork tools and processes and if they have used them. The survey identifies the perception of the main problems that the students have with teamwork, the processes used by the students during their development, the technological tools used, and the method of evaluation of the processes and evidence used by the teachers.

The study was carried out in two Spanish universities: University of Zaragoza and Technical University of Madrid, in the first year of two different Engineering degrees, with a sample of 171 students. The results show, for example, that the main problem with teamwork, as perceived by the students, is the unequal workload among team members.

Regarding the training received, processes in which the students have received a high level of training are identified, such as the presentation of the final work, and other processes with very little training, such as the creation of evidences for the follow-up of the work. There is a significant lack of knowledge and use concerning the use of technological tools in the different processes. This work confirms the hypothesis that teamwork is carried out through a "black box" model, since the evaluation is mostly carried out at the end of the teamwork and not during its development. This makes it difficult for teachers to detect deficiencies in the individual formation of this competence and, therefore, to solve them during its development.

In the following sections, the teamwork model applied during the experience will be presented, followed by the context, the tools, and the results which support the research hypothesis and the conclusions of this work.

2 Teamwork Model

The realization of teamwork involves a set of processes and phases that are planned to achieve both a good result of the work and adequate development of the work. This set of phases and processes is called the teamwork model. One of the most widely used models in the realization of academic teamwork is the Tuckman model [8], which establishes four phases before the final delivery of the work: Forming, Storming, Norming, and Performing.

This model was extended from various contexts, for example, in the university context by MIT [9] and in the professional field by IPMA, and, in both cases, a fifth phase called "Delivering& Documentation" was added [5].

Subsequently, in 2018 IPMA [7] added a set of individual competencies, competencies that participants in teamwork should develop to acquire TC.

The first column of Table 1 shows the competence indicators of successful teamwork competencies in the TC, which are included in IPMA. The second column of Table 1 includes some of the measures which describe highly detailed performance points within each competence indicator, which can be observed in the teams' development of the current work.

Table 1. Indicators and measures for individual competencies of teamwork (IPMA, 2018) [7]

Indicator	Measure
I-1-Facilitates the selection and building of the team	- Clarifies outcomes and creates a common vision Facilitates the team to develop norms and rules
I-2-Promote cooperation and networking between team members	-Promotes cooperation with people both within and outside the team - Uses tool for collaboration
I-3-Support, facilitate and review the development of the team and its members	-Promotes continuous Learning and knowledge sharing -Plans and promotes "lessons learned" events
I-4-Empower teams to determine tasks and responsibilities	-Challenges the team to distribute all the tasks - Stimulates transparency about performance
I-5-Recognise opportunities to facilitate learning and inspires form continuous improvement	-Uses effects of errors as opportunities to learn - Analyses and discusses mistakes to determine improvement in processes

From the teamwork phases mentioned above (Forming, Forming, Storming, Norming, Performing, and Delivering& Documentation), evidence is obtained to evaluate group competencies, and through the indicators in Table 1, individual competencies can be assessed.

In this work, and based on these individual competencies, a tool (survey) was developed to measure the acquisition of TC before entering university. In the section defining the survey questions, the relationship of the question to the indicator expressed in column 1 of Table 1 is indicated next to the group of questions or a specific question.

To train and evaluate this teamwork model, the authors defined the Comprehensive Training Model of the Teamwork Competence (CTMTC) method [10, 11] that allows obtaining individual and group evidence to train, follow and evaluate the group and individual competencies defined in IPMA. The CTMTC method makes intensive use of information and communication technologies through technological ecosystems [12], making it possible to obtain evidence continuously. The analysis of this evidence in real-time makes it possible to observe the evolution and possible deficiencies in individual and group competencies.

Groups have conducted research from several universities [13–16] using the CTMTC method with excellent results and characteristics typical of agile organizations, such as process transparency [17]. Likewise, this method uses shared leadership, exercised by several team members [18], which improves the team's performance [19] since it allows a wide variety of behaviors [20].

Regardless of the teamwork model applied, the evaluation can be carried out in two ways: after the teamwork is completed (black box) and during the teamwork (white box).

The teamwork model defined here as a "black box" represents a method where the teacher does not observe the evolution of teamwork in real-time. That is to say, the evaluation in the acquisition of TC is performed once the teamwork is finished, together with the final result of the teamwork.

In this process, there may be initial training on TC, as well as the different roles of the team members. However, there is usually no follow-up, which makes it impossible to check the evolution of teamwork or to verify the acquisition of individual competencies.

The model referred to in this paper as the "white box" is one in which the teacher can see the evolution of teamwork in real-time In this method, the teacher can evaluate the competence continuously without waiting for the work's final result. This model also allows for a continuous training process, detecting critical situations and being able to correct them.

The following is a description of the context in which the study was conducted.

3 Context

The present study is based on the elaboration of a survey that was filled out by the students of two subjects in the first year (first semester) in two different universities:

- Subject "Mathematics II" of the Chemical Engineering degree of the University of Zaragoza, with 105 enrolled students, of which 85 participated in the survey (17 work teams with an average of 5 students per team).
- Subject "Fundamentals of Programming" of the Biotechnology degree at the Polytechnic University of Madrid, with 109 enrolled students, of which 86 participated in the survey (18 work teams with an average of 6 students per team).

At the beginning of the course, and before starting the training on the CTMTC teamwork method applied in each subject, the students filled out the survey included in the next section, followed by the results and the conclusions of this study.

4 Tool (Survey)

1. Identification: write the first letter of your first surname followed by the last three numerical digits of your ID (or equivalent) (e.g., P123).
2. Gender

   Answers: •Female •Male •I prefer not to answer

3. Age
4. Indicate your overall grade, out of 14. (e.g., 10.5 separated by a comma)
5. When did you start your university studies?

   Answers: •This year: 2022-2023 • Previous year: 2021-2022 •Year before 2021

6. How much academic teamwork have you completed during your high school or vocational module studies? Select a range: •None •Between 1 and 5 •Between 6 and 10 •More than 10
7. Have you been trained in the following aspects of teamwork? (1-never, 5-always). ***NOTE:*** It corresponds to the indicators I-1, I-2, I-3, and I-4 of Table 1.

- Explanation of teamwork characteristics
- Approach to work in terms of the work objectives
- Planning, assignment of tasks, milestones, and timeline
- Table of individual responsibilities
- How to follow up on the work
- Parts of the final report
- How to present and defend the work

8. Answer between 1 and 5 (1 never, 5 always) the following questions about how you have carried out the previous teamwork

   NOTE: It corresponds to the indicators I-3, I-4, and I-5 of the Table 1.

8.1 - A portion of the work was assigned to each team member, and a completion date was set.
8.2 - A follow-up mechanism was established to check how each team member's work was progressing.
8.3 - The steps that should be taken to carry out the teamwork was identified before the tasks were distributed.
8.4 - A calendar of activities was drawn up, including the result to be obtained in each activity.

9. Indicate what you liked least about the teamwork you have done in the past.

   NOTE: It corresponds to indicator I-2 of Table 1.

– The different workload among members
– The "freeloader"
– The little learning of teamwork skills
– All members getting the same grade
– Other

– If you checked “Other” in the previous question, please briefly indicate which one it would be.

The following questions (11 to 32) refer to your experience with teamwork during your high school or vocational module studies. In some of them you will be asked how often certain behaviors have been given. The values mean: 1 (never), 5(always).

NOTE: It corresponds to the indicators I-1, I-2, I-3, I-4, and I-5 of Table 1.

11. Detail technological tools (specific software) that you have used to develop teamwork
12. Did the faculty score planning (execution of work, significant tasks, coordination, etc.) as part of the teamwork grade?
13. A.1. If in A you marked 1(never), do not answer this question. What information did the teacher use to score such planning?
14. A.2. If in A you marked 1 (never), do not answer this question. When did the teacher evaluate this planning?

Answers: • Before finishing the work •After finishing the work • No answer

15. B. Have you made a map of responsibilities (the document that reflects the tasks and responsibilities of each component and is visible to the whole team)?
16. B.1 Did the faculty member rate the mapping of responsibilities?
17. B.2 If in B.1. You marked 1(never), do not answer this question. What information did the teacher use to score this responsibility map?
18. B.3 If in B.1 you marked 1 (never), do not answer this question. When did the teacher evaluate the map of responsibilities? •Before finishing the work •After finishing the work •No answer
19. C. Did you help your colleagues in any work team (solve doubts, provide useful information, help with more complicated tasks, ideas for improvement, etc.)?
20. C.1 Did the faculty member score that helps?
21. C.2 If in C.1 you marked 1(never), do not answer this question. What information did the teacher use to rate the help provided?
22. C.3 If in C.1 you marked 1 (never), do not answer this question. When did the teacher carry out the evaluation related to this help? •Before finishing the work •After finishing the work •No answer
23. D. When you have carried out a teamwork, have you tried to make it useful, original, understandable, and with a sufficient scientific level?
24. D.1 What aspect did the faculty value the most?
    - Understandable
    - With a sufficient scientific level
    - Original
    - Useful
25. E. Did the team have any mechanism for its members to know, at all times, how the work was progressing?
26. E.1. If in E you answered “1(never)”, do not answer this question. What was that mechanism?
27. E.2 Did the faculty punctuate the use of such a mechanism?

28. E.3 If in E.2 you marked 1 (never), do not answer this question. When did the teacher evaluate the use of this mechanism? • Before finishing the work. • After finishing the work. • No answer
29. F. In the team, were decisions made through discussions?
30. F.1 Did the faculty grade your participation in such discussions?
31. F.2 If in F.1 you marked 1(never) do not answer this question. What information did the teacher use to score your participation in the discussions?
32. F.3 If in F.1 you marked 1 (never), do not answer this question. When did the teacher evaluate your participation in the discussions? •Before finishing the work. •After finishing the work. •No answer

5 Results

Students enrolled in both subjects totaled 214, of whom 171 participated in the research, representing a participation rate of 79.91% of the total number of students enrolled.

To check that the sample can be formed by the sum of students from both universities (Technical University of Madrid- UPM and University of Zaragoza-UZ), questions Q6 and Q8 will be used to check that there are no significant differences between both groups of students. Question Q6 is about the number of academic teamwork the students have completed before starting at the university, and question Q8 is composed by 4 subquestions about how you have carried out the previous teamwork.

Table 2 shows the mean and standard deviation Mean and Sd for each of the questions used as contrast variables for each of the university (UPM and UZ).

Table 2. Questions Q6 and Q8 for both universities

Variable	Mean UZ	Sd UZ	Mean UPM	Sd UPM
Q6	2.788235	0.8604279	2.965116	0.8602007
Q8.1	3.823529	1.0255831	4.104651	0.8681159
Q8.2	2.529412	1.1400526	2.500000	0.9911372
Q8.3	3.164706	1.111060	3.453488	1.080925
Q8.4	2.352941	1.120224	2.000000	1.017494

To check that the samples (of the two universities) are equivalent, the Shapiro-Wilk test is applied to analyze whether the distribution is non-normal. Subsequently, the Wilcoxon test is applied, considering two paired samples. Table 3 shows the p-values of each test. Therefore, it can be concluded that the samples are not parametric and that there are no significant differences between them. Thus, the entire set of samples will be considered in the following analyses.

Once it has been demonstrated that the research can be done with the total number of participating students, the means and standard deviation for each subquestion in section Q8 are included in Table 4.

Table 3. Tests to show that the samples are equivalent

Variable	p-value Shapiro Wilk	p-value Wilcoxon
Q6	0.000000004208	0.2007
Q8.1	0.00000001267	0.0853
Q8.2	0.0000005548	0.9413
Q8.3	0.00001027	0.1224
Q8.4	0.000000008269	0.03714

Table 4. Total mean and standard deviation for the items in question Q8.

Variable	Mean	Sd
Q8.1	3.964912	0.9572924
Q8.2	2.51462	1.064711
Q8.3	3.309942	1.102332
Q8.4	2.175439	1.081222

Table 4 shows that the most common teamwork characteristic is the one reflected in option 8.1, "Part of the work was assigned to each team member, and a completion date was set," and the least used is 8.4, "A calendar of activities was drawn up, including the result to be obtained in each activity."

Next, the analysis of both characteristics ("assignment of work" 8.1 and "planning" 8.4) will be carried out to determine the processes used in the previous teamwork and the evaluation method used by the teachers.

Regarding the most used teamwork characteristic, "assignment of work" (8.1), it corresponds to the "Norming," one phase of the CTMTC method, where the different responsibilities are defined. The survey asked about the procedure used to make the team aware of the distribution of tasks (Q15), whether the teacher evaluated this procedure (Q16), and when the evaluation was carried out (Q18).

In Figs. 1 and 2, the y-axis represents the number of students who responded to the response (x-axis) answers from 1-never to 5-always, on a Likert scale.

Figure 1 (Q15) shows the number of students who used a document to specify tasks (planning- 8.4) and, therefore, to know the workload of each team member. It can be seen that 63.15% have never or rarely used it. At the same time, 36.85% recognize that they have used it some time, almost always, or permanently.

Figure 2 (Q16) analyzes that 36.85% of the students whether the teacher considered such work in the evaluation of teamwork. 84.79% of participants recognized that it was never or seldom evaluated. In turn, out of the 15,21% who indicated that it was evaluated at least once, 64% recognized that it was done before the end of the teamwork, as shown in Fig. 3 (Q18).

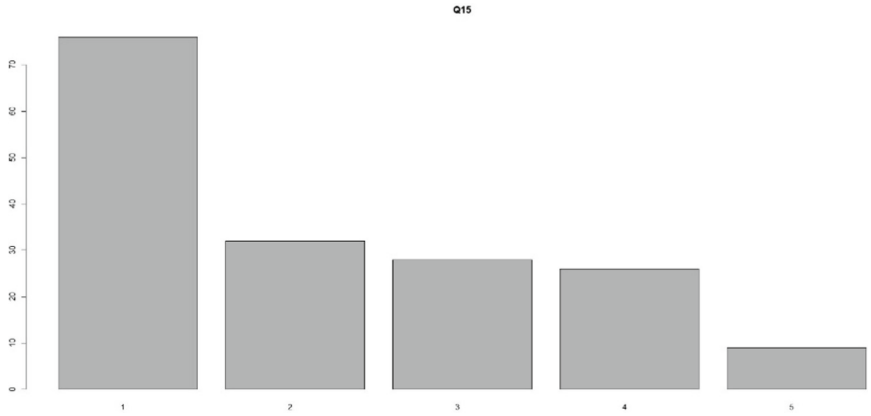

Fig. 1. Question Q15, Frequency distribution for each value of Likert scale: 1 (44.44%), 2 (18.71%), 3 (16.37%), 4 (15.22%) and 5 (5.26%).

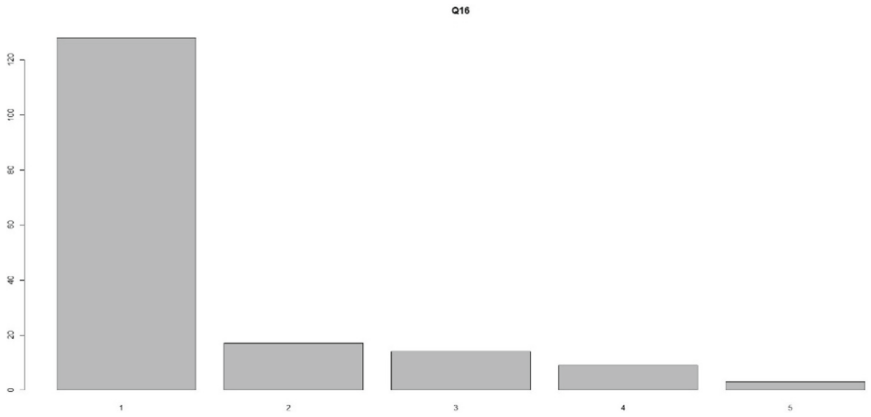

Fig. 2. Question Q16. Frequency distribution for each value of Likert scale: 1 (74.85%), 2 (9.94%), 3 (8.20%), 4 (5.26%) and 5 (1.75%).

As this habit is the most used by the students, the survey also clearly reflects the reason. If question Q9 is analyzed, the issue that most concerns the students is the unequal workload distribution. Figure 4 shows in a visual way how the variables “freeloader” and “unequal distribution of the workload” stand out.

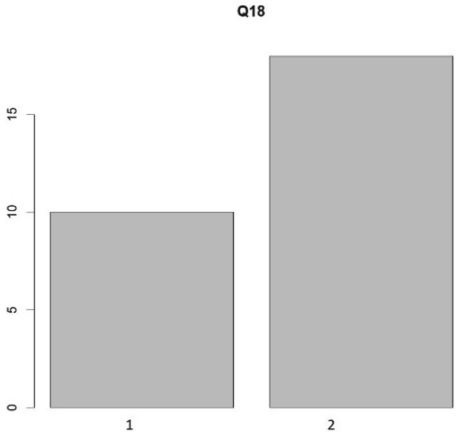

Fig. 3. Question Q18. Frequency distribution for each answer: 1-After (35.71%) and 2- Before (64.29%).

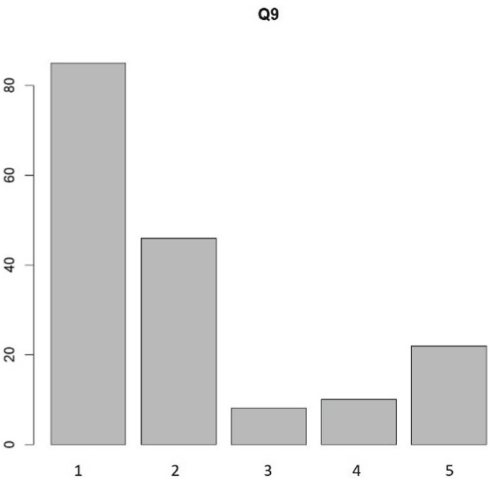

Fig. 4. Question Q09. Frequency distribution for each response: "1-freeloader" (49.71%), "2-different workload" (26.90%), "3-little learning" (8.20%), "4-other" (5.85%) and "5-the same grade" (12.86%). Thus, concern about unequal workload accounts for a per-centage of 76.61%.

Regarding the least used characteristic, "planning," this corresponds to the execution phase in the development of teamwork, where the most used tool is the chronogram. Question Q12 analyzes whether the teacher evaluated the planning, and question Q14 when this evaluation was made.

Figure 5 shows the number of answers on the Likert scale (1-Never to 5-Always) 34.5% recognize that the teacher did not evaluate the planning as opposed to 8.77% who indicate that the planning was always evaluated. However, a high percentage of the students, 54.97%, recognize that at least once they had completed the evaluation.

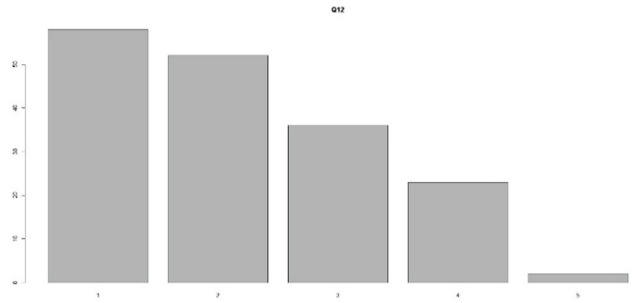

Fig. 5. Question Q12. Frequency distribution for each value of the Likert scale: 1 (34.5%), 2 (10.53%), 3 (22.22%), 4 (23.98%) and 5 (8.77%).

Figure 6 shows the responses to question Q14, which indicates the time the teachers did the evaluation (1- After, 2-Before) and shows that the planning evaluation was mainly carried out at the end of the teamwork.

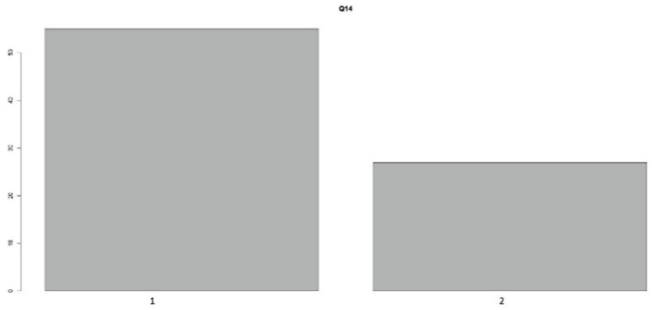

Fig. 6. Question Q14. Frequency distribution for each answer: After (67.07%) and Before (32.93%).

6 Conclusions

To determine whether the teamwork method used by the sample of students before starting university is a "white box" or "black box" model, the students' teamwork habits have been identified, and two habits have been analyzed: the most used and the least used.

The habit most used by the students when performing previous teamwork, the "assignment of tasks to each team member," is of great concern to the students, mainly because of the unequal distribution of work, which produces members with a significantly lower workload than the rest.

A detailed analysis has been carried out for this feature, and the diagnosis is as follows:

- No mechanisms are used to reflect student workload in a shared manner. Figure 1 shows that 64% have never or rarely used any mechanism. This means that no evidence

is left that can be used by both faculty and team members to check, evaluate and make decisions about this aspect.

- Teachers do not usually evaluate this characteristic. Figure 2 shows that teachers do not usually evaluate the workload distribution, with 75% acknowledging that it has never been done and 10% indicating that it has seldom been done.
- Likewise, of the small percentage that indicates that they have been evaluated, 36% recognize that they are evaluated afterward and 64% before (Fig. 3).

For the feature least used by the work teams, planning, with a mean of 2,17, the results show that there is a significant difference between those who always used mechanisms to leave evidence of what they were doing during teamwork (9%) and those who never used them (35%).

Therefore, although in a less significant way than the most applied characteristic (the distribution of tasks), mechanisms for leaving evidence are not usually used. However, if we analyze the percentage of students who at least once use mechanisms to leave evidence, 56% of students are in that case.

Although the teachers have used a mechanism to assess the ongoing development of teamwork, the evaluation is done only at the end of the teamwork process.

Thus, two analyses with different results lead to the same conclusion:

- Students do not usually use mechanisms that reflect evidence of teamwork development.
- Teachers do not usually evaluate such evidence.

On the other hand, when there is such a follow-up, although not significantly, a percentage of close to 50% of participants say that they have produced evidence and that the teacher evaluated them, but this evaluation was carried out after the teamwork was completed.

Thus, it is possible to confirm the hypothesis that teamwork, carried out before entering university, has followed a "black-box" method, where it is tremendously challenging to train this competency.

The IPMA model shows the need for training in individual competencies; however, this study demonstrates that acquiring these competencies is challenging due to the "black box" model used for the most part. This model does not offer the possibility of continuous monitoring of students to determine whether they are acquiring the competencies. On the other hand, students do not usually carry out processes that leave evidence of the individual competencies expressed in IPMA, making training in these competencies even more difficult.

Students are not accustomed to using tools that leave evidence to evaluate this competency, and when teachers perform this evaluation, it is done at the end of the work, when it is no longer possible to make decisions to improve the learning of this competency.

It should be noted in this study that the aspect of teamwork that students like the least is the unequal workload of each person in the team.

One of the aspects to be improved is the provision of mechanisms to ensure that the work team has a homogeneous workload and that there are no people who take advantage of the work of the rest of the team.

It is essential to carry out training on teamwork competencies under "white box" methods and generate processes that generate evidence showing the degree of acquisition of individual competencies. It is necessary to identify those educational environments and contexts where teamwork is being carried out under the "black box" method and to identify whether the team uses processes that generate evidence. Therefore, the research will continue using the same measurement tool in different courses and grades in different universities.

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References

1. Scott, C.L.: The Futures of learning 2: what kind of learning for the 21st century? In: ERF Working Papers Series, No. 14. p. 14. UNESCO Education Research and Foresight, Paris, France (2015)
2. Belanger, E., Moller, J., She, J.: Challenges to engineering design teamwork in a remote learning environment. Educ. Sci. **12**, 741 (2022). https://doi.org/10.3390/educsci12110741
3. James, M., et al.: Collaborative case-based learning with programmatic team-based assessment: a novel methodology for developing advanced skills in early-years medical students. BMC Med. Educ. **22**, 1–12 (2022). https://doi.org/10.1186/S12909-022-03111-5
4. Sein-Echaluce, M.L., Fidalgo-Blanco, Á., Balbín, A.M., García-Peñalvo, F.J.: Flipped Learning 4.0. An extended flipped classroom model with Education 4.0 and organisational learning processes. Univers Access Inf Soc. 1, 1–13 (2022). https://doi.org/10.1007/s10209-022-00945-0
5. IPMA: ICB -IPMA Competence Baseline Version 3.0. International Project Management Association, Nijkerk (NL) (2006)
6. Sedlmayer, M.: Individual Competence Baseline for Project Management. , 4th ed. Zurich (2015)
7. IPMA: IPMA Reference Guide ICB4 in an Agile World. International Project Management Association, Zurich (2018)
8. Tuckman, B.W., Ann, M., Jensen, C.: Stages of small-group development revisited. Group Organ. Stud. **2**, 419–427 (1977). https://doi.org/10.1177/105960117700200404
9. Stein, J.: Using the Stages of Team Development | MIT Human Resources, https://hr.mit.edu/learning-topics/teams/articles/stages-development, last accessed 2022/08/29
10. Fidalgo-Blanco, Á., Leris, D., Sein-Echaluce, M.L., García-Peñalvo, F.J.: Monitoring Indicators for CTMTC: comprehensive training model of the teamwork competence in engineering domain. Int. J. Eng. Educ. **31**, 829–838 (2015)
11. Sein-Echaluce, M.L., Fidalgo-Blanco, Á., García-Peñalvo, F.J.: Agile CTMTC: Adapting Stages for a Shorter Application of the Teamwork Method. In: Zaphiris, P., Ioannou, A. (ed.) Learning and Collaboration Technologies. Novel Technological Environments. HCII 2022. Lecture Notes in Computer Science, vol 13329. pp. 274–286. Springer, Cham (2022). https://doi.org/10.1007/978-3-031-05675-8_21

12. Sein-Echaluce, M.L., Fidalgo-Blanco, Á., Esteban-Escaño, J.: Technological ecosystems and ontologies for an educational model based on Web 3.0. Univ. Access Inf. Soc. **18**(3), 645–658 (2019). https://doi.org/10.1007/s10209-019-00684-9
13. Barreiro García, J., Martínez Pellitero, S., González Alonso, M.I.: Aplicación de la metodología CTMTC para evaluación formativa del trabajo grupal en ingeniería de fabricación. Revista Infancia, Educación y Aprendizaje. 3, 499–504 (2017). https://doi.org/10.22370/IEYA.2017.3.2.770
14. González, M.Á.C., et al.: Evaluación cuantitativa de la adquisición de la competencia de trabajo en equipo mediante la metodología CTMTC. Premios a la innovación en la enseñanza. **16**, 73–107 (2017)
15. Conde, M.Á., Hernández-García, Á., García-Peñalvo, F.J., Fidalgo-Blanco, Á., Sein-Echaluce, M.: Evaluation of the CTMTC Methodology for Assessment of Teamwork Competence Development and Acquisition in Higher Education. In: Zaphiris, P., Ioannou, A. (eds.) LCT 2016. LNCS, vol. 9753, pp. 201–212. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-39483-1_19
16. Fidalgo-Blanco, Á., Lerís, D., Sein-Echaluce, M.L., García-Peñalvo, F.J.: Indicadores para el seguimiento y evaluación de la competencia de trabajo en equipo a través del método CTMTC, pp. 280–285. Aprendizaje, Innovación y Competitividad (2013)
17. Fidalgo-Blanco, Á., Sein-Echaluce, M.L., García-Peñalvo, F.J.: Education 4.0-based Method to Improve Learning: Lessons Learned from COVID-19. RIED-Revista Iberoamericana de Educación a Distancia. 25, (2022). https://doi.org/10.5944/RIED.25.2.32320
18. Lyndon, S., Pandey, A., Navare, A.: Emergence and outcomes of shared leadership: unraveling the role of transactive memory system and team mindfulness using mixed-methods approach. Leadership and Organization Development Journal. 43, (2022). https://doi.org/10.1108/LODJ-05-2021-0202
19. Shoukat, M.H., Elgammal, I., Shah, S.A., Shaukat, H.: Nexus between shared leadership, workplace bullying, team learning, job insecurity and team performance in health care. Team Performance Management. 28, (2022). https://doi.org/10.1108/TPM-04-2021-0034
20. Sweeney, A.: Looking within: a longitudinal qualitative analysis of shared leadership behaviours in organisational teams. Team Perform. Manag. **28**, 441–460 (2022). https://doi.org/10.1108/TPM-02-2022-0013