

PAPER

# Development of Teamwork Skills Using ICTs in Undergraduate Students of Food Industry Engineering Degree

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## ABSTRACT

The development of soft skills is considered vitally important for the professionals in the Food Industry Engineering field. Employers in the food industry seek graduates who are prepared for work and possess strong teamwork skills. One effective strategy for students to practice and enhance their teamwork skills is through team-based assignments. In this study, three different team-based tasks were assigned to students in the three Food Industry Engineering courses. These tasks included the preparation of a Kahoot! questionnaire, a video presentation, and a traditional written report, all related to specific topics covered in the courses. The teamwork skills of the students were evaluated using VALUE rubrics. The acceptability of these three learning methodologies was also measured. The results indicated that the use of Kahoot! and student video presentations resulted in higher teamwork scores compared to the traditional methodology ( $P < 0.05$ ). No significant differences were found between the uses of Kahoot! and video presentation in any of the courses ( $P > 0.05$ ). The level of student satisfaction, regarding the general acceptance of Kahoot! and video presentation tools, as well as the acquisition of teamwork skills, was very positive. These findings undoubtedly encourage faculty to incorporate these new teaching methodologies in Food Industry Engineering courses.

## KEYWORDS

teamwork, ICT, rubrics, Food Industry Engineering

## 1 INTRODUCTION

Soft skills are considered essential in various professional fields as they encompass a combination of personal and professional traits that individuals use to interact with others, enhance their proficiency in hard skills and attain success in their

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respective domains. These skills include areas such as communication, management and technology skills [1].

The development of skills requires a combination of knowledge, attitude and practice, as skills are cultivated and refined over time [1]. Consequently, it is crucial for higher education curricula to incorporate these competencies. Specifically, for Food Industry Engineers it is imperative to possess a balanced set of technical and professional skills to effectively collaborate within teams [2]. Unfortunately, food engineering graduates often find that their soft skills are not adequately developed during their studies. Graduate students frequently encounter challenges in their professional lives, such as difficulties in finding essential information, a poor level of communication skills, poor time management skills and sometimes struggles in effectively fulfilling tasks. Additionally, they may face unexpected conflicts or face difficulties in team management [3, 4].

Tertiary education institutions are actively promoting soft skills by engaging students in cooperative learning environments. Traditional teaching methodologies have undergone a continuous change, where the focus of learning has become more student centered [5, 6]. Universities across Europe are actively enhancing traditional courses and methodologies are through the integration of new software, expanded networks and innovative teaching approaches [7–9]. Learning in groups or in teams is recognized as a significant approach for helping students in developing communication, collaboration and teamwork skills [10]. It should be underlined that Covid pandemic has had negative significant adverse impact on students [11]. Consequently, there is an even greater need to encourage teamwork skills in the present circumstances.

Teamwork can be fostered through different strategies. Information and Communication Technology (ICT) serves as the foundation for developing, storing and disseminating digital information. It relies on computer technology and other electronic devices [7]. In recent years, the global number of mobiles users has significantly increased, with young people considering their mobile phone as indispensable. This shift has brought about a transformation in the teaching and learning process. Teachers should capitalise on this accessible technology to enhance students' interest, attention and skills [12].

In this context, Kahoot! can be considered as one of the most useful interactive methods for enhancing and honing soft skills as supported by scientists investigating the ways to master soft skills in educational settings [13]. Kahoot! was developed in 2013 by Alf Inge Wand. It enables the implementation of activities to those facilitated by Clickers (an electronic control system used for real-time question answering and result tracking by speakers), but without the technical issues that were attributed to them [14]. Although the number of published experiences utilising tools like, Kahoot!, specifically in the field of food engineering within tertiary education, is limited, it is generally recognised that these tools have the potential to boost student motivation, enhancing long-term learning and foster the development of social skills [13–15].

In recent years, students have become increasingly familiar with video recording using electronic devices, as well as editing and publishing [16]. This convenience tool can also be regarded as an effective means of enhancing teamwork skill [17]. When assigned digital media tasks, students are required to engage in various activities such as, searching for content, reading and understanding the topic and summarizing the information [17, 18]. Subsequently, they must think of a way to represent the content effectively, and finally they must produce the digital media task, which is time-consuming process that needs a reorganisation of what they have learned [16]. Hence, video production (digital media) inherently involves teamwork.

However, assessing the acquisition of competencies, such as soft skills, by students remains a challenge. The shift towards competency-based learning has promoted significant changes in higher education [2]. A rubric is a guide for measuring student learning and its use at universities is considered an innovative teaching tool that allows the evaluation of competencies [19]. But, there is still shortage of rubrics in many curricula [20]. Teamwork involves the interaction among two or more individuals, and in a classroom setting it involves at least three participants: individual students, their peers (teammates) and the facilitating teacher. Hence, these three entities can provide valuable insights into the team dynamics from a multiple perspective [20, 21].

Therefore, the main objectives of this article were: (i) to promote teamwork skills as part of soft skills development through the utilisation of ICT tools, specifically Kahoot! and video editing (ii) to employ rubrics for monitoring the progress of students' soft skills development using these ICT tools in comparison to the traditional approach of written reports; and (iii) to analyse student's acceptance of students of these ICT tools compared to traditional approaches.

Based on the literature discussed in the preceding paragraphs, the following hypotheses are proposed: Hypothesis 1; students who utilised ICT tools, specifically Kahoot! and video editing, demonstrated enhanced teamwork skills and Hypothesis 2; the acceptability of tasks involving ICT tools was higher among students compared to "traditional" approaches.

## 2 METHOD

At the outset of the study the authors conducted a thorough review of scientific literature to explore the characteristics of soft skills and gain an understanding of the Kahoot! platform and video presentations. To conduct their research, the authors designed an experiment wherein students enrolled in Food Industry Engineering courses were assigned to learn about a specific topic using three different methodologies. The students completed the assignment through these methodologies, and their teamwork skills were assessed using rubrics. Finally, students were asked to complete a questionnaire to evaluate their acceptance of the three methodologies.

### 2.1 Participants

The research was carried out among the second- and third-year students pursuing a Food Industry Engineering Degree in three courses at the University of Extremadura: Unit Operations Course, Vegetable Products Industries Course and Food Technology Course. A total of 120 students participated in the study. During the screening process, five incomplete questionnaires were discarded, and two additional questionnaires were removed due to the presence of extreme outliers.

These particular students were selected because of the need for future food professionals in the food industry to possess strong soft skills and second- and third-year students were chosen due to their existing level of professional knowledge.

### 2.2 Design of the experiment

Students were randomly allocated to groups of 3–4 people by the professor, based on students' surname and consequent alphabetical order.

The next step of the experiment involved assigning specific tasks to the three experimental groups. Each group was given a particular topic from the course and instructed to produce different outcomes using different methodologies or tools: (i) written report, (ii) video presentation and (iii) Kahoot! questionnaire. To ensure sufficient time for collaboration and to avoid conflicting with final exams, all students were given the first five weeks of the course duration to complete their assignments. The students attended 120 min sessions (2 h per week) where they worked together on their respective tasks.

### 2.3 Tasks

Some students were assigned “traditional” written reports and were provided with specific instructions about structure, sections, language and edition (TRADITIONAL). Another group of students were tasked with developing a Kahoot! Questionnaire (KAHOOT) on the assigned topic, consisting of ten multiple choice questions with only one correct answer. Finally, the remaining group was assigned to prepare a video on the topic (VIDEO), with a maximum duration of 15 minutes. The students were expected to conduct research for information on the internet and refer to recommended bibliographies.

### 2.4 Measuring teamwork

Measuring teamwork is a challenging task that has been tackled by a considerable number of researchers [22–24]. For educational purposes, Hughes & Jones [25] suggested using the Valid Assessment of Learning in Undergraduate Education (VALUE) rubrics (<https://www.aacu.org/value-rubrics>), developed by the Association of American Colleges and Universities [22]. The VALUE rubric was selected to assess teamwork in this study because it incorporates several rubrics from the literature, allows for data collection from students, peers and professors [22], and it evaluates the teams’ overall functioning [22]. Moreover, the VALUE rubric is a less time-efficient method compared to others. In summary, according to McConnell *et al.*, [26] the VALUE rubrics measure the skills and knowledge requirements that the industry deems necessary for successful student participation in the global economy after graduation.

Each student completed the VALUE rubric as a self-assessment and assessed their team members in a manner that concealed the identity of the individual student from those being assessed, but not from the supervising teachers. The teachers also evaluated each student based on their observed behaviour during the sessions.

Specifically, the teamwork rubric is designed to evaluate the individual student’s, rather than assessing the team as a whole. It encompasses five criteria [27]: (1) contribution to team meetings, (2) facilitation of team members’ contribution, (3) individual contributions outside of team meetings, (4) fostering constructive team climate, and (5) response to conflict. Each criterion is evaluated using performance descriptors that correspond to four attainment levels. The rubric criteria invite the choice of a performance level, where A represents the highest score (4) and E the lowest (0) [27].

## 2.5 Satisfaction of the students in the use of the different methodologies

To gather information on students' satisfaction with the different teaching-learning methodologies, a questionnaire based on the Driscoll Questionnaire, designed in 2012 was used by Curto Prieto *et al.* [14]. The questionnaire consisted of ten questions rated on a Likert scale, with 5 being totally in agreement/higher score and 1 being totally in disagreement/lower score [14].

The items included in the questionnaire were:

1. I have learnt the contents in a cheerful way
2. Lessons are more interesting
3. It encourages my participation
4. It helps me to understand the contents
5. I enjoy co-working with other players
6. I improve my leadership skills
7. I have improved my technology skills
8. I have improved my analytical thinking
9. I have improved my creative thinking
10. My overall satisfaction with the task

## 2.6 Data analysis

To test the hypothesis regarding the improvement of teamwork skills among students who used Kahoot! and video editing, a composite score for teamwork skills was calculated. This composite score incorporated the ratings provided by each participant, following the procedure outlined by Guaman-Quintanilla *et al.*, [24]:

To calculate this combined score, the following formula was applied (1), according to [24]:

$$\text{Combined score} = \frac{\left( \text{Self score} + \text{Average peers score} \right)}{2} - (\text{Self score} - \text{Facilitator score}) \quad (1)$$

Data were analysed using the statistical software package SPSS 19.0 (SPSS Institute Inc. Cary, NC). Descriptive analysis was performed to calculate the means and standard deviations of the measurements for each parameter. The General Linear Models (GLM) procedure was used for conducting a one-way analysis of variance. Significance was defined as  $P \leq 0.05$ . In cases where there was a significant effect of certain independent variables, means were compared using the Tukey test ( $P \leq 0.05$ ).

## 3 RESULTS AND DISCUSSION

### 3.1 Evaluation of teamwork skills using rubrics

One of the aims of this research was to analyse the influence of a digitally supported task on students' teamwork skills. The evaluation scores for teamwork skills are presented in Table 1.

**Table 1.** Combined scores (mean±standard deviation) for students enrolled in different food courses, after carrying out their tasks

Course	TRADITIONAL	KAHOOT!	VIDEO	P
<b>Unit Operations</b>	2.38±0.68b	3.38±0.68a	3.03±0.65a	0.032
<b>Vegetable Industries</b>	2.27±0.73b	3.31±0.70a	2.85±0.72a	0.039
<b>Food Technology</b>	2.29±0.75b	3.31±0.63a	2.89±0.69a	0.041

Notes: 1–4 scale, according to rubrics. Means within a row with different letters were significantly different, P-value < 0.05.

The use of ICTs by students to complete the task of lesson preparation resulted in significantly higher scores compared to when a traditional methodology, such as written report was employed in all courses ( $P < 0.05$ ). These findings indicate a clear relationship between the use of ICTs and the fostering of teamwork skills. This observation aligns with the work of Pedro [7], who similarly observed evidence that ICTs contribute to the reinforcement of teamwork skills when comparing to a traditional course based on lectures. Our results are also consistent with previous studies that also supports the effectiveness of ICT tasks in cooperative learning [7, 28].

Some authors [29–31] have reported that ICT ensures success in the teaching-learning process by fostering student exploration, interaction and to acquire new knowledge. According to these authors [29–31], ICT also prepares students to perform their tasks in real context and promotes collaboration among students, which is closely linked with teamwork. A few other studies have also highlighted that the use of ICT, including Augmented Reality Technologies, facilitates easier learning and understanding among students while enhancing collaboration, ultimately leading to improved teamwork [32]. Cueva & Inga [33] described that the Inverted Learning Model, combined with the integration of ICT, had a positive impact on student learning, communicating, collaborating, participating and discussion. Similarly, Vaquero-Cristobal *et al.*, [34] stated that cooperative learning was enhanced following the implementation of digitally supported tasks, which aligns with the findings of the current research.

In terms of student's use of ICTs, no significant differences were found between the uses of Kahoot! and video presentation in any of the courses ( $P > 0.05$ ). This finding suggests that both digital approaches contribute to the development of teamwork skills in students at a similar level. Furthermore, [35] reported that involving students in the creation of educational digital material enhanced the learning experience in postgraduate courses. Previous studies in literature have highlighted that these digital alternative methodologies facilitates the acquisition of transversal skills in modern education [36–38]. However, no scientific research focused specifically on comparing Kahoot! and video assignments in terms of their impact on teamwork skills, has been identified.

Based on the results obtained, the following hypothesis can be accepted: students who used ICTs, namely Kahoot! and video editing, improved their teamwork skills as compared to students who produced "traditional" written reports.

### 3.2 Analysis of the acceptability of approaches to different tasks

Figures 1–3 displays the attitude of the participants’ attitude towards the different assigned methodologies for learning.

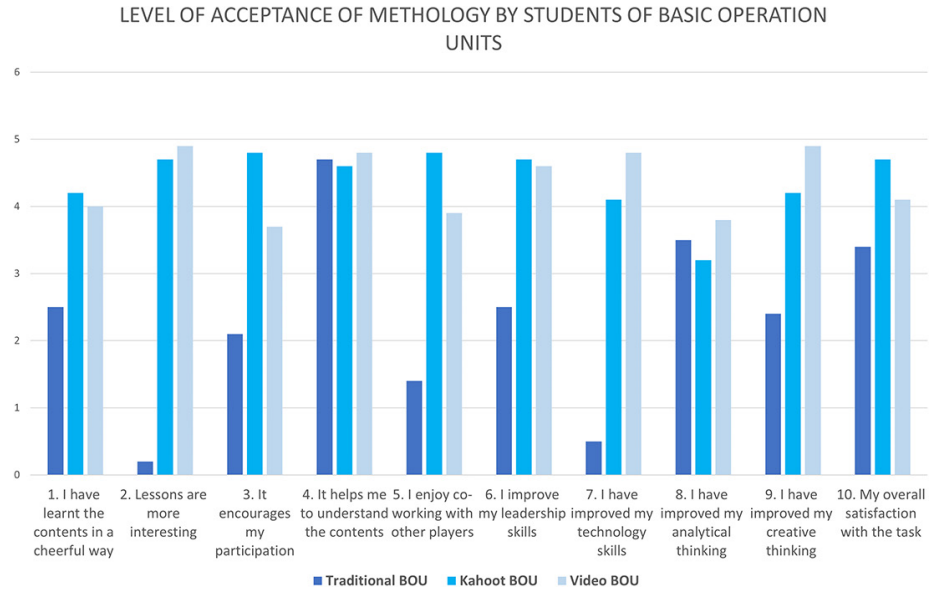


Fig. 1. Questionnaire data analysis (N=42) for students of Unit Operations

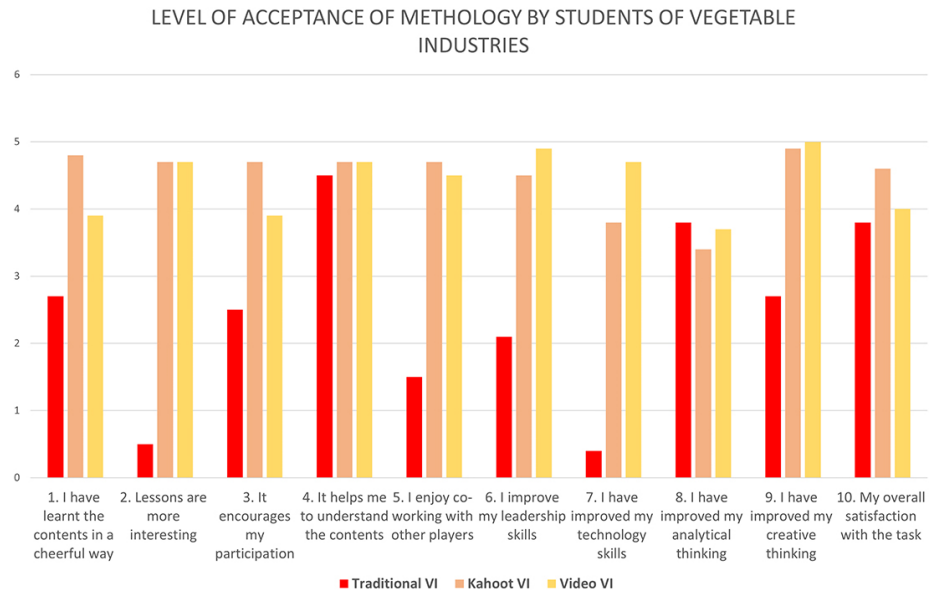
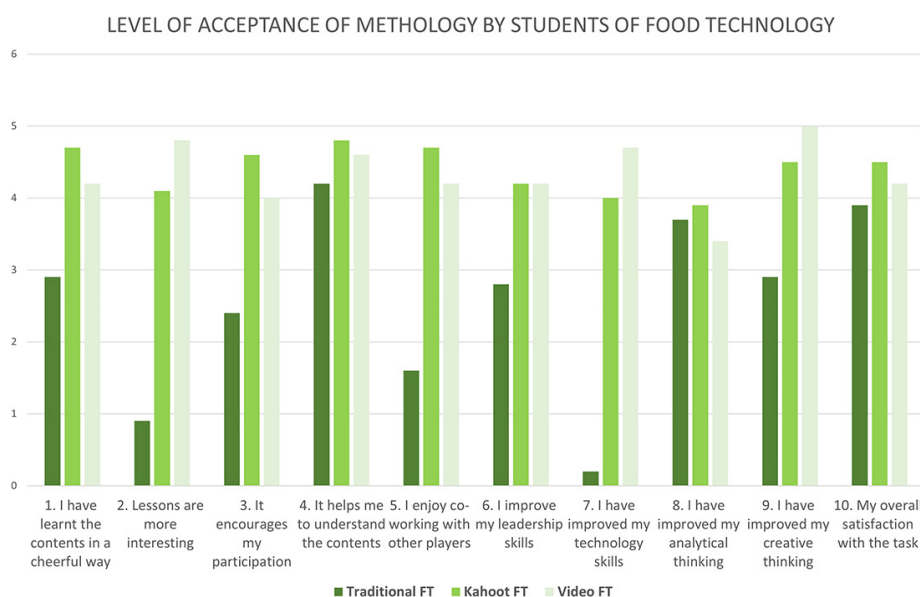


Fig. 2. Questionnaire data analysis (N=38) for students of Vegetable Industries



**Fig. 3.** Questionnaire data analysis (N=40) for students of Food Technology

Based on the findings from Figures 1–3, it can be inferred that all items were rated with the highest level of acceptance in all courses when students utilised ICTs (with a score of 5 indicating totally in agreement/higher score and 1 indicating totally in disagreement/lower score), with statistical significance ( $P < 0.05$ ). This aligns with the observations made by [39], who also found that undergraduate students perceived ICTs as easy to use and useful.

In contrast, the scores for items “It helps me to understand the contents” and “I have improved my analytical thinking” were consistently similar, with an average score of around 4 across all courses, regardless of the methodology used ( $P > 0.05$ ). These findings suggest that students believe that they can effectively learn content using both traditional or ICT methodologies. This perception may be attributed to the high motivation observed among the students who were generally engaged and stimulated by the assigned tasks. Motivation is, in fact, essential in learning success [40].

When traditional method was used, the level of acceptance for the remaining items ranged between 2 and 4. Notably, for the items “Lessons are more interesting” and “I have improved my technology skills”, the scores did not exceed 1.

The level of acceptance of the items was found to be very similar when students used either Kahoot! or video presentation in all courses ( $P > 0.05$ ), with one exception. The item “It encourages my participation” received higher ratings when students use Kahoot! in the Unit Operations and Vegetables courses ( $P < 0.05$ ) (Figures 1 and 2). Similarly the item “I have learnt the contents in a cheerful way” showed a higher level of acceptance among students using Kahoot! Specifically in the Vegetable course ( $P < 0.05$ ) (Figure 2). Brodie [41] also observed similar results when implementing Kahoot! in chemistry students. The lower level of difficulty associated with using the Kahoot! tool compared to the video presentation tool may explain the differences observed. Bicen & Kocakoyun [42] also stated that Kahoot! had a positive impact on students, increasing their motivational levels.

In contrast, regarding the item “I have improved my technology skills”, student who used the video presentation methodology for the Vegetable course expressed higher levels of acceptance for this item ( $P < 0.05$ ). This finding suggests that the technology involved in creating video presentations may be more complex compared to the technology used for Kahoot! questionnaires.



However, it should be noted that some negative aspect that was not gathered in the survey and was perceived by the participant teachers as a result of personal interaction with students, was the added pressure on them. All the three assignment approaches required an extra effort from the students. Despite this, the students generally, considered the assignment as a challenge and demonstrated remarkable outcomes in their selected topics.

Finally, it is worth highlighting that the scores for the item “My overall satisfaction with the task” were very similar across all courses, regardless of whether students used a traditional or ICT methodology ( $P>0.05$ ). This indicates that students had an equal level of satisfaction with the task, irrespective of the methodology used. These findings suggest that students were conscious of the fact that teamwork skills are fostered when ICTs are used in comparison to traditional methods, but this did not significantly affect the overall satisfaction with the task. As mentioned earlier, the high scores for the item “My overall satisfaction with the task” can be attributed to the students’ collaborative nature and genuine interest in the assignment, regardless of the methodology used.

Based on these results obtained, it can be concluded that the second hypothesis is supported: the acceptability of students towards tasks involving the use of ICTs was higher compared “traditional” approaches.

## 4 CONCLUSIONS AND FUTURE WORK

This study aimed to assess the effectiveness of three different approaches—Kahoot!, video presentations and “traditional” written reports—for developing teamwork skills in students enrolled in Food Science courses within the Degree in Food Industry Engineering. The rationale for investigating these approaches lies in the high demand for soft skills, including teamwork, in the Food Industry sector. Additionally the acceptability of these approaches was examined to gauge student’s attitudes towards them. The manuscript provides a comprehensive review of the relevant research background and strives to address various research questions pertaining to these approaches. While this research focused on students enrolled in Food Science courses within the Degree in Food Industry Engineering, the findings can be extrapolated to Engineering students across various disciplines. The results imply that the use of ICT tools such as Kahoot! and Video presentations has the potential to foster students’ development of teamwork skills compared to traditional learning methodology. Moreover, the level of students’ satisfaction, in terms of acceptability of the use of Kahoot! and Video presentation tools and specifically in relation with the acquisition of soft skills, was also very positive, which undoubtedly will encourage faculty to use these new teaching methodologies in Food Science courses. However, it is important to note that further research is required to validate the effectiveness of different task approaches in long-term learning as well as knowledge consolidation.

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