The Correlation of Students' Communication and Collaboration Skills to Work Ethics through Project-Based Learning

Lianto Lianto[1]*, Yulista Trias Rohayati[2], Sri Rahayu Lestari[3]

[1]Faculty of Teacher Training and Education, University of Mataram, Mataram, West Nusa Tenggara, 83114, Indonesia
[2]SD Negeri Krucil II, Probolinggo, East Java, 67288, Indonesia
[3]Faculty of Mathematics and Natural Sciences, State University of Malang, East Java, 65145, Indonesia

*Correspondence: lianto@staff.unram.ac.id

ABSTRACT: Effective communication and collaboration were vital competencies that students needed to master to enhance their work ethic in the 21st century. This study sought to investigate the relationship between communication, teamwork, and work ethic qualities in the context of Project-Based Learning (PBL). The sample for this study comprised students enrolled in an introductory immunology course at the Faculty of Biology, Malang State University, Indonesia. Data were analyzed using multiple regression and correlation analysis. The findings indicated a correlation among communication, collaboration, and work ethic skills. Communication and teamwork contributed 61.5% to students' work ethic skills in project-based learning. The project-based learning style was crucial for enhancing students' communication and collaboration abilities. Project-based learning also influenced students' work ethic. It was strongly recommended to implement the project-based learning approach in higher education institutions to enhance students' 21st-century competencies.

KEYWORDS: Communication; collaboration; work ethics; project-based learning

1. Introduction

A multitude of strategies arose to clarify the significant educational issues encountered in the 21st century. The advent of technological devices and digital media, along with innovative interpersonal interactions and strengthened global competition, encouraged corporations to seek new competencies from their employees, thereby requiring educational systems to improve their offerings of pertinent continuous training [1]. Students who had recently graduated needed to possess employability skills to comply with labor market demands [2]. Contemporary businesses preferred candidates who exhibited twenty-first-century competencies. These skills included the capacity to work independently, solve problems, communicate effectively, manage time efficiently, and perform successfully under pressure [3].

Effective communication skills made precise scientific information more accessible and appealing to a broader audience, allowing for widespread discussion between scientists and others such as policymakers, participants, and the public [4, 5]. Communication from

trustworthy group members significantly diminished disinformation about complex subjects [6–8]. In collaborative settings, communication allowed continuous and effective information transfer, thereby assisting in the achievement of specific goals [9].

Communication was linked to collaboration skills. Increased collaborative abilities were associated with improved communication skills among students [10]. Effective collaboration evolved gradually when executed harmoniously, depended on mutual confidence in decision-making, promoted candid discourse, and optimized healthcare for patients [11]. Interaction in the workplace aimed to build and maintain high-quality professional relationships while also improving field performance standards [12]. Collaboration or teamwork strengthened and harmonized communication skills. In the twenty-first century, improved collaboration skills aided integration into the ideal workforce [13].

Collaboration was recognized as essential in education, as student interaction and the exchange of ideas significantly improved the learning experience [14]. Collaborative efforts were also essential for the advancement of various fields. Extensive research endeavors increasingly necessitated collaboration among faculty members across disciplines and institutions [15]. Students were required to possess the fundamental 21st-century ability of collaboration in order to successfully manage the challenges of an emerging workforce. Collaboration guided learners in engaging with peers, fostering cognitive growth, and acquiring knowledge, while also fostering the ability to think critically and develop brainstorming skills [16–18]. Collaboration provided both academic and commercial advantages for all industry partners. Cooperation enabled people to transfer their knowledge and technology through combining external information from colleagues [19].

Work ethic denoted the importance of diligence and hard work, the condemnation of laziness, the completion of obligations, and the conviction that work should be performed to the utmost quality [20]. Work ethic reinforced the beneficial effects of work satisfaction on life fulfillment [21]. Work ethic encouraged the incentive to succeed, which fostered economic development by emphasizing the importance of independence training. This conceptualization of ethics placed it alongside various motivational elements such as the desire for wealth, the pursuit of excellence, the goal of achieving exceptional standards, the ambition to attain elevated recognition, the desire to compete and excel above peers, and the aspiration for high status and prestige [20]. Work ethic also affected student productivity [22].

Immunology was one of the most rapidly evolving areas of contemporary biological research [23]. As an interdisciplinary domain encompassing epidemiology, disease mechanisms, microbiology, genetics, and ecological science, immunology became increasingly recognized in higher education institutions worldwide [24]. Advances in immunology education and research helped build a team of researchers with specialized knowledge and abilities to meet community and national health requirements, especially in the context of global pandemics such as COVID-19 and Ebola. Immunology research and teaching also encouraged the design of devices and equipment more appropriate for developing nations [25]. Effective performance in immunology necessitated proficient interpersonal and cooperative abilities.

The ability for effective communication was intrinsically linked to one's work ethic. Feedback criteria were highly connected, with strong listening and speaking skills being particularly important. Nurses and nursing scientists understood the importance of effective communication and interaction in the nursing profession and played an essential role in

healthcare teams [26]. This suggested that workplace representatives had successfully integrated their collaborative skills to promote passion and a strong work ethic, resulting in excellent support that matched community demands [27].

PBL represented an educational approach utilized to enhance competencies related to the 21st century. Collaboration, proficient communication, problem-solving, organizational, and analytical thinking skills were among the transferable competencies developed through PBL. In PBL, students generally engaged in collaborative efforts as peers to achieve a common goal [28]. The integration of collaborative endeavors within PBL demonstrated a positive impact on student well-being [29]. Students working toward a common goal needed to maintain time management skills by continuously analyzing project objectives, setting explicit and attainable goals, and making decisions regarding the pace, manner, and direction of their learning [30]. Students were also required to engage in effective collaboration with their peers when tasked with the collective creation of a project in a PBL assignment. These tasks nurtured an atmosphere that promoted knowledge-sharing and personal growth through the establishment of constructive peer relationships. Such efforts contributed to the improvement of collaborative and communicative skills [31, 32].

A growing body of research highlighted the significance of communication skills, collaboration, and work ethic in shaping students' academic and professional competencies. While previous studies examined the interrelationships among communication, collaboration, and other influencing factors, empirical evidence directly linking communication skills and collaboration to work ethic remained limited. Addressing this gap, the present study aimed to investigate the relationship between communication skills and collaboration in fostering students' work ethic through the implementation of project-based learning in the Basic Immunology course. Understanding this correlation benefited education by showing that project-based learning could be designed not only to enhance academic outcomes but also to foster responsibility, accountability, and professionalism. By embedding structured opportunities for interaction and teamwork into curricula, educators could strengthen students' ethical dispositions while preparing them with essential competencies for the 21st-century workforce.

2. Materials and Methods

2.1. Study design.

This research utilized a correlational descriptive design. Communication and collaboration abilities served as predictors, whereas work ethic was the criterion. The study was conducted at the Department of Biology, State University of Malang, Indonesia. The sample consisted of 23 students enrolled in the introductory immunology course.

2.2. Instrument of the study.

Collaborative skills were evaluated using an observation sheet with four indicators. Communication skills were assessed with five indicators, also using an observation sheet. Work ethic competencies were measured with an observation sheet containing seven indicators. The validity and reliability of all instruments were tested using Pearson's product-moment correlation coefficient and Cronbach's Alpha. Results confirmed that all test items were both valid and reliable.

2.3.Data collection and data analysis.

Data on communication, collaboration, and work ethic were collected through observation. Prior to multiple regression analysis, normality and homogeneity were tested using the Kolmogorov-Smirnov and Levene's tests. Data were then analyzed with multiple regression using SPSS for Windows at a 5% significance level.

3. Results and Discussion

3.1. Results.

The findings of the ANOVA analysis, which assessed the significance of the link between communication and collaboration skills and work ethic, were displayed in Table 1. Table 1 indicated a significant value of $0.000 < 0.050$, signifying that communication and collaboration abilities were strongly associated with work ethic through the implementation of the PBL learning model.

Table 1. ANOVA analysis result.

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13.492	2	6.746	15.924	.000[b]
	Residual	8.473	20	.424		
	Total	21.964	22			

Table 2. The correlation of communication and collaboration skills to work ethics skills.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.784[a]	.614	.576	.65087

The regression test findings in Table 2 revealed a correlation coefficient (R) of 0.784 and an R square value of 0.614. Communication and teamwork abilities accounted for 61.4% of work ethic, while other factors influenced the remaining 38.6%. The comparative and significant impact of communication and collaboration abilities on work ethic was illustrated in Table 3. Table 3 indicated that communication skills contributed 62.1% to students' work ethic, whereas collaboration abilities accounted for 37.9%. Communication and teamwork abilities contributed 38.2% and 23.3%, respectively, resulting in a total contribution of 61.5%.

Table 3. The relative and effective contribution of communication and collaboration skills to work ethics skills.

Variable	Relative Contribution (%)	Effective Contribution (%)
X_1	62.1	38.2
X_2	37.9	23.3
Total	100	61.5

X_1: Communication skills; X_2: Collaboration skills

The findings from the correlational regression analysis examining the relationship between communication and collaboration skills and students' work ethic were presented in Table 4. This table showed the multiple regression equation correlating communication and collaboration abilities with students' work ethic through the project-based learning approach, expressed as $Y = 0.544X_1 + 0.374X_2 + 12.38$. The regression coefficient value for communication (X_1) was 0.544, indicating that a one-unit increase in communication skills corresponded to a 0.544 increase in work ethic score. The regression coefficient for collaboration skills (X_2) was 0.324, indicating that a one-unit increase in collaboration resulted in a 0.324 increase in work ethic score.

Table 4. Coefficient analysis of communication and collaboration skills to work ethics skills.

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.387	12.751		.971	.343
	X_1	.544	.166	.531	3.275	.004
	X_2	.374	.166	.365	2.249	.036

3.2. Discussion.

Undergraduate biology students could be a source of both accurate and erroneous information in their communities. Communication from credible group members effectively reduced misconceptions about controversial topics [8]. Understanding communication practices could inspire educators to incorporate science communication training into their curricula and highlight the importance of improving communication education on disputed scientific matters in the classroom [33]. Effective communication skills increased the accessibility and appeal of scientific knowledge to a larger audience, enabling widespread discussion among scholars, the public, authorities, stakeholders, and communities [4].

Collaborative activities facilitated students' exchange of views about challenges or project implementation. These features influenced cognitive processes, which were reflected in communication abilities. The students' tasks involved complex interactions between team members over time and required the use of various essential transferable skills, including communication, planning, and teamwork [34]. Project-based learning (PBL) was rooted in constructivist philosophy, incorporating the phases of the scientific process. This illustrated the fundamental nature of science, particularly its inquiry-based approach. The articulation of problems that supported project completion through collaborative activities offered students multiple opportunities for interaction and communication [35]. The groups utilized a social interaction platform and coordinated with the instructor to strengthen follow-up efforts, thereby improving interpersonal abilities between learners and between learners and the instructor [36].

The study demonstrated that communication and collaboration skills enhanced students' work ethic following the implementation of the PBL learning model. Table 3 showed that communication skills accounted for 62.1% and collaboration skills for 37.9% of students' work ethic. Implementing the PBL learning model in the educational process significantly improved students' communication and teamwork skills while positively influencing their work ethic. These findings aligned with previous research that demonstrated how PBL effectively enhanced communication and collaboration as key 21st-century competencies [31][37]. Similarly, Khalil emphasized that collaborative learning activities improved teamwork and communication, thereby fostering students' engagement and responsibility [38]. However, while earlier studies largely focused on communication and collaboration in relation to learning outcomes or employability skills, they did not explicitly address their influence on students' work ethic.

This study extended the literature by providing empirical evidence that both communication and collaboration directly contributed to the development of work ethic, particularly in the context of PBL in higher education. Work ethic was closely linked to motivation, productivity, and responsibility [39]. Unlike studies that treated work ethic as an outcome influenced by organizational culture or motivation, the present results highlighted communication and collaboration as crucial soft skills that fostered ethical dispositions such as

diligence, accountability, and discipline. This distinction underscored the novelty of the study, as it bridged the gap between soft skills development and ethical values formation in students.

The research findings demonstrated a positive correlation between work ethic and autonomous motivation, as well as the pursuit of recognition, which included acknowledgment from others and self-satisfaction. Individuals with high intrinsic motivation, a preference for engaging work, and a commitment to high standards were considered to have a strong work ethic [40]. Human ethical behavior influenced both individual and collective outcomes across various performance domains. University graduates in leadership positions were required to manage teams, communicate effectively, and participate in productive endeavors, necessitating independent decision-making and risk-taking [41]. The findings revealed significant correlations between transformational learning and professional development, transformational learning and work ethic, as well as between teachers' work ethic and professional growth [42].

Effective communication inspired individuals to improve their work environment through constructive contributions. The study confirmed that effective communication improved organizational performance [43]. Sharing knowledge through communication contributed to workers' work ethic [44]. Work ethic, alongside self-efficacy and quality of work life, was related to communication [45]. Communication was one of the key factors contributing to work satisfaction. Clear, transparent, and consistent communication built trust, reduced ambiguity, and promoted alignment with organizational goals, which encouraged employees to act with greater responsibility and professionalism. In this way, communication not only transmitted information but also reinforced values such as accountability, discipline, and dedication [46]. Moreover, internal communication significantly influenced performance.

Collaboration also had a direct correlation with work ethic. Teamwork helped individuals to create a healthy work environment that enhanced professional attitudes [47]. Collaboration through effective teamwork significantly contributed to strengthening professional ethics by fostering mutual support, trust, and shared responsibility [48]. Furthermore, collaboration through joint problem-solving and teamwork significantly enhanced individuals' attitudinal dispositions such as perseverance, responsibility, and engagement—core dimensions of work ethic. By working together to solve complex tasks, participants developed greater commitment to shared goals, respect for diverse perspectives, and accountability for their contributions [49].

A conscientious work ethic had a significant impact on development and collaboration capabilities within the West Sulawesi Territory Government Office. Territorial official organizations were advised to prioritize collaborative skills, particularly by improving the development of community services. They also needed to establish the criteria for an excellent work ethic, thereby cultivating a proficient work culture that provided substantial institutional support [27]. While this study provided empirical evidence of the contribution of communication and collaboration skills to students' work ethic through PBL, certain limitations should be acknowledged. The relatively small sample size (n = 23) restricted the generalizability of the findings to broader student populations. Furthermore, the study focused on a single course context (Basic Immunology), which might not capture variations across disciplines or educational levels. Future research should therefore involve larger and more diverse samples, as well as longitudinal designs, to examine whether the observed relationships remain consistent over time. Despite these limitations, the study highlighted the critical role of communication and collaboration in shaping ethical dispositions, offering valuable insights for the design of 21st-century skills-oriented pedagogy.

4. Conclusions

A significant relationship existed between communication and collaboration skills and work ethic. Following the implementation of the PBL model, communication enhanced work ethic more strongly than collaboration abilities. The practical implications of these findings suggested that educators should intentionally design PBL activities that provide structured opportunities for both communication and collaboration. For example, assigning rotating roles in group projects, integrating peer-feedback sessions, and emphasizing joint accountability for outcomes could help ensure that communication was not only dialogical but also reciprocal, while collaboration was practiced equitably. At the curricular level, embedding explicit training in communication and teamwork within discipline-specific courses, such as Basic Immunology, could strengthen students' work ethic by cultivating responsibility, persistence, and professionalism. These strategies might also better prepare students for the demands of the workplace, where strong communication, effective collaboration, and ethical conduct are increasingly recognized as indispensable.

Author Contribution

Lianto: Conceptualization, Data Collection, Data Analysis, Writing; Yulista Trias Rohayati: Conceptualization, Methodology, Data Collection, Data Analysis; Sri Rahayu Lestari: Conceptualization, Supervision.

Competing Interest

No competing interest has been identified.

Data Availability

Data will be made available upon reasonable request from the corresponding author, due to privacy restrictions related to student participants.

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