

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

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Abstract

E-collaborative platforms like Google Classroom enhance cognitive and social skills through structured team interactions. Information and Communication Technology (ICT) courses are essential for undergraduate STEM programs. This study investigated the effectiveness of teaching an I.C.T. (information, communication, technology) course by using an e- collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at the faculty of education, Ain Shams University, Egypt, a course delivered to first-year STEM students in the Google classroom as an e- collaborative platform. To measure using digital media literacy, the researcher designed a self-assessment and peer assessment scale, and to measure teamwork skills, the researcher designed a self-assessment and peer assessment scale. This study used a quantitative method based on one experimental group (n=37) of first-year STEM students. While the sample size is a limitation for generalizability, it represents a significant portion of the pioneering cohort in this new program. The results revealed that there were significant differences between the pre- and post-application of self- and peer assessment teamwork scales and that there were significant differences between the pre- and post-application of the self-assessment of using digital media literacy scale and some aspects of using digital media literacy on the peer-assessment scale. In conclusion, the effects of using an e-

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collaborative platform for developing some aspects of using digital media literacy and teamwork skills were investigated.

Keywords: ICT; e- collaborative platform; using digital media literacy; teamwork skills; STEM; undergraduate students.

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Introduction

Current e-learning environments frequently lack adequate interaction support, hindering student progress and motivation (Giannoukos, 2008; Wang et al., 2017). ICT offers collaborative potential through two key factors: (1) social interaction and (2) structured process design, which are essential for effective collaborative learning (Reneland-Forsman & Ahlbäck, 2007).

In terms of, Collaboration scripts are constantly applied in Computer-Supported Collaborative Learning (CSCL) to facilitate collaboration processes and individual learning (Wang, et al., 2017).

Therefore, there are attempts to apply collaborative learning on online platforms, for instance, Goda and Yamada (2013) mention that applying Collaborative learning, with high interaction between learners in both e-collaborative platform and face-to-face situations, can lead to high performance in socioemotional development, cognitive aspects, and personal satisfaction.

Consequently, Li et.al (2012) refers that e-collaborative platform provides personalized space for users where students can interact and collaborate with each other, moreover, facilitates interaction and collaboration between students, thus it connects course network of users with their social network and knowledge network.

Information and communication technology (ICT) could provide a variety of opportunities that could support collaborations, and there are two critical factors influence the level of collaboration

connected to the knowledge process, firstly, Social interaction, to establish a team culture and the exchange of experiences, as a foundation for knowledge production is a key factor for designing a web-based collaborative learning, secondly, the vision into these processes is central for planning and Selecting methods for collaborative courses, and analyzing tool can be used for evaluation of group work and assessments context (Reneland and Ahlbäck, 2007).

Further, Monahan et.al (2008) states that there is significant importance on communication and the benefits of e-collaborative platforms, and it influences students' performance regarding acquiring knowledge, skills, and attitudes.

As a part of 21st-century skills and dimensions, using digital media literacy dimensions are essential for a student to develop active inquiry and critical thinking, be reflective, and engage students and help them understand that the media is part of culture and functions as an intermediary in socialization (Potter et al., 2017; Agustina, 2022).

Using digital media literacy is defined as the ability to access the media, understand, and critically evaluate distinct aspects of the media and media contents, and create communications in a variety of contexts (Aguaded, 2010)

Despite the rapid growth in using digital media literacy in education, scholars and educators are still working on pedagogical approaches regarding how using digital media literacy methods work best in the classroom (Romero,2022)

Consequently, using digital media literacy supports students bring media culture to their classrooms, Students who are conscious media literates can better resist messages that consider untrusted, harmful, or inappropriate, thus, Teachers should require using digital media literacy as an essential component which is interdisciplinary and easy to integrate into the existing curriculum (Dolanbay,2022)

Subsequently, Students are no longer just passive participants in the educational environment. Students are the ones who are supposed to create and extract value from a modern teaching and learning experience that goes beyond participatory engagement solely to ensure that their opinions and perceptions provide meaningful input in the context of education (Barron, 2003).

Salas et al (2005) defines teamwork as a set of actions, thoughts and emotional behaviors that combine to coordinate, achieve task objectives, and cope performance to accomplish the outcomes.

Subsequently, the ability to work in a team is presently one of the most required competencies of professionals and, thus, constitutes one of the key transversal aspects to target by educational techniques (Romero-Díaz de la Guardia et al., 2022).

On the other hand, there are characteristics of students' teamwork are Helping each other to work and allocating tasks according to duties and abilities, collaborating with teammates, and working together as a team, consequently, students can exchange and discuss ideas. Having good leadership and team members is essential and a leader distributes the work to other members of the team (Kitcharoenpanya& Chantraukrit.,2022).

Consequently, using digital media literacy and teamwork skills co-develop in e-collaborative environments; Google Classroom's shared tools (e.g., Docs) necessitate both technical media creation and interpersonal coordination (Tandoc et al., 2021; Hernández-Sellés et al., 2019).

As mentioned above, the importance of development of using digital media literacy and teamwork skills for students is unbearably inadequate; hence, this study attempts to redirect the focus of scholars to developing and addressing the embeddedness of these skills in our teaching techniques and curricula. Subsequently, teamwork skills are crucial skills to consider in our courses, especially in EGYPT, as we struggled in our schools because of our lack of teamwork skills (Sulaiman et al., 2017).

Based on researcher experience in teaching ICT courses for undergraduate students in different programs, the researcher notices the weakness of using digital media literacy and teamwork skills of undergraduate students.

Besides, the researcher conducts a pilot study among undergraduate students in science program (N=20) and applied teamwork survey (Guaman-Quintanilla et al. 2022) and survey of using digital media literacy (Chang et al, 2011), and the results indicate that 80% of students didn't obtain using digital media literacy dimensions or teamwork skills.

Therefore, this study investigated the effectiveness of teaching an I.C.T. through the use of an e-collaborative platform for the development of using digital media literacy dimensions and teamwork skills of undergraduate STEM students who enrolled in a new STEM program that existed in only five faculties in EGYPT. It considers an innovative approach applied at the university level.

Research problem:

The research problem determines in the following” there are weaknesses in using digital media literacy dimensions and teamwork skills among undergraduate STEM students at faculty of education Ain Shams University” therefore this research admits answering the main question:

“What is the effectiveness of teaching an I.C.T. through the use of an e-collaborative platform for the development of using digital media literacy dimensions and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University.”

Based on the main question there are sub-questions which are:

- RQ1. What are the necessary of using digital media literacy dimensions to develop for undergraduate STEM students at faculty of education Ain Shams University?
- RQ2. What are the necessary teamwork skills to develop for undergraduate STEM students at faculty of education Ain Shams University?

- RQ3. What is the effectiveness of teaching I.C.T course by using an E-collaborative platform in the development of using digital media literacy dimensions for undergraduate STEM students at faculty of education Ain Shams University?
- RQ4. What is the effectiveness of teaching an I.C.T course by using an E-collaborative platform in developing teamwork skills for undergraduate STEM students at faculty of education Ain Shams University?

Research purpose:

This study aims to:

1. Examining the Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy dimensions and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University.
2. The development of using digital media literacy dimensions and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University.

Research hypothesis:

Based on the above questions, this study will attempt to verify the following hypotheses:

- H1: Teaching ICT via Google Classroom will significantly improve using digital media literacy dimensions (access, analyze, evaluate, create, communicate) in STEM students ($p < 0.05$).
- H2: Teaching ICT via Google Classroom will significantly improve teamwork skills (coordination, conflict resolution, etc.) in STEM students ($p < 0.05$).

Research delimitation:

- The major of students was in STEM program in first year at faculty of education Ain Shams University.
- First semester academic year 2022/2023.

- Google classroom platform as an e-collaborative platform for several reasons: it is a free e- collaborative platform that is easy to use with smartphones or PCs and is connected to a personal Google Drive.

Research methodology

- Descriptive methodology: I analyze scholars and studies related to the variables:
- Quasi- experimental to investigate the effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills within a single-group pretest-posttest design was employed due to institutional constraints (single cohort availability).

Research terminologies:

1. **E-collaborative platform:** in this study refers to an electronic platform (google classroom) that promotes cognitive change through teams' interaction and activities and affords a set of tools for undergraduate STEM students acting in teams to interact and achieve tasks, assignments, and projects.
2. **Using digital media literacy** in this study are defined as the ability of undergraduate STEM students to access, analyse, evaluate, create, and communicate various media messages in tasks, assignments, and projects of the I.C.T. Course
3. **Teamwork skills** in this study are defined as the ability of STEM undergraduate students to contribute to STEM-based team projects, plan and manage different tasks, deal with conflicts, solve problems, foster a constructive team climate, and have a collective advantage toward the team.

Research importance:

This research contributes to the following:

1. Researchers: by providing using digital media literacy and teamwork scales.
2. Instructors: by providing vision about teaching ICT courses via collaborative platform and provide using digital media literacy scales and teamwork scales to assess using digital media literacy and teamwork.
3. Faculties of education: by providing an applicable course of ICT that develop using digital media literacy and teamwork.

Literature review

E-collaborative platform

The pedagogical aspects of collaborative learning can be found in Vygotsky's work, which extended Piaget's constructivist perspective toward the social field. the dialogue between learners who interact and develop a shared understanding of a problem and its solution process (Magnisalis, et al., 2011). The social constructivists revealed that collaborative learning occurs when learners engage in pairs or groups to discuss and solve a learning issue to achieve a learning task (Laal & Ghodsi, 2012). Consequently, students are allowed to share their ideas, actions, reflections, interpretations of what happened within their practices, and products (Laurillard, 2008).

This study is grounded in the social constructivist theory (Vygotsky, 1978) and social interdependence theory (Johnson & Johnson, 2009). The development of using digital media literacy, particularly the 'evaluate' and 'analyze' dimensions, aligns directly with Vygotsky's concept of the Zone of Proximal Development (ZPD). Students co-construct knowledge and critical thinking skills by collaboratively critiquing media sources, evaluating information, and providing peer feedback within the e-collaborative environment, scaffolded by the instructor and more capable peers. Furthermore, teamwork skills are fostered through the positive interdependence and individual accountability emphasized in social

interdependence theory, where the group's success is tied to each member's contribution to the media-related tasks.

Computer-supported collaborative learning (CSCL) tools enhance learning outcomes and platform satisfaction (Fanguy et al., 2023), combining social and constructive learning elements (Chen, 2005). Effective CSCL requires understanding collaborative interaction dynamics (Wise & Schwarz, 2017), where active engagement drives success. E-collaborative platforms facilitate cognitive development through team interactions, with ICT serving as the foundation for distributed, interactive learning environments (Yamada et al., 2015).

Information and Communication Technology (ICT) provides a variety of opportunities for collaboration, and two critical factors influence the extent to which collaboration connects to the knowledge process: first, social interaction is used to establish a team culture and share of experiences; second, planning and selection methods for collaborative courses and analysis tools can be used for evaluating (Reneland-Forsman & Ahlbäck, 2007).

Hence, this study aimed to determine the effects of teaching an I.C.T. by using the e- collaborative platform “Google Classroom,” which has a mobile version and a web-based version, as well, with the support of some technology tools.

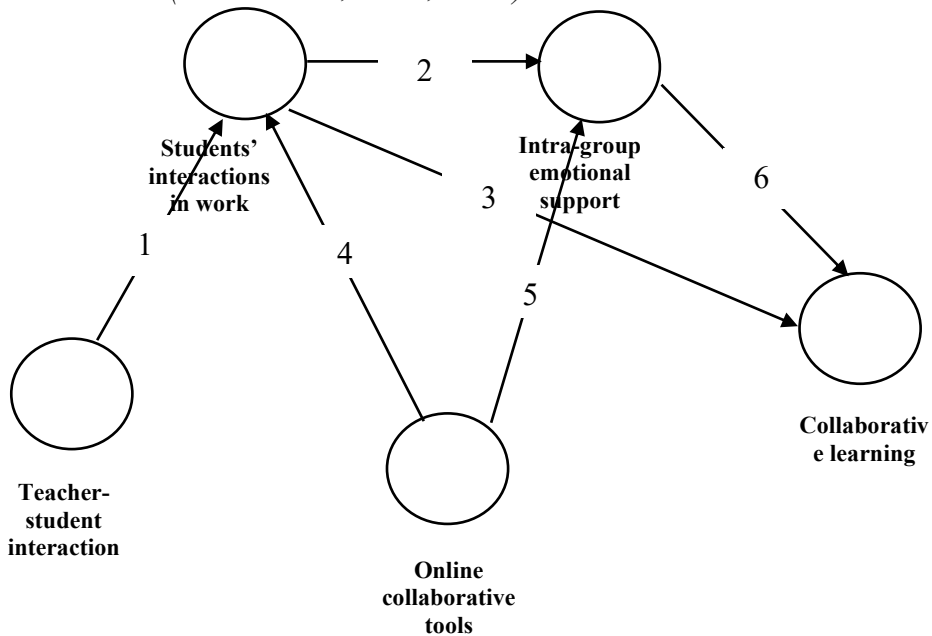
Collaborative learning is a constant part of group interaction, to promote socialized learning, involving cognitive, social, and teaching presence, and to sustain communication, coordination, and collaboration in platforms, it is essential to design a framework that addresses the distinctive characteristics of learning in online environments. Furthermore, technological tools and platforms should allow for exchanges between teachers, students, and students (synchronously or asynchronously) and for observing group processes (Hernández-Sellés., et al., 2019).

Hernández-Sellés et al. (2019) constructed a model to support an e-collaborative platform consisting of six factors: (1)

Teacher–student interaction has a positive and considerable influence on students’ interaction in their work groups. (2) Student interaction in work groups has a positive and considerable influence on intragroup emotional support. (3) Student interaction in work groups has a positive and considerable influence on collaborative learning. (4) Online collaborative tools have a positive and considerable influence on students’ interactions in their work groups. (5) Online collaborative tools have a considerable impact on intragroup emotional support; e-collaborate platforms require synchronous and asynchronous tools to encourage social interaction and active learning. (6) Intragroup emotional support has a positive and considerable influence on collaborative learning as shown in fig (1).

Figure 1.

Model of building an affecting online collaborative learning environment (Hernández., et.al., 2019).



In Figure 1. Model of factors affecting online collaborative learning (Hernández-Sellés et al., 2019). Arrows indicate hypothesized positive relationships between constructs. The present

study's instructional design explicitly targeted these pathways: (1) Teacher-student interaction via feedback; (2 & 3) Student interaction via team tasks; (4 & 5) Use of online tools (Google Docs, etc.); (6) Fostering emotional support through team stability and recognition.

In summary, e-collaborative platforms play a preeminent role in enhancing cognitive aspects, communication, and social skills. Therefore, in this study, the researcher used an e-collaborative platform (Google Classroom) for the development of teamwork skills and using digital media literacy, which are crucial for undergraduate STEM students.

In terms of teaching I.C.T., the researcher used a blended technique with face-to-face and e-collaborative platforms (Google Classroom) supported with technological tools to promote interactivity and communication by applying a model of e-collaborative platform.

Using digital media literacy

The term “media literacy” is sometimes seen as a politically pragmatic term, while being flawed as a description and lacking a focused and coherent vision for its future. Moreover, there is a main curriculum available for media education, a subject that is available only on an optional basis for children in secondary school (Potter, et al, 2017).

Using digital media literacy become a key concern in contemporary society, as they promise to educate students to become and remain active, critical members of society (Afrilyasanti et al., 2023). Using digital media literacy dimensions include accessing, analyzing, evaluating, creating, and communicating media messages across formats (Glas et al., 2023). Using digital media literacy aim to create individuals who are both critical thinkers and individuals who can control the media by being aware of what they see and hear (Tandoc, et al.,2021).

UNESCO (2013) highlights using digital media literacy development: 1) increases awareness of media's role, 2) enhances skills at institutional and individual levels, and 3) improves teaching by fostering independent, critical thinkers. Conversely, using digital media literacy creates demand for better learning environments and transforms students into creative knowledge workers.

According to this study, using digital media literacy defined as the ability of undergraduate STEM students to access, analyse, evaluate, create, and communicate various media messages in tasks, assignments, and projects of the I.C.T. Course.

Using digital media literacy frameworks vary across studies: Dolanbay (2022) identifies four dimensions (cognitive, emotional, aesthetic, moral), while Glas et al. (2023) propose eight action-based dimensions (operate, explore, create, find, connect, discuss, understand, reflect). UNESCO (2013) categorizes using digital media literacy into three core components (access, evaluation, communication), each with sub-dimensions for proficiency assessment. These differing approaches reflect the multidimensional nature of using digital media literacy development.

In summary, there have been various attempts to develop using digital media literacy among students, and there are different frameworks to follow, and different classifications based on the aims of studies. In this study, using digital media literacy comprised five dimensions (access, analyse, evaluate, create, and communicate), and those dimensions covered the social theme in communication, the technical theme in creating or producing, and the information theme in access, analysis, and evaluation. These dimensions were based on ICT course outcomes and considered adequate for undergraduate STEM students in their first year at faculty of education Ain Shams University.

Teamwork skills

Teamwork skills are considered vital soft skills that can be applied to every student and could help to improve critical and creative thinking to solve problems related to tasks and the quality of the learning process, in addition to enhancing the added value of

students, building their self-confidence and helping to expand their communication skills and interactions with others (Sulaiman et al.,2017).

de Prada Creo et al. (2020) define teamwork as several interrelated actions, such as performance monitoring, giving, and receiving feedback, close-loop communication, backup behaviours, adaptability, and coordination of action, which are very competencies frequently associated with soft skills.

In this study, teamwork skills are defined as the ability of STEM undergraduate students to contribute to STEM-based team projects, plan and manage different tasks, deal with conflicts, solve problems, foster a constructive team climate, and have a collective advantage toward the team.

There have been attempts to determine teamwork skills, and Romero-Díaz de la Guardia et al. (2022) indicated that there are aspects such as collective identity, communication and interaction between team members, execution of planning, and continuous adjustment. In addition, Avila et al. (2021) identified three essential components of teamwork skills: team learning, team performance, and team cohesion. According to De Prada et al. (2022), there are six key soft skills for teamwork: coordination, decision making, leadership, interpersonal development, adaptability, and communication.

In conclusion, there are two main domains in teamwork skills: the first domain is related to teamwork performance regarding the accomplishment of the task, and the second domain is related to teamwork performance regarding interaction and communications between teammates. Consequently, in this study, the researcher identified the following six vital components: contributing to STEM-based team projects, planning, and management, dealing with conflict, problem solving, fostering a constructive team climate, and collective efficacy.

Methodology

Research methodology

As noted above in the literature section, e- collaborative platforms are sufficient in education and are an effective way to teach and deliver courses and develop knowledge, skills, and attitudes. In addition, there were limited contributions related to e- collaborative platforms.

A single-group (n=37) pretest-posttest design was employed due to institutional constraints (single cohort availability), consistent with similar studies in resource-limited contexts (Fanguy et al., 2023). To mitigate bias, triangulation via self- and peer-assessments was used. Scales were piloted with 80 students in different majors in the first year ($\alpha = 0.75\text{--}0.95$) Undergraduates STEM students in the faculty of education consider STEM to be an innovative approach to education; therefore, the sample of participants were small, this study aimed to determine the effectiveness of teaching an ICT (information and Communication Technology) course by using an e- collaborative platform for first-year undergraduate STEM students.

Regarding the I.C.T., the course was uploaded to Google Classroom as an e-collaborative platform on the following link: <https://classroom.google.com/c/NTI4Mzc5MzIxODEy?cjc=v7bk3re>, classified into topics, the stream section concerning announcements and students' activities, and the classwork concerning assignments, materials, and resources.

Teaching the I.C.T. course started on 23 October 2022 and ended on 26 December 2022, with twelve sessions; each session was conducted on Monday every week, nine sessions were physically conducted at the faculty, and five sessions were conducted online by using Microsoft teams.

In the first session, the instructor presented guidelines about how to log into the e- collaborative platform, how to deal with the tools, and how to operate them on smartphones or PCs. In addition, self- and peer assessment teamwork and using digital media literacy

scales were used to review the assessment criteria to ensure that the participants understood and were able to assess their performance.

On the other hand, in the last session concerned with finalizing the course, the students presented their e-portfolios with their insights into their performance in terms of using digital media literacy and teamwork skills before and after they studied this course. The researchers applied post-tests of the self- and peer assessment using digital media literacy and teamwork scales.

In addition, in each session, the instructor announces the best list of students and the best team, and this announcement is presented every session according to their performance regarding using digital media literacy and teamwork skills. The criteria for assessing and selecting students and teams were presented in the first session; thus, all the students competed to make progress in their performance and be on this list.

The teams of undergraduate STEM students were randomly assigned, with the instructor observing and documenting group dynamics to provide targeted support. Task reports assessed collaboration and individual contributions, while exit tickets collected sessions feedback. A final satisfaction survey evaluated the course overall. Students received personalized feedback on their work throughout.

Teams were redistributed each session for the first seven weeks, then remained fixed until the course ended. The changes in the teams' distributions in the first seven sessions enabled the students to deal with different situations and obtain teamwork skills and were able to observe their performance progress on their teams.

Learning environments, technology tools and applications

In this study, the researcher followed ADDIE model to design the e-collaborative platform that delivered the ICT course, thus, in analyze stage, the researcher determined the outcomes of the course which are developing using digital media literacy

dimensions and teamwork skills of undergraduate STEM students in level one.

In design stage, the researcher determined the learning objectives of each session and choose to use Google Classroom as an e-collaborative platform for several reasons: it is a free e-collaborative platform that is easy to use with smartphones or PCs and is connected to a personal Google Drive; therefore, uploaded documents will be saved on students' drive if they want to use them again.

In addition, there were technological tools, websites and applications embedded in a collaborative way with the Google Classroom to make it more interactive and enjoyable and to achieve the aim of this study. These include Google Forms, Google Drive, Google Slide, Google Docs, Wooclap, Mentimeter, Edupuzzle, Microsoft Teams, and WhatsApp.

These tools were integrated to facilitate specific collaborative actions:

- Google Docs/Slides: Used for real-time, synchronous co-creation of reports and presentations, requiring teams to coordinate, communicate, and manage tasks.
- Wooclap & Mentimeter: Used to foster whole-class interaction and peer learning through live polls, word clouds, and Q&A sessions, allowing students to analyze and evaluate collective responses.
- Peer Assessment via Google Forms: Structured forms were used to guide students in providing constructive feedback on their teammates' contributions to media products and teamwork processes, making the evaluation criteria explicit.

After that, the researcher created a storyboard of the course and distribute it among jury members to ensure the quality of planning and designing the course before start create it in developing stage.

In development stage the researcher started to upload the materials and documents related to the ICT course, additionally the researcher conduct a pilot study to ensure that the all material ,

links, and documents were available and easy to access among students, the pilot study occurs in 15 October 2022, among science students (n=20), and the findings of pilot study showed that some links were unavailable, some documents were not able to access, thus the researcher adjusted all obstacles before the implement stage.

In implement stage, the researcher started teaching the I.C.T. course on 23 October 2022 and ended on 26 December 2022, with twelve sessions; each session was conducted on Monday every week, nine sessions were physically conducted at the faculty, and five sessions were conducted online by using Microsoft teams.

Considering the above, each student could log into the e-collaborative platform and interact with the materials, classmates, and instructor regarding the topics identified via Google Classroom (ICT introduction—ppt skills and storyboarding—learning theories—instructional design models—instructional design standards—design in practice—digital citizenship—data literacy—game-based learning and gamification).

As mentioned above, the Google Classroom is an e-collaborative platform divided into a stream section where students' activities appear, announcements from instructors, students' interactions, or comments on their classmates' work, and the second section is classwork where students will find materials, resources, assignments, and activity resources.

Based on the model of collaboration, the researcher follows the following model:

Teacher–student interaction has a positive and considerable influence on students' interaction in their teamwork.

The instructor encourages undergraduate STEM students to engage in team presentations and discussion at the beginning of each session. The instructor provided feedback on the students' assignments after each session by writing a private comment to each student or in public by illustrating the good points and explain the

points that should be revised in online or face to face sessions, and the students could follow the instructor comment and edit their work. In addition, the instructor conducted a feedback discussion at the beginning of each session about the students' work and then announced the best students in the previous session and the criteria for selecting them.

Student interaction in work groups has a positive and considerable influence on intragroup emotional support.

The teams distributed in each session differed, except for the last three sessions, where the teams closely followed their teamwork progress, made students more engaged, became familiar with each other, and collaborated to manage teamwork.

The relationship between students rapidly increases, which is revealed in task-based reports that were completed after each task, additional exit tickets that were applied after each session, and feedback about each other working on the same team. The course satisfaction questionnaire was administered in the final session.

Student interaction in work groups has a positive and considerable influence on collaborative learning:

After each session, the instructor requested an exit ticket to collect students' feedback about the session, such as the best parts and the parts that needed improvement, what they gained from the session, and the obstacles they encountered.

Their feedback helped the instructor modify teaching strategies and then assess instructor performance. At the end of the course, the instructor applied a course evaluation questionnaire to gather students' opinions regarding acquiring knowledge, skills, and attitudes from the course.

Online collaborative tools have a positive and considerable influence on students' interactions in their work groups:

These tools (synchronous or asynchronous) eventually enhance teamwork tasks and enhance communication, collaboration, and coordination.

The researcher employed synchronous tools such as Microsoft Teams and WhatsApp and chat and asynchronous tools

such as course materials, activities (individual or teamwork), assignments, and projects to design the course via the Google Classroom.

Online collaborative tools have a considerable impact on intragroup emotional support:

E-collaborative platforms use synchronous and asynchronous tools to promote social interaction and active learning; therefore, instructors use different activities to support collaboration among teams, and for each task or assignment, team members must assess each other's effort and provide feedback about the task.

Intragroup emotional support has a positive and considerable influence on collaborative learning.

Making a team each week helps to improve teamwork skills and using digital media literacy dimensions. Providing sustained feedback on teams makes each team aware of the strengths and weaknesses of teamwork and provides them with time to reflect on their performance and modify their performance in future endeavours.

In evaluation stage, the researcher managed a final session to evaluate of using digital media literacy dimensions and teamwork skills among the students, as mentioned above.

Participants

This study involved first-year undergraduate STEM students in four majors (math-biology-chemistry-physics) at the faculty of education, Ain Shams University.

A total of 37 first-year undergraduate STEM students (23 females, 14 males) who fully participated in an information and Communication Technology (I.C.T.) course. The gender imbalance and small sample size are acknowledged as limitations to the generalizability of the findings, though they are representative of the enrollment in this pioneering cohort.

Ain Shams University's STEM program is among Egypt's first (established 2022), emphasizing project-based learning.

Participants (N=37) were pioneers in this program, representing a unique cohort with limited prior exposure to collaborative e-learning.

Instruments:

To accomplish the aim of this study, which examined the effectiveness of teaching an information and Communication Technology (I.C.T.) course by using an e-collaborative platform for developing using digital media literacy dimensions and teamwork skills, the researcher designed the following instruments:

- self-assessment using digital media literacy scale.
- peer assessment using digital media literacy scale.
- self-assessment teamwork scale.
- peer assessment teamwork scale.

The instructor encouraged students to write in detail about the benefits gained from the activity and the challenges they encountered, how to overcome those challenges as a team, how to deal with their teams and how to be honest in their responses. The scales were applied pre- and post-tests.

Using digital media literacy scales

Using digital media literacy are important for student teachers. Since using digital media literacy dimensions are interrelated with other 21st-century skills, students need to be involved in ICT programs; therefore, several attempts have been made to develop and assess using digital media literacy dimensions (Inan & Temur, 2012; Agustina, 2022).

To assess using digital media literacy in undergraduate STEM students, several studies contributed to reach the final version of suitable using digital media literacy self- assessment scale , using digital media literacy peer assessment scale; such as: (Eristi & Erdem, 2017), (Chang, et al.,2011), (Ranieri & Bruni., 2018), and (the Central Board of Secondary Education, 2020), and the final version in this study comprised 38 items distributed on five dimensions: access, analyse, evaluate, produce/create, and communicate, as follows

1. Access refers to the effective selection and use of various media tools to search, access, retrieve, and store media content and knowledge (7 items).
2. Analyse is defined as the ability to effectively select, organize, assess, interpret, and distinguish between media content and knowledge resources (8 items).
3. Evaluate refers to the ability to evaluate, compare, and authenticate, in terms of ethical principles, the media content gathered, and its sources included (7 items).
4. Create/produce, identified as the ability to create/produce new media content or knowledge for a specific purpose in an innovative, ethical, and creative manner (7 items).
5. Communication refers to communicating and participating with one's group and audience in media content and knowledge in an ethical, legal, and effective manner using appropriate channels and tools (9 items).

Accordingly, both the self- and peer-assessment scales consisted of closed questions with a five-item Likert scale for each statement (Drinkwater, 1965), enabling undergraduate STEM students in the first year to express their level of performance, with each statement ranging from “excellent” =1 to “very weak” =5 (Pintrich et al., 1993; Ryan, 1982).

Consequently, the last version of the self- and peer-assessment scales of using digital media literacy contains thirty-eight items distributed across the five dimensions mentioned above, and the reliability test illustrates the strong coefficient of the two scales. The scales were transformed into online versions by using Google Forms and uploaded to Google Classrooms.

In addition, to assess using digital media literacy of the undergraduate STEM students, the researcher applied the using digital media literacy self- and peer-assessment scales as a test in the first session of the course and a post-test in the last session.

Teamwork scales

The importance of developing teamwork skills is considered a crucial soft skill that should be acquired by every student, and several attempts have been made to assess and develop teamwork skills (Sulaiman et al.,2017).

Hence, the researcher created self- and peer-assessment scales to assess the teamwork skills of undergraduate STEM students. The teamwork scales consisted of six aspects extracted from the following studies: Shofiyah et al., 2022; Guaman-Quintanilla et al., 2022; Ohland et al., 2012; Avila et al., 2021; Careau et al., 2014; and Hebles et al., 2022. This study focused on the following aspects of teamwork: contributing to STEM-based team projects, planning, and management, dealing with conflict, solving problems, fostering a constructive team climate, and maintaining collective efficacy. The last version contains 36 items distributed across 6 dimensions, as follows:

1. Contribution to STEM-based Team Projects refers to the ability to commit, work and participate actively and efficiently (7 items).
2. Planning and Management are defined as effectively selecting, organizing, assessing, interpreting, and distinguishing between media content and knowledge resources (5 items).
3. Dealing with conflict refers to implementing reactive ways to solve teams' obstacles, challenges, and misunderstanding (6 items).
4. Problem solving was identified as the ability to identify the problem, test assumptions, reach a solution, and make a conclusion (7 items).
5. Foster constructive team climate refers to the ability to share opinions, motivate, listen, and respect each other (6 items).
6. Collective efficacy was identified as team members' beliefs about the ability of the team to accomplish tasks (5 items).

Both the self- and peer-assessment scales consisted of closed questions with a five-item Likert scale for each statement (Drinkwater, 1965), enabling undergraduate STEM students in the first year to express their level of performance, with each statement ranging from “excellent” =1 to “very weak” =5 (Pintrich et al., 1993; Ryan, 1982).

Consequently, the last version of the teamwork scales contains 36 items distributed on the six dimensions mentioned above, and the reliability test illustrates a strong coefficient of the two scales. The scales were transformed into online versions by using the Google Form application and uploaded to the Google Classroom.

Subsequently, to assess the teamwork skills of the STEM students, the researcher applied the teamwork self- and peer-assessment scales as a pretest in the first session of the course and as a post-test in the last session.

Reliability

To assess the reliability of the self- and peer-assessment scales of using digital media literacy, teamwork self- and peer-assessment scales were piloted at an earlier stage with (n=80) undergraduate students in different majors in the first year. The following tables depict a reliability analysis of the instrument by using IBM SPSS software, which was assessed by calculating the Cronbach's alpha confident (Cronbach, 1951). The coefficients show that the self- and peer-assessment of using digital media literacy and teamwork scales and subdimensions have acceptable internal consistency; all values of reliability exceeded the accepted minimum of 0.70 (Nunnally, 1978). The following tables: Table 1,

Table2, Table 3, Table 4 illustrate the value of each scale and its subdimensions.

Table 1.

Reliability statistics of self-assessment using digital media literacy scale (n=80)

Dimensions	Cronbach's Alpha	N of Items	Items
Access	0.75	7	1-7
Analysis	0.73	8	8-15
Evaluate	0.79	7	16-22
Create/produce	0.79	7	23-29
Communicate	0.84	9	30-38
The whole scale	.941	36	

Table 2.

Reliability statistics of peer assessment using digital media literacy scale (n=80)

Dimensions	Cronbach's Alpha	N of Items	Items
Access	0.79	7	1-7
Analysis	0.83	8	8-15
Evaluate	0.77	7	16-22
Create/produce	0.83	7	23-29
Communicate	0.85	9	30-38
The whole scale	.955	36	

Based on the reliability, the last version of the using digital media literacy scales contains 38 items distributed among the five elements mentioned above, and the reliability test illustrates a strong coefficient of the two scales.

Table 3.

Reliability statistics of self-assessment teamwork (n=80)

Dimensions	Cronbach's Alpha	N of Items	Items
Contribution to STEM-based Team Projects	0.7	7	1-7
Planning and Management	0.70	5	8-12
Dealing with conflict	0.84	6	13-18
Problem solving	0.81	7	19-25
Fosters constructive team climate	0.79	6	26-31
Collective efficacy	0.77	5	32-36

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

Table 3.

Reliability statistics of self-assessment teamwork (n=80)

Dimensions	Cronbach's Alpha	N of Items	Items
The whole scale	.950	36	

Table 4.

Reliability statistics of peer assessment teamwork (n=80)

Dimensions	Cronbach's Alpha	N of Items	Items
Contribution to STEM-based Team Projects	0.75	7	1-7
Planning and Management	0.74	5	8-12
Dealing with conflict	0.79	6	13-18
Problem solving	0.76	7	19-25
Fosters constructive team climate	0.80	6	26-31
Collective efficacy	0.79	5	32-36
The whole scale	.951	36	

Considering reliability, the last version of the teamwork scales contains 36 items distributed across six aspects, and the reliability test illustrates a strong coefficient of the two scales.

Data collection

The aim of the study is examined the effectiveness of teaching an information and Communication Technology (I.C.T.) course by using Google Classroom as an e-collaborative platform for developing using digital media literacy dimensions and teamwork skills, to achieved this aim, the study used a quantitative method exhibited in using digital media literacy scales and teamwork scales, the researcher used a one-group (experimental) pretest/post-test design because the nature of participants was unique because the STEM program is the first undergraduate program in EGYPT, and there are the first students who enrolled in this program.

This study was conducted in accordance with the ethical standards. As the researcher is a faculty member within the institution, the study was conducted in accordance with the institution's ethical guidelines for internal research and the principles of the Declaration of Helsinki. All participants provided informed consent. They were clearly informed about the study's purpose, the voluntary nature of their participation, and their right to withdraw at any time without penalty. Confidentiality and anonymity of their data were guaranteed.

The scales (self-assessment and peer-assessment) of using digital media literacy contains, both scales are delivered online via Google Forms because they do not require official email with Gmail, and all undergraduate STEM students have a smartphone registered with Gmail; thus, it was easy for them to respond to questions, and there were a links for both scales: using digital media literacy pre self-assessment scale: <https://forms.gle/tRFPrf2zayHZ1jRx5>, pre-peer-assessment using digital media literacy scale: <https://forms.gle/DXeZCkQ4PVeRamVY8>

teamwork scales (self -assessment and peer assessment) encompassed 36 closed questions distributed on the six dimensions, both scales are delivered online via Google Forms because they do not require official email with Gmail, and all undergraduate STEM students have a smartphone registered with Gmail; thus, it was easy for them to respond to questions, and there were a links for both scales: teamwork pre self-assessment scale: <https://forms.gle/39VWxWQZfkeshChj6> , pre-peer-assessment teamwork scale: <https://forms.gle/PF6KocZVXt5BnRr29>

Data analysis

The data from 37 first year undergraduate STEM students were used in the statistical analysis. to anonymized data were processed in the statistical software IBM SPSS using appropriate statistical methods. Significance was assessed using parametric tests, T-test for paired-samples group with the significance level set at $\alpha=0.05$. regarding assessment teamwork skills, this study focused

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

on the following aspects: contributing to STEM-based team projects, planning and management, dealing with conflict, solving problems, fostering a constructive team climate, and maintaining collective efficacy, in terms of using digital media literacy dimensions, this study measures the following dimensions: access, analyse, evaluate, produce/create, and communicate.

The study implemented ICT instruction through Google Classroom and supplementary collaborative tools. The approach emphasized: (1) teacher-student interaction enhancing group engagement, (2) peer interaction fostering emotional support and collaborative learning, and (3) online tools (both synchronous and asynchronous) facilitating interaction and emotional support. These elements collectively promoted active learning through intragroup dynamics and platform-supported collaboration.

Results

First, the effectiveness of an e- collaborative platform for developing using digital media literacy dimensions of undergraduate STEM students.

To test H1—that post-test using digital media literacy scores would significantly improve ($p < 0.05$)—paired-samples *t*-tests compared to pre/post self-, and peer-assessment means across all domains (Table 5).

Table 5.

Pre/post applying results of the Group of students in each aspect of the self-assessment using digital media literacy scale

Using media aspects	digital literacy	Group	Total	The mean	Std. Deviation	DF	T value	sig
Access		Pre	35	25.11	4.23	36	2.71	0.01
		Post		27.65	3.79			
Analyse		Pre	40	28.89	4.35	36	3.06	0.01
		Post		32.08	3.91			
Evaluate		Pre	35	24.65	4.96	36	2.03	0.01
		Post		27.24	4.79			
Create/produce		Pre	35	25.05	4.84	36	2.92	0.01
		Post		28.13	3.64			

Table 5.

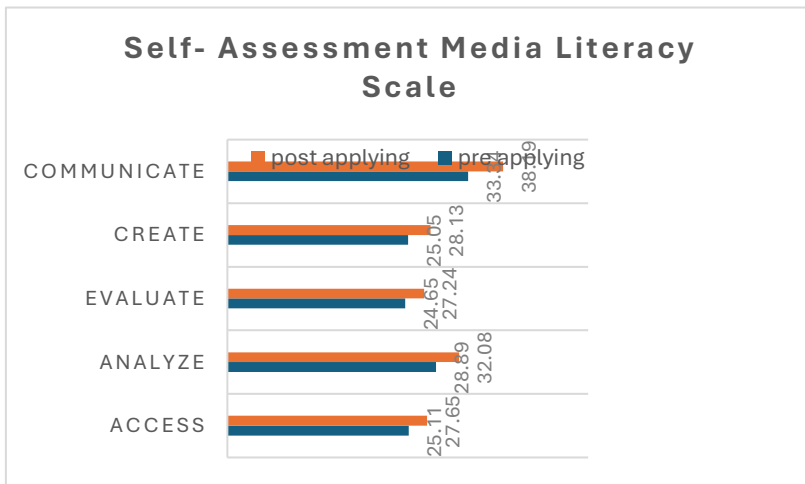
Pre/post applying results of the Group of students in each aspect of the self-assessment using digital media literacy scale

Using media aspects	digital literacy	Group	Total	The mean	Std. Deviation	DF	T value	sig
Communicate		Pre	45	33.34	5.43	36	3.88	0.01
		Post		38.19	5.17			
Total		Pre	190	137.08	19.75	36	3.40	0.01
		Post		153.29	18.72			

The previous table reveals that there is a significant difference in all aspects of the scale and that the total score exceeded 0.05; consequently, there were significant differences between the mean scores of the pre- and post-applications of self-assessment using digital media literacy scales of the experimental group's students in favour of the post application, and the following figure demonstrates the previous results.

Figure 2.

A graph showing the mean score for each aspect in the self-assessment using digital media literacy scale.



Pre/post peer-assessment means (total and by domain) were analyzed, with results shown in Table 6.

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

Table 6.

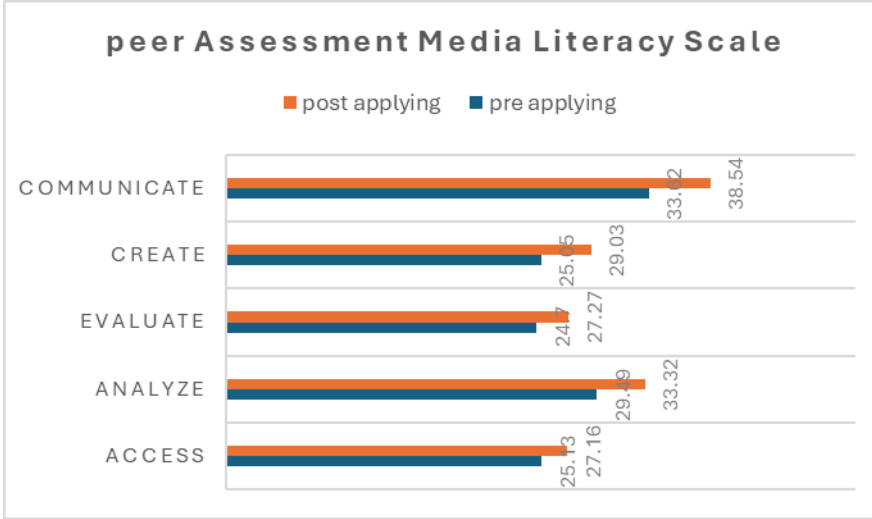
Pre/post applying results of the Group of students in each aspect of the peer-assessment using digital media literacy scale

Using digital media literacy aspects	Group	Total	The mean	Std. Deviation	DF	T value	sig
Access	Pre	35	25.13	6.81	36	1.46	0.15
	Post		27.16	4.20			
Analyse	Pre	40	29.49	7.29	36	2.54	0.05
	Post		33.32	4.16			
Evaluate	Pre	35	24.70	6.60	36	1.75	
	Post		27.27	5.03			0.08
Create/produce	Pre	35	25.05	6.96	36	3.14	0.01
	Post		29.03	3.44			
Communicate	Pre	45	33.62	8.71	36	2.82	0.01
	Post		38.54	4.76			
Total	Pre	190	138.00	34.42	36	2.57	0.05
	Post		155.43	18.50			

The table shows that there was a significant difference in all aspects of the scale and that the total score exceeded 0.05, except for “Access and evaluate.” Specifically, there were significant differences between the mean scores of the students in the peer-assessment using digital media literacy scale (analyse, create, communicate) and in access and evaluation for the students in the pre- and post-application groups. In other words, in the two dimensions (access and evaluation), students assessed that they could not access or evaluate media as they expected, and the following figure demonstrates the previous results.

Figure 3.

A graph depicting the mean score for each aspect in the peer-assessment using digital media literacy scale.



Second: the effectiveness of an e- collaborative platform for developing teamwork skills of undergraduate STEM students

To test H2, paired t-tests analyzed pre/post differences in teamwork assessments (self and peer). Results showed significant gains across all domains ($p < 0.05$), supporting the hypothesis (Table 7).

Table 7.

Pre/post applying results of the Group of students in each aspect of the self-assessment teamwork scale (n=37)

teamwork aspects	Group	Total scores	The mean	Std. Deviation	DF	T value	Sig (2-tailed)
Contribute to STEM based Team Projects.	Pre	35	18.92	8.49	36	8.52	0.01
	Post		30.41	2.86			
Planning and Management.	Pre	25	13.81	5.82	36	7.31	0.01
	Post		20.70	2.42			
Dealing with conflict.	Pre	30	16.73	6.92	36	5.47	0.01
	Post		23.43	3.77			
Problem solving.	Pre	35	18.78	8.16	36	3.75	0.01
	Post		25	6.94			
Fosters Constructive Team Climate.	Pre	30	16.32	7.77	36	7.47	0.01
Collective	Post	25	26.11	2.73	36	7.77	0.01
	Pre		13.51	7.84			

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

Table 7.

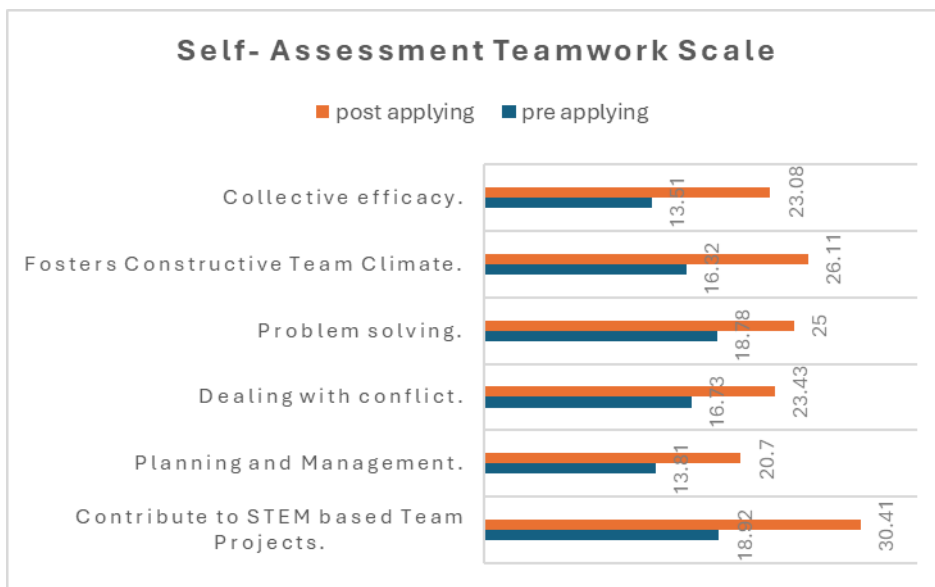
Pre/post applying results of the Group of students in each aspect of the self-assessment teamwork scale (n=37)

teamwork aspects	Group	Total scores	The mean	Std. Deviation	DF	T value	Sig (2-tailed)
efficacy.	Post		23.08	1.91			
Total	Pre	180	98.08	42.70	36	8.07	0.01
	Post		152.62	13.75			

The self-assessment teamwork scale showed significant improvement ($p < 0.05$; Table 7), which indicates that there is a significant difference in the favour of the post applied, and the following figure demonstrates the previous results.

Figure 4.

A graph illustrating the mean score for each aspect in the self-assessment teamwork scale.



Pre/post peer-assessment teamwork scores (total and by domain) demonstrated significant gains ($p < 0.05$), detailed in Table 8.

Table 8.

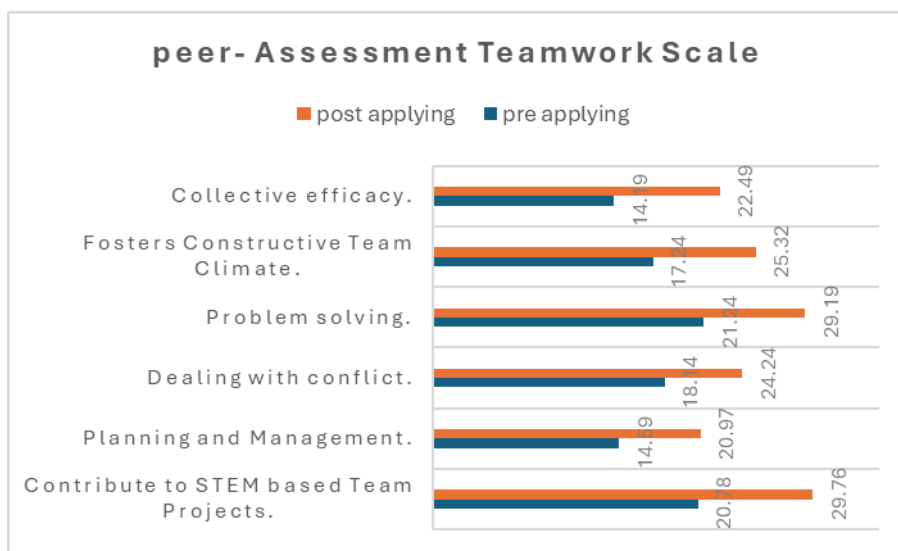
Pre/post applying results of the Group of students in each aspect of the peer-assessment teamwork scale(N=37)

teamwork aspects	Group	Total	The mean	Std. Deviation	DF	T value	sig
Contribute to STEM based Team Projects	Pre	35	20.78	8.85	36	5.74	0.01
	Post		29.76	3.51			
Planning and Management-	Pre	25	14.59	5.71	36	6.15	0.01
	Post		20.97	2.55			
Dealing with conflict	Pre	30	18.14	6.52	36	4.90	0.01
	Post		24.24	4.12			
Problem solving	Pre	35	21.24	8.15	36	5.55	0.01
	Post		29.19	3.86			
Fosters Constructive Team Climate	Pre	30	17.24	7.57	36	6.32	0.01
	Post		25.32	3.29			
Collective efficacy	Pre	25	14.19	6.08	36	7.85	0.01
	Post		22.49	2.65			
Total	Pre	180	106.19	40.34	36	6.61	0.01
	Post		151.97	16.53			

The previous table shows that there is a significance level exceeding 0.05 for the peer-assessment teamwork scale, indicating that there is a significant difference in the favour score of the post applied, and the following figure demonstrate the previous results.

Figure 5.

A graph depicting the mean score for each aspect in the peer-assessment teamwork scale.



In summary, the results indicate the effectiveness of teaching I.C.T.

Effectiveness of Teaching I.C.T course via an e-collaborative platform for the development of using digital media literacy and teamwork skills of undergraduate STEM students at faculty of education Ain Shams University

by using an e- collaborative platform to develop using digital media literacy and teamwork skills of undergraduate STEM students in the first year.

Effect size calculations:

Effect sizes (Cohen's d and Pearson's r) quantified the ICT course's educational impact (Kelley & Preacher, 2012; Cohen, 1988). Table 9 shows all values exceeded 0.4, demonstrating the e-collaborative platform's effectiveness in developing using digital media literacy and teamwork skills among first-year STEM undergraduates at Ain Shams University, Egypt.

Table 9.

Calculate effect size of teaching ICT course via e-collaborative platform on development of using digital media literacy and teamwork skills

Measurements	Cohen's d	effect-size r
Using digital media literacy self-assessment scale	1.1	0.5
Using digital media literacy peer-assessment scale	0.8	0.5
Teamwork self-assessment scale	2.6	0.8
Teamwork peer-assessment scale	2.2	0.7

Discussion and conclusion:

The findings were related to the participation of first-year STEM students who were enrolled in a STEM undergraduate program involving four majors (math biology, chemistry, physics), which is a unique program in the faculty of education, Ain Shams University, and EGYPT. Since only five faculties conduct STEM undergraduate program, the students were entering a program with a different pedagogy and mindsets. Therefore, the findings are limited by the nature of the students and the context of the STEM program.

The findings revealed a statistically significant improvement in teamwork skills, as depicted in Tables 7 and 8. This outcome is consistent with previous research by Hebles et al. (2022), who aimed to improve teamwork skills for university students. The effectiveness of an e-collaborative platform with undergraduate STEM students contributed to the development of teamwork skills,

which agreed with the findings of Shofiyah et al. (2022), who emphasized the importance of developing teamwork skills in the STEM context. Accordingly, de Prada Creo (2020) and Sulaiman et al. (2017) agreed with the study results. The findings indicate the importance of developing teamwork skills in enhancing the added value of students, building their self-confidence, and helping to expand their communication skills and interactions with others. It is important to note that the researcher emphasized the significance of considering contextual and cultural factors when interpreting the findings.

The improvement in teamwork skills may stem from Google Classroom's structured feedback loops (e.g., weekly 'best team' announcements) and task interdependence. Using digital media literacy gains in 'create/communicate' likely reflect hands-on use of tools like Slides and Docs, whereas weaker 'evaluate' scores suggest need for explicit instruction in source critique.

The results for using digital media literacy reveal that the e-collaborative platform used to teach ICT courses to first-year undergraduate STEM students affects the development of using digital media literacy dimensions. According to the using digital media literacy peer assessment scale, there are significant differences between the mean scores of students on the peer-assessment using digital media literacy scale in three aspects (analyse, create, and communicate), which is consistent with the findings of (Fanguy, et al.,2023), who revealed the efficient of online collaboration learning in enhancing learning outcomes, additionally, this findings consent with (Tandoc et al.,2021; Ranieri & Bruni., 2018), who depicted developing using digital media literacy dimensions for university students. Otherwise, in two dimensions (access and evaluation), students assess that they cannot access or evaluate media as they expect and based on level one students' ability to evaluate other teammates, Limited proficiency in evaluation tasks may reflect insufficient practice time or platform limitations.

Conversely, for the self-assessment using digital media literacy scale, the findings reveal the significance of all aspects of using digital media literacy, which agrees with the findings of Afrilyasanti & Basthomi (2023) that Flipgrid application improves students' communication and critical using digital media literacy through the adoption of digital storytelling. Consequently, the findings indicate that first-year students can evaluate their performance and hesitate to evaluate others because peer assessment is a new technique for use with our students in the faculty. We usually focus on the final exam rather than developing assessment techniques in our classes. However, STEM education programs, which have recently been applied by our faculty, provide more unique techniques for assessing our students, which are reflected in students' behaviours and mindsets.

An interesting finding was the lack of significant improvement in the 'Access' and 'Evaluate' dimensions on the peer-assessment scale, despite significant gains in self-assessment. This discrepancy warrants explanation. It may stem from the nature of peer-assessment itself. Evaluating a peer's ability to *access* information is inherently difficult to observe directly. Similarly, critically *evaluating* information is often an internal cognitive process. Peers may have only been able to assess the final product ('Create' and 'Communicate'), which saw significant gains, rather than the nuanced processes of sourcing and critical analysis. This highlights a potential limitation of peer-assessment for measuring certain metacognitive and suggests that students in this context may have required more explicit training on how to evaluate these specific competencies in their peers (Falchikov & Goldfinch, 2000).

In conclusion, this study emphasizes the need to strengthen the using online collaborative platform in teaching technology courses such as ICT course for STEM undergraduate students in first year, the online collaboration enhances the using digital media

literacy and teamwork skills. Additionally, using diverse ways of assessment such as peer assessment and self-assessment considered as new technique and students does not adapt with it yet, otherwise, it reflected on the students learning progress.

Limitations:

This study has several limitations. First, the small sample size ($n=37$) and its gender imbalance limit the statistical power and generalizability of the results beyond this specific pioneering cohort. This small sample size may limit the representativeness of the results. The majority of the participants in this study were female. Additionally, the sample included first-year undergraduate STEM students in four majors (math-biology-chemistry-physics) at the Faculty of Education, Ain Shams University. The STEM program is a newly established undergraduate program for the faculty. Regarding the e-collaborative platform, the researcher used the Google Classroom.

Second, the use of a single-group design, while necessary due to institutional constraints, prevents causal claims without comparison to a control group.

Third, as discussed, the reliability of peer-assessment, particularly for harder-to-observe skills like 'Access' and 'Evaluate,' may have been impacted by the students' novelty to this assessment technique.

Fourth, the study's scalability within the Egyptian context may be affected by infrastructural barriers such as unequal internet access and device availability, which could limit the adoption of such e-collaborative models in other institutions.

Finally, the Hawthorne Effect may be present, as participants knew they were part of a novel study on a new STEM program.

Recommendations of research:

This study demonstrates the potential of e-collaborative platforms to develop crucial 21st-century skills. For successful implementation in the Egyptian higher education context, recommendations include:

1. Faculty development programs to train instructors on designing collaborative online activities and managing peer assessment.
2. Investment in reliable institutional IT infrastructure and considering blended models to mitigate internet access issues.
3. Integrating training for students on how to effectively give and receive peer feedback.
4. Examining the impact of e-collaborative platforms on specific performances regarding other literacies (digital, technology, AI, etc.).
5. Include a large number of participants and use different samples with different variables.

Suggestions for Future research:

The following are suggestions for future research:

1. The effects of platforms in developing teamwork skills of preparatory students.
2. The impact of collaborative platform on developing digital literacy of undergraduate students.
3. The effects of platform in developing scientific literacy of primary stage students.
4. The effects of mobile learning in developing reflective thinking for secondary stage students.

References

- Afrilyasanti, R., Basthomi, Y., & Zen, E. L. (2023). EFL students' participations and teachers' roles in online discussion forum for critical media literacy learning. *Contemporary Educational Technology*, 15(2), ep414. <https://doi.org/10.30935/cedtech/12965>
- Aguaded, I. (2010). The European Union passes a recommendation on media literacy in the European digital environment. *Comunicar*, 17(34), 7–8. <https://doi.org/10.3916/c34-2010-01-01>
- Agustina, I. W. (2022). Media Literacy-Based and Project-Based Syllabus for The English in Media Discourse Subject. *Indonesian Journal of Educational Assessment*, 4(2).
- Avila, D. T., Van Petegem, W., & Snoeck, M. (2021). Improving teamwork in agile software engineering education: The ASEST+ framework. *IEEE Transactions on Education*, 65(1), 18-29. <https://doi.org/10.1109/te.2021.3084095>
- Barron, B. (2003). When Smart Groups Fail. *Journal of the Learning Sciences*, 12(3), 307–359. https://doi.org/10.1207/s15327809jls1203_1
- Careau, E., Vincent, C., & Swaine, B. R. (2014). Observed Interprofessional Collaboration (OIPC) During Interdisciplinary Team Meetings: Development and Validation of a Tool in a Rehabilitation Setting. *Journal of Research in Interprofessional Practice and Education*, 4(1). <https://doi.org/10.22230/jripe.2014v4n1a118>
- Central board of secondary education. (2020) .*21st 6 Century Skills: A Handbook*, DELHI. retrieved from:https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0CAQQw7AJahcKEwjQ2TVlcT5AhUAAAAAHQAAAAAQAg&url=https%3A%2F%2Fcbs.eacademic.nic.in%2Fweb_material%2FManuals%2F21st_Century_Skill_Handbook.pdf&psig=AOvVaw1qD0WUODMAwR3ePrgnPNz4&ust=1660492207312521
- Chang, C. S., Liu, E. Z. F., Lee, C. Y., Chen, N. S., Hu, D. C., & Lin, C. H. (2011). Developing and validating a media literacy self-evaluation scale (MLSS) for elementary school students. *Turkish Online Journal of Educational Technology-TOJET*, 10(2), 63-71.

- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Routledge. <https://doi.org/10.4324/9780203771587>
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334. <https://doi.org/10.1007/bf02310555>
- de Prada Creo, E., Mareque, M., & Portela-Pino, I. (2020). The acquisition of teamwork skills in university students through extracurricular activities. *Education + Training*, 63(2), 165–181. <https://doi.org/10.1108/et-07-2020-0185>
- De Prada, E., Mareque, M. & Pino-Juste, M. Teamwork skills in higher education: is university training contributing to their mastery?. *Psicol. Refl. Crít.* 35, 5 (2022). <https://doi.org/10.1186/s41155-022-00207-1>
- Dolanbay, H. (2022). On the way of improving the media literacy: the case of faculty of education students: Improving the media literacy. *International Journal of Curriculum and Instruction*, 14(2), 1644-1659.
- Drinkwater, B. L. (1965). A Comparison of the Direction-of-Perception Technique with the Likert Method in the Measurement of Attitudes. *The Journal of Social Psychology*, 67(2), 189–196. <https://doi.org/10.1080/00224545.1965.9922270>
- Eristi, B., & Erdem, C. (2017). Development of a Media Literacy Skills Scale. *Contemporary Educational Technology*, 8(3). <https://doi.org/10.30935/cedtech/6199>
- Falchikov, N., & Goldfinch, J. (2000). Student Peer Assessment in Higher Education: A Meta-Analysis Comparing Peer and Teacher Marks. *Review of Educational Research*, 70(3), 287–322. <https://doi.org/10.3102/00346543070003287>
- Fanguy, M., Costley, J., Almusharraf, N., & Almusharraf, A. (2023). Online collaborative notetaking and discussion forums in flipped learning environments. *Australasian Journal of Educational Technology*, 39(2), 142–158. <https://doi.org/10.14742/ajet.8580>
- Giannoukos, I., Lykourantzou, I., Mpardis, G., Nikolopoulos, V., Loumos, V., & Kayafas, E. (2008, July). Collaborative e-learning environments enhanced by wiki technologies. *In Proceedings of the 1st international conference on Pervasive Technologies*

- Related to Assistive Environments* (p. 1-5).
<https://doi.org/10.1145/1389586.1389657>
- Glas, R., van Vught, J., Fluitsma, T., De La Hera, T., & Gómez-García, S. (2023). Literacy at play: an analysis of media literacy games used to foster media literacy competencies. *Frontiers in communication*, 8, 1155840.
<https://doi.org/10.3389/fcomm.2023.1155840>
- Goda, Y., & Yamada, M. (2013). Application of CoI to Design CSCL for EFL Online Asynchronous Discussion. *Educational Communities of Inquiry*, 295–316. <https://doi.org/10.4018/978-1-4666-2110-7.ch014>
- Guaman-Quintanilla, S., Everaert, P., Chiluiza, K., & Valcke, M. (2022). Fostering Teamwork through Design Thinking: Evidence from a Multi-Actor Perspective. *Education Sciences*, 12(4), 279.
<https://doi.org/10.3390/educsci12040279>
- Hebles, M., Yániz-Álvarez -de-Eulate, C., & Alonso-Dos-Santos, M. (2022). Teamwork competency scale (TCS) from the individual perspective in university students. *Journal of Technology and Science Education*, 12(2), 510. <https://doi.org/10.3926/jotse.1478>
- Hernández-Sellés, N., Muñoz-Carril, P. C., & González-Sanmamed, M. (2019). Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers & Education*, 138, 1-12.
<https://doi.org/10.1016/j.compedu.2019.04.012>
- Inan, T., & Temur, T. (2012). Examining media literacy levels of prospective teachers. *International Electronic Journal of Elementary Education*, 4(2), 269-285.
- Johnson, D. W., & Johnson, R. T. (2009). An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning. *Educational Researcher*, 38(5), 365–379.
<https://doi.org/10.3102/0013189x09339057>
- Kelley, K., & Preacher, K. J. (2012). On effect size. *Psychological Methods*, 17(2), 137–152. <https://doi.org/10.1037/a0028086>
- Kitcharoenpanya, J., & Chantraukrit, P. (2022). Developing Students' Scientific Modeling Ability and Attitude towards Teamwork through the Predict-Share-Observe-Explain (PSOE) Instructional Model. *Eurasian Journal of Educational Research*, 97(97), 301-315.

- Laal, M., & Ghodsi, S. M. (2012). Benefits of collaborative learning. *Procedia - Social and Behavioral Sciences*, 31, 486–490. <https://doi.org/10.1016/j.sbspro.2011.12.091>
- Laurillard, D. (2008). The pedagogical challenges to collaborative technologies. *International Journal of Computer-Supported Collaborative Learning*, 4(1), 5–20. <https://doi.org/10.1007/s11412-008-9056-2>
- Li, Q., Wang, Z., Li, W., Li, J., Wang, C., & Du, R. (2013). Applications integration in a hybrid cloud computing environment: modelling and platform. *Enterprise Information Systems*, 7(3), 237–271. <https://doi.org/10.1080/17517575.2012.677479>
- Magnisalis, I., Demetriadis, S., & Karakostas, A. (2011). Adaptive and Intelligent Systems for Collaborative Learning Support: A Review of the Field. *IEEE Transactions on Learning Technologies*, 4(1), 5–20. <https://doi.org/10.1109/tlt.2011.2>
- Monahan, T., McArdle, G., & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education*, 50(4), 1339–1353. <https://doi.org/10.1016/j.compedu.2006.12.008>
- Nunnally, J. C. (1978). An Overview of Psychological Measurement. *Clinical Diagnosis of Mental Disorders*, 97–146. https://doi.org/10.1007/978-1-4684-2490-4_4
- Ohland, M. W., Loughry, M. L., Woehr, D. J., Bullard, L. G., Felder, R. M., Finelli, C. J., Layton, R. A., Pomeranz, H. R., & Schmucker, D. G. (2012). The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self- and Peer Evaluation. *Academy of Management Learning & Education*, 11(4), 609–630. <https://doi.org/10.5465/amle.2010.0177>
- Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1993). Reliability and Predictive Validity of the Motivated Strategies for Learning Questionnaire (Mslq). *Educational and Psychological Measurement*, 53(3), 801–813. <https://doi.org/10.1177/0013164493053003024>
- Potter, J., McDougall, J., Potter, J., & McDougall, J. (2017). Dynamic literacies. *Digital media, culture and education: Theorising third*

- space literacies*, 15-36. https://doi.org/10.1057/978-1-137-55315-7_2
- Ranieri, M., & Bruni, I. (2018). Digital and Media Literacy in Teacher Education. *Advances in Higher Education and Professional Development*, 90–111. <https://doi.org/10.4018/978-1-5225-4059-5.ch006>
- Reneland-Forsman, L., & Ahlbäck, T. (2007). Collaboration as quality interaction in web-based learning. *Journal Advanced Technology for Learning*, 4, 30-35.
- Romero Walker, A. (2022). A more equitable film pedagogy: Including media literacy in higher education film classrooms to result in better media practitioners. *Journal of Media Literacy Education*, 14(1), 153–167. <https://doi.org/10.23860/jmle-2022-14-1-11>
- Romero-Díaz de la Guardia, J. J., García-Garnica, M., Chacón-Cuberos, R., & Expósito-López, J. (2022). Psychometric Validation of a Teamwork Skills Scale in a Vocational Training Context. *SAGE Open*, 12(2), 215824402211032. <https://doi.org/10.1177/21582440221103256>
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 43(3), 450–461. <https://doi.org/10.1037/0022-3514.43.3.450>
- Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a “Big Five” in Teamwork? *Small Group Research*, 36(5), 555-599. <https://doi.org/10.1177/1046496405277134> (Original work published 2005)
- Shofiyah, N., Wulandari, F. E., Mauliana, M. I., & Pambayun, P. P. (2022). Teamwork skills assessment for STEM Project-Based Learnig. *Jurnal Penelitian Pendidikan IPA*, 8(3), 1425-1432. <https://doi.org/10.29303/jppipa.v8i3.1678>
- Sulaiman, M., Mat, Z. H., Nizah, M. A. M., & Latif, L. A. (2017). The impact of teamwork skills on students in Malaysian Public Universities. *Social Sci*, 12(9), 1682-1686.
- Tandoc Jr, E. C., Yee, A. Z., Ong, J., Lee, J. C. B., Xu, D., Han, Z., ... & Cayabyab, M. Y. (2021). Developing a perceived social media literacy scale: evidence from Singapore. *International Journal of Communication*, 15, 22.

- UNESCO. (2013). *Global media and information literacy assessment framework: Country readiness and competencies*. Paris, France. Retrieved from: <http://unesdoc.unesco.org/images/0022/002246/224655e.pdf>
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (Vol. 86). Harvard university press.
- Wang, X., Kollar, I., & Stegmann, K. (2017). Adaptable scripting to foster regulation processes and skills in computer-supported collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, 12, 153-172. <https://doi.org/10.1007/s11412-017-9254-x>
- Wise, A. F., & Schwarz, B. B. (2017). Visions of CSCL: eight provocations for the future of the field. *International Journal of Computer-Supported Collaborative Learning*, 12(4), 423–467. <https://doi.org/10.1007/s11412-017-9267-5>
- Yamada, M., Goda, Y., Matsukawa, H., Hata, K., & Yasunami, S. (2015). A computer-supported collaborative learning design for quality interaction. *Ieee Multimedia*, 23(1), 48-59. <https://doi.org/10.1109/mmul.2015.95>