Journal of Infrastructure, Policy and Development 2024, 8(8), 5678.
https://doi.org/10.24294/jipd.v8i8.5678

Article

Enhancing information literacy using SMARTER collaborative blended learning model

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CITATION

Sayekti R, Napitupulu E, Sitompul H. (2024). Enhancing information literacy using SMARTER collaborative blended learning model. Journal of Infrastructure, Policy and Development. 8(8): 5678. https://doi.org/10.24294/jipd.v8i8.5678

ARTICLE INFO

Received: 5 April 2024
Accepted: 24 May 2024
Available online: 20 August 2024

Abstract: The SMARTER model, an innovative educational framework, is designed for blended learning environments, seamlessly integrating both online and face-to-face instructional components. Employing a flipped classroom methodology, this model ensures an equitable division between online and traditional classroom interactions, aiming to cultivate a dynamic and collaborative learning atmosphere. This research focused on developing and rigorously evaluating the SMARTER model's validity, practicality, and effectiveness. Adopting a research and development (R&D) approach informed by the methodologies of Borg, Gall, and Gall, this study utilized a mixed-methods strategy. This encompassed a robust validation process by experts in design, content, and media, alongside an empirical analysis of the model's application in actual educational settings. The aim was to comprehensively assess its effectiveness and practicality. The findings from this study affirm the SMARTER model's validity, practicality, and effectiveness in improving students' information literacy skills. Comparative analysis between a control group, taught using a traditional expository approach, and an experimental group, educated under the SMARTER model, highlighted significant improvements in the latter group. This effectiveness underscores the model's capacity not only to efficiently deliver content but also to actively engage students in a collaborative learning process. The results advocate for the model's potential broader adoption and adaptation across similar educational contexts. They also establish a foundation for future research aimed at exploring the SMARTER model's scalability and adaptability across diverse instructional environments.

Keywords: flipped classroom; information literacy; collaborative learning; library science program; educational technology; learning model development

1. Introduction

In the current digital era, the education sector faces new challenges and opportunities in the learning process, particularly within the field of Library Science (Carlozzi, 2018). One critical challenge is the development of effective information literacy skills among students (Chigwada, 2019; Feekery et al., 2021). Information literacy is an essential skill that Library Science students must master, given their crucial role in managing and utilizing information in the future (Perry, 2017). The goal of information literacy education in Library Science Programs is to equip students, who will become professional librarians, with the skills to find and use information ethically. At its core, information literacy embodies critical thinking skills (CILIP, 2018).

In line with advancements in information technology, instructional models must also adapt. Collaborative learning based on blended learning emerges as a promising

solution to this challenge (Capone et al., 2017; Patmanthara and Hidayat, 2018). This model combines the advantages of online and face-to-face learning, allowing for more dynamic and flexible interactions among instructors and students, and between students themselves. However, despite the continued development of blended learning models, their implementation in information literacy courses, especially within Library Science Programs, still encounters various obstacles (Normawati, 2021; Ó Ceallaigh, 2021). One major issue is the lack of learning models that effectively integrate technology and active student collaboration within an integrative learning environment. The integration of technology with active student collaboration is crucial for enhancing student motivation and learning retention (Han et al., 2021; Herrera-Pavo, 2021; Toprani et al., 2019). To address this issue, research by Rohim et al. (2023) emphasizes the need for educational leaders to enhance leadership skills comprehensively to improve educational quality management. This presents a new perspective on the importance of leadership roles in implementing and managing innovative learning models like blended learning.

Previous research has highlighted the importance of collaboration in information literacy education (Biswas et al., 2020; Feekery et al., 2021; Moore, 2021; Racelis, 2021). Collaborative learning is known to enhance student understanding of course material, develop social skills, and prepare students for teamwork in future work environments. However, research on collaborative learning models based on blended learning specifically designed for information literacy courses remains limited.

Furthermore, existing literature tends to focus on the technological aspects of blended learning, while the collaborative aspect is often overlooked (Zheng et al., 2019). This indicates a research gap that needs to be bridged with the development of more holistic models that combine both technological and collaborative aspects, especially in the context of information literacy. This is particularly true for information literacy courses that require a multidisciplinary approach (Valero et al., 2020).

Considering all these factors, this study aims to fill the existing gap in literature by developing a collaborative learning model based on blended learning with a SMARTER approach for information literacy courses.

2. Literature review

Learning is defined as a change in an individual who engages in the act of learning (Albers et al., 2024). This change can manifest as a skill, a habit, an attitude, an understanding, knowledge, or appreciation (acceptance or recognition). Asad Ali and Masih (2021) describe learning as a relatively permanent change in behavior or behavior potential resulting from experience, which cannot be attributed to temporary bodily states such as those induced by illness, fatigue, or drugs. Furthermore, they outline five key considerations pertaining to learning: (1) learning is measured by changes in behavior, (2) these behavioral changes are relatively permanent, (3) changes in behavior may not always occur immediately following the learning process, (4) behavioral changes stem from experiences or practice, and (5) experiences or practice need reinforcement.

On the other hand, Hutchens and Hynd (2018) asserts that learning is a

neurological process that arises from experience and results in individual behavioral changes. This statement is reinforced by Lamichhane (2018) who state that learning is the process by which individuals acquire knowledge, skills, attitudes, values, beliefs, emotions, and understanding. The changes that occur in the learning process are fundamental and require the earnest effort of the individual learner to gain abilities, attitudes, beliefs, knowledge, mental models, and skills (Spector, 2009). Learning is the process of transforming experiences to create meaning (Maslo, 2022), thereby generating knowledge (Mezirow, 1991). Bloom (1956) developed a taxonomy of learning behaviors into several categories including: cognitive, affective, and psychomotor. Education involves efforts to organize the external environment or to facilitate the occurrence of learning in the learner.

Information literacy education fundamentally signifies lifelong learning. According to the latest definition set by the Chartered Institute of Library and Information Professional (CILIP), which updates the former definition from 2004, information literacy is the critical thinking skill and the ability to make balanced decisions about any information we encounter and use (CILIP, 2018). The Association of College and Research Libraries (ACRL) describes information literacy as a set of capabilities requiring individuals to recognize their need for information and have the ability to locate, evaluate, and use the needed information effectively (Riedling, 2007). Information professionals, such as librarians, must possess information literacy skills as they create, gather, and assist others in using various types of information ethically.

Researches (Mbandje and Loureiro, 2023; Naveed et al., 2017; Odede and Nsibirwa, 2018) confirm that information literacy is a set of skills. This concept encompasses more than the basic ability to read and write—it requires active and skillful interaction with information. These competencies include the capacity to efficiently research and identify relevant information, which necessitates a discerning eye for sourcing credible data. Furthermore, it extends to the adept selection and rigorous evaluation of information, ensuring that only the most accurate, reliable, and pertinent information is utilized (Nierenberg and Dahl, 2023). The organization of this information into a coherent and structured format is another critical skill, facilitating easier access and retrieval in future endeavors. Moreover, Information literacy also involves the competence to effectively communicate and disseminate information (Bell, 2021; Koler-Povh and Turk, 2020). This skill ensures that information is not only understood by the individual but can also be effectively shared with others, making it a pivotal tool in educational, professional, and personal settings. Thus, information literacy is not merely about access but about the judicious application of the information within various contexts to make informed decisions and solve problems. This holistic approach to handling information is what makes information literacy a fundamental skill set in the digital age.

The standards for information literacy skills are set based on the Framework for Information Literacy for Higher Education established by the ACRL in 2015, developed under the belief that information literacy represents an educational reform movement that will realize potential through a series of richer and more complex data (Association of College and Research Library, 2016). Hammons (2020) introduced a "teach the teachers" approach to develop information literacy education. In this scenario, librarians along with faculty agree to incorporate information literacy

education into the learning curriculum. The collaboration between librarians and faculty is vital as, aside from librarians always facing a shortage of staff capable of developing curriculum, the faculty is the official body with authority over managing and implementing learning curriculums in classrooms. If librarians focus on them, it will provide the opportunity to concentrate on institutional initiatives to implement information literacy into the curriculum.

Adult information literacy programs must be designed based on the background, needs, and interests of the learners (Rosen, 2020). More importantly, information literacy education programs should create democratic situations where students can use their literacy skills to critically analyze their position in society, understand how certain cultural assumptions and biases have positioned them within their families, and ultimately learn how to challenge the status quo. Adult education programs not only teach literacy and other basic skills but also demonstrate to students how they can use these skills to transform their lives and the communities they live in (Addae, 2021). Therefore, information literacy learning must be innovative and student-centered, utilizing a project-based learning approach (Maia and Furnival, 2021).

Research conducted by Busch et al. (2021) on collaborative learning within e-learning platforms indicates that e-learning-based education is supported by pedagogical foundations, ethics, evaluations, and information resources and activities. Another study by Ng et al. (2022) reveals a supportive collaborative learning community emerged as they participated in collaborative learning in e-learning. One tool that can be used to encourage collaborative learning in e-learning is Wiki. The use of Wiki as a tool in collaborative e-learning has been studied by Gunduz (2023) and Sula and Sulstarova (2022). This research, explains that wikis are information technology tools that can be used in e-learning-based education. Wikis, in particular, offer spaces for collaborative work among students. However, it must be acknowledged that e-learning-based education still presents many challenges related to students' skills in using e-learning systems and the extensive amount of data required to access e-learning (Igere, 2021).

The research mentioned above can be visualized in **Figure 1**.

Figure 1 illustrates the theoretical underpinnings of the SMARTER model, which is grounded in a diverse body of research that has evolved over time. The figure presents a chronology of relevant research studies that have contributed to the development of the SMARTER model, highlighting the increasing relevance and application of theories and research findings related to blended learning (Normawati, 2021; Stacey and Gerbic, 2009), collaborative learning (Ghavifekr, 2020; Tiruwa et al., 2018), problem-based learning (Diamond, 2020; Gu et al., 2020; MacDonald, 2019), inquiry learning (Arnold et al., 2021; Chen et al., 2017; Lance, 2020; Mieg, 2019), and information literacy (Chang, 2020; Lawless, 2021; Lokse, 2017; Marshall, 2022; Moore, 2021; Morris, 2020; Nierenberg and Dahl, 2023). These theories and research findings have informed the design of the SMARTER model, which emphasizes the integration of these approaches to create a comprehensive and learner-centered instructional design. This figure provides a visual representation of the cumulative knowledge that has shaped the development of the SMARTER model.

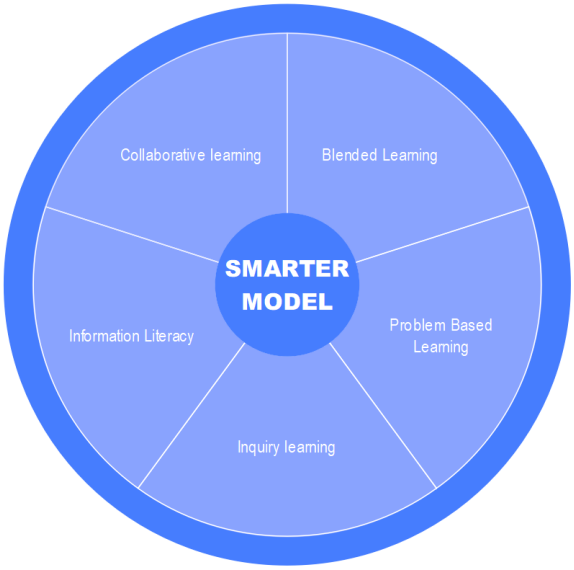

Figure 1. Increasing relevant research underlying the SMARTER model.

3. Methods

This study was conducted in the Department of Library and Information Science, Universitas Islam Negeri Sumatera Utara, Indonesia. This study employs the Research and Development methodology as outlined by Gall et al. (2003) which describes development research as a process used to develop and validate educational processes. This study employed a mixed-methods approach, which combines the strengths of both qualitative and quantitative research paradigms to ensure the rigor and validity of the findings. The mixed-methods approach was designed to provide a comprehensive understanding of the SMARTER model and its products. Specifically, the qualitative component of the study involved a multi-stakeholder approach, where data were gathered from experts in design, media, and language to provide insights into the theoretical foundations of the SMARTER model and its products, including learning materials, teacher's guide, and student's guide. This phase enabled the collection of in-depth data and insights that informed the development of the SMARTER model. The quantitative component of the study, on the other hand, focused on analyzing students' learning effectiveness by examining numerical data and statistical patterns. Additionally, data were gathered from teachers regarding their experiences with the SMARTER model, providing practical feedback on its usability and effectiveness. Finally, data were gathered from students regarding their experiences with the student's guide book, offering a student-centered perspective on its learning outcomes.

3.1. Research procedure

Development research is defined as a systematic investigation in designing, developing, and evaluating instructional programs, processes, and products that must meet criteria for internal consistency and effectiveness (Richey, 1994). One of the most popular educational research models is that of Walter Dick and Lou Carey (commonly referred to as the Dick and Carey model), which consists of ten steps of activity (Gall et al., 2003) as presented in **Figure 2**.

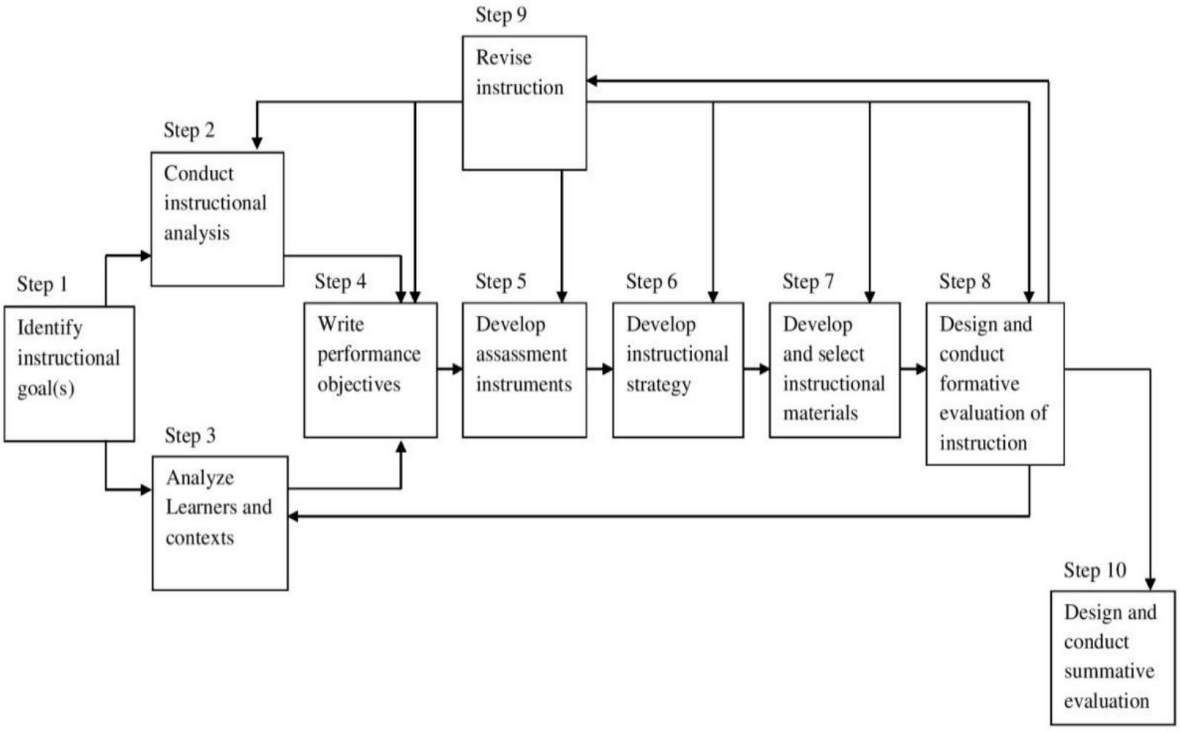

Figure 2. Dick, Carey and Carey systematic approach model.

The initial phase of the research procedure involved a comprehensive needs analysis to identify the instructional goals and desired learning outcomes for the proposed SMARTER model. This phase commenced with an extensive literature review to establish a solid theoretical foundation and identify gaps or areas for improvement in current instructional practices. Subject matter experts, including experienced educators, were consulted to gain insights into the essential knowledge, skills, and competencies required in the target domain. Learner needs were analyzed through surveys, with the target audience to understand their prior knowledge, interests, learning preferences, and specific areas where instructional support was needed. To understand the context of teaching more comprehensively, the researcher surveyed teachers of library and information science from 26 universities in Indonesia, gathering information about the use of learning management systems and the support systems they employed in teaching. Additionally, the researcher surveyed students' experiences being taught using learning management systems. Based on the information gathered from the literature review, expert consultations, and learner needs analysis, specific instructional goals were formulated, stated in clear, measurable, and achievable terms, outlining the desired knowledge, skills, and attitudes that learners should acquire through the SMARTER model. These identified instructional goals were then prioritized based on their importance and relevance, and a logical sequence for addressing them was established, considering prerequisites and dependencies among the goals.

The second step involved conducting a thorough learning analysis to determine the specific knowledge, skills, and attitudes required to achieve the identified instructional goals. This analysis broke down the learning content into smaller components and identified prerequisite skills and knowledge. The third step covered

an in-depth analysis of the learners and the learning context. This included assessing learners' characteristics, prior knowledge, learning preferences, and the learning environment to ensure the model's alignment with the target audience and contextual factors. In the fourth step, the researcher developed clear and measurable learning objectives based on the analyses performed in the previous steps. These objectives specified the expected learner behaviors and outcomes. The fifth stage involved the development of assessment instruments, such as tests, rubrics, and evaluation tools, to measure the achievement of the learning objectives. In the sixth step, the researcher began to develop learning strategies, incorporating various teaching methods, materials, and activities to facilitate the effective delivery of the instructional content. The seventh step involved selecting and developing learning materials, including both electronic and printed resources, such as textbooks, multimedia resources, and interactive activities, to support the implementation of the learning strategies. The eighth stage focused on the design and implementation of formative tests, which involved subject matter experts, instructional designers, and learners, to identify areas for improvement and refine the model throughout the development process. During the implementation stage, the researcher used expert judgment to validate the model and conducted one-to-one tests (involving 3 students), small group tests (involving 10 students), and large group tests (a field group test involving 31 students). The research product testing included a model book, a textbook, an instructor's guide, and a student's guide, involving expert judgment from content experts, development model experts, and media experts. In the ninth stage, researchers made revisions to the products based on the feedback and insights gathered from the formative tests. The final step in this process was the execution of summative tests to assess the overall effectiveness of the final model in achieving the desired instructional goals and learning outcomes.

3.2. Data collection

This research employed both non-test and test methods for data collection. Specifically, non-test techniques, in the form of checklists, were utilized to gather data pertaining to the needs analysis, assess the validity of the developed model, and evaluate the practicality of the proposed learning model. Concurrently, test techniques were administered to examine the effectiveness of the model, employing a learning achievement test instrument.

Using a four-point Likert scale that incorporated both multiple choice and multi-point scales, the instruments employed in this research were multifaceted: (1) a needs analysis validation instrument, designed to assess the relevance and necessity of the proposed model; (2) a product validity assessment instrument, used to evaluate the validity and robustness of the developed model; (3) an expert and practitioner validation instrument, aimed at assessing the feasibility, implementation, and practicality of the model from the perspectives of subject matter experts and experienced practitioners; and (4) a learning achievement test, utilized to measure the effectiveness of the model in facilitating student learning outcomes.

3.3. Data analysis

The validation process in this research utilized Nieveen's (1999) theory on the evaluation of educational research products. The validity of the research product was obtained from expert judgments, small group tests, and field group tests. Data analysis to determine the model's validity was conducted after collecting the necessary data and information through product validity assessment instruments. The gathered data were then tabulated, and the average scores were calculated. Subsequently, the average scores from the expert assessments were compared against the model validity classification criteria, as outlined in **Table 1** below.

Table 1. Criteria for model validity assessment.

Interval score	Validity criteria
3.50–4.00	Highly valid
3.00–3.49	Valid
2.50–2.99	Fairly valid
2.00–2.49	Less valid
1.00–1.99	Invalid

4. Results and discussion

This study aimed to develop and evaluate the validity, practicality, and effectiveness of the SMARTER model, a collaborative blended learning for the Information Literacy course.

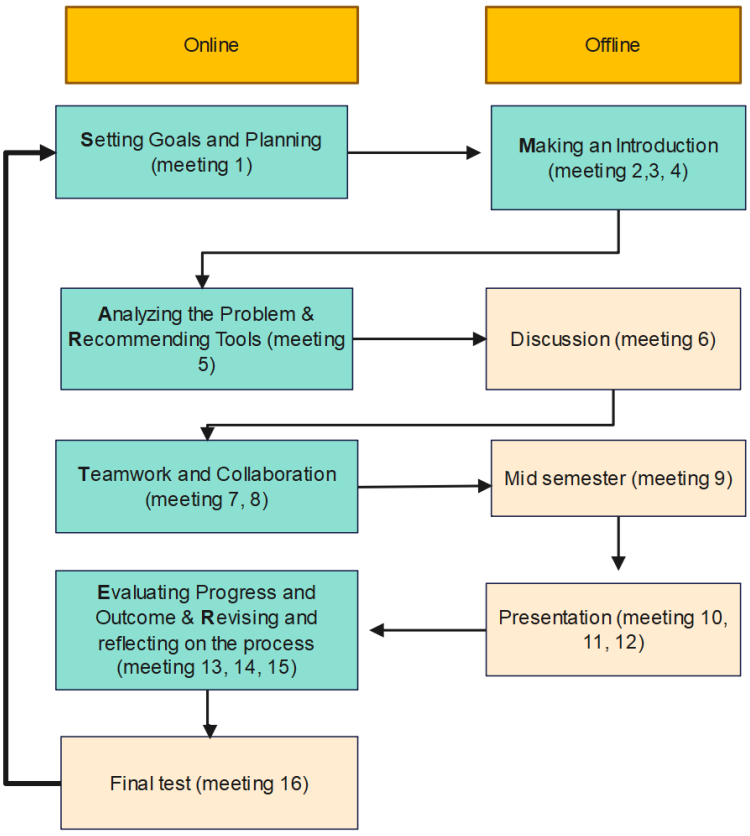

Figure 3. The SMARTER model.

The syntax of the SMARTER learning model includes seven principal components: setting goals and planning, making an introduction, analyzing the problem, recommending tools, teamwork and collaboration, evaluating progress and outcome, and revising and reflecting on the process. Furthermore, in implementing the syntax of the SMARTER collaborative learning model based on blended learning for the Information Literacy course, a flipped classroom model is used. Using fifty percent online and fifty percent face to face model, the SMARTER learning model is illustrated in **Figure 3**.

The **Figure 3** can be briefly explained as follows: In the first meeting, students access online learning resources and instructions prepared by the instructor remotely from their respective homes.

During meetings 2–4, face-to-face sessions are conducted where the instructor provides explanations about the course and the tasks students will complete. The instructor informs students that they will work in groups to solve information literacy skill-related problems posted on the Learning Management System (LMS). The instructor also guides students on how to collaborate using the Wiki tool within the LMS.

After the in-class sessions, the instructor prepares problem scenarios requiring information literacy skills for students to solve in groups and posts them on the LMS, along with instructions for using the Wiki tool. In week 5, students access the problems online, analyze them in groups, and familiarize themselves with the Wiki instructions. Subsequently, they collaborate online outside class to find solutions, dividing tasks within their groups and contributing their answers to the Wiki.

In meeting 6, the instructor and students convene for a face-to-face discussion and clarification of the problems and the tools provided. Meetings 7 and 8 are conducted online, where groups collaborate virtually, work on solving the problems on the LMS using the Wiki, and the instructor monitors their progress.

Meeting 9 is dedicated to the midterm examination. Meetings 10, 11, and 12 involve face-to-face sessions where each group presents their collaborative work on the Wiki, receiving feedback from the instructor and peers.

During meetings 13–15, students revise and reflect on their group performance based on the feedback received. Finally, in meeting 16, the instructor conducts an online evaluation of the students' performance in solving information literacy skill-related problems.

The implementation of the proposed model that was created must include the components of principle of reaction, social system, and support system. This can further be visualized as an integrated model as shown by **Figure 4** below.

Figure 4 illustrates the integrated SMARTER model that combine elements of syntax, principles of reaction, social system, support system and the material of Information Literacy. As a consequential outcome of the development of the SMARTER model, a set of learning materials was created, including book of SMARTER learning model, teacher's guide, a student's guide, and textbook of information literacy. The results of the recapitulation of the average scores from experts' evaluations regarding the validity of the learning materials are shown in **Table 2** as follows.

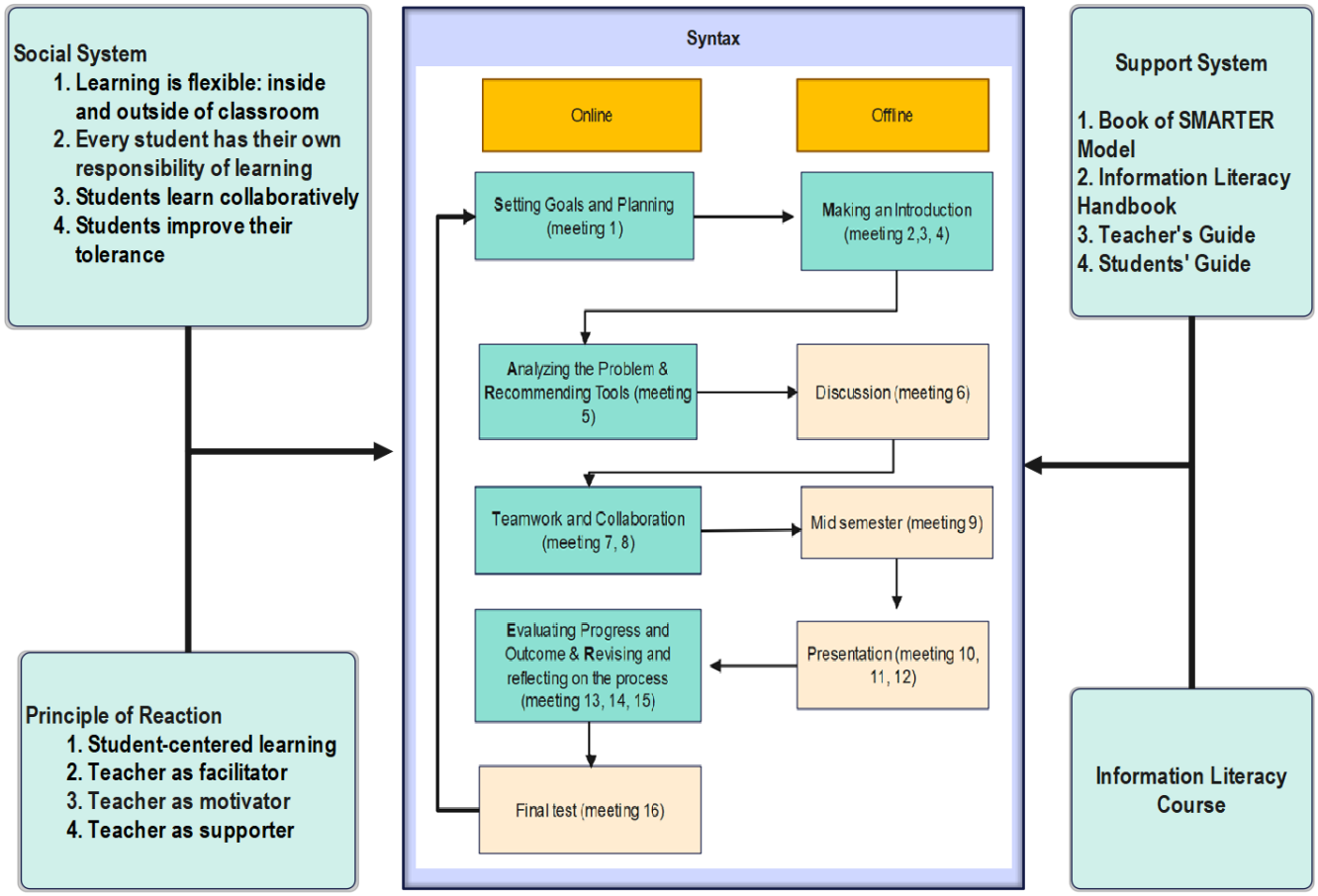

Figure 4. The integrated SMARTER model for Information Literacy course.

Table 2. Recapitulation of the average scores for the validity evaluation of the learning materials.

Name of products	Average scores	Category
Book of SMARTER learning model	3.53	Valid
Teacher's handbook	3.42	Valid
Students' handbook	3.45	Valid
Textbook of information literacy	3.47	Valid

The summarized findings from the field test evaluating the validity of the learning material products are presented in **Table 3**:

Table 3. The recapitulation of the field test of learning material.

Test	Average scores	Category
One-to one learner test	3.36	Valid
Small group test	3.38	Valid
Field trial test	3.42	Valid
Average score	3.39	Valid

The practicality of the SMARTER learning model was evaluated through observations conducted by two raters—a lecturer and a student—over two separate

sessions. The observations focused on three key components: syntax, social system, and principles of reaction. The average scores from the raters' observations are presented in **Tabel 4** below:

Table 4. The average scores of raters' observation on the practicality of the SMARTER model.

Components of model	Average scores		Category
	I	II	
Syntax	2.92	3.4	Practical
Social system	3	3.62	Practical
Principles of reaction	2.97	3.54	Practical

The results, presented in **Table 4**, indicate that the SMARTER model was deemed practical across all three components. Specifically, the syntax component received average scores of 3.4 in the second observation sessions, falling into the "practical" category. Regarding the social system component, the average scores were 3.62, categorized as practical. Finally, the principles of reaction component were also rated as practical, with average scores of 3.54 from the second observation sessions.

To measure the effectiveness of the SMARTER learning model, researchers compared the learning outcomes of students taught using the SMARTER model with those taught using the expository model. The comparison yielded the following learning outcome scores. The frequency distribution of the learning outcome data for students taught with the SMARTER-based collaborative blended learning model can be seen in **Table 5** below.

Table 5. Distribution of learning outcome for students taught with the SMARTER model.

Interval class	$F_{absolut}$	$F_{relatif}$ (%)
60–66	3	9.68
67–73	3	9.68
74–80	10	32.25
81–87	7	22.58
88–94	5	16.13
95–101	3	9.68
Total	31	100

Based on the data presented in **Table 5**, it is illustrated that the learning outcome achievements of students taught with the SMARTER collaborative learning model based on blended learning have an average (mean) of 80.84, rounded to 81, positioning them within the interval class of 81–87. This indicates that there are 7 students (22.58%) at the class average score, 16 students (51.61%) below the class average score, and 8 students (25.81%) above the class average score.

The distribution of scores amongst students who were taught using the SMARTER collaborative blended learning model reveals interesting insights into its effectiveness. With the majority of students (51.61%) scoring below the class average,

it beckons a closer examination of the model's implementation and the possible challenges faced by students. It's noteworthy, however, that a significant portion of students (25.81%) scored above the class average, suggesting that while the SMARTER model may facilitate superior outcomes for certain students, it might not uniformly achieve this across the entire cohort. The data suggests that the SMARTER model has the potential to support high achievement, as evidenced by the students scoring above the class average.

To visualize the data above, the histogram graph of the learning outcome taught with SMARTER model can be seen in **Figure 5** below:

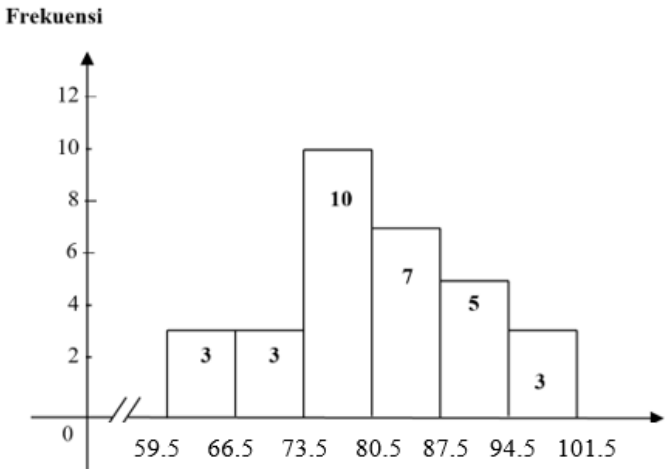

Figure 5. Histogram graph of the learning outcome taught with SMARTER model.

The analysis of the learning outcomes of students taught using the expository learning model shows an average value or mean of 63.89; mode of 60.30; median of 63.00; variance of 148.64; standard deviation of 12.19; maximum score of 86; and a minimum score of 40. The frequency distribution of the learning outcome data for students taught using the expository learning model can be viewed in **Table 6** as follows:

Table 6. The frequency distribution of the learning outcome data for students taught using the expository learning model.

Interval class	$F_{absolut}$	$F_{relatif}$ **(%)**
40–47	3	9.68
48–55	5	16.13
56–63	8	25.81
64–71	6	19.35
72–79	5	16.13
80–87	4	12.90
Total	31	100

Based on the data presented in **Table 6** above, it can be elaborated that students' achievement of learning outcomes taught using the expository learning model, with an average (mean) of 63.89 rounded to 64, falls into the interval class of 64–71. This indicates that there are 6 students (19.35%) scoring at the class average, 16 students

(51.62%) below the class average score, and 9 students (29.03%) above the class average score.

The statistical analysis of students' performance who were taught through the expository learning model reveals certain insights into lack of effectiveness of this traditional instructional approach. The mean score of 63.89 suggests a moderate overall performance level among the students, with a relatively tight grouping around this average indicated by the standard deviation of 12.19. The mode and median, being close to the mean, further suggest a normal distribution of scores, albeit skewed towards the lower end as the minimum score is 40.

This data, especially when visualized as suggested by the frequency distribution in **Table 6**, provides a valuable basis for comparison with alternative teaching methods such as the SMARTER collaborative blended learning model discussed previously. Such comparisons are crucial for educators and curriculum developers aiming to identify the most effective instructional strategies to enhance student learning outcomes and engagement across different subject matters and learning environments.

The data can further be visualized in **Figure 6**:

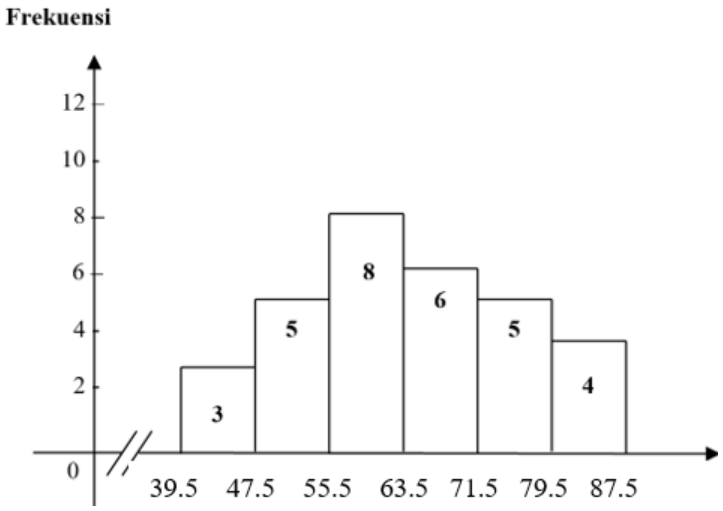

Figure 6. Histogram of students' achievement taught with expository approach.

Based on the statistical test results, a *t*-value of 6.01 was obtained and the critical *t*-value (*t*-table value) at $\alpha = 0.05$ is 1.69. Because the calculated *t*-value is greater than the critical *t*-value, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted. In other words, there is a significant difference in the learning outcomes of students taught with the SMARTER learning model compared to those taught with the expository learning model. Specifically, the average learning outcomes of students taught with the SMARTER model were higher than those of students taught with the expository model. Consequently, it can be concluded that the SMARTER learning model is effective in enhancing learning outcomes in the Information Literacy course.

The data on the practicality assessment of the SMARTER collaborative learning model based on blended learning were obtained from the evaluation of raters who assessed the implementation of the learning model, which includes syntax, social system, and principles of reaction. In this case, raters conducted observations twice.

The practicality of the model was determined by comparing the rating results from the first and second observations, as shown in **Table 7** below.

Table 7. Recapitulation of rating scores on the observation of the learning implementation by raters.

Components	Observation		Category
	1	**2**	
Syntax	2.92	3.4	Practical
Social system	3.00	3.62	Practical
Management reaction principle	3.00	3.6	Practical
Average score	-	3.54	-

From **Table 7** above, it can be observed that there is a difference in ratings between the first observation and the second observation, with an increase in scores noted during the second observation.

Upon comprehensive evaluation, the SMARTER learning model has undergone meticulous assessment in three critical areas: its validity, effectiveness, and practicality for Information Literacy courses. Firstly, the model's validity was confirmed through expert evaluation, which resulted in an average score of 3.39. This score substantiates the model as a credible and appropriate tool for educational implementation in information literacy contexts, thus affirming the first hypothesis regarding the model's validity. Following this, the model's practicality was examined through observer assessments, yielding an average score of 3.54. This evaluation demonstrates that the SMARTER learning model is not only applicable but also user-friendly and feasible for instructors and students in Information Literacy courses, thereby confirming the second hypothesis on its practicality. Lastly, the model's effectiveness was proven through a statistical effectiveness test. The test revealed a calculated *t*-value of 6.01, which surpasses the critical *t*-value of 1.69 at an alpha level of 0.05. This significant statistic strongly supports the third hypothesis, indicating the SMARTER model's efficacy in enhancing learning outcomes in Information Literacy courses. In sum, the systematic assessments across these three domains—validity, practicality, and effectiveness—cohesively demonstrate the SMARTER learning model's robust applicability in information literacy education. These findings advocate for the model's broader adoption and implementation, highlighting its capacity to enrich educational practices and learning experiences in academia.

5. Discussion

The development of the SMARTER learning model for Information Literacy courses has demonstrated significant potential in enhancing the effectiveness of collaborative and technology-based learning. A theoretical review of the relevant literature revealed that this approach aligns with the social constructivism theory introduced by Vygotsky (1997), which emphasizes learning as a social process and the importance of interaction in the construction of knowledge. The collaborative learning principle, which is fundamental to the SMARTER model, reinforces the assumption that knowledge is constructed through collaboration with others, a concept highly

relevant in the context of information literacy. From the perspective of social constructivist experts, education should occur in a meaningful context (Ananda Kumar, 2023; Lopes and Vieira, 2018), and efforts should be made to connect school experiences with learners' experiences outside of school.

Moreover, the integration of blended learning within the SMARTER model reflects principles from the multimodal learning theory, acknowledging that learning occurs across various modes and media. The SMARTER model accommodates diverse learning styles, allowing students to interact with the course material in more dynamic and profound ways.

The analysis of the validity, practicality, and effectiveness of the SMARTER model, employing rigorous research methodologies, highlights the importance of continual evaluation in educational program development (Ramirez-Sanchez et al., 2022). This notion is emphasized in the literature on Design-Based Research (DBR), advocating for ongoing design iterations and evaluations in curriculum development (Peschl et al., 2023).

In the context of information literacy education, the requirement for critical skills in searching, evaluating, and effectively utilizing information has never been greater. According to the Association of College and Research Libraries (ACRL), information literacy is identified as an essential skill in the 21st century (Association of College and Research Library, 2019; MacDonald, 2019). The SMARTER model places students in scenarios where they are actively involved in the learning process, aligning with ACRL guidelines that underscore the importance of active learning.

The literature on information literacy also highlights the significance of problem-solving and critical thinking skills (Durnali, 2022; Goodsett, 2020). With its emphasis on collaboration and technology, the SMARTER learning model provides an excellent platform for fostering these skills. Research by Buselic (2023) and Masko et al. (2020) indicate that problem-solving and critical thinking are key components of information literacy, both of which can be strengthened through the implementation of learning models like SMARTER.

Student engagement is a pivotal factor in the success of learning models (Stein et al., 2020). According to Astin's theory of engagement (Smith, 2021), active student participation in their learning experiences is directly correlated with positive learning outcomes. The SMARTER model facilitates this engagement by providing a structure that positions students at the center of the learning process.

The adoption of technology in education, as advocated by the SMARTER model, aligns with the theory of digital natives proposed by Prensky (2001). This approach acknowledges shifts in learning preferences and the adaptation to technology by the current generation, viewing technology as a crucial tool in the educational process. However, Smith et al. (2020) suggests a transition from the concept of digital natives (digi-native) in education to a focus on developing digital literacy, which is more relevant to the evolution of professional education. Aziz et al. (2020) emphasize the importance of understanding and adopting the learning styles of the digital native generation.

Research on the effects of collaborative learning models in an online context indicates that virtual collaboration can enhance student motivation and learning outcomes (Kim, 2021). The SMARTER model, with its use of blended learning,

provides space for collaboration in both physical and virtual environments. Furthermore, the application of blended learning models suggests that well-designed online learning can reduce cognitive overload in students, enabling more efficient information processing (Warrick, 2021). The SMARTER model leverages this by offering an adaptive and flexible framework that addresses the diversified learning style needs. By accommodating the distinct preferences of visual, auditory, kinesthetic, and reading-based learners, the SMARTER model provides an inclusive and holistic learning approach (Ferreira and Vasconcelos, 2020; Volpe and Gori, 2019). These features highlight the model's potential to not only improve student motivation and learning outcomes but also to create a more engaging and effective learning environment.

While the SMARTER model is grounded in established learning theories and research, it is crucial to evaluate its adaptability to diverse learning contexts and evolving educational needs. Theories and best practices in education are constantly evolving, and this model must be adapted to incorporate new insights and approaches. Education practitioners should consider mechanisms for regularly reviewing and updating the theoretical foundations of the model to ensure its continued relevance and alignment with current pedagogical advancements.

The SMARTER model's emphasis on stakeholder involvement and learner needs analysis is commendable. However, it is essential to examine the extent to which the model truly accommodates learner diversity and provides opportunities for personalized learning experiences. As information literacy skills are applicable across various disciplines and contexts, the model should be adaptable to cater to the unique needs and preferences of learners from different backgrounds and educational levels.

The SMARTER model's effectiveness may depend on its seamless integration with existing curricula and instructional practices. It is essential to evaluate the model's compatibility with established course structures, assessment methods, and institutional policies. There is a need for guidance and support for educators to effectively integrate the SMARTER model into their existing teaching practices, minimizing disruptions and facilitating a smooth transition.

6. Conclusion

The research findings on the SMARTER model for teaching information literacy courses point to a robust validation process that ensures the model's effectiveness and quality. Utilizing Nieveen's (1999) theory on educational product evaluation, the study meticulously gathered data through expert judgments, small group tests, and field group tests. The systematic data analysis, involving tabulation and calculation of average scores, allowed for a comprehensive assessment of the model's validity. The results, reviewed against the established criteria for model validity, demonstrated that the SMARTER model consistently met the standards. This rigorous validation process underscores the SMARTER model's potential as an effective instructional design framework for information literacy education. The model's theoretical grounding, stakeholder involvement, and iterative refinement through testing and feedback have contributed to its demonstrated strengths. However, for broader adoption and long-term sustainability, further attention to scalability, contextual adaptability, and

ongoing evaluation will be crucial. Overall, the SMARTER model presents a promising approach to enhancing information literacy instruction for collaborative learning environment, providing a comprehensive, validated, and learner-centered framework that can significantly improve educational outcomes in diverse learning environments.

Author contributions: Conceptualization, RS; methodology, RS, EN and HS; software, RS; validation, RS, EN and HS; formal analysis, RS; investigation, RS; resources, RS; data curation, RS; writing—original draft preparation, RS; writing—review and editing, EN and HS; visualization, RS; supervision, EN and HS. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

References

Addae, D. (2021). Adults who learn: Evaluating the social impact of an adult literacy project in rural South Africa. Social Sciences and Humanities Open, 3(1), 100115. https://doi.org/10.1016/j.ssaho.2021.100115

Albers, M. (Marjolein), Reitsma, M. (Margreet), Benning, K. (Kelsey), et al. (2024). Developing a theory of change model for a learning and innovation network: A qualitative study. Nurse Education in Practice, 77, 103954. https://doi.org/10.1016/j.nepr.2024.103954

Ananda Kumar, A. (2023). Meaningful Learning among Under Graduate Student-Teachers. Shanlax International Journal of Education, 11(2), 74–82. https://doi.org/10.34293/education.v11i2.5828

Arnold, J. C., Mühling, A., & Kremer, K. (2021). Exploring core ideas of procedural understanding in scientific inquiry using educational data mining. Research in Science and Technological Education, 1–21. https://doi.org/10.1080/02635143.2021.1909552

Asad Ali, M., & Masih, A. (2021). Enhancing the Quality of Learning through Changes in Students' Approach to Learning. International Journal of Asian Education, 2(3), 455–461. https://doi.org/10.46966/ijae.v2i3.242

Association of College and Research Library. (2016). Framework for Information Literacy for Higher Education. Available online: http://www.ala.org/acrl/files/issues/infolit/framework.pdf (accessed on 28 January 2024).

Association of College and Research Library. (2019). ACRL Framework for Information Literacy Toolkit. Available online: https://acrl.libguides.com/framework/toolkit (accessed on 28 January 2024).

Aziz, M. N. A., Harun, S. N., Baharom, M. K., & Kamaruddin, N. (2020). Preferred Learning Styles for Digital Native and Digital Immigrant Visitors in The Malaysian Music Museum. Asian Journal of University Education, 16(3), 234–246. https://doi.org/10.24191/ajue.v16i3.11085

Bell, D. L. (2021). A qualitative investigation of the digital literacy practices of doctoral students. Journal of Information Literacy, 15(3), 82–99. https://doi.org/10.11645/15.3.2829

Biswas, P., Priyanka, P., & Banerjee, T. (2020). Importance of Collaborative Learning. Available online: https://api.semanticscholar.org/CorpusID:226442807 (accessed on 28 January 2024).

Bloom, B. S. (1956). Taxonomy of Educational Objectives. Longmans.

Busch, M., Berg, J., & Zwaal, W. (2021). From on-site to online collaborative learning. Research in Hospitality Management, 11(3), 191–197. https://doi.org/10.1080/22243534.2021.2006916

Buselic, V. (2023). Teaching Information Literacy and Critical Thinking Skills in Chat GPT Time. 2023 International Conference on Computing, Networking, Telecommunications & Engineering Sciences Applications (CoNTESA), 14–20. https://doi.org/10.1109/CoNTESA61248.2023.10384921

Capone, R., Caterina, P., & Mazza, G. (2017). Blended Learning, Flipped Classroom, and Virtual Environment: Challenges and Opportunities for the 21st Century Students. Available online: https://api.semanticscholar.org/CorpusID:117510517 (accessed on 28 January 2024).

Carlozzi, M. (2018). Teaching in Libraries: Not an Elective Part of the Job. Available online: https://api.semanticscholar.org/CorpusID:158927186 (accessed on 28 January 2024).

Chang, N. (2020). A comparison of the learning outcomes for a PBL-based information literacy course in three different innovative teaching environments. Libri, 70(3), 213–225. https://doi.org/10.1515/libri-2018-0132

Chen, L. C., Huang, T. W., & Chen, Y. H. (2017). The effects of inquiry-based information literacy instruction on memory and comprehension: A longitudinal study. Library and Information Science Research, 39(4), 256–266. https://doi.org/10.1016/j.lisr.2017.11.003

Chigwada, J. P. (2019). Supporting Information Literacy Skills of Students for a Successful Transition to Higher Education. Available online: https://api.semanticscholar.org/CorpusID:158092812 (accessed on 28 January 2024).

CILIP. (2018). CILIP Definition of Information Literacy 2018. Available online: https://infolit.org.uk/ILdefinitionCILIP2018.pdf (accessed on 28 January 2024).

Courtney, A. M., & King, F. B. (2009). Online Dialog: A Tool to Support Preservice Teacher Candidates' Understanding of Literacy Teaching and Practice. Contemporary Issues in Technology and Teacher Education Journal, 9, 226–256.

Diamond, K. (2020). Problem—Based Learning and Information. In: Teaching Information Literacy and Writing Studies. Purdue University Press. pp. 157–168.

Dougiamas, M., & Taylor, P. (2003). Moodle: Using Learning Communities to Create an Open Source Course Management System. National Key Centre for Science and Mathematics Education Curtin University of Technology. EDMEDIA.

Durnali, M. (2022). 'Destroying barriers to critical thinking' to surge the effect of self-leadership skills on electronic learning styles. Thinking Skills and Creativity, 46, 101130. https://doi.org/https://doi.org/10.1016/j.tsc.2022.101130

Eisenberg, M. B., & Berkowitz, R. E. (1992). Information Problem-Solving: The Big Six Skills Approach. School Library Media Activities Monthly, 8(5), 27–29.

Elgün Gündüz, Z. (2023). Teaching Writing with Wiki-based Collaborative Writing Tasks in an EFL Context at Higher education. Acuity: Journal of English Language Pedagogy, Literature, and Culture, 8(1), 68–86. https://doi.org/10.35974/acuity.v8i1.280

Feekery, A., Chisholm, K., Jeffrey, C. J., & Diesch, F. (2021). Enhancing students' professional information literacy. Available online: https://api.semanticscholar.org/CorpusID:237391717 (accessed on 28 January 2024).

Ferreira, F. M., & Vasconcelos, C. (2020). The impact of multisensory instruction on geosciences learning and students' motivation. Geosciences (Switzerland), 10(11), 1–13. https://doi.org/10.3390/geosciences10110467

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). Educational Research: An Introduction. Pearson Education, Inc. https://doi.org/10.2307/3121583

Ghavifekr, S. (2020). Collaborative Learning: A Key to Enhance Students Social Interaction. Malaysian Online Journal of Educational Sciences, 8, 9–21.

Goodsett, M. (2020). Best practices for teaching and assessing critical thinking in information literacy online learning objects. Journal of Academic Librarianship, 46(5), 102163. https://doi.org/10.1016/j.acalib.2020.102163

Gu, P., Zhang, Y., & Gu, H. (2020). Creating a technology-enhanced constructivist learning environment for research ability development in a BA Thesis Writing course. Computer Assisted Language Learning, 33(5–6), 538–566. https://doi.org/10.1080/09588221.2019.1576735

Hammons, J. (2020). Teaching the teachers to teach information literacy: A literature review. Journal of Academic Librarianship, 46(5), 102196. https://doi.org/10.1016/j.acalib.2020.102196

Han, S. J., Lim, D. H., & Jung, E. (2021). A Collaborative Active Learning Model as a Vehicle for Online Team Learning in Higher Education. Available online: https://api.semanticscholar.org/CorpusID:69440934 (accessed on 28 January 2024).

Hergenhahn, B. R., & Olson, M. H. (2008). Theories of Learning (Teori Belajar). Kencana Prenada Media Group.

Herrera-Pavo, M. Á. (2021). Collaborative learning for virtual higher education. Learning, Culture and Social Interaction, 28, 100437.

Hutchens, T., & Hynd, G. W. (2018). Neurological Basis of Learning. In: School Psychology International. SAGE Publications, Inc. pp. 265–270. https://doi.org/10.1177/014303438700800408

Igere, M. A. (2021). E-Learning Amongst Library Science Students, Case of Delta State University, Nigeria during COVID-19 Pandemic Lock down:Pros and Cons. Library Philosophy and Practice, 2021, 1–21.

Kim, M. H. (2021). Effects of Collaborative Learning in a Virtual Environment on Students' Academic Achievement and Satisfaction. Journal of Digital Convergence, 19, 1–8.

Koler-Povh, T., & Turk, Ž. (2020). Information literacy of doctoral students in engineering and the librarian's role. Journal of Librarianship and Information Science, 52(1), 27–39. https://doi.org/10.1177/0961000618767726

Lamichhane, C. D. (2018). Understanding the Education Philosophy and Its Implications. NCC Journal, 3(1), 24–29. https://doi.org/10.3126/nccj.v3i1.20245

Lance, K. C. (2020). Linking librarians, inquiry learning, and information literacy? Phi Delta Kappan, 101(7), 47–51. https://doi.org/10.1177/0031721720917542

Lawless, B. (2021). Can you spot a troll? Teaching information literacy through conversations about social media attacks. Communication Teacher, 35(1), 12–16. https://doi.org/10.1080/17404622.2020.1769849

Lokse, M. (2017). Teaching Information Literacy in Higher Education: Effective Teaching and Active Learning. Available online: https://api.elsevier.com/content/abstract/scopus_id/85040637738 (accessed on 28 January 2024).

Lopes, A. L. S., & Vieira, M. M. S. (2018). Meaningful Learning and Effectiveness in Virtual Learning Spaces. European Journal of Education, 1(3), 96. https://doi.org/10.26417/ejed.v1i3.p96-103

MacDonald, H. (2019). First-year student essays shed light on their experience of ACRL framework threshold concepts. Evidence Based Library and Information Practice, 14(4), 168–170. https://doi.org/10.18438/eblip29614

Maia, C. M., & Furnival, A. C. M. (2021). Information Literacy Practices Using Active Teaching-Learning Methodologies in Higher Education. Available online: https://api.semanticscholar.org/CorpusID:229393333 (accessed on 28 January 2024).

Marshall, D. (2022). Teaching information literacy to online learners: challenges, advantages, and tools to consider in light of the COVID-19 pandemic. Public Services Quarterly, 18(1), 54–58. https://doi.org/10.1080/15228959.2021.2013389

Masko, M. K., Thormodson, K., & Borysewicz, K. (2020). Using Case-Based Learning to Teach Information Literacy and Critical Thinking Skills in Undergraduate Music Therapy Education: A Cohort Study. Music Therapy Perspectives, 38(2), 143–149. https://doi.org/10.1093/mtp/miz025

Maslo, E. (2022). Creating spaces for engagement in meaningful activities. Hungarian Educational Research Journal, 12(4), 401–410. https://doi.org/10.1556/063.2021.00097

Mbandje, D. C., & Loureiro, M. J. (2023). Digital competence and information literacy: clarifying concepts based on a literature review. Educational Media International, 60(3–4), 306–316. https://doi.org/10.1080/09523987.2023.2324584

Mezirow, J. (1991). Transformative Dimensions of Adult Learning. Jossey-Bass Inc.

Mieg, H. A. (2019). Inquiry-Based Learning—Undergraduate Research: The German Multidisciplinary Experience. Springer Open. https://doi.org/10.1007/9783030142230

Moore, P. (2021). Revealing Thinking: Teachers Working Together on Information Literacy. IASL Annual Conference Proceedings, 133–144. https://doi.org/10.29173/iasl8141

Morris, D. (2020). A review of information literacy programmes in higher education. Journal of Information Literacy, 14(1), 19. https://doi.org/10.11645/14.1.2668

Normawati, A. (2021). The Implementation of Blended Learning in Teaching Reading. English Language and Education Spectrum, 1(2), 45–51. https://doi.org/10.53416/electrum.v1i2.26

Naveed, R. T., Jantan, A. H., Saidu, M. B., & Bhatti, S. M. (2017). The validation of the organizational change construct using confirmatory factor analysis. Cogent Business and Management, 4(1), 1–10. https://doi.org/10.1080/23311975.2017.1338330

Nierenberg, E., & Dahl, T. I. (2023). Is information literacy ability, and metacognition of that ability, related to interest, gender, or education level? A cross-sectional study of higher education students. Journal of Librarianship and Information Science, 55(1), 57–69. https://doi.org/10.1177/09610006211058907

Nieveen, N. (1999). Prototyping to Reach Product Quality. In: Design Approaches and Tools in Education and Training. Springer Science + Business Media Dordrecht. p. 125. https://doi.org/10.1007/s00477-014-0937-9

Ó Ceallaigh, T. J. (2021). Blended Learning Immersion Teacher Education: Evidence-Based Practices and Data-Driven Instruction. Development of Innovative Pedagogical Practices for a Modern Learning Experience, 1–30. https://doi.org/10.46679/978819484836301

Odede, I. R., & Nsibirwa, Z. (2018). Information Literacy Skills in using Electronic Information Resources. Library Philosophy and Practice, 1–17.

Patmanthara, S., & Hidayat, W. (2018). Improving Vocational High School Students Digital Literacy Skill through Blended Learning Model. Journal of Physics: Conference Series, 1028.

Perry, H. B. (2017). Information Literacy in the Sciences: Faculty Perception of Undergraduate Student Skill. Coll. Res. Libr., 78, 964–977.

Prensky, M. (2001). Digital Natives, Digital Immigrants Part 1. On the Horizon, 9(5), 1–6.

https://doi.org/10.1108/10748120110424816

Racelis, J. V. (2021). Collaboration as Locus for Information Literacy Teacher Knowledge Development. Available online: https://api.semanticscholar.org/CorpusID:232286371 (accessed on 28 January 2024).

Ramirez-Sanchez, M. Y., Gutierrez-Pallares, E., Pereira, V. A., & Florencio da Silva, R. (2022). Evaluation of the Main Components for Learning with Materials in Educational Platforms. International Journal of Education and Practice, 10(2), 96–106. https://doi.org/10.18488/61.v10i2.2954

Richey, R. C. (1994). Developmental Research: The Definition and Scope. In: Proceedings of the National Convention of the Association for Educational Communication and Technology.

Riedling, A. M. (2007). An educator's guide to information literacy: What every high school senior needs to know. In: Teacher Librarian. Libraries Unlimited.

Rohim, S., Surip, M., Lubis, M. J., & Fardian Gafari, M. O. (2023). Leadership contribution and organizational commitment on the work achievement of the school principals and teachers in high schools in Medan. Cogent Education, 10(2). https://doi.org/10.1080/2331186X.2023.2239595

Smith, E. E., Kahlke, R., & Judd, T. (2020). Not just digital natives: Integrating technologies in professional education contexts. Australasian Journal of Educational Technology, 36(3), 1–14. https://doi.org/10.14742/ajet.5689

Smith, C. (2021). A Comprehensive First Year Engagement Theory. Journal of Access, Retention, and Inclusion in Higher Education, 1(1), 1.

Spector, J. M. (2009). Adventures and Advance in Instructional Design Theory and Practice. In: Learning and Instructional Technologies for the 21st Century. Springer.

Stein, S. J., Goodchild, A., Moskal, A., et al. (2020). Student perceptions of student evaluations: enabling student voice and meaningful engagement. Assessment and Evaluation in Higher Education, 1–15. https://doi.org/10.1080/02602938.2020.1824266

Sula, G., & Sulstarova, A. (2022). Using Wikis as a Teaching Tool for Novice Teachers—Pedagogical Implications. Journal of Learning for Development, 9(2), 163–175. https://doi.org/10.56059/jl4d.v9i2.638

Tiruwa, A., Yadav, R., & Suri, P. K. (2018). Modelling Facebook usage for collaborative learning in higher education. Journal of Applied Research in Higher Education, 10(3), 357–379. https://doi.org/10.1108/JARHE-08-2017-0088

Toprani, D., AlQahtani, M., & Borge, M. (2019). Children's Interactive Strategies Around Digital Technology in Collaborative Learning Environments. In: Proceedings of the International Conference on Computer Supported Collaborative Learning.

Valero, M. D. R., Reid, T., Dell, G., Stacey, D., et al. (2020). Embedding employability and transferable skills in the curriculum: a practical, multidisciplinary approach. Higher Education Pedagogies, 5(1), 247–266. https://doi.org/10.1080/23752696.2020.1816846

Volpe, G., & Gori, M. (2019). Multisensory interactive technologies for primary education: From science to technology. Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.01076

Vygotsky, L. S. (1997). Educational Psychology. St. Lucie Press.

Warrick, A. (2021). Strategies for Reducing Cognitive Overload in the Online Language Learning Classroom. International Journal of Second and Foreign Language Education, 1(2), 25–37. https://doi.org/10.33422/ijsfle.v1i2.124

Zheng, L., Zhang, X., & Gyasi, J. F. (2019). A literature review of features and trends of technology-supported collaborative learning in informal learning settings from 2007 to 2018. Journal of Computers in Education, 6, 529–561.