



Promoting health literacy in school: A systematic literature review and meta-analysis

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ARTICLE INFO	ABSTRACT
<p>Article history Received: 21 June 2022 Revised: 08 August 2023 Accepted: 01 September 2023</p> <p>Keywords: Biology Health literacy Promotion School</p>	<p>Health literacy is the capacity of an individual to locate, read, comprehend, and internalize health-related information in their environment. This study aims to: (1) identify the design of health literacy learning in Biology subjects at the high school level, (2) map out learning designs that can affect students' health literacy in Biology subjects at the high school level, (3) analyzing the design learning can affect students' health literacy in Biology subjects at the high school level. The chosen research methodology involves a systematic literature review of articles released between 2011 and 2021. This comprehensive analysis encompasses 20 articles and adheres to the established PRISMA guidelines. The data analysis technique uses thematic analysis, which includes methods to identify, analyze, and report themes in the data. The results of the distribution visualization show that the research topics are grouped into four clusters: PBL, media, school policies, and curriculum. The results of the research topic test were based on the highest Cohens'd criteria, namely PBL topics, curriculum, school policies, and media. The PBL variable with the media, school policy with the media, and school policy with the curriculum have the most vital relationships in the correlation test between concerns. We can use educational techniques like PBL and practical, theoretical tasks to improve health literacy. Due to its student-centered design, which encouraged collaborative problem-solving by utilizing knowledge and information from many sources, the learning model received higher results.</p>

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INTRODUCTION

One of the challenges and changes in environmental conditions is public health, and the COVID-19 pandemic has dramatically impacted various aspects, especially human health. Health is essential to life and influences policies to anticipate the infection rate. One of the policies in the field of education is the closure of schools so that distance learning can occur. Understanding the truth and suitability of the information and the importance of maintaining health during the COVID-19 pandemic requires health literacy for the community (Paakkari & Okan, 2020). This condition is also a significant factor for students to adapt to the learning process to acquire health literacy competencies.

Students have an excellent opportunity to develop health literacy skills through learning Biology. Biology is one of the subjects that can integrate health literacy conceptually and contextually. Health literacy can be defined as a person's ability to obtain, read, understand, and process health information in the community to make an appropriate decision on one's health (Berkman et al., 2010). The World Health Organization (WHO) defines health literacy as a cognitive and social ability that shapes individuals to access, understand, and use information to maintain health (WHO, 1998).

Hanson & Gluckman (2011) explained that health literacy for children and adolescents is a crucial aspect to be taught because it is essential in reducing non-communicable potential. The promotion of health literacy at an early age is seen as being able to shape appropriate behavior into adulthood (Marx et al., 2007). Efforts to sustainably promote health must support schools' curriculum and teaching (Simovska et al., 2016). However, senior high schools need help encouraging health literacy, including aligning the curriculum to health literacy, which is rarely carried out. There are other priorities to complete the achievements in the curriculum (learning time), the lack of learning resources to support health literacy, and the gap between policy and practice in the education sector (Gould et al., 2010; St. Leger, 2001).

Individuals with low literacy skills will make themselves less concerned about their health, becoming vulnerable to disease, decreasing their quality of life, and having a higher mortality rate (Wolf et al., 2010). Besides that, someone with a low level of health literacy may face risks of harm to their health (Lau et al., 2022). Low health literacy can lead to a lack of understanding of important health-related information, including the necessary precautions and ways to maintain personal well-being. In Biology learning, it is essential to instill conceptualizations about health, body literacy, and health to reinforce understanding to behave and behave toward health (Driessnack et al., 2014). By increasing students' knowledge about health literacy, they can shape their behavior and character to care for themselves.

Health literacy is an element of thought taught early to all ages (Hrivnová, 2016). Thus, learning needs to target the delivery of health literacy following the needs of students in their teens. With the proper teaching method, health literacy can help promote healthy behavior and sustainably improve health risks in attitude and behavior aspects (Jones et al., 2013). Focusing on adolescence is crucial because it will significantly influence future health in the primary development phase. Increasing students' health literacy knowledge can shape their behavior and character to care for themselves.

Several studies have shown that health literacy can be realized through sequential and progressive school teaching designs to train knowledge and skills (Chinn, 2011; L. R. Peralta et al., 2021). For example, Moreno et al. (2018) research for adolescent students in science learning that links HIV disease with identifying the type of virus, its potential spread, and the impact of the epidemic on the world. School-based health literacy provides opportunities for students in their teens to develop a critical understanding of specific behaviors that pose a health risk (Peralta & Rowling, 2018). Schools can also provide health literacy skills to students through learning health information, solving health-related problems, and making critical decisions (Begoray et al., 2009).

The targets in the health literacy domain for students consist of three parts, namely functional health literacy, related to the ability to find and understand information; interactive health literacy, related to personal application related to involvement with health care providers; and critical health literacy, namely the assessment of information, awareness social responsibility and understanding of personal responsibility (Guo et al., 2018). Students must be able to critically evaluate the sources of knowledge obtained (Nutbeam D, 2015). This situation will cause students to ask about the truth of the obtained seeds (Paakkari & Paakkari, 2012).

Improving health literacy with critical ideas requires both methods and substance of supportive subject matter for cognitive development. Each learner distinguishes various sources of information,

critically analyzes its meaning and relevance, and uses relevant information (Sykes & Wills, 2018). Research Winkelman et al. (2016) shows that health literacy at the high school level has been carried out based on the curriculum. However, according to Bruselius-Jensen et al (2017) some challenges are often faced in integrating curriculum teaching in the classroom. So a review related to learning and teaching needs to be done to analyze research related to classroom teaching design that can improve health literacy. The purpose of this study was to: (1) determine how health literacy education is structured within the context of biology courses at the high school level; (2) identify the different learning designs that may impact students' health literacy within biology courses at the high school level; (3) assess how these learning designs may affect students' development of health literacy within the context of high school biology courses.

METHODS

Research Design

By PRISMA principles, this study reviews instructional design research from 2011 to 2021 to improve health literacy. The systematic review method produces insightful findings by classifying, evaluating, and synthesizing pertinent material. The investigation is divided into four phases, each directing the selection of pertinent materials and assessing their caliber, relevance, and applicability. Following these standards guarantees a thorough, unbiased, and reproducible evaluation, enhancing the results' reliability and offering a solid framework for analyzing how instructional design and health literacy initiatives interact. The PRISMA guidelines include a checklist consisting of 27 items and flowcharts on four phases outlining essential items for transparency in reviewing the literature (Liberati et al. 2009).

Criteria Appropriateness

The researchers entered "health literacy" in the Scopus database search box. The collected data is saved as *CSV and *RIS files and then synchronized with the reference manager (Mendeley). Subsequent related documents with literacy health conducted mapping using Vosviewer 1.6.17 software. The following were the Scopus search histories: TITLE-ABS-KEY(Health literacy in school) AND PUBYEAR > 2010 AND PUBYEAR < 2022 AND (LIMIT-TO (OA,"all")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (SUBJAREA,"SOCI")) AND (LIMIT-TO (LANGUAGE,"English")). Using the keywords and search patterns, the researchers came across 4549 publications. To control the inclusion and exclusion of papers in this analysis, the researchers used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) approach. In this model, Roux et al., (2021) are cited. The following are the points of the inclusion criteria that served as the foundation for this organized research: (1) content from January 2011 to December 2021; (2) only freely accessible articles; (3) works that fall within the heading of original research publications; (4) the article's topic is related to the social sciences; (5) English-language articles that are solely concerned with "learning science and biology" study.

Data analysis technique

Data analysis uses thematic analysis, which covers the method for identifying, analyzing, and reporting themes in the data. Every theme is pertinent information with data on research. Determination to scheme rating is conducted by reading the whole article (N=20) and then Doing system coding for map category based on (a) teacher, (b) curriculum/material, (c) participants educated, (d) model/ learning strategy, (e) learning media. In the effect size (E.S.) summary, the value derived from the random effect model serves as the dependent variable. In contrast, the independent variable pertains to implementing health literacy learning in various formats and approaches. The Jeffreys Statistical Program (JASP) version 0.17.2.1 was utilized to explore effect sizes and generate visualizations, predominantly employing the Hunter-Schmidt methodology. This approach is chosen due to its capacity to estimate the dispersion of the effect size distribution using a two-step process involving reduction to yield residual variance and elevation through a function of reliability and range limitation distribution (Hunter & Schmidt, 2004). This meta-analysis methodology applied the classification framework to ascertain the magnitude of effect sizes. The classification levels employed in this study adhere to the recommendations of Sawilowsky (2009). In this context, an effect size is classified as very small if it falls below 0.20 and as slight if it ranges between 0.20 and 0.49. Effect sizes

from 0.49 to 0.79 are considered moderate, while those from 0.80 to 1.19 indicate substantial levels. A classification of exceedingly substantial applies to effect sizes between 1.20 and 1.99. Values exceeding 2.0 are recognized as having a profoundly meaningful impact. When the coefficient d is 1, the standard deviation (S.D.) between the two means is equal. If Cohen's d exceeds 1, the difference between the two means is more than one S.D. This calculation offers a standardized scale to express the entire spectrum of expressions that illustrate the correlation between variables.

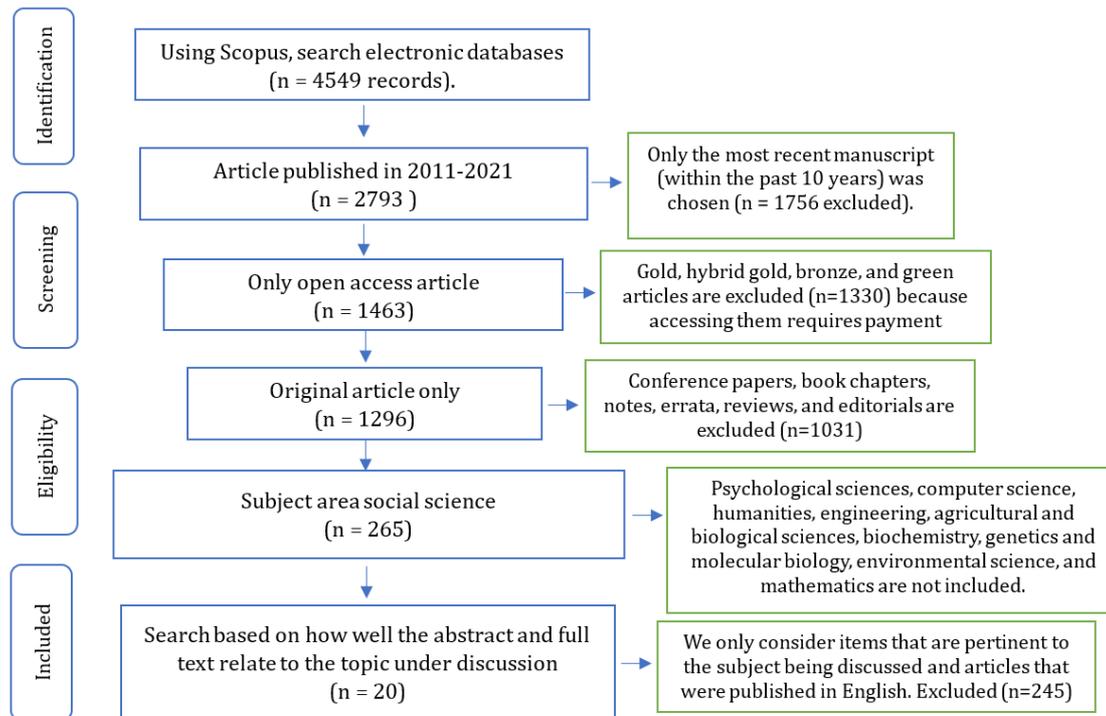


Figure 1. The SLR flow diagram (the PRISMA flow diagram for SLR shows the number of database searches, abstracts screened, and full texts retrieved) (Produced through the PRISMA technique).

RESULTS AND DISCUSSION

Health Literacy Research Trends

The first stage of our analysis comprised a thorough search of the Scopus database, which produced a vast collection of 4549 health literacy research papers. We used the VOSviewer program, which successfully converts complex data into a visual representation that is lucid but also engaging and communicative to improve the usability and accessibility of this large amount of information (see [Figure 2](#)). The choice to use the VOSviewer program was motivated by its use, and respected publications have acknowledged its usefulness (Jun et al., 2018; Li & Yan, 2018). A stringent and meticulous selection procedure was executed to ensure the incorporation of articles that exemplified the utmost relevance, credibility, and scholarly excellence. We emphasized our dedication to building a research dataset that is big and reliable through this meticulous curation.

Four color gradations are visible through database visualization, and they represent the timeframe in which health literacy research was most actively done, particularly from 2016 to 2019. [Figure 2](#) depicts how a larger circle is occupied by health literacy. This information shows that health literacy has garnered more research attention compared to other terms like health education, schools, and physical education. Health literacy is closely related to several other keywords, including student, school, knowledge, ability, curriculum, instructor, and youth. This connection shows how closely related health literacy is to education, particularly in the context of schools. This confirms that interactions with students in educational settings are more heavily weighted in efforts to enhance health literacy. This visualization highlights the evolution of the field of health literacy research as well as the intricacy of the interactions between health literacy, education, and other factors like student, teacher, and curriculum characteristics. This information gives readers a fuller knowledge of the relationship between health literacy and the educational setting and how these elements might interact to help students and young people understand and practice health better.

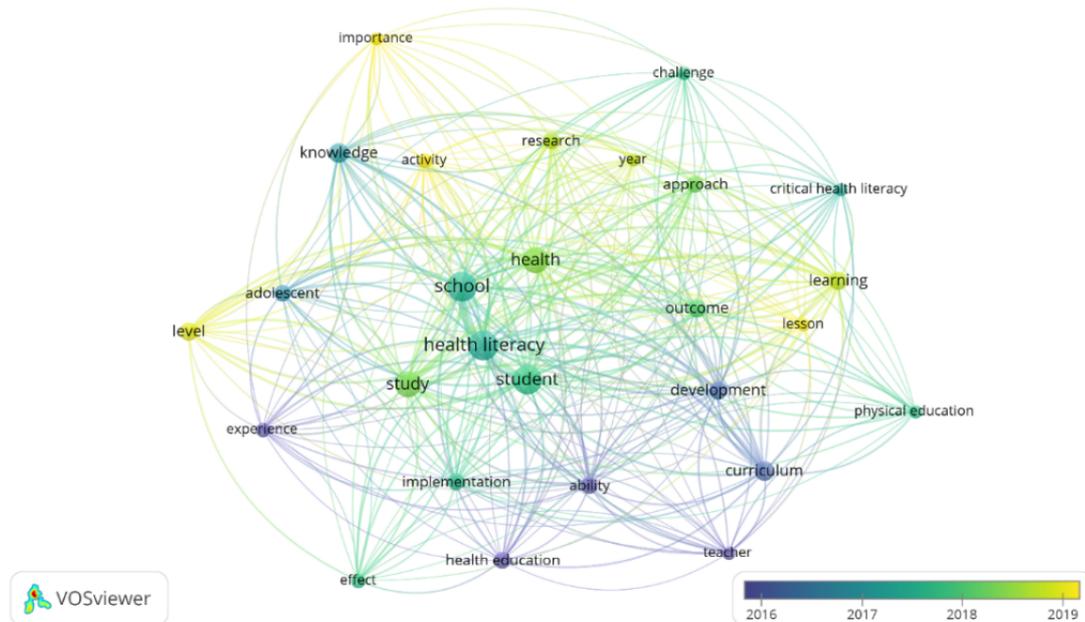


Figure 2. Cooccurrence keywords displayed in VOS-viewer
(Source: Authors' own elaboration using VOSviewer program)

Then, each group of 20 articles was thoroughly examined by carrying out an analysis based on crucial factors, such as the study's location, the sample size employed, the age of the participants, and the context in which it was carried out. With this analysis, we hope to learn more specifically about the developments in health literacy research. We examine these characteristics to find trends and distinctions that might appear in campaigns to advance health literacy. We looked at research locations to determine if there were variations in methodology and focus between studies in various geographical regions. Additionally, the sample size and participant age will reveal how well the study represents the target population and whether there are any appreciable differences in the strategy depending on the sample size and participant age. We can also determine whether the health literacy strategy is more frequently used in formal educational settings, health services, or even through the community by studying the research implementation context. The data we compile from this study will give us a complete picture of how health literacy is used in various circumstances and how it might affect other societies. [Table 1](#) details current developments in health literacy research.

Table 1. Review articles' Demographic Profile

Num.	Study	Location	Sample size	Setting	Participant
1	Akpinar (2016)	Turkiye	223	Schools: school greening is linked to student recovery and health.	12-20 years old
2	Azevedo et al. (2020)	Portugal	66	School: theoretical/practical intervention implemented.	13-17 years old
3	Dadaczynski et al. (2020)	Germany	680	Implementation of health-promoting school (HPS).	School principals and members of the school management
4	Haruna et al. (2021)	Hongkong	108	Learning media: game elements and the use of digital technology.	Three classes: class A, class B, and class C
5	Jacque et al. (2016)	United States	398	Schools: Assessment skills essential for 21 st -century health literacy.	School grades 10-12
6	Kilgour et al. (2015)	United States	34	Schools: implementation of curriculum in school health promotion in Physical Education (PE), Personal, Social and Health Education (PSHE), as well as food technology and science (especially biology).	School grades 9 and 11
7	Lai, H. R., Wu, D. M., Lee, P. H., & Jhang (2018)	Taiwan	337	Teachers: education level affects health literacy.	Teachers
8	Widnall et al., (2021)	England	12	Peer Education Project (PEP) of the Mental Health Foundation, which seeks to raise secondary school students' mental health literacy.	16-17 years old
9	Peralta et al. (2017)	Australia	-	School: theoretical/practical intervention implemented.	Adolescent
10	Peralta & Rowling (2018)	Australia	-	Implementation of school-based health and changes in school ethos on health literacy	High school student
11	Peralta et al. (2021)	Australia	530	Health and Physical Education (HPE) department.	Years 7-10 (12-16 years of age)
12	McCuaig et al. (2014)	Australia	500	School-based health education: Designing a critically oriented health literacy unit of work.	School grades 10-12
13	Paakkari & Paakkari (2012)	Finland	-	Define health literacy as a learning outcome.	High school student
14	Prihanto et al. (2021)	Indonesia	1066	Comprehensive Health Literacy (CHL) and Functional Health Literacy (FHL) and Health-Promoting Schools (HPS).	14-19 years old
15	Simkiss et al. (2020)	Wales	205	The Guide Cymru, a mental health literacy program, is set to be introduced in all secondary schools in Wales, aiming to increase awareness and reduce stigma.	High school student (13-14 year olds)
16	Shabi & Oyewusi (2018)	Nigeria	1200	Internet health information to health problems.	14-16 years old
17	Bjørnsen et al. (2018)	Norwegia	357	The research outlines the need for further research on MEST, a promising school health approach for adolescent mental health, focusing on gender differences and implementation feasibility.	15-21 years from five Norwegian upper secondary schools
18	Suwono et al. (2021)	Indonesia	122	Model: Problem-Based Learning topics of viruses, bacteria, protozoa, and insects.	School grades 10
19	Masayuki et al. (2014)	Japan	162	School: The usefulness of a mouth drawing as a visual oral health literacy instrument.	School grades 10-12
20	Vongxayid et al. (2019)	Laos	461	Schools: Emphasize curriculum and focus on teacher training.	15-19 years old

The demographic analysis summarizes some general observations through the literature review results (Table 1). Overall, countries in Asia and Europe dominate in researching health literacy. Although the database for publication search involved 265 articles at the eligibility stage, the literature search yielded only 20 articles, all of which originated from eight years (2014-2021). These findings indicate the recent acceleration in work related to school strategies in promoting health literacy, leading to an increased interest in health literacy among the community, especially among students.

The study results are based on existing trends, the fact that the six articles that started focus on promoting health literacy as the primary goal to build self-care awareness through the integration of learning and school programs (McCuaig et al., 2014; Peralta & Rowling, 2018; Shabi & Oyewusi, 2018; Suwono et al., 2021; Ueno, 2014). The importance of health literacy is a concern in schools in the Asian region. The discussion on the issue of health disparities shows that health literacy talks a lot about poor health and an incomprehensive understanding of health problems and treatment. For example, the inability to read or understand medical instructions or protect personal health from the start will make students' understanding of health less likely, and they may even tend not to care about health issues.

Biology learning is one of the subjects that can be used as a basis for health education, especially for adolescents. Generations of young people are expected to be able to find, understand, and use the information and even digital information to develop healthy behaviours and habits. With the ability to understand information, adolescent students and adults can make better health decisions and avoid health risk behaviours. Efforts to reach and teach young people need school strategies to integrate essential topics about health that can carry out in collaborative learning, teaching materials, simulations or experiments (Ettel et al., 2012).

All-access to information to build student knowledge is needed to make decisions about health. Many health problems arise in the community due to the lack of building promotions since school. The understanding formed through health literacy will enable students to independently decide all their habits about their health and even the health of the wider community. On the other hand, encouraging health literacy can also be done through communication that utilizes existing facilities to promote student participation. Health literacy is the core concept for implementing the pro-health movement. So schools must also be able to develop a communication approach that focuses on creating information and positively sending messages.

The most significant strategy for improving health literacy is through school educational programs. The results demonstrate that schools have a substantial role in implementing initiatives that involve all students and raise the calibre of instructors who work with students. Various complementing factors make up schools' crucial role in developing health literacy (Smith et al., 2021). First of all, school-based initiatives have a vast potential to reach many pupils concurrently. This condition offers an efficient platform for sharing health information and fostering greater awareness of the value of caring for one's health.

Additionally, a vital component of this process is the teacher's role. Teachers have the chance to educate pupils on health-related topics fun and engagingly (Nash et al., 2021). For students to make informed decisions about their health, it is essential to increase their health literacy. Therefore, children's awareness and comprehension are significantly impacted by training and equipping instructors to offer suitable health literacy materials in the classroom. In this situation, educational interventions provide a solid basis for assisting young people in changing their attitudes toward their health. It offers knowledge while assisting students in developing knowledge and awareness that they may use daily. As a result, education in schools focuses on giving students the knowledge and skills necessary to make informed decisions about their health and future in general and academics.

Regarding demographic data, Australia is a country that is very focused on efforts to promote health literacy. This country is committed to increasing public awareness and understanding of relevant health issues. Concrete steps have been taken to provide broad access to reliable health information and encourage individuals to take proactive action regarding their health. In Australia, the country offers several programs to increase health literacy that involve various community members, including adults and children, in schools (McCuaig et al., 2014). These programs offer pertinent information on health-related subjects, such as good eating, exercise, and disease prevention.

In the study of other countries, for example, Indonesia, efforts to improve health literacy among children and adolescents have been realized through digital interventions specifically designed to increase understanding of mental health, primarily related to anxiety and depression, as well as self-

management skills (Brooks et al., 2023). As a progressive step, this intervention has been directed towards creating a better understanding of mental health aspects among the younger generation. In addition, in Indonesia, special efforts have been made to address the problem of children's stunting (Asriadi et al., 2023). This problem is generally found in rural areas with limited literacy rates and limited access to health services. The main focus on tackling stunting illustrates a commitment to dealing with concrete and urgent health problems, especially in areas with accessibility and education challenges. Indonesia seeks to address different health challenges among children and adolescents through these two approaches by embracing health literacy and stunting management approaches. Both are strategic steps in improving this country's younger generation's welfare.

Internet media has the most significant potential of all the media outlets utilized to improve health literacy. In this digital age, having quick online access to health information has become increasingly crucial (Jiang, 2020). People can quickly access a variety of resources on the internet, including articles, videos, infographics, and interactive platforms, to better comprehend health-related subjects (Goodyear & Armour, 2021). However, intriguing results from two research demonstrate that games can significantly advance students' health literacy. The play-based learning method captures students' interest and enables them to participate actively in the learning process. Through games, students can learn in a more laid-back and enjoyable style, enhancing comprehension and knowledge retention (Parisod et al., 2018).

Well-made games can encourage children to think critically, make choices, and address health-related issues while reinforcing essential health messages. Students can use their health knowledge in interactive games (Dadaczynski et al., 2023), which can aid in internalizing the principles taught. Games and digital media both have the potential to be valuable instruments for increasing health literacy despite their differing methods. Games offer interactive and immersive learning opportunities, while internet media offers flexibility in information access (Ouedraogo et al., 2022). A younger generation that comprehends and is more conscious of the significance of health in their daily lives can be produced by combining these two approaches.

A general pattern suggests that research on health literacy involves many people and a diverse group of participants. Researchers generally like to use a sample size greater than 100 participants. This condition demonstrates the value of learning meaningful insights from people with various backgrounds, skill sets, and experiences. The choice to involve thus many people shows that it is understood that spreading health literacy requires extensive coverage to have a meaningful impact. Research involving many participants can reflect the community's diversity more accurately and offer a more comprehensive perspective of the difficulties and opportunities in comprehending and using health.

The ultimate objective of initiatives to improve health literacy is connected to the significance of having enough participants. Research attempts to expand individual health knowledge and promote long-lasting behavior change by involving many people. There is potential to create a more widespread culture of health awareness in society if health-related knowledge and skills can be taught to many students. A significant participation pool also creates the potential for greater knowledge dissemination. Students with a better understanding of health can influence change in their neighborhoods. They can share the knowledge they learn with their friends, family, and community, starting a chain reaction that improves health awareness (Mathias et al., 2023). Gathering trustworthy data and catalyzing substantial societal transformation both necessitate the active engagement of many participants in health literacy evaluations. Employing this approach ensures that endeavors to enhance health literacy are designed to yield extensive and enduring societal advantages.

Table 2. Health Literacy Promotion in School

Num.	Study	Health Literacy Topic	Stated health literacy focus to be promoted by the study	The action of the Health Literacy Promotion Strategy
1	Suwono et al. (2021)	The Problem-Based Learning (PBL) of Biology for Promoting Health Literacy in Secondary School Student	Improving health literacy using the PBL model on the topic of viruses, bacteria, protozoa, and insects.	The Problem-Based Learning (PBL) model in biology education can significantly improve health literacy by exposing students to complex, real-world health issues related to viruses, bacteria, protozoa, and insects. This approach, particularly when framed within the context of tropical diseases, encourages self-directed learning and critical thinking skills. Students are encouraged to research and analyze these microorganisms, understanding their roles in disease transmission, infection mechanisms, and control strategies. This approach builds a foundation in biological knowledge and hones students' ability to apply this knowledge to practical scenarios. The PBL model empowers students with biological knowledge and critical skills to comprehend, analyze, and address health challenges holistically.
2	Widnall et al. (2021)	Evaluate a questionnaire on mental health literacy created exclusively for 11- to 12-year-olds. Future research can use this questionnaire to track results and evaluate the efficacy of interventions aimed at improving young people's mental health literacy.	The Peer Education Project's (PEP) process evaluation offers insights into the ways in which the intervention might raise secondary school students' mental health literacy. This data can be utilized to strengthen the project's logic model and pinpoint problem areas.	The results of the process evaluation will be used to guide the design of a later effectiveness study to determine how much the PEP increases mental health literacy. This can serve as guidance for the creation and implementation of mental health literacy programs that are implemented in schools, thereby improving the outcomes for children. Understanding the mechanisms of change underpinning peer education and the effects of various school contexts can be improved with the help of the realism assessment approach utilized in this study. Effective peer-led initiatives for promoting mental health in schools can be created and implemented using this knowledge.
3	Haruna et al. (2021)	Improving Instruction and Sexual Health Literacy With Serious Games and Gamification Interventions: an Outlook to Students' Learning Outcomes and Gender Differences	Improving health literacy through the use of game elements, as well as showing that gender has nothing to do with use of digital technology.	There was a statistically significant increase from the pre-test to the post-test results, so student learning outcomes increased after the intervention of the three classes after the use of the game. This study suggests that using a combination of game elements such as leaderboards, point systems, competitions, badges, levels, and direct feedback can serve as information for interactive learning because it can improve student learning outcomes.
4	Azevedo et al. (2020)	Filling a gap: Knowledge in Health-Related Science for Middle School Students in Formal and Informal Contexts	Improving health literacy with practical theoretical activities on infectious disease materials such as malaria, tuberculosis, and diarrhea.	Hands-on academic activities enhance students' understanding of infectious diseases and health literacy by fostering critical thinking, independent research, and collaboration. They also promote health literacy by emphasizing the importance of health-related knowledge in real-world challenges and enhancing interpersonal skills.
5	Simkiss et al. (2020)	Effective mental health practices and getting assistance for mental health issues	The program is an adaption of "The Guide," a Canadian program that has been successful in raising mental health literacy among 16 to 17-year-olds in North America.	The program aims to promote positive mental health habits in adolescents during crucial developmental stages, focusing on early detection and prevention. Raising mental health literacy and lowering stigma can improve access to care and support, potentially enhancing young people's mental health outcomes. At the beginning, 12 weeks

Num.	Study	Health Literacy Topic	Stated health literacy focus to be promoted by the study	The action of the Health Literacy Promotion Strategy
6	Vongxayid et al. (2019)	Sexual and Reproductive Health Literacy of School Adolescents in Lao PDR	Improving health literacy through curriculum and development of school program that focus on the material of the human reproductive system.	after The Guide Cymru was given to the active group and 24 weeks after The Guide Cymru was given to the wait-list control group, assessments of mental health literacy and difficulties were made. Some adolescents in schools have inadequate sexual and reproductive health literacy, and this is due to lack of supervision from family, promiscuity, and lack of knowledge among adolescents related to sex and reproduction. Based on the results presented, it is important to emphasize good quality and curriculum-based sexual education programs in secondary schools. School policy should focus on teacher training and developing continuing sexual education programs in schools that can incorporate into the curriculum. Currently, the curriculum for the subject of biology in the human reproductive system is still very limited.
7	Bjørnsen et al. (2018)	Understanding and promoting mental health are the main goals of the specialty of health literacy known as "mental health literacy" (MHL).	The MEST universal working plan aims to improve mental health and wellbeing in teenage girls. A study found that girls who attended MEST had significantly higher mental health than those who did not, supporting the need for more research funding to improve adolescent mental health.	The MEST (coping) strategy was implemented in school health services as part of the study's health literacy promotion strategy with the goal of promoting positive mental health literacy (MHL) and mental wellbeing among Norwegian adolescents. In order to investigate the impacts of MEST, the study examined the mean differences in positive MHL and mental health between adolescents who participated in MEST and those who did not over the course of a school year. When compared to females who did not attend MEST, girls who did showed a substantial improvement in their mental health, but neither boys nor the full sample of both genders showed any meaningful change.
8	Shabi & Oyewusi, (2018)	Health Literacy and Internet Health Information Use Among In-School Adolescents in Osun State, South-West, Nigeria	Improving health literacy information through digital communication processes to address personal problems.	Among school youth, 63% utilize information every weekweekly, and all respondents, which accounts for 100%, access information monthly. Respondents exploit this information to tackle personal concerns, including matters related to adopting healthy dietary habits, managing nutritional challenges, and more. Findings derived from the Chi-square test underscore a noteworthy correlation between health literacy levels and the utilization of online health-related information.
9	Peralta et al. (2017)	Conceptualizing a New Approach to Adolescent Health Literacy	Improving health literacy with practical theoretical activities to form the concept of adolescent learning, health literacy organizations, and critical health literacy.	Modern educational theories can enhance health literacy in adolescents by incorporating health literacy principles into curriculums. This condition involves adapting instructional strategies to teenagers' cognitive, emotional, and social qualities. Organizations like Health Literacy Enhancement Organizations help shape the health literacy landscape through information dissemination, workshops, and interactive platforms.
10	Jacque et al. (2016)	Addressing Health Literacy Challenges with a Cutting-Edge Infectious Disease Curriculum for the High	Improving health literacy through a curriculum in contextual biology learning that focuses on infectious disease material.	Integrating health literacy principles into the biology curriculum through contextual learning is a powerful method for developing skills related to health literacy. This approach allows students to explore health-related topics within biological systems and processes,

Num.	Study	Health Literacy Topic	Stated health literacy focus to be promoted by the study	The action of the Health Literacy Promotion Strategy
		School Biology Classroom		deepening their understanding of biological concepts and their implications on individual and community health. It encourages critical thinking, analytical thinking, and the interpretation and evaluation of health information. Contextual learning fosters relevance and engagement among students, encouraging them to actively participate in discussions, research, and projects related to health literacy. It also encourages effective communication, enabling students to share knowledge, make informed decisions, and contribute to their communities' health literacy.
11	Kilgour et al. (2015)	Health Literacy in Schools: Prioritising Health and Well-Being Issues Through the Curriculum	Improving health literacy through the curriculum that is taught to give birth to a young generation who are health literate, and can improve healthy school programs.	Physical education (PE), Personal, social and health education (PSHE), and Food Technology and Science (particularly in Biology) were identified by students and staff as 'core' subjects for conveying health messages through the curriculum being taught. The curriculum being taught provides students with clues to the environment, which will contribute to the level of health literacy. Students demonstrate a good understanding of health and the importance of being healthy, and many conceptualize health literacy accurately.
12	Ueno (2014)	Application of Visual Oral Health Literacy Instrument in Health Education for Senior High School Students	Improving health literacy information through the use of visual media in the form of picture of teeth and mouth.	Visual aids in oral and dental health education can greatly enhance students' capacity to maintain their oral and gingival health. These materials, encompassing illustrations, photographs, and interactive models, are pivotal in enhancing students' understanding of the intricate architecture of teeth and gums. Additionally, they facilitate the timely recognition of prevalent concerns such as cavities and gum inflammation. Additionally, they emphasize the negative effects of disregarding oral health, inspiring kids to take preventative action. The interactive learning technique fosters an increased sense of connection to the material, which promotes active participation. Students gain life skills, such as self-awareness and adopting preventative behaviors, by learning the early warning signs of dental and gingival issues.
13	McCuaig et al. (2014)	Enacting Critical Health Literacy in the Australian Secondary School Curriculum: The Possibilities Posed by e-Health	Improving health literacy information through interactive activities using digital technology.	Engaging activities play a pivotal role in aiding students to explore and cultivate concepts regarding health literacy. Additionally, students are highly assured when sourcing health-related information online. The integration of technology in enhancing health literacy has equipped students to assess resources adeptly. Notably, all students acknowledge technology as an enjoyable and integral component of their learning journey.

According to [Table 2](#), there has been a steady rise in the implementation of health literacy in high school settings until 2021. This field's research found significant differences in the emphasis on increasing health literacy among students. For instance, in 2021, some academics focused on specific strategies, including employing learning models, creating instruments, and incorporating game components. In greater depth, there is a definite propensity to select the approach that will best meet students' needs in acquiring health literacy. The learning model's application as a method demonstrates recognition of the significance of interactive involvement in enhancing students' understanding of health issues. Creating tools and gameplay components is another example of motivating and enticing pupils to learn.

Research on school interventions for health literacy is one of the trends in the literature that has been noted, and this covers a range of activities, like utilizing technology to give pupils accurate and timely health information. To promote health literacy, for instance, information on managing one's health and knowing specific disorders is a priority. Overall, the development of health literacy among high school students shows a positive trend. The diverse approaches to promoting health literacy reflect the complex and varied needs of developing a comprehensive understanding of health. Through the use of relevant and innovative strategies, these efforts continue to contribute to strengthening health literacy among students. Other factors are also found in the formulation, which will be explained in the next point, including learning models, curriculum design, instructional media, and school policies.

Learning Model

Various unique learning strategies are utilized in the classroom to improve health literacy. Among these methods, the active practical-theory approach, Problem-Based Learning (PBL), is practical. The PBL model enhances students' understanding of health-related material and their capacity to use it effectively differently. Particularly in biology education, the PBL model has great potential to increase health literacy. PBL encourages students to participate in class discussions actively, arouse curiosity, and develop a genuine interest in the material. PBL fosters excellent knowledge of health concepts and ownership of the learning process by encouraging student inquiry and engagement (Suwono et al., [2021](#)).

This finding resonates with Peralta's study, which delves into critical awareness and socio-critical pedagogy, enabling young individuals to assess health-related information critically, collectively construct meaning, and cultivate skills beyond mere knowledge acquisition (Peralta et al., [2017](#)). Employing a pedagogical approach that fosters deep thinking, critical analysis, and comprehensive understanding can pave the way for educational experiences that enhance health literacy among adolescents. To achieve this, it becomes essential to embed such a pedagogical approach into the school's ethos and seamlessly integrate it across various subjects and throughout the school day.

The activity theoretical-practical approach is another applicable methodology for connecting theoretical knowledge with practical applications. This strategy creates a link between conceptual comprehension and examples from the real world supported by scientific discoveries. By placing theoretical concepts into concrete circumstances, activities that combine theory and hands-on experiences with students can improve health literacy and foster critical thinking (Azevedo et al., [2020](#)). By using these approaches, instructors can create a more prosperous learning environment where students are empowered to investigate health-related topics from various angles and actively engage. These strategies' overall effects have a wide range of effects: promoting a thorough understanding of health concepts, developing critical thinking capabilities, fostering efficient dialogue, developing a sense of duty and curiosity in those who read about health.

Curriculum design

Policy curriculum influences the level of literacy and existing health at school. The biology curriculum can cultivate pertinent health literacy skills, enabling health literacy students to enhance their proficiency (Jacque et al., [2016](#)). The Applied curriculum will instruct the student on the environment and things that will contribute to literacy and health. The applied curriculum must also focus on teacher training and related program development health literacy (Vongxayid et al., [2019](#)). To give birth to a generation of literate young health, meaning reducing the gap in health, recommended that the message of health be delivered through curriculum and practice based on schools like School Healthy Program (Kilgour et al., [2015](#)).

The curriculum's emphasis on integrating technology led to the creation of an innovative online health resource designed for young people and jointly developed by their peers. Almost all students widely regarded the planned use of technology as a rewarding aspect of the educational unit and a crucial element in encouraging and maintaining continuous student involvement throughout the team. The use of technology by students was viewed as a source of motivation and fun, which greatly influenced their engagement and involvement with the course material (Merga, 2023; Thompson et al., 2022). This connection between students' passion and technology demonstrated how technology has the potential to be an effective teaching tool that connects with the generation that grew up with the internet (Shabi & Oyewusi, 2018).

The teachers emphasised the value of technology in piquing students' interest early on and encouraging sustained engagement with the program. They noted that technology enhanced the subject's appeal while enabling dynamic and participatory learning styles that inspired students to learn more about the discussed concepts and ideas. This integration of technology and education improved learning and demonstrated how pedagogy is a dynamic field. The effective integration of technology and curriculum highlighted the ability of contemporary educational paradigms to adapt and incorporate new tools, ensuring that learning remains engaging, pertinent, and responsive to the preferences and inclinations of today's students.

Using Media Instructional

Through various teaching tools, it is possible to improve students' health literacy effectively. Strategic implementation of educational tools combining gamification features can enhance students' literacy and general health understanding by creating a dynamic learning environment that captivates students, promotes literacy skills, and increases awareness of health concepts. Integrating these elements can infuse educational encounters with intrigue, fostering student engagement, autonomy, and the cultivation of critical thinking skills (Haruna et al., 2021).

Media platforms enhance health literacy by giving students judicious information, insights, and strategies, empowering them to make informed decisions about health-related matters (Wardiati et al., 2023). Students can use these resources as helpful tools to sort through the wealth of health-related information available, allowing them to differentiate between credible sources and unverified claims. Images, especially visual media, present a novel way to evaluate and improve health literacy. Infographics and diagrams are visual aids that simplify health-related concepts, aiding comprehension and memory recall and providing a simplified representation of complex information (Ueno et al., 2014).

Modern education must incorporate digital media, especially the Internet. Students have access to a multitude of health-related information by using online tools. However, educators continue to play a crucial role. Teachers actively assist students in exploring Internet sources to guarantee the veracity and correctness of the material accessed (McCuaig et al., 2014). Combining numerous learning media creates a multidimensional strategy considering students' various learning preferences and styles. Educators create a more prosperous learning environment that promotes holistic health literacy by adopting gamification, interactive technologies, instructional media material, visual aids, and digital resources. In this comprehensive paradigm, students learn the information and develop the critical thinking abilities to decide on their health and well-being.

School Policy

In terms of the experience of health promotion participants in health schools based on educational settings, they are learning knowledge, understanding, and ability to determine actions individually or in groups. Engaging in health promotion in a community setting demonstrates the importance of experiential learning outside the health education classroom. One's health literacy can also determine public health (Sykes & Wills, 2018). Studying health education at the highest level of the curriculum forms students into critical consumers of health-related information and understand that information in their context (Hubbard & Rainey, 2007). They not only passively accept information as truth but question and judge the validity of the claims made or the information provided (McCuaig et al., 2014; Paakkari & Paakkari, 2012)

The school library may frequently help schools improve their health literacy initiatives. Professionals in school libraries have a tremendous opportunity to take the lead in fostering health

literacy in the educational environment (Vassilakaki & Moniarou-Papaconstaninou, 2022). They were essential in supporting health literacy in particular situations. However, suitable training and assistance are still necessary to maximize their performance. A good tool for recognizing and developing digital health literacy at a younger age may be the school library. They can serve as a platform to assist students in acquiring the knowledge necessary to comprehend health information, particularly in the current digital era. Students can be empowered to access and evaluate diverse mental health and well-being materials with the help of a school library that strongly emphasizes health literacy. However, difficulties also appear along with the potential that exists. According to research, school librarians can be less confident about promoting students' health literacy (Merga, 2023). Some research demonstrates that a lack of health need for improved knowledge and training may hamper their work (Luo & Park, 2013; Whitney et al., 2017). Evaluating library and information science programs also revealed considerable room for enhancement in health literacy education.

Schools can equip students with health by developing and improving health literacy skills. One of them is the digital aspect that can be done by training students' abilities by going online for health information to make informed decisions about search results and online health information assessments. Peralta investigates that there are challenges that need to be considered by schools in promoting health literacy based on functional, interactive, and critical aspects. School-based health literacy cannot rely solely on intervention-based interventions because of the limited existence of students' self-administered health literacy levels (Khanal et al., 2023). So, to create a health literacy program using a curricular framework, Peralta et al., (2017) advocated adopting an environmental approach that recognizes the relationship between various groups, cultures, and policies. Planning for health literacy is vital to allow instructors to collaborate with local communities and schools to create learning activities for health literacy that go beyond what is taught in the classroom (Orkan, 2020).

The Magnitude of the Impact of the Research Topic

A one-sample t-test is used to conduct the impact test for each research topic, and Cohen's d criteria are used to determine the influence's strength. Table 3 displays the outcomes of the influence test.

Table 3.

Test the influence of health literacy research topics

Research Topic	t	df	p	Cohens'd
Learning Model	12.161	3	0.001	6.080
Media Instructional	2.499	3	0.088	1.249
School Policy	8.372	3	0.004	4.186
Curriculum	9.735	3	0.002	4.867

Size effect: see the comparison between before and after (pre-post), and the impact of treatment on the measured variable can be seen through the calculation of Cohen's d. The topic test results showed that the learning model had higher marks than other topics. This result is because problem-based learning (PBL) is an active learning approach in education (Riyanto, 2009). Learning model design by student-centred, where students can collaboratively devise various solutions to real-life problems. The key is achieved using their knowledge and new information obtained from multiple sources (Ayyildiz, Y. Tarhan, 2015).

For example, the learning model positively affects student academic achievement because problem-based learning can increase school test scores (Lestari et al., 2017). The results of the study by Suwono (2021), stated that there was a significant increase from pre-test to post-test using the PBL model compared to the conventional model. This condition is also reinforced by research by Albanese and Mitchel, which states that compared to traditional learning models, it is better to use PBL models to construct concepts and develop process skills. The media has a low Cohens'd value. This result is because the media used in several studies are found only to use game-based media, which only contains images, tips and tricks, and game elements such as points, levels, and ratings.

Correlation Test between Research Topics

The use of media in the classroom and problem-based learning (as learning model) show a substantial correlation and fall into the high category of correlation criterion. The nature of media-assisted PBL, which serves as an educational strategy incorporating real-world issues into the learning process, might be credited with this result. In this dynamic method, real-world problems are brought up, and students interact with them using well-designed learning resources and platforms. Table 4 displays the correlation between the factors.

Table 4.
Correlation Test between Research Topics

Variable		Learning Model	School Policy	Media Instructional	Curriculum
1. Learning Model	Pearson's r	—			
	p-value	—			
2. School Policy	Pearson's r	0.578	—		
	p-value	0.133	—		
3. Media Instructional	Pearson's r	0.792	0.567	—	
	p-value	0.208	0.433	—	
4. Curriculum	Pearson's r	-0.730	-0.527	-0.671	—
	p-value	0.162	0.362	0.329	—

A learning model that bridges the gap between theoretical ideas and their practical implementation is media-assisted PBL. The critical component of this strategy is to convey real-world issues that students can relate to from their environment and experiences. Furthermore, this strategy can be combined with media in student worksheets as a guide for their activities, carefully designed to harness the educational opportunities offered by various forms of media. PBL, which involves media, challenges students to solve complex problems by immersing them in situations that reflect their challenges outside the classroom (Abdulah et al., 2021). These complex problems can be expressed and explored through media, which can encompass a variety of audiovisual techniques, interactive platforms, and digital technologies. Students' abilities to solve problems, think critically, and possess strong analytical skills are all enhanced through this engagement.

The media-enhanced PBL framework progresses through several key phases. These include exposing students to the main issues, guiding their learning process, enabling both individual and group investigations, and concluding with an analysis and evaluation of the solutions they come up with. Media plays a crucial role throughout these phases in disseminating knowledge, igniting debates, and guiding students as they investigate the problem domain. PBL and media can be combined to give teachers a robust methodology that moves students beyond rote memorization (Hwang et al., 2019). This strategy fosters self-directed learning, encourages active participation, and develops problem-solving abilities in a real-world setting. Students can transcend theoretical abstractions and begin a transformative educational journey marked by experiential learning and deep comprehension thanks to the merger of media and PBL.

Various studies in the article found that literacy affects the ability to access information and navigate, affecting cognitive and linguistic skills and self-efficacy. An individual's literacy level directly affects an individual's ability to (1) access health information, (2) learn about disease prevention and health promotion, (3) monitor low-risk health care, and (4) communicate health messages with others (Liu et al., 2020). The school environment intervention provides information boards for conveying messages. Other means of communication, such as pictures, photos, graphic illustrations, audio, and video, are considered in producing materials. Crafting a school environment that emphasizes comfort and health, coupled with the availability of a health counsellor (Indrawati et al., 2019).

The instructional approach serves as a tactic to structure classroom teaching and facilitate students in achieving their predetermined educational objectives. Learning methodologies such as PBL and incorporating theoretical and practical activities can enhance health literacy. Students consider PBL a learning method to improve health literacy because there are significant results between pre-test and post-test. PBL can help students participate through open discussions, stimulate interest in learning, and play a more active role during the learning process (Tsai et al., 2018). There is a relationship

between PBL and increased health literacy in schools (Jamshidi et al., 2021; Karimi et al., 2019). The high perception of PBL can motivate students to achieve the desired learning outcomes. Therefore, students benefit from problem-based learning because it can improve knowledge, skills, problem-solving abilities, and critical thinking.

The curriculum for secondary schools in Indonesia was analyzed, resulting in four biology topics addressing health, disease, and prevention, particularly viruses, bacteria, protozoa, and insects. According to the literature, various tropical infectious diseases are caused by viruses such as HIV/AIDS, dengue hemorrhagic fever (DHF), influenza, and coronavirus. Infections caused by bacteria include tuberculosis and typhoid fever, while protozoa cause malaria. Furthermore, biology studies insects as disease vectors, including mosquitoes that transmit malaria and dengue fever to humans. In addition, they can use material on the human reproductive system, respiratory system, digestive system, nutrition, and physiological mechanisms of food, as well as skills that can be useful in dealing with health problems, including analyzing health problems. Such knowledge and skills can be defined as health literacy (Suwono et al., 2021).

Schools have a role in promoting health, highlighted in the School Health Promotion (SHP) framework (WHO, 1998). To improve health literacy in students, schools have an essential role in health literacy, especially in Physical Education, Sports, and Health. These subjects teach about skills in various sports and health material. Schools are pivotal in enhancing students' health literacy, particularly in Physical Education, Sports, and Health subjects. These courses include a variety of sports and health-related abilities. Schools are crucial in improving students' health literacy, especially in physical education, sports, and health. These courses provide skills in a variety of sports and health-related fields. The Minister of Education and Culture Regulation Number 24 of 2016 establishes Core Competencies (CC) and Basic Competencies (BC), including health information, and makes this requirement official. Including these core skills in the curriculum shows that the government is seriously trying to improve students' health literacy.

Schools must broaden the scope of their health literacy initiatives to encompass other crucial aspects. This condition includes fostering teacher professional development and engendering shifts in the school's overall ethos. These comprehensive efforts collectively enhance students' health literacy (Haugen et al., 2023). Teacher professional learning should be the primary foundation for improving youth health literacy programs in the future, not just because of a paradigm shift. Health literacy outcomes can improve if schools work to become health-literate organizations (i.e., systems and organizations that provide the conditions for their members to act on the newly developed understanding of health).

CONCLUSION

Health literacy is crucial in education, involving students, schools, curriculum design, educators, and youth demographic. Enhancing health literacy involves dynamic student engagement and curriculum attributes, highlighting the educational process's interrelationships. Based on the systematic review and meta-analysis results, technology-based learning designs such as websites can affect health literacy in biology subjects in high school. The learning model, centered around problem-based learning, achieved higher marks due to student-centered design, enabling collaborative problem-solving using knowledge and information from multiple sources. Secondary school biology learning often uses a constructivism-based model involving problem-solving and active student involvement. Educational institutions are crucial in health-centered interventions, designing health service programs, and adjusting curriculums to cover health aspects. This holistic understanding of health helps students develop analytical and problem-solving skills. Technology promotes health literacy by providing access to diverse health information and facilitating dynamic, fact-based learning. Constructivism-oriented learning models, health education interventions, and technology can enhance students' knowledge and critical thinking abilities for daily life health concerns. Problem-based learning (PBL) and media integration in classrooms have a strong correlation, as media-enhanced PBL integrates real-world challenges into learning, encouraging students to actively engage with these issues through thoughtfully curated platforms and resources.

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