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Literacy Analysis of Chemistry Teachers on STEAM (Science, Technology, Engineering, Arts and Mathematics) Learning Approach in Senior High Schools in West Nusa Tenggara Province

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Abstract: The research was conducted with the following objectives: (1) to determine the literacy ability of chemistry teachers in West Nusa Tenggara Province towards the STEAM leaning approach; (2) knowing the supporting and inhibiting factors of the chemistry teacher's literacy about the STEAM learning approach. The research was conducted at A-accredited Senior High Schools in West Nusa Tenggara Province. The sample selection in this study used a purposive sampling technique with a total of 40 participants in 20 schools. Data collection include open question sheets and interview guidelines. The data analysis technique in this study uses the Miles and Huberman model with data reduction technique, data display, and verification. The result of this study the literacy of state high schools' chemistry teacher in West Nusa Tenggara Province related to the STEAM approach is in the medium category. The supporting factor for the literacy of chemistry teachers in State High Schools in West Nusa Tenggara Province is the existence of professional training and development such as training workshop, MGMP and P4TK. Other supporting factors are professional relationship and the ability to access internet media. The factors that hinder the literacy of chemistry teacher are the lack of training and professional development, the lack of ability to access the internet as an information tool in the search for literature and the limitations of school facilities and infrastructure and time allocation.

Keywords: Chemistry learning; STEAM approach; Teacher literacy

Introduction

Education is one of the benchmarks of a country's progress. Siahaan *et al.*, (2023) states that quality education can refer to process quality and product quality. Good quality education is needed to produce competitive Human Resources (HR) and be able to face challenges in the future. The Ministry of Education, Culture, Research and Technology stated that based on the results of the 2022 PISA study, Indonesia has increased compared to 2018, when viewed from the scores obtained, in 2018 Indonesia obtained a score of 396 in the field of science, while in 2022 Indonesia reached a score of 398. The increase experienced is still minimal, namely only 2 points, so Indonesia is still classified as low from other countries in the survey. Many factors hinder the progress of education in Indonesia. Kurniawan (2016) stated that the factors that determine the success of an education system include the factors of students, teachers, economic conditions, facilities and infrastructure, and the environment.

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21st century education has the characteristic of student-centered learning. Through the social constructivism approach, knowledge is built through social interaction, able to utilize technology optimally in the learning process to integrate various sciences, and improve 21st century skills such as digital literacy, cooperation, creativity, problem-solving skills, and able to develop teacher competencies in accordance with the times (Alpaydin & Demirli, 2022). In the era of the 4.0 revolution, the development of technology, information and digital is very rapid so that it brings a new perspective in the world of education *(*Griffin *et al*., 2012; Shidiq & Yamtinah, 2019). Lestari & Kurnia (2023) stated that in the rapidly evolving digital era, changes and advances in technology have changed *landscape* education. Hargreaves (2000) stated that 21st century professional teachers are teachers who are skilled in teaching, able to build and develop relationships between teachers, schools and community that more broad. Learning changes are needed to bring out skills effectively.

Teachers need to improve their professional competencies, master digital literacy, the use of technology, and innovative learning methods to develop 21st century skills in students (Idin, 2020). Education must be able to connect classroom learning with technological and industrial advances, including chemistry learning (Shidiq *et al*., 2020). Chemistry is a subject that is generally considered difficult and requires skills in solving learning problems in the form of theories, concepts, laws and facts (Nurfadilah & Siswanto, 2020). Pekdağ (2010) stated that learning chemistry becomes difficult, because of the large amount of abstract and intangible material. Many chemistry teachers in practice do not meet the qualifications, due to the lack of facilities such as school infrastructure such as laboratories and the use of unqualified teaching materials (Uchegbu *et al*., 2016). Students have difficulty accepting chemical concepts because of minimal initial knowledge, incoherence and in the learning process students memorize chemical concepts without knowing the basic concepts (Pekdağ, 2010).

The grades and learning outcomes of students in West Nusa Tenggara (NTB) in chemistry in 2019-2022 are still relatively low, in some schools as many as 91.00% of students do not reach the KKM standard score. Some of the factors that affect this are the teacher's learning process that is still conventional, chemistry lessons that are considered difficult and abstract, and students' literacy that is considered lacking (Ahmadurifai, 2020; Masban, 2021; Iswara *et al*., 2021; Nurhidayah *et al*., 2022). The depiction of abstract material is important in the chemistry learning process. Teachers must have high creativity so that chemistry learning in the classroom is more interesting and can be logically accepted by students so that they are able to understand the concepts taught, for that the competence and professionalism of chemistry teachers in teaching are needed (Agogo & Onda, 2014).

Learning chemistry, technology, industry and chemical problems related to daily life can be integrated into classroom learning by applying the STEAM (Science, Technology, Engineering, Arts and Mathematics) approach (Annisa *et al*., 2019; Zubaidah, 2019). The STEAM approach is a multi-disciplinary approach that develops from the STEM approach by adding an element of art in learning (Mu'minah & Suryaningsih, 2020). The STEM approach has six aspects that must be fulfilled, namely interdiscipline, exploration, interactivity, innovation, flexibility and adaptability, and content integration (Halim & Roshayanti, 2021).

STEAM literacy is the ability of individuals to identify a question, gain knowledge, formulate, explain phenomena that occur scientifically, understand information and make decisions based on facts and reasoning skills with related issues (Kuswidi, 2015; Asari *et al*., 2019; Irhandayaningsih, 2020; OECD, 2019a). Chemistry teachers' literacy about the STEAM approach is one of the important factors in learning success, for that it is important for chemistry teachers to have good literacy about the approach, because teachers play a role in the success of the learning process.

Based on the Policy Research Center of the Research and Development Agency of the Ministry of Education and Culture in 2019 2020, stated that basically the STEAM approach has begun to be applied to several accredited schools in NTB Province, this is also supported by several studies related to the implementation of STEAM in the province, one of which is research from Nurhayati *et al*., (2021) about the development of STEAM-based chemical E-modules.

Currently, research related to the STEAM approach is mostly based on the development of implementation models (Tseng *et al*., 2013; Wijaya *et al*., 2015; Anggraini & Huzaifah, 2017; Widarti *et al*., 2020; Mufida *et al*., 2020; Sa'ida, 2021; Sigit *et al*., 2022), increasing literacy, critical thinking processes and soft skills possessed by students (Nurlitiani, 2017; Mustain, 2020; Suciari *et al*., 2021; Nurfadilah & Siswanto, 2020). However, research from the perspective of chemistry teachers' literacy about STEAM has never been conducted in State High Schools in West Nusa Tenggara Province. Given the importance of teacher literacy related to the STEAM approach, this criterion is a consideration for researchers in analyzing the literacy of chemistry teachers about the approach.

Method

This type of research is a qualitative research using a survey research method. This research was carried out in A-accredited State High Schools throughout NTB Province. The research was conducted in July-September 2022 on chemistry teachers at State High Schools in NTB Province. In line with this study, the data source used is a primary data source obtained directly from informants or participants by distributing questionnaires and direct interviews to the person concerned. The primary data source in this study is a chemistry teacher of a State High School accredited A in NTB Province. In this study, the data collection technique used is purposive sampling, by distributing questionnaires and interview activities.

The research questions in the questionnaire refer to the literacy aspect of chemistry teachers about STEAM. The questionnaire consists of 41 question items which are an elaboration of seven aspects about STEAM, the research questionnaire has been validated by two expert validators. The questionnaire used was in the form of open-ended questions given online and directly to participants (Sugiyono, 2011).

This form of questionnaire follows a model developed by Halim & Roshayanti (2021). In qualitative research, the researcher himself plays the role of a research instrument or tool (Sugiyono, 2016). The number of participants in this study was 40 people with a total of 20 schools spread across districts and cities of NTB Province, including Mataram City, West Lombok Regency, Central Lombok Regency, East Lombok Regency, Sumbawa Besar, Dompu Regency, Bima Regency and Bima City.

Table 1. STEAM Questionnaire Grid

Aspects	Aspect Description
Interdisciplinary	A chemical problem-solving method that integrates various perspectives from related sciences in a relevant and integrated manner.
Exploration	Activities gain new experiences through situations, experiments, and project work related to chemistry learning,
Interactive	Techniquesor techniques when presenting chemical materials, play a role in creating interactive situations. There is interaction between teachers and students as well as learning resources.
Innovation	A creative and dynamic process in designing, developing, and managing learning with a multiperspective approach,
Flexibility and Adaptability	**Flexibility,** includes the ability to adapt and effectively work in a variety of situations with different individuals or study groups. **Adaptability,** involves the ability to understand chemical matter and appreciate different views and opinions on an issue.
Content integration	**Science** Science explains the concept of science material in learning. **Technology** explains the use of the latest technology that makes it easier for teachers to manage chemistry learning activities in the classroom. **Engineering** explains the techniques used in completing the project, such as making a simple tool to test electrolyte solutions. **Art** will bring out creativity in designing chemical projects, artistic and artistic abilities in the design of chemistry practicum tools. **Mathematics** is the formulas, calculations or building spaces used by teachers during chemistry learning activities in the classroom.
Creativeness	Refers to their capacity to use imagination, innovation, and critical thinking in understanding, applying, and developing chemical concepts.

Research it uses data analysis according to Miles & Huberman (1992) which is defined as qualitative data analysis consisting of three streams of activities that occur simultaneously, which are as follows:

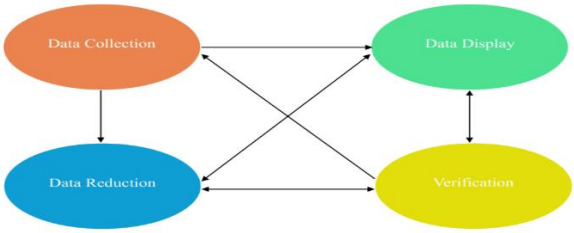

Figure 1. Miles & Huberman Analysis Interactive

Data Collection

The researcher collects data through filling out an open questionnaire, interviews, and documentation (triangulation). A total of 40 State High School teachers in 20 schools in West Nusa Tenggara Province played a role as participants. Participants gave varied answers, so the researcher grouped the answers in various specific categories.

Data Reduction

In data reduction, the researcher conducts a selection process or selection of raw data obtained from filling out participant questionnaires. Researchers focus,

simplify, and abstract all types of information that support the research data. The researcher identified answers based on gender, length of teaching participants, level of education and teacher certification. Then the researcher classifies or codes according to the characteristics of the participants' answers, answers with the same or similar meaning are classified in one category, and so on.

Data Display

The results of the data reduction analyzed by the researcher are presented in the form of a table describing the observation results. Data feeds are displayed for each question item along with the frequency and percentage of participant answers, so that researchers can take the next action.

Verification

Drawing conclusions involves interpreting the data from the analysis. In this study, the conclusion stage is re-examined periodically to ensure its validity. The meaning of the data is tested for validity and accounted for. The verification process of the conclusions is carried out by re-examining all the research steps carried out, including examining field data, reducing data from questionnaires and interviews, and field notes.

The classification of the level of participants is used by the classification proposed by Sudjana (2017) as in the following table:

Table 2. Classification of Average Achievement Levels

Percentage Range	Category
90% - 100%	Excellent
80% - 89%	Good
65% - 79%	Medium
55% - 64%	Less
0% - 54%	Very less

Result and Discussion

Chemistry Teacher's Literacy Analysis About STEAM

Regarding the discussion of chemistry teachers' literacy about STEAM, it is explained based on question items according to the aspects assessed about the STEAM approach. In this journal, each question item is explained as a representative of each aspect of STEAM.

Interdisciplinary

One of the interdisciplinary aspects of the STEAM approach is the collaboration between chemistry and mathematics teachers in designing learning concepts using a STEAM-based learning approach, from the results of the analysis as many as 32.50% of chemistry teachers stated that one of the effective ways to apply STEAM is to design learning projects related to chemical concepts and mathematical calculations, for example in pH calculation material with logarithmic concepts, From this explanation, of course, from the side of the mathematics teacher, must be able to provide the correct logarithmic concept.

In the research conducted by Ramful & Narod (2014) Regarding how prospective teachers understand the mathematical knowledge required and used in the context of stoichiometry, in the study it is explained that stoichiometry involves quantitative calculations that require mathematical knowledge, chemical equations represent proportional relationships resulting from a certain number of substances. From this research, it is further strengthened that it is necessary to collaborate between chemistry and mathematics teachers to achieve learning goals.

In addition, as many as 10.00% of teachers stated that chemistry and mathematics teachers can collaborate in designing lesson plans and modules as teaching materials, because in principle the STEAM integrated module is designed to integrate the concepts of various disciplines, including science, technology, engineering, art, and mathematics. This can make students able to understand the relationship between disciplines and apply the knowledge they have in a broader context.

Exploration

In the exploration aspect, one example is the integration of chemistry in daily life. From the results of the analysis, most teachers stated that almost all chemical materials can be related to the context in daily life in the learning process with the STEAM approach. As many as 37.00% stated that examples of chemical substances that can be associated with daily life are hydrocarbon compounds, equilibrium, redox and reaction rate, and as many as 15.00% stated that colligative material of solutions, polymers and hydrocarbon compounds can be associated with daily life. A total of 15.00% stated that chemical substances related to life are atomic matter, solution pH, solution colligative properties, buffer solution, corrosion, macromolecules and functional groups, voltaic cells, earth oil. As many as 5.00% stated that the concept of water purification is related to the era of daily life.

Innovation

Regarding the innovation aspect, one of the items discussed was the ability of teachers to design learning strategies with the STEAM approach on chemistry. Based on the results of the study, as many as 20.00% of teachers stated that one of the ways teachers do to design STEAM-based learning strategies in improving student learning outcomes is by conducting experiments in the laboratory, and developing learning media such as youtube and LKPD. For example, corrosion materials in

redox learning, and teachers direct students to do project assignments to choose electrical materials *platting*, be able to divide groups, determine the schedule and duration of the experimental project, make worksheets, make procedures and designs of electroplating equipment, communicate, and apply them in daily life. In the research conducted by Nopiansyah *et al*., (2022) about stating that the implementation of STEAM-based LKPD gives a positive response to students. This shows that the learning process using LKPD that has been integrated with STEAM provides an interesting learning nuance.

Another example as many as 7.50% of teachers think that in redox material, students are directed to analyze the browning problem in fruit due to oxidation by air, students are directed to imagine and find the best solution to overcome the problem, then students design and implement the design results to prevent oxidation in fruit, finally students are expected to produce the best way to overcome the problem oxidation in fruits. Furthermore, as many as 2.50% of teachers gave an example by providing understanding to students, conducting a short demonstration in front of the class by taking a piece of chalk, then taking water with a transparent glass, the teacher squeezed the lime into powder, then put it in water, then the teacher associated and likened the atom to the powder in the water, While the molecule is a slate that is still intact.

Interactive

Regarding how teachers improve student communication in the learning process, from the results of the research, teachers have different ways of training their students' communication skills, as many as 30.00% of teachers think that one way is to present the results of assignments or discoveries made by the students themselves. Through presentations, students must speak in public, which helps them improve their speaking skills and express ideas clearly and effectively. Students also learn to listen better when listening to other friends' presentations.

As many as 10.00% of teachers believe that by having discussions with peers, students can train students to actively participate by contributing, asking questions, and responding to ideas shared by their peers. This helps build confidence in speaking in front of others. The discussion triggers students to consider various points of view and ask in-depth questions.

Research conducted by Suciari *et al*., (2021) about the influence of the STEAM integrated PjBL model on improving students' communication skills, in the study students collaborated with classmates to do a project together. The results of the study stated that PjBL-based STEAM learning has a significant effect on improving communication skills and mastery of the concept of peseta students, from this we can know that collaboration and cooperation with peers are quite influential on communication skills. In addition, as many as 15.00% of teachers stated that the way to improve student communication is by giving assignments in groups. Many tasks involve drafting reports, essays, or written presentations. Certain tasks ask students to produce creative works. This helps develop their creative expression skills as well as improve lateral thinking skills.

Flexibility and Adaptability

Regarding the influence of the STEAM approach on the optimization of the teacher's teaching process, from the results of the study, it can be seen that as many as 12.50% of respondents stated that literacy is very influential in the teacher's ability to apply STEAM in the classroom, lack of literacy will make the application and ability of teachers to apply the STEAM approach less than optimal. Several teachers expressed their opinions regarding this, as many as 10.00% of teachers stated that learning is not optimal because of the lack of teacher literacy about STEAM so that teachers will have difficulty developing learning. Literacy, or the ability of teachers to understand, apply, and integrate STEAM principles into their teaching, has a significant influence on the effectiveness of implementing the STEAM approach in the classroom.

Teachers who have good STEAM literacy tend to have skills in using the latest technology relevant to STEAM teaching. Literacy about STEAM allows teachers to identify individual learners' needs, interests, and learning styles, as well as tailor learning experiences to meet those needs.

One of the studies from Badriyah *et al*., (2020) who applied the STEAM approach in collaboration with the PjBL model stated that the application of the STEAM-based PjBL model can affect learning outcomes. Other studies also conducted an assessment of the influence of STEAM-based learning on the improvement of student learning outcomes, with the results of the study concluding that the application of the STEAM approach in the learning process has a positive effect on improving student learning outcomes. As many as 2.50% of participants thought that teachers need to know the character of teaching materials that are compatible with STEAM and appropriate learning models/methods.

In addition, as many as 2.50% of participants also stated that, if teachers lack literacy about STEAM, then it will be difficult for teachers to apply the STEAM approach in the learning process. Without an understanding of the STEAM concept, teachers may tend to limit learning to only the chemistry aspects. This can make learning less diverse and less relevant for students. Teachers who do not understand STEAM may

tend to use conventional learning methods in teaching chemistry, such as lectures, readings, or written assignments. This can make learning less interesting and less interactive for learners. This is in line with the results of interviews conducted with chemistry teachers, that STEAM is difficult to implement due to constraints on teachers' limited understanding of STEAM, plus students who are not enthusiastic about learning, so teachers often apply the learning process in a conventional way. Without an understanding of the STEAM concept as well, teachers may not focus on developing the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity) skills in chemistry learning. This can make learners less trained in critical thinking skills, communicating effectively, working together in teams, and thinking creatively in problem-solving.

In the research conducted by Martins & Bapitista (2024) related to the influence of TPD (Teacher Professional Development) STEAM integrated into PCK development (Pedagogical Content Knowledge) physics teacher, stated that PTD has succeeded in influencing the development of teachers' PCK, especially in the aspect of knowledge of teaching strategies, so that it can improve teachers' ability to teach with the STEAM approach. Overall, a lack of understanding of the concept of STEAM can limit a learner's chemistry learning experience, making it less diverse, less engaging, and less relevant to the needs of the modern world.

Content integration

Regarding the importance of developing chemical content in the learning process with the STEAM approach. The development of chemical content in the application of the STEAM approach can be very important in classroom learning. While STEAM naturally includes science, technology, engineering, art, and math, chemistry content in particular can make a unique contribution to a holistic and meaningful learning experience. As many as 12.50% of chemistry teachers think that it is necessary to add and develop chemistry content in the learning process with the application of STEAM. One of the ways done by teachers is to make simple calorie meters in thermochemistry learning and petroleum processing on hydrocarbon compounds. In addition, some teachers, 5.00% of teachers think that the chemical content that can be applied with the STEAM approach is the creation of indicators from natural materials, the manufacture of voltaic cells using fruits and vegetables in nature, and 2.50% of the participants gave another example, namely by providing content about the relationship between the chemical matter studied and daily life in the form of videos.

This is in line with research conducted by Route *et al*., (2023) related to the investigation of differences in learning motivation, learning effectiveness, creativity, learning preferences, learning outcomes and learning satisfaction between students with different cognitive styles (holistic and serialistic) after participating in STEAM-6E-based virtual activities. The results of this study explain that the application of STEAM-6E in VR learning has a positive impact on students' learning motivation and creativity. In addition, research from Hsiao & Su (2021) about the influence of STEAM and VR-based learning *(Virtual Reality)* on students' learning motivation, learning satisfaction and student learning outcomes. The results of the study stated that the combination of STEAM-based VR application can increase learning satisfaction, learning outcomes and students' learning motivation, from this we can conclude that the application of the STEAM approach also affects students' learning motivation, if applied with a complete and correct concept.

Creativeness

Related to the creative media used by teachers in the learning process in the classroom with the STEAM approach. Some of the opinions conveyed by teachers regarding this creative media, as many as 32.50% of participants stated that creative media can be used as one of the learning tools that can be visualized, remembering that chemical materials are abstract materials, one of which is that teachers make and direct students to visualize molecular shapes. Through the use of creative media such as animation or 3D visualization, learners can visualize these concepts more clearly and strengthen their understanding.

According to Al-Azawi *et al*., (2016) Video games and subjects in general are combined due to the often tedious process of conventional learning. Previous research Perrotta *et al*., (2013) He also mentioned that video games can help improve the understanding of students by inviting them to actively participate in the learning process. Therefore, students can easily remember important things and apply them to the real world. Coupled with the many interesting 3D video games so that it can improve the learning experience of students and increase students' interest in the content provided by videos and games.

This is also in line with the research conducted Liesatyadharma *et al*., (2022) In his research on hologram-based educational games, from the results of the study, it turns out that interactive media such as hologram-based game methods are able to increase students' understanding of analytical chemistry concepts and can be useful as an effective and interesting learning tool. This means that in general, the use of creative media in the learning process in chemistry can

provide a practical and interactive learning experience. For example, a chemistry teacher can use animation software to create a video that illustrates the structure of an atom in detail. This video can show how electrons move around the nucleus of an atom and how the electron configuration affects the properties of chemical elements.

A total of 17.50% of participants stated that the media used in chemistry learning was made as attractive as possible to attract students' attention, and 5.00% of participants stated that teachers also used video media as a learning medium. Students can create videos that visually demonstrate chemistry experiments, combining verbal explanations, images, and animations. This video can be used to present the basic principles of chemical reactions in the learning process in the classroom. As in the research conducted by Berg *et al.*, (2019) related to the use of the effectiveness of making animations made by students after doing The experiment helped students understand the relationship between macroscopic observations and sub-microscopic models in chemistry, and the results showed that involving students in creating their own repression can encourage students to think critically about observations and sub-microscopic models of a phenomenon.

In line with the research conducted by Chen & Huang (2023) about the influence of STEAM-based learning and *Mobile Learning* It turns out to be beneficial to increase students' learning achievement and reduce their cognitive burden. As many as 2.50% of participants argued that teachers not only have to make learning plans, but must also follow learning that is in accordance with the times, teachers and students must be able to utilize technology as a creative medium used in the learning process such as applying materials through correl draw programs, photo shops, animations and so on.

Based on the seven aspect of the STEAM explained above, overall the results literacy of state high school chemistry teachers in West Nusa Tenggara Province on STEAM can be described in the diagram:

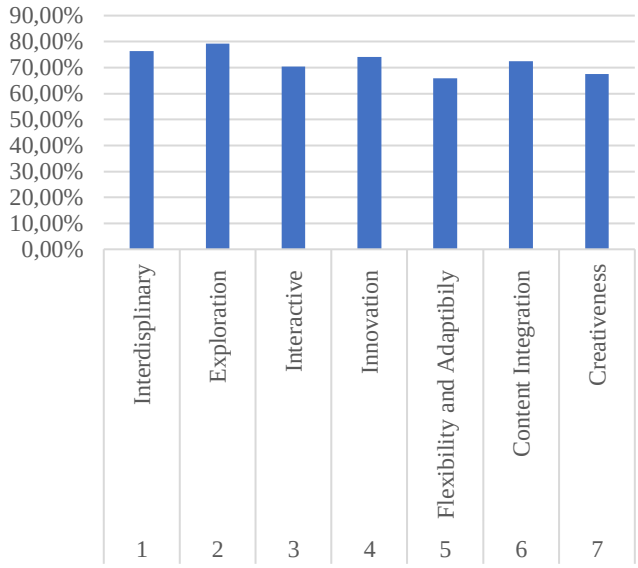

Figure 2. Literacy of State High School Chemistry Teachers in West Nusa Tenggara Province about STEAM

Factors Inhibiting Literacy of Chemistry Teachers about STEAM

Some of the factors that support the literacy of chemistry teachers about STEAM. There are activities and professional development, from the results of observation, chemistry teachers get structured and continuous training related to the development and application of the STEAM approach. For example, training activities, wokrshop, MGMP and PT4TK. Structured and continuous training is the main supporting factor in improving teachers' literacy about STEA. According to Johnson *et al.* (2016), continuous professional training provides opportunities for teachers to develop skills and an in-depth understanding of STEAM concepts. This is also in accordance with research conducted by Irdalisa *et al.*, (2022) that training on STEAM-based learning tools for science teachers provides benefits and increases teachers' awareness about STEAM, so that teachers can improve their ability to design learning media and videos.

Another factor is professional relations and internet media. Relations and access to media are significant supporting factors in increasing teachers' literacy about STEAM. According to research by Haris & Jones (2017), collaboration between teachers through professional learning communities can expand their knowledge and skills in implementing STEAM education. In addition, a study by Kim *et al.*, (2019) shows that the use of internet media as information and learning tools allows teachers to access a variety of the latest materials and methods in STEAM education, as well as participate in online discussion forums and training that support teachers' professional development.

Factors Inhibiting Literacy of Chemistry Teachers about STEAM

In addition to supporting factors, based on the results of the study, some of the factors that hinder teachers' literacy about STEAM are the limitations of training and professional development, the lack of special training on STEAM, causing teachers not to understand the STEAM learning approach. The limitation of digital resources and technology occurs in kimai teachers with advanced age, so they still apply conventional learning. In addition, school infrastructure facilities are also adequate to support the implementation of STEAM in schools, plus minimal support from students.

Meanwhile, the limitations of training and professional development are the main inhibiting factors in improving the literacy of chemistry teachers about STEAM. This is in line with research conducted by Darling-Hammond *et al*., (2017), that the lack of access to relevant and continuous training causes teachers to have difficulty in adopting and implementing the STEAM approach effectively. This happens to some teachers in remote areas, which are far from urban areas. So that information related to the development of learning about STEAM is still difficult for teachers to obtain. This also makes teachers experience limitations in accessing literature and using internet media. The limitations of reliable internet access limit teachers' ability to search for the latest information, participate in online training, and access digital education resources essential for teaching STEAM. A study by Van Dijk and Hacker (2019) shows that the digital divide hinders teachers' professional development, reducing teachers' opportunities to adopt and apply the STEAM approach effectively in the classroom.

In addition, the lack of infrastructure is a significant inhibiting factor in improving the literacy of chemistry teachers about STEAM. Infrastructure hinders teachers' professional development efforts, making it difficult for them to keep up with the latest technology and methodologies in STEAM education.

Based on the results of the analysis, overall the literacy of state high school chemistry teachers in NTB Province regarding the STEAM learning approach is in the medium category, but this is in contrast to the learning outcomes of students in chemistry learning in 2019-2022 that as many as 91.00% of students did not pass the Minimum Completeness Standard. After reviewing, it turns out that some teachers are only limited to knowing the concept of the STEAM approach, but it is not fully implemented in the learning process in the classroom. From the results of filling out questionnaires and interviews, as many as 25.00% of teachers stated that schools were constrained in the availability of facilities and infrastructure, besides that 10.00% of teachers stated that insufficient time allocation was one of the inhibiting factors, judging from the relatively long time allocation, so that it would have the potential to change the scheduling of previously designed material settings. As many as 10.00% of teachers said that it was due to the cost factor and 7.50% because of the influence of minimal student literacy.

Conclusion

Based on the seven aspects of STEAM, it can be concluded that in the interdisciplinary aspect, the literacy of chemistry teachers related to STEAM reached 76.43%, being in the medium category, and in the exploration aspect of literacy of chemistry teachers reaching 79.17% were in the medium category, in the interactive aspect of chemistry teachers' literacy reaching 70.42% were in the medium category, in the innovation aspect of chemistry teachers' literacy reaching 74.17% were in the medium category, and in terms of flexibility and adaptability, chemistry teachers reached 65.83%, included in the medium category. The content integration aspect reached 72.50% in the medium category and in the creativity aspect reached 67.50%, meaning that the literacy of chemistry teachers in the creativity indicator was in the medium category.

The supporting factor for the literacy of high school chemistry teachers in West Nusa Tenggara Province is the existence of professional training and development such as training, wokrshop, MGMP and P4TK. In addition, other supporting factors are professional relationships and the ability to access internet media. The factors that hinder the literacy of chemistry teachers are the lack of training and professional development, the lack of ability to access the internet as an information tool in the search for literature and the limitations of school facilities and infrastructure and time allocation.

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