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A Systematic Review of Energy Literacy Programs at Primary and Middle Schools

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ABSTRACT

Energy literacy is high on the agenda in the education sector, including in the contexts of primary and middle schools. It has the purpose of building awareness of wise energy use. A systematic review of various energy literacy studies in the period 2010–2021 was conducted to explore study trend, research methods, and adapted energy literacy programs. Data were sourced from Taylor & Francis and ERIC databases. Using the PRISMA search method, 26 relevant articles were obtained out of 152 articles. The search results were analyzed using the NVivo application for description. The synthesized result is that energy literacy programs were carried out in a comprehensive, integrated manner in instructions at schools, at home, and within communities, involving all stakeholders. The programs were able to inspire a change in behavior toward energy saving through habituation in learning activities. Educational institutions are expected to develop awareness of environmental sustainability. It is recommended that future research develop energy literacy programs based on cultural and religious values—given that these values bear relevance to the lives of the learners—in instructions at schools, at home, and within communities.

Keywords: Energy literacy, program, primary school, middle school

INTRODUCTION

Energy conservation is a vital issue many countries have to deal with for the purpose of reducing energy consumption. Energy literacy as an energy conservation strategy has captured the attention of numerous countries as shown in the running of energy literacy programs and activities involving school children in their educational pursuit (Dahlbom et al., 2009; Hogan et al., 2019; NERI, 2007; U.S. EPA, 2011).

Existing systematic reviews have been heavily focused on energy conservation and the environment in general. For instance, a study (Jorgenson et al., 2019) conceptualized energy conservation behavior in environmental actions with a focus on the roles of action, network, and innovation in the energy transition process. Another environment-focused study (O’Flaherty & Liddy, 2018) reviewed steps into the impact assessment of development education and education for sustainability development intentional learning interventions, (Nurtanto et al., 2020) while not all test participants can acquire it. Until now, studies that discuss relevant competency test models on automotive engine technology are still limited, not specific or even non-existent. The objective of this research is to produce a Competency Test Model for Engine Tune Up-System Injection and determine the characteristics after the model is applied. The subject of development consists of assesses (vocational education graduates, workers and educators. Meanwhile, a review of character development study program (Diggs & Akos, 2016) examined the relationship between character education study

program and academic, behavioral, and social outcomes as well as personality in young adolescents at middle schools in general. For example, the application of habituation programs and role models based on religious teachings as the most dominant strategy by schools (Suyatno et al., 2019) and education of life values in school habituation programs for instilling character values in students (Saripudin & Komalasari, 2015).

In this research, we reviewed energy literacy programs at primary and middle schools. Energy literacy programs or interventions are a paramount process in education to create energy literacy behaviors according to the characteristics of students at primary and middle schools. Students in childhood and adolescence typically undergo cognitive development that enables them to

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develop logical and scientific thinking abilities gradually. With respect to moral development, these students have acquired the understanding of rights and obligations (Seifert & Sutton, 2009). Energy literacy is a form of character or moral imprinting regarding the rights and obligations of a learner in using energy wisely to conserve the environmental sustainability in this generation and in the next.

The aim of this research was to explore the comprehensive approaches of energy literacy programs at primary and middle schools. The results of this review are to serve as feedback for future research based on previous research gap. They may also inform other researchers in designing energy literacy programs suitable for the development of primary and middle school students.

Energy Literacy

Literacy is not only a matter of reading and writing abilities; it also concerns the use of such abilities to engage in social life (Collins & O'Brien, 2003). Energy literacy particularly is a concept that encompasses scientific, technological, and environmental literacy (DeWaters et al., 2013). It is the understanding of the nature and role of energy in the world and in life along with its use to inform energy decision-making.

Energy literacy is comprehensive and interdisciplinary in nature. As a result, it requires not only an understanding in natural science or engineering; it involves literacy in both natural and social science (U.S. Department of Energy, 2012).

The development of energy literacy criteria employs educational taxonomy in the cognitive, affective, and behavioral psychology domain (DeWaters et al., 2013), as well as in the socio-emotional one (UNESCO, 2017). Energy literacy is an attempt to purposefully instill virtue in learners for them to develop a character through character education. Its implementation uses a range of strategies comprehensively in and outside the classroom or within and beyond the school environment involving various parties such as parents and the community (Lickona, 1997, 1999).

The school can make a good use of students' experiences outside it with an emphasis on their moral development (Iwasa, 2017) and then strengthen the positive character the students have developed at home (Lickona, 2004). Students become the center in the learning and teaching activities, in which case the teacher can explore their experiences and cooperation. Therefore, energy literacy programs essentially are continuous in nature, involving the creation of various energy literacy activities at school, at home, and in the community.

Energy Literacy Programs

Programs are important for the achievement of energy literacy goals in terms of learner behavioral change and wise energy use. The concept entails a set of resources and activities that

is directed for the attainment of one or more goals as well as the characteristics by an entity or a group to the organization level (Wholey et al., 2004), as with educational institutions, home, and the community. Programs as a primary motor for modern societies (Pawlak & Vinter, 2004) comprise at least three components—series of activities, targeted outcomes, and mechanism or interconnection—for them to run toward the expected benefits (Stufflebeam et al., 2000). They usually are presented visually for easy understanding and contain ideas with interconnected elements for their operation or for change efforts (Knowlton & Phillips, 2012).

In the context of energy literacy programs, the series of activities is performed not only at school, but also in the family setting at home and in the community with the involvement of various stakeholders. Stakeholders per se are key individuals or groups of individuals, internal and external, who are involved and affected directly and indirectly and are assuming critical roles in every stage (UNDP, 2009).

Research Questions

The research questions posed as a guide to determine the scope and objectives of the research are as follows: What does the trend of studies conducted from year to year look like? (RQ1); What research methods were used by such studies? (RQ2); How were energy literacy programs implemented at primary and middle schools according to the studies? (RQ3).

METHOD

The research employed the systematic review method from the positivist tradition (Torgerson, 2003) which consists of identification of topic of interest, search and extraction of relevant pieces of literature, analysis and synthesis of findings, and report writing (Cronin et al., 2008). The systematic review method is widely used to generate the latest concepts based on a collection of empirical studies and adjusted for relevance according to the field (Nurtanto et al., 2021). Besides that, this method is useful in the understanding of significant information that contributes to questions answered and unanswered. This method involves the identification, assessment, and synthesis of all studies that are relevant to a certain topic comprehensively (Petticrew & Roberts, 2006), and it serves as a more rigorous alternative to narrative review (Torgerson, 2003). Systematic review is a vital part of a research process and a starting point for practice and policy development (Cronin et al., 2008; Petticrew & Roberts, 2006; Torgerson, 2003). It is also an important instrument for summarizing proofs accurately and reliably (Liberati et al., 2009).

Review Protocol

Topic identification as the first step, or development of a review protocol, was based on substantial inputs from authors with

expertise in education and systematic review. The general topic of energy literacy was specified under PICOC (population or problem, intervention, comparison, outcome, and context) criteria as a reference for formulating questions, objectives, and scope, determining terms, and setting inclusion and exclusion criteria. Sound, clear formulation would help with the research process effectively and efficiently. The review protocol might change at the onset of the review, and such a change must be documented (Petticrew & Roberts, 2006; Torgerson, 2003). Table 1.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria used for paper search, screening, and assessment were set based on the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) standard (Liberati et al., 2009) (Table 2).

Data Source Searching

Main literature search was conducted on Taylor & Francis database (Kalogiannakis et al., 2021) via the National Library of the Republic of Indonesia. Search of articles from other publishers was also conducted on a widely used database in the education sector, ERIC (Education Resource Information Center) (Aydın & Gürol, 2019; Chalkiadaki, 2018; Diggs &

Akos, 2016; Kalogiannakis et al., 2021; O'Flaherty & Liddy, 2018; Quadri & Shukor, 2021; Retuerto et al., 2020), involving excellent, peer-reviewed articles (Petticrew & Roberts, 2006; Torgerson, 2003). Based on ERIC database sources, we obtained articles from publishers International Council of Associations for Science Education, Australian Geography Teachers Association, International Society of Educational Research, Sciedu Press, Eastern Mediterranean University, and OmniaScience.

The search strategy was that it used the search keywords energy literacy, energy saving, energy education, education, and Boolean logic (Petticrew & Roberts, 2006) (Table 3). The search was limited within the inclusion and exclusion criteria, publication type, and duration frames. From the search, 152 articles were obtained (Figure 1).

Screening and Assessment

Screening involved title and abstract examination, while assessment involved reading and examining the full texts of the papers. In every stage of the process, the authors archived the data systematically and structurally on a reference management application for easy history tracking. The results of the screening and assessment are presented in Figure 1.

Table 1: Topic description based on PICOC

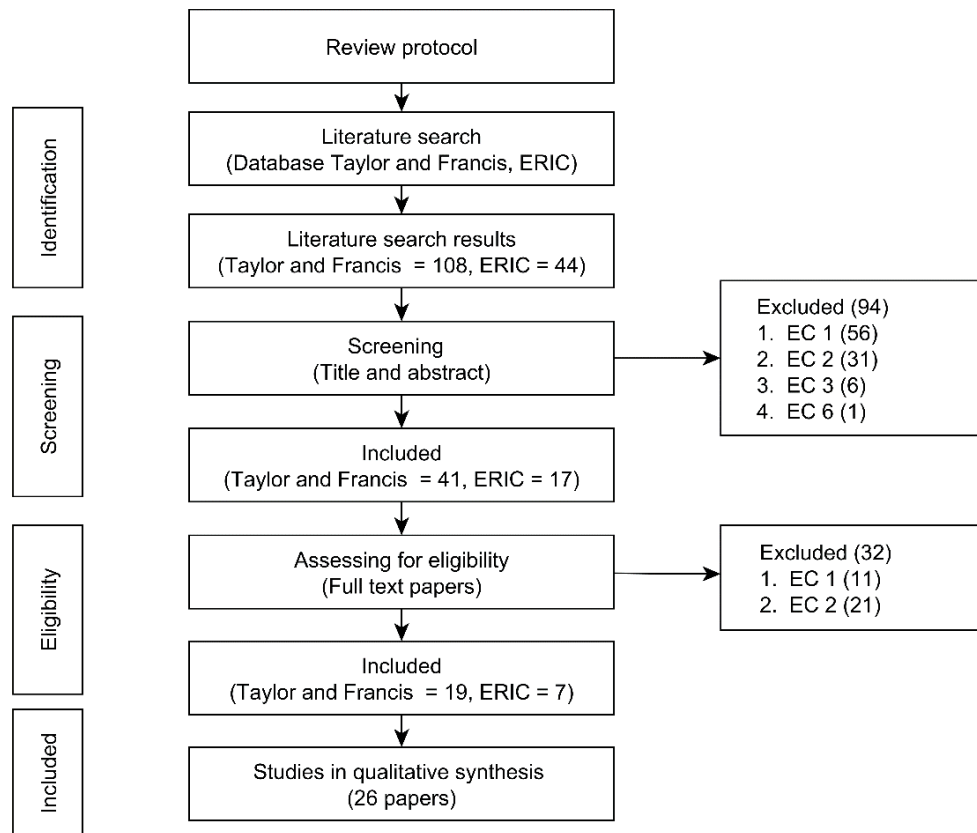
<i>Criteria</i>	<i>Description</i>
Population or problem	Low awareness of energy literacy in primary and middle school students
Intervention or program	Energy literacy program in primary and middle schools
Comparison	-
Outcome	Increased behavior in using energy wisely
Context	Issues that form the basis for developing energy literacy programs and activities in primary and middle schools

Table 2: Eligibility Criteria

<i>Criteria (C)</i>	<i>Inclusion (IC)</i>	<i>Exclusion (EC)</i>
Study topic	<ul style="list-style-type: none"> Studies discussing energy literacy, energy education, and environmental education or education in general that concerned the three topics aforementioned (IC 1) Studies conducted on primary and middle school levels (6–15 years age group) (IC 2) 	<ul style="list-style-type: none"> Studies in the form of literature reviews on criteria setting, instruments, and measurement concerning energy literacy without implementation in instructions and in the form of analyses of documents and programs, curriculums, and more (EC 1) Studies conducted on kindergarten, senior high school, higher education, teacher, or other levels (EC 2)
Document type	<ul style="list-style-type: none"> Research findings articles published in scientific journals (IC 3) 	<ul style="list-style-type: none"> Studies in the form of summarized dissertations or theses, conferences or editorials, literature reviews, books, book reviews, editorial notes, news, and reports (EC 3) No peer-reviewing (EC 4) Unavailable for access in full texts (EC 5) Duplicated articles (EC 6) In language other than English (EC 7)
Language		
Period	<ul style="list-style-type: none"> Studies published online, available for access in full texts, within the period 2010–2021 (IC 4) 	

Table 3: Searching strategy

Database	Description
Taylor and Francis	[All: “energy literacy”] OR [All: “energy saving”] OR [All “energy education” AND [All Subjects: education] AND [in journal: Environmental Education Research*] AND [Publication Date: (01/01/2010 TO 12/31/2021)] Access type: Only show content I have full access to
ERIC	“energy literacy” OR “energy saving” OR “energy education” Peer reviewed only Full text available on ERIC Journal articles Publication date: Since 2010


Fig. 1: Systematic review process summary

Analysis and Synthesis

Qualified papers according to the qualitative analysis and synthesis were then subjected to data extraction according to the research theme and questions; these data included the titles, authors, publishing years, study objectives and types, settings, data collection methods, and findings (Cronin et al., 2008). Data analysis and synthesis were conducted manually (using paper and pencil) and with the assistance of the Nvivo 12.0 software (Aguirre-Bielschowsky et al., 2017; Amrutha & Geetha, 2020; Erstad & Silseth, 2019). Coding through category and theme identification went through three stages, namely initial coding (110 nodes), focused or category coding (10 nodes), and theoretical or theme coding (1 node) (Ouariachi et al.,

2019; Qureshi & Ünlü, 2020). The data synthesis results were summarized using a synthesis matrix.

Findings

Studies Conducted from Year to Year (RQ 1)

From the literature search, screening, and assessment process based on the eligibility criteria (inclusion and exclusion criteria), 26 (17%) of 152 papers in the last twelve years were selected. More than half of the 26 papers reviewed (57%) were published in 2013, 2017, and 2019. None of the papers published in 2011 and 2020 met the eligibility criteria, hence excluded from the synthesis stage (Figure 2).

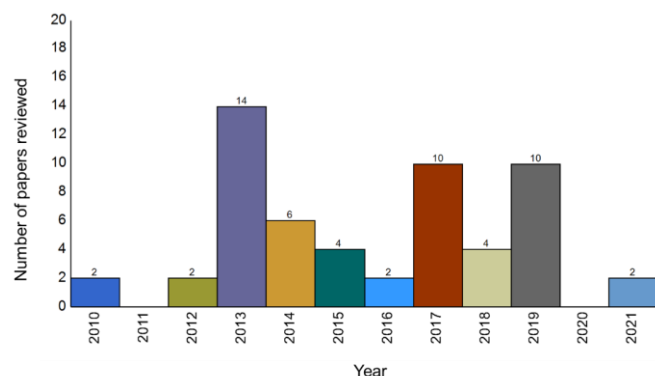


Fig. 2: Papers per year

Based on the paper distribution by country in which the studies were conducted, the majority of the papers (61%) were conducted more than once: in the US these included (Bernstein & Puttick, 2014; Bodzin et al., 2013; Hestness et al., 2019; Ouariachi et al., 2019; Zangori & Cole, 2019), in Taiwan (Chao et al., 2017; Chou et al., 2015; Lee et al., 2013; Tsai, 2013), UK (Avramides et al., 2016; Fleming et al., 2019; Walshe, 2017), in Australia (Lewis et al., 2014; Maddock & Kriewaldt, 2014), and in Turkey (Bezen et al., 2017; Ercan et al., 2017). The rest of the studies were conducted once, including those conducted in Germany (Sellmann & Bogner, 2013), Spain (Samperiz & Herrero, 2018), Greece (Sissamperi & Koliopoulos, 2021), Sweden (Ojala, 2012), South Korea (Cho & Lee, 2018), Thailand (Chokriensukchai & Tamang, 2010), Portugal (Barata et al., 2017), New Zealand (Aguirre-Bielschowsky et al., 2017), Malaysia (Karpudewan et al., 2015), dan Finland (Ratinen, 2013).

Research Methods Employed in The Studies (RQ 2)

Most of the studies on the energy literacy topic used the quantitative approach (54%), including (Barata et al., 2017; Bernstein & Puttick, 2014; Bodzin et al., 2013; Chao et al., 2017; Cho & Lee, 2018; Chokriensukchai & Tamang, 2010; Chou et al., 2015; Ercan et al., 2017; Fleming et al., 2019; Lee et al., 2013; Ojala, 2012; Samperiz & Herrero, 2018; Sellmann & Bogner, 2013; Tsai, 2013). The second most commonly used for that study topic was the qualitative approach (27%), including (Aguirre-Bielschowsky et al., 2017; Avramides et al., 2016; Hestness et al., 2019; Lewis et al., 2014; Maddock & Kriewaldt, 2014; Ouariachi et al., 2019; Walshe, 2017). In addition to those two approaches, mixed methods were also used for energy literacy studies, although their use accounted for only 19% of the studies, including (Bezen et al., 2017; Karpudewan et al., 2015; Ratinen, 2013; Sissamperi & Koliopoulos, 2021; Zangori & Cole, 2019). The studies used either of the grounded theory, qualitative case study, experimental, explanatory sequential, and embedded design methods (Figure 4)

The studies usually used data collection and analysis methods that not only suited their approaches and types. In

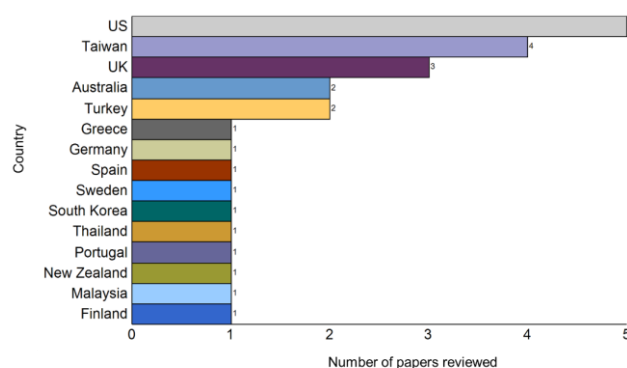


Fig. 3: Papers distribution by country

practice, some quantitative studies also used qualitative data collection and analysis methods to enrich their quantitative data, and vice versa.

Some data collection methods involved methods and media that were used for energy literacy instructions, such as diary, dialog, discussion, drawing, interview, questionnaire, quiz, rubric, writing, test, observation, brainstorming, document, idea sharing, portfolio, assessment, comment card, feedback, focus group, graffiti wall, photo, blog, and voice audio recording. Meanwhile, analysis was conducted using statistical analysis, qualitative analysis, thematic analysis, and content analysis (Figure 5).

Energy Literacy Programs Implemented in The Studies (RQ 3)

Energy literacy programs come with interconnected components for the running of the series of activities involved to arrive at the expected goals, involving environmental inputs of a variety of issues and human resource inputs, including external and tertiary stakeholders (Figure 6). The energy literacy programs in the studies were underlain by environmental and educational issues or contexts. The environmental issues included energy conservation (Aguirre-Bielschowsky et al., 2017; Bernstein & Puttick, 2014), energy consumption (Avramides et al., 2016; Ercan et al., 2017), energy saving and carbon reduction (ESCR) (Chao et al., 2017; Lee et al., 2013), global warming (Chokriensukchai & Tamang, 2010; Karpudewan et al., 2015), renewable energy (Chou et al., 2015), greenhouse gas emissions (Fleming et al., 2019; Ratinen, 2013), climate change (Fleming et al., 2019; Hestness et al., 2019; Karpudewan et al., 2015; Ojala, 2012; Ouariachi et al., 2019; Ratinen, 2013; Sellmann & Bogner, 2013), energy generation systems (Sissamperi & Koliopoulos, 2021). Meanwhile, the educational issues consisted of environmental education (Barata et al., 2017; Cho & Lee, 2018; Samperiz & Herrero, 2018), education for sustainability (Lewis et al., 2014; Walshe, 2017), ecology literacy (Zangori & Cole, 2019), energy literacy (Bodzin et al., 2013; Maddock & Kriewaldt, 2014), science education (Bezen et al., 2017), and e-learning (Tsai, 2013).

literacy studies that were conducted both at school and at home accounted for 15% of all the studies (Avramides et al., 2016; Lee et al., 2013; Lewis et al., 2014; Walshe, 2017), and so did those that were conducted both at school and in the community (Barata et al., 2017; Hestness et al., 2019; Samperiz & Herrero, 2018; Sellmann & Bogner, 2013).

In general, the studies were focused only on primary schools (46%) (Aguirre-Bielschowsky et al., 2017; Cho & Lee, 2018; Chou et al., 2015; Ercan et al., 2017; Hestness et al., 2019; Karpudewan et al., 2015; Lee et al., 2013; Lewis et al., 2014; Ratinen, 2013; Sissamperi & Koliopoulos, 2021; Tsai, 2013; Zangori & Cole, 2019) attitudes, and intended behaviour and on middle schools (42%) (Avramides et al., 2016; Bezen et al., 2017; Bodzin et al., 2013; Chao et al., 2017; Chokriensukchai & Tamang, 2010; Maddock & Kriewaldt, 2014; Ojala, 2012; Ouariachi et al., 2019; Samperiz & Herrero, 2018; Sellmann & Bogner, 2013; Walshe, 2017) but little is known of their conceptions about energy and energy saving. We report on empirical research with two groups of teenagers. This is part of ongoing work to design learning technologies that support teenagers learn about personal energy consumption. In this paper we describe our analysis and methodology, which are shaped by the Ecology of Resources (EoR). Only 3 papers (11%) conducted studies at both primary and middle schools (Barata et al., 2017; Bernstein & Puttick, 2014; Fleming et al., 2019).

The energy literacy programs aimed to enable learners to have the understanding, attitude, and behavior to consciously and wisely use energy in their lives. In institutional terms, the program outputs could improve the performance of the schools as environmentally aware educational institutions. The outcomes and implementations of the energy literacy programs were achieved thanks to the contributions of the stakeholders. The internal stakeholders included headmasters, teachers, and school staff, while the external (secondary) stakeholders included students and parents. In addition, there were also tertiary stakeholders consisting of academics, community partners, experts, governments, the industry, non-governmental organization (NGOs), and mass media.

DISCUSSION

The issues raised in various studies to develop energy literacy interventions and activities do not specifically stem from the energy literacy issues themselves. They arise from wider contexts like environmental issues and their impacts on earth, like global warming and climate change. This shows that energy literacy as part of environmental education for environmental awareness building continuously develops in its paradigm from environmental education itself to education for sustainable development goals (Palmer, 1998; UNESCO, 2017). Sustainability issues have grabbed the attention of the public as they bear relevance to the fulfilment of energy needs and climate change they are anxious about (Dwyer, 2011).

The various energy literacy interventions or activities formulated from such issues are not only implemented formally in the classroom through school subjects; they are also implemented at home and in the public space. Based on the findings of the studies, learning activities were typically student-centered in problem-solving to encourage learners'

higher-order thinking abilities and character building (Suhirman et al., 2020). The instructions in the studies had adapted information and communications technologies highly popular with children and adolescents of today's generation. These media use is one of the efforts to improve learner characters, as shown by (Rina et al., 2020) in its finding of the effectiveness of digital comic media use at increasing learner character value and by (Asrial et al., 2020) in its finding of electronic assessment use for evaluating learning outcomes in character. The instructional models found in the studies had generally applied comprehensive and integrated approaches.

Comprehensive approaches in instilling character value were also implemented by continuously involving a variety of learning loci, school climate, and curricula that incorporated character value to be explored in depth for it to be well internalized (Lickona, 1997, 1999; Meidl & Meidl, 2013). School culture as a central element of education imprinted character value in wise energy use as an integrated approach which required teacher skills in teaching and communicating value as well as increased active involvement of the students (Veugelers & Vedder, 2003). The home also played a critical role in family assistance for the students in order for them to always have virtuous character (Meidl & Meidl, 2013).

Literacy interventions or activities were aimed at altering the understanding, attitudes, and behaviors of students for them to be able to make decisions by adopting and using moral beliefs; therefore, they had implications for the behaviors of the students in their interactions with their immediate environments (Diggs & Akos, 2016), including in using energy wisely. Unfortunately, none of the studies' findings revealed the importance of energy literacy based on cultural and religious values that underlay the students' virtuous behavior and sound moral decision-making (Lickona, 1997, 2004; Sukardi, 2016). School culture included explicit character value instilling that was linked to school missions (Meidl & Meidl, 2013).

Such was for emphasizing the significance of conserving the environment and wise energy use as part of religious teaching and good culture prevailing in the community. It appeared that the value instilling involved in energy literacy found in the studies put an emphasis more on the pragmatic motivation to modify limited fossil energy consumption pattern and on increased carbon emissions in relation to climate change to alleviate anxiety as was the case in (Dwyer, 2011). In the Indonesian context, for example, fossil energy (coal, oil, and gas) consumption remained in domination in all life sectors (Indonesian National energy Council, 2016).

Therefore, learners are expected to apply the energy literacy learning experience they have gained from school at home and to influence their parents, other family members, and the community (Zografakis et al., 2008). The application of energy saving learning activity at home is important to close the gap between the theory given at school and the practice (Lee et al., 2017).

The energy literacy outcomes identified from the studies were the students' sound understanding, attitudes, and behaviors in relation to the awareness to use energy wisely and their influence on other people in their surroundings.

Empirically speaking, behavior covers identity, intention, knowledge, know-how, performance, expected achievements, personal characteristic, and significance (Bergner, 2011) that of lacking an adequate explication of what is arguably our central concept as a "science of behavior," the concept of "behavior" itself. The three sections comprising the paper are devoted, respectively, to (a. It is thus critical that teachers and educational institutions promote wise energy use according to the need, given that learners have grown extremely familiar with electronics that use electrical power, like smartphones, for academic, entertainment, and other purposes (Gyamfi, 2021).

The outcomes in a wider context will have an impact on school organizations that from the start have been committed to green school programs. In the short term, from the financial perspective, these will concretely benefit them in improving the learning resources using the share of funds spared from the energy saving (NERI, 2007). The schools are also benefited by being beneficiaries of incentives from governments and the private sector (U.S. EPA, 2011). These outcomes are attained thanks to the support of various stakeholders such as the headmaster, school staff, parents, the community, and others who come together to decide on the central meaning of virtuous character for students (Meidl & Meidl, 2013)

in conserving the environment by using energy wisely, irrespective of the short-term financial benefits earned.

Our findings are to strengthen energy literacy programs in Indonesia, especially those that have been implemented in primary and middle schools. In previous studies, energy literacy activities were still in subjects, especially Natural Sciences and thematic environments were able to increase students' knowledge. However, habituation and exemplary in shaping attitudes and behavior in energy utilization is still a serious challenge (Rohmatulloh et al., 2021). This activity is also not enough to change the energy-saving behavior of students. Therefore, it must be carried out comprehensively or continuously not only at school but also at home and in the community as suggested (Lickona, 1997, 1999).

CONCLUSION

Environmental issues have spurred the emergence of energy literacy programs at primary and middle schools. Research

trends are mostly carried out in countries with good education systems. This means that the problem of low energy awareness is a problem that needs serious attention to find an integrated solution in primary and middle schools. Developed countries such as the US, which in particular already have an energy education curriculum, are still a concern of researchers in conducting research on energy literacy programs.

Research on energy literacy topics generally uses a quantitative approach. However, the use of mixed and qualitative methods has become a popular approach in this research. This shows that energy literacy learning which is part of character education requires further deepening of students' attitudes and behavior in using energy wisely, although efforts to instill values have been carried out in an integrative way in subjects in the classroom, school environment, home and community.

Energy literacy programs are effective in accustoming learners to use energy wisely using comprehensive and integrated approaches through character building at school, at home, and in the community. The role of cultural and religious values in literacy programs goes high on the future agenda yet to be explored in currently extant energy literacy studies. This is necessary as energy literacy programs that are integrated with cultural and religious values bear more relevance to learners' real lives, allowing easy application. This emphasis also serves as feedback for other researchers in energy literacy program designing.

LIMITATION

This research's limitation lies in its use of data that were sourced from only two databases. Therefore, it is suggested that a systematic review on energy literacy programs be conducted using data from other databases reputed to be scientific references for researchers. Furthermore, the recommendation for government practitioners and community managers in the field of energy conservation is that in designing energy literacy programs in schools, teachers always involve teachers so that they can be directly integrated into all subjects and school culture. For researchers, the development of an energy literacy model based on religious and cultural values has an important and superior role because these values are closest and directly actualized in students' daily lives. During the Covid-19 pandemic, the development of a model for energy literacy programs at home is a gap that researchers need. This is important because most student learning activities are convenient and can be done online at home and in hybrid (school and home).

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