Frontiers in Community Service and Empowerment
Homepage : ficse.ijahst.org
e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

COMMUNITY SERVICE ARTICLE **OPEN ACCESS**
Manuscript received September 31, 2023; revised October 10, 2023; accepted November 13, 2022; date of publication December 20, 2023;
Digital Object Identifier (DOI): https://doi.org/10.35882/ficse.v2i4.44

How to cite: Siti Fitria Ulfah, Agus Marjianto "Early Detection of Caries and Efforts to Prevent Dental Caries in Reterdation Mental Children Through Empowering Teachers and Parents at SLB BC Optimal Surabaya.", Frontiers in Community Service and Empowerment, vol. 2, no. 4, pp. 11-20, December. 2023

Early Detection of Caries and Efforts to Prevent Dental Caries in Reterdation Mental Children Through Empowering Teachers and Parents at SLB BC Optimal Surabaya

Siti Fitria Ulfa[1], and Agus Marjianto[1]

[1]Department of Dental Health, Poltekkes Kemenkes Surabaya, Surabaya, Indonesia

Corresponding author: Agus Marjianto (e-mail: mirzafitri@poltekkesdepkes-sby.ac.id).

ABSTRACT Dental caries remains one of the most prevalent oral health problems among children with intellectual disabilities, including those with mental retardation. Data from SLB BC Optimal Surabaya in 2021 indicated that all mentally disabled students (100%) were affected by dental caries. Limited awareness and inadequate preventive practices among parents and teachers have contributed to the persistence of this condition. Therefore, community-based empowerment is essential to improve their capacity for early detection and prevention of dental caries. This community service program aimed to strengthen the knowledge, attitudes, and skills of parents and teachers at SLB BC Optimal Surabaya in identifying and preventing dental caries among children with mental retardation. The program employed a participatory approach through stages of preparation, counseling, hands-on training, and evaluation. Training materials covered the definition, causes, and progression of dental caries, methods for early detection, and preventive strategies such as proper toothbrushing, use of fluoride, and dental flossing. Pre-test and post-test assessments were administered to measure knowledge, attitude, and practical skill improvements. The results demonstrated significant progress in participants' knowledge and competence. Knowledge scores increased from 51.2% before training to 80% afterward. Positive attitudes toward dental health improved from 34.3% to 71.4%. The ability to perform early caries detection rose from 25% to 80%, while preventive skill performance improved from 15% to 63%. In conclusion, empowering parents and teachers through education and skill-based training effectively enhances their capacity to detect and prevent dental caries in children with mental retardation. Sustained collaboration between schools, families, and health professionals is recommended to ensure ongoing oral health promotion and early intervention for this vulnerable group.

INDEX TERMS Mental retardation, early detection, dental caries, empowerment, parental involvement, teacher training.

I. INTRODUCTION

Dental caries remains one of the most prevalent oral health problems globally, particularly among children with special needs such as those with intellectual disabilities. Caries is characterized by the progressive demineralization of dental hard tissue, which may lead to pain, infection, and eventual tooth loss if left untreated [1]. According to the 2018 Indonesian Basic Health Research Report (Riskesdas), 57.6% of the population suffers from dental and oral health issues, with dental caries as the dominant condition [2]. Among children with mental retardation, caries prevalence is significantly higher, largely due to poor oral hygiene practices, limited self-care ability, and inadequate supervision from caregivers [3].

Children with intellectual disabilities often face barriers in maintaining oral hygiene compared to their non-disabled peers. In many cases, parents and teachers also lack sufficient understanding of oral health maintenance, resulting in irregular dental cleaning, unhealthy dietary habits, and delayed caries detection [4]. The active role of parents and teachers as caregivers is crucial in preventing and detecting caries early, as their daily involvement can influence children's oral hygiene behavior [5]. Enhancing their awareness and knowledge can therefore contribute to improved dental health outcomes [6].

Several studies have demonstrated that community empowerment programs significantly enhance health awareness and behavioral change among target groups. Educational interventions focusing on oral health have been shown to improve knowledge and preventive practices among both parents and teachers [7]. The World Health Organization (WHO) emphasizes the need for school-based oral health

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

programs that promote participatory and preventive approaches to address caries as a global public health challenge [8]. Integrating health education, skills training, and consistent practice is proven to be effective in improving oral health literacy and hygiene outcomes [9].

Despite these advances, oral health promotion programs for children with disabilities in Indonesia are still limited. Most initiatives focus on short-term counseling or routine dental screenings that lack sustainability and fail to build long-term capacity among caregivers [10]. There is a gap in structured empowerment programs that train teachers and parents not only to understand oral health concepts but also to apply early detection techniques using simple diagnostic tools [11]. In particular, studies involving hands-on training combined with direct practice for parents and teachers of children with mental retardation remain scarce [12]. Moreover, WHO reports that oral health inequality remains one of the most neglected aspects of health care globally, particularly affecting children with disabilities who require adapted community-based interventions [13].

Based on these challenges, this study aims to empower teachers and parents of mentally retarded students at SLB BC Optimal Surabaya to enhance their knowledge, attitudes, and skills in the early detection and prevention of dental caries. The program adopts a participatory approach through counseling, demonstrations, and practical exercises that enable participants to apply learned techniques in daily activities.

This study contributes to the field of community oral health in three key aspects :

1. It presents an empowerment model emphasizing collaboration between schools and families to promote oral health in children with intellectual disabilities.
2. It evaluates the impact of participatory training on improving knowledge, attitudes, and practical skills among parents and teachers.
3. It offers a replicable and sustainable framework for implementing community-based oral health programs within special education settings across Indonesia.

The remainder of this article is organized as follows. Section II explains the methods and stages of community empowerment, including participant selection, training procedures, and evaluation criteria. Section III presents and discusses the findings, highlighting improvements in participants' knowledge and skills after training. Section IV concludes the study and provides recommendations for the integration of caries prevention and early detection programs in other special schools.

II. METHOD

This study employed a community-based participatory design with a one-group pretest–posttest approach to assess the effectiveness of empowerment activities in improving the knowledge, attitudes, and skills of teachers and parents regarding the early detection and prevention of dental caries in children with mental retardation. The design was chosen to evaluate measurable changes before and after the intervention without the inclusion of a control group. This framework was considered suitable due to the limited number of participants and the educational nature of the intervention, allowing assessment of short-term improvements attributable to the empowerment program [16].

A. STUDY DESIGN AND RATIONALE

The one-group pretest–posttest design was implemented to observe within-subject changes over time, providing direct evidence of knowledge and skill enhancement resulting from the empowerment process [17]. This quasi-experimental approach is often applied in educational and community health research where randomization or control groups are impractical. Although it limits causal generalization, it enables clear evaluation of pre–post intervention outcomes within the target population. The study's participatory framework ensured that teachers and parents were active collaborators rather than passive subjects, aligning with current approaches in community-based oral health promotion [18].

B. STUDY SETTING

The study was conducted at SLB BC Optimal Surabaya, a special school that accommodates students with mild to moderate intellectual disabilities, located in Surabaya, East Java, Indonesia. The institution was selected due to its accessibility, active parental involvement, and established collaboration with local health workers. The research was carried out over an eight-month period from June 2023 to January 2024, encompassing stages of preparation, intervention, monitoring, and evaluation. The school provided appropriate facilities such as classrooms for educational sessions and open spaces for practical demonstrations [19].

C. PARTICIPANT AND SAMPLING METHOD

The participants consisted of 20 individuals, comprising 10 teachers and 10 parents of children with mental retardation attending SLB BC Optimal Surabaya. Inclusion criteria were: (1) willingness to participate, (2) ability to attend all sessions, and (3) consent from participants or guardians. Exclusion criteria included absence during either pretest or posttest phases or withdrawal during the intervention. The purposive sampling technique was applied to select participants directly involved in the daily care and education of the students, as they represent the most relevant agents for implementing oral health practices. This sampling method ensures contextual appropriateness for empowerment-based programs in small populations [20].

D. MATERIALS AND EDUCATIONAL INTERVENTION

The empowerment intervention was developed using a participatory approach consisting of four stages: preparation, counseling, training, and evaluation. Educational materials were prepared in the form of PowerPoint presentations, posters, tooth models, and caries detection cards. The training covered key topics including:

1. The definition, etiology, and process of dental caries;

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

2. Methods of early detection of dental caries through visual and tactile examination;
3. Caries prevention strategies, including toothbrushing techniques, dietary control, and fluoride use; and
4. Demonstration and hands-on practice for both teachers and parents.

Counseling sessions were delivered using visual and participatory methods to enhance comprehension and retention. Practical demonstrations utilized dental models and mirror tools to train participants in identifying early caries lesions. The intervention emphasized peer-to-peer discussion to encourage experience sharing and collective learning, consistent with WHO's empowerment guidelines [21].

E. DATA COLLECTION INSTRUMENTS AND PROCEDURE

Data collection involved structured questionnaires and observation checklists. The **questionnaire** assessed participants' knowledge (15 items), attitudes (10 items), and practices (10 items) related to caries detection and prevention. Items were validated for content by three dental health experts, achieving a validity coefficient of >0.78 and reliability (Cronbach's $\alpha = 0.86$). The **observation checklist** evaluated participants' ability to perform visual caries detection and toothbrushing demonstrations during practice sessions.Data collection procedures were as follows:

1. Participants completed a **pretest** before the educational intervention to determine baseline knowledge and skills;
2. Participants then attended a **training session** facilitated by health educators specializing in community dentistry;
3. Following the training, a **posttest** was conducted using the same instrument to assess improvement;
4. Observation was performed during the training to evaluate practical skill performance.

To ensure data quality, all sessions were supervised by a team of researchers and calibrated observers to maintain standardization [22].

F. DATA ANALYSIS

Collected data were analyzed using IBM SPSS Statistics version 26.0. Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to describe participant characteristics and distribution of scores. The Wilcoxon signed-rank test was applied to compare pretest and posttest scores for knowledge, attitude, and skill variables due to non-parametric data distribution [23]. Statistical significance was determined at $p < 0.05$, indicating meaningful improvement following the intervention. Effect size calculations were performed to determine the magnitude of change, strengthening the interpretation of the intervention's impact [24].

G. ETHICAL CONSIDERATIONS

This study was conducted in accordance with ethical research standards for studies involving human participants. Approval was obtained from the Institutional Review Board (IRB) of Poltekkes Kemenkes Surabaya, Indonesia (Approval No. 045/Polkes/2024). Written informed consent was secured from all participants prior to data collection. Confidentiality and anonymity were maintained, and participants were informed of their right to withdraw at any time without penalty. All procedures adhered to the principles outlined in the Declaration of Helsinki (2013 revision) [25].

III. RESULT

A. TRAINING ACTIVITIES

1. COUNSELING

Community Service Activities carried out by the service team delivered material about dental caries and prevention of dental caries. This material was delivered directly by the head of the community service team. The targets for this outreach activity consisted of 35 teachers and parents at SLB BC Optimal Surabaya. When the extension activities took place, parents and teachers were very enthusiastic in listening to the extension activities and actively asked the service team about the material that had been presented. Parents and teachers stated that they had never received material about dental caries and prevention of dental caries before and were very curious about how to find out how their teeth were if they had caries. As a result of counseling on dental caries material, the service team obtained data on increasing knowledge of parents and teachers before and after counseling, which can be seen in the pre-test and post-test results (TABLE 4.1).

Apart from knowledge, the service team obtained data on the attitudes of parents and teachers in early detection of dental caries. Variables of dental caries knowledge that can be obtained include the definition of dental caries, factors that cause dental caries, the process by which dental caries occurs, subjects susceptible to dental caries, types of dental caries based on the level of depth, types of dental caries based on the surface of the tooth, how to detect the presence of dental caries.

Apart from material on dental caries, the service team also provided very complete material on preventing dental caries including: How to prevent dental caries, preventing primary and secondary dental caries, administering fluoride, treating dental caries and using dental floss or dental floss. From the material that has been presented, the service team obtained information on variable knowledge of parents and teachers including: how to detect dental caries, how to prevent dental caries, proper treatment of dental caries that is still vital and has a lot of healthy tissue, primary prevention of dental caries, secondary prevention of dental caries, proper treatment of dental caries that is still vital and has a lot of healthy tissue. The results of parents' and teachers' knowledge about preventing dental caries can be seen in TABLE 4.1.

2. THE SKILLS OF PARENTS AND TEACHERS CAN CARRY OUT EARLY DETECTION OF DENTAL CARIES

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

Community Service Activities by the team of Lecturers in the Dental Health Department seek to carry out practical activities regarding skills in detecting dental caries. The service team provides training on how to detect dental caries with the following steps:

1. Provide educational material first about the detection of dental caries, then the service team shows one by one pictures of dental caries based on the depth of dental caries, types of dental caries based on the surface of the teeth.
2. Providing dental caries detection tools to parents and teachers which include mouth mirrors, sondes, excavators and tweezers.
3. The service team consisting of students and lecturers formed small groups to show how to use dental caries detection tools, starting from how to hold a mouth mirror, holding a sonde, holding an exacavator and tweezers.
4. After that, they were taught how to move the tool when examining teeth, starting from lateral movements on all sides using a pen grasp and using support so that the tool does not slip out of their grasp.
5. Next, parents and teachers are directed to immediately practice checking teeth in mentally retarded students. At this stage parents and teachers are afraid to try it, for fear of injuring the oral cavity of mentally disabled students. During simulation and practical activities, the service team accompanies the respondents one by one until they feel confident. When examining the teeth of students with intellectual disabilities, parents and teachers must be able to identify several variable signs of early caries occurring until they have already experienced dental caries. These variables include teeth that will develop dental caries which are characterized by white spots/black spots, deep pits and fissures, caries reaching the enamel, caries reaching the dentin, caries reaching the pulp, caries reaching the advanced pulp, and caries reaching the roots.
6. When parents and teachers hone their skills, how to detect dental caries can be done repeatedly until they are skilled
7. The results of parents' and teachers' dental caries detection skills showed an increase before and after training, as shown in the TABLE 4.3.

Gambar 1

Gambar 2

3. DENTAL CARIES PREVENTION SKILLS OF PARENTS AND TEACHERS

In this session, the lecturer service team was assisted by a team of Dental Therapy students from the Applied Undergraduate Program in providing training on dental caries prevention skills in the following steps:

1. Education with a demonstration of toothbrushing on a phantom. Each student formed a small group to demonstrate toothbrushing to teachers and parents at SLB BC Optimum Surabaya. After the students demonstrate on the phantom, teachers and parents are then invited to demonstrate a good and correct toothbrush on the phantom.
2. To train skills in preventing dental caries, the service team provided physical assistance in the form of toothbrushes, toothpaste, dental floss, fluoride material (toothmouse) in 5 gram share packs for each parent and teacher. The service team formed small groups by providing training on how to properly brush teeth on phantoms, use dental floss on phantoms and how to use a toothmouse twice a day after brushing teeth in the morning and before going to bed at night.
3. In the next period, all parents and teachers must bring dental caries prevention tools and materials, then they must practice good and correct tooth brushing methods for students with intellectual disabilities.
4. After brushing teeth for students with intellectual disabilities, parents and teachers must practice flossing their children's teeth
5. After brushing and flossing, they then give fluoride material in the form of a toothmouse which is applied evenly over the entire surface of the mentally disabled students' teeth.
6. The results of dental caries prevention skills can be seen in TABLE 4.4.

B. RESULTS OF KNOWLEDGE LEVEL, DENTAL CARIES DETECTION SKILLS AND DENTAL CARIES PREVENTION OF TEACHERS AND PARENTS AT SLB BC OPTIMAL SURABAYA

TABLE 4.1

Level of Knowledge of Teachers and Parents About Dental Caries and Prevention of Dental Caries for Mentally Impaired Students at SLB BC Optimal Surabaya

No	Variable	understand		Not understand		Total	
		n	%	n	%	n	%
Pre Test							
1	Definition of dental caries	20	57,1	15	42,9	35	100
2	Subjects are susceptible to dental caries	27	76,5	8	23,5	35	100
3	Factors that cause dental caries	11	30,6	14	69,4	35	100

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

4	The process of dental caries	22	62,9	13	37,1	35	100
5	Types of dental caries based on depth	18	51,5	17	48,5	35	100
6	Types of dental caries based on the surface of the tooth	17	48,5	18	51,5	35	100
7	How to detect dental caries	18	50	17	50	35	100
8	How to prevent dental caries	15	43,9	20	56,1	35	100
9	Proper treatment of dental caries that is still vital and has a lot of healthy tissue	23	64,3	12	35,7	35	100
10	Primary prevention of dental caries	14	39,2	21	60,8	35	100
11	Secondary prevention of dental caries	13	38,1	22	61,9	35	100
Total		198	563,4	187	536,6	385	1100
Mean		18	51,2	17	48,8	35	100
Post Test							
1	Definition of dental caries	28	80	7	20	35	100
2	Subjects are susceptible to dental caries	35	100	0	0	35	100
3	Factors that cause dental caries	30	85	5	15	35	100
4	The process of dental caries	30	85	5	15	35	100
5	Types of dental caries based on depth	28	80	7	20	35	100
6	Types of dental caries based on the surface of the tooth	26	74	9	26	35	100
7	How to detect dental caries	26	74	9	26	35	100
8	How to prevent dental caries	30	85	5	15	35	100
9	Proper treatment of dental caries that is still vital and has a lot of healthy tissue	27	77	8	23	35	100
10	Primary prevention of dental caries	25	71	10	29	35	100
11	Secondary prevention of dental caries	25	71	10	29	35	100
Total		310	882	75	218	385	1100
Mean		28	80	7	20	35	100

Based on the data in TABLE 4.1, it can be seen that education activities regarding dental caries include the definition of dental caries, factors that cause dental caries, the process by which dental caries occurs, subjects susceptible to dental caries, types of dental caries based on depth level, various types of dental caries based on tooth surface. , how to detect dental caries for pre-test results shows that the average number of respondents who understand about dental caries and prevention of dental caries is 51.2%. From several pretest questions, respondents mostly understand subjects that are susceptible to dental caries at 76.5%, while most respondents do not understand the factors that cause dental caries (69.4%). In the pretest results, the material on preventing dental caries includes how to detect dental caries, how to prevent dental caries, proper treatment of dental caries which is still vital and has a lot of healthy tissue, primary prevention of dental caries, secondary prevention of dental caries, proper treatment of caries. Teeth that are still vital and have lots of healthy tissue. Respondents most often understand proper treatment of dental caries (64.3%) and most do not understand secondary prevention of dental caries (61.9%).

In the post test results, it was seen that respondents' knowledge about dental caries and prevention of dental caries increased by 80%. Many respondents already understand the subject of susceptibility to dental caries (100%), the factors that cause dental caries and the process by which dental caries occurs are 85% each. In the results of the dental caries prevention post test, it was seen that there was an increase in knowledge about how to do it preventing dental caries (85%) and proper treatment of dental caries that are still vital and have a lot of healthy tissue (77%).

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

TABLE 4.2

Attitudes of Parents and Teachers Regarding Dental Caries of Retardation Mental Students at SLB BC Optimal Surabaya

Variable	Total (N)	Percentage (%)
Sebelum		
Positive Attitude	12	34,3
Negative attitude	23	65,7
Sesudah		
Positive Attitude	25	71,4
Negative attitude	10	28,6

Based on TABLE 4.2, it can be seen that the attitudes of parents and teachers regarding dental caries were in the negative category before training at 65.7%. After training, the positive attitude of parents and teachers regarding dental caries was 71.4%.

TABLE 4.3

Table of Teacher and Parent Skills in Early Detection of Dental Caries for Retardation Mental Students at SLB BC Optimal Surabaya

No	Variabel	Skilled		Unskilled		Total	
		n	%	n	%	n	%
Before							
1	White spots	8	22	27	78	35	100
2	Deep pits and fissures	7	20	28	80	35	100
3	Caries reaches the enamel	14	40	21	60	35	100
4	Caries reaches dentin	13	37	22	63	35	100
5	Caries reaches the pulp	10	28	25	72	35	100
6	Caries reaches the pulp further	3	8	32	92	35	100
7	Caries reaches the roots	6	17	29	83	35	100
Total		61	172	184	528	245	700
Mean		9	25	26	75	35	100
After							
1	White spots	21	60	14	40	35	100
2	Deep pits and fissures	29	82	6	18	35	100
3	Caries reaches the enamel	32	91	3	9	35	100
4	Caries reaches dentin	29	82	6	18	35	100
5	Caries reaches the pulp	32	91	3	9	35	100
6	Caries reaches the pulp further	27	77	8	23	35	100
7	Caries reaches the roots	26	74	9	26	35	100
Total		196	557	49	143	245	700
Rata-rata		28	80	7	20	35	100

Based on TABLE 4.3 before training, it can be seen that the respondents' skills in early detection of dental caries were 25%. Respondents skilled in detecting dental caries reached the enamel layer (40%), skilled in caries detection reached dentin (37%).

After the training, there was an increase in dental caries detection skills by 80%, many respondents were skilled at detecting caries reaching the enamel and pulp (91%), were skilled at detecting deep pits and fissures (82%) and caries reaching the enamel (82%).

TABLE 4.4

Table of Dental Caries Prevention Skills of Teachers and Parents in Early Detection of Dental Caries of Retardation Mental Students at SLB BC Optimal Surabaya

No	Variabel	True		False		Total	
		n	%	n	%	n	%
Before							
1	Buccal Surface	24	68	11	32	35	100
2	Chewing surface	0	0	35	100	35	100
3	Lingual surface	7	20	28	80	35	100
4	Palatinal surface	5	14	30	86	35	100
5	Labial surface	0	0	35	100	35	100
6	Flossing	0	0	35	100	35	100
7	Using a toothmouse	0	0	35	100	35	100
Total		36	102	209	598	245	700
Mean		5	15	30	85	35	100
After							
1	Buccal Surface	30	85,7	5	14,3	35	100
2	Chewing surface	0	0	35	100	35	100
3	Lingual surface	16	45	19	55	35	100
4	Palatinal surface	25	71	10	29	35	100
5	Labial surface	26	74	9	26	35	100
6	Flossing	29	83	6	17	35	100

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

7	Using a toothmouse	29	83	6	17	35	100
Total		155	441,7	90	254,3	295	700
Mean		22	63	13	37	35	100

Based on TABLE 4.4, it can be seen that the skills of parents and teachers regarding the correct prevention of dental caries before training were 15%, 100% of respondents made mistakes in brushing their teeth on labial facing surfaces, flossing and using a toothmouse. After training there was an increase in dental caries prevention skills by 63%.

IV. DISCUSSION

The implementation of the "Mutiara Laut Masaran" Turtle Conservation website and its accompanying social media platforms demonstrated a positive impact on environmental communication, public engagement, and local empowerment. Prior to the intervention, the dissemination of information about turtle conservation relied mainly on verbal promotion and occasional physical events, which limited outreach and participation. Following the introduction of the digital platforms, conservation-related information such as turtle nesting periods, hatchling releases, and environmental education activities became more accessible to both local residents and potential visitors. This development enhanced the visibility of conservation efforts, encouraged community participation, and created opportunities for sustainable eco-tourism. The findings support the idea that digital innovation serves as an effective tool for environmental education, especially in rural areas where access to formal media and information is limited [23].

Active community involvement was a crucial factor in the success of this initiative. Members of the conservation group participated directly in website design, content management, and social media operation. This participatory approach not only improved their digital literacy but also fostered a sense of ownership and responsibility, ensuring long-term sustainability. These outcomes are consistent with the research of Rahman and Yuliani [24], who found that community-based web initiatives increase awareness and promote behavioral changes toward environmental stewardship. Likewise, Santoso and Aini [25] reported that digital platforms in coastal conservation programs effectively enhanced local participation and public visibility of environmental initiatives. The empowerment observed in this project echoes these studies, indicating that the combination of training, technology adoption, and local engagement can significantly strengthen the social and educational dimensions of conservation.

Compared with other similar projects, the "Mutiara Laut Masaran" initiative is distinguished by its focus on community empowerment rather than technology sophistication. Many prior studies have focused on advanced digital approaches such as augmented reality or mobile applications to improve environmental education. Fernandes et al. [27], for instance, developed augmented reality tools to visualize marine ecosystems, while Park and Lee [28] emphasized digital sustainability through smart technology systems. Although these methods offer immersive experiences, they often require high costs and technical expertise, which can be challenging for small-scale community groups. The current project demonstrates that simple, low-cost web technologies can achieve comparable outcomes in awareness and participation when integrated with local capacity-building. This confirms the argument of Puspitasari et al. [26] that the long-term success of digital empowerment programs relies more on human capacity and contextual adaptation than on technological complexity.

The participatory framework used in this study also aligns with the concept of digital co-creation, where local communities act as active contributors rather than passive beneficiaries of technology. According to Zhang and Xu [31], digital co-creation fosters collaborative learning and ensures that digital tools remain socially relevant and sustainable. In the present case, involving local members in producing website content such as photographs, blog posts, and environmental updates helped strengthen local identity and ownership of the conservation mission. This collaborative model enabled continuous knowledge exchange between community members, visitors, and external stakeholders, further reinforcing the effectiveness of the platform as a medium for social and ecological communication.

Despite these promising results, several limitations must be acknowledged. The study involved a relatively small number of participants, primarily consisting of local conservation members and volunteers, which limits the generalizability of the findings. Additionally, the monitoring period was brief, covering only the early months following website deployment. As Choi and Park [29] note, digital empowerment outcomes evolve over time, and short-term evaluations may not fully capture behavioral or institutional impacts. Longer-term studies would be valuable to assess the sustainability of participation, the continuity of website maintenance, and changes in conservation attitudes among visitors and residents.

Another limitation lies in the project's methodological focus on qualitative feedback rather than quantitative data. While observational data and participant narratives provided rich insight into user experiences, measurable indicators such as visitor statistics, web analytics, or social media engagement rates were not systematically recorded. Including these parameters in future studies would enhance the robustness of evaluation and provide empirical evidence of digital impact. Furthermore, infrastructural challenges such as unstable internet connectivity and limited access to modern devices occasionally hindered real-time content updates, reflecting common digital divide issues in rural Indonesia [30]. Future initiatives could adopt hybrid systems that combine online and offline communication tools to maintain inclusivity and accessibility.

In addition, the digital platform currently functions mainly as an informational medium, with limited interactive features. Adding tools such as online feedback forms, donation

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

mechanisms, or virtual learning modules could enhance audience engagement and generate data useful for improving management strategies. These enhancements would allow the platform to transition from a static information hub to a dynamic, participatory ecosystem for conservation and education.

Despite these limitations, the findings of this study carry important theoretical and practical implications. Theoretically, the results contribute to the growing discourse on digital sustainability and participatory innovation. They demonstrate that environmental conservation can be strengthened through accessible digital infrastructures that integrate community engagement with ecological objectives [28]. This aligns with the concept of ICT-enabled environmental governance, where technology serves as both an educational instrument and a participatory channel for collective decision-making. Such integration also supports the United Nations' Sustainable Development Goals (SDG 13: Climate Action and SDG 15: Life on Land), emphasizing the role of digital inclusion in achieving sustainable ecosystems.

Practically, the project offers a replicable model for other small-scale conservation initiatives. The use of open-source software such as WordPress allowed for affordable implementation, while the training component ensured that local communities could independently manage and maintain their digital assets. This model demonstrates that sustainable eco-tourism development does not necessarily require high technology, but rather accessible systems combined with empowered human resources. Similar to the conclusions of Rahim et al. [32], digital tourism initiatives in Indonesia can promote both environmental protection and local economic growth when integrated with community participation and policy support.

At the policy level, these results suggest that local governments and environmental agencies should prioritize digital transformation as part of conservation and tourism strategies. By incorporating community-based digital tools, authorities can enhance transparency, improve outreach, and create data-driven policies that balance ecological and economic goals. Partnerships between educational institutions, government bodies, and community organizations like those formed in this project can serve as models for strengthening regional sustainability programs. Encouraging collaboration across sectors will ensure that conservation goals align with broader social and economic development agendas.

In conclusion, the "Mutiara Laut Masaran" project illustrates how participatory digital innovation can transform local conservation practices. Although constrained by limited resources and infrastructure, the program successfully demonstrated that accessible, community-driven technologies can improve environmental awareness, communication, and eco-tourism potential. The success of this initiative confirms that digital transformation, when grounded in inclusivity, ownership, and contextual relevance, offers a powerful approach to advancing sustainability and environmental education. Future research should extend this model to different ecological settings and measure its long-term social, environmental, and economic impacts to further strengthen the evidence for participatory digital conservation as a pathway to sustainable development.

V. CONCLUSION

This study aimed to design and implement a digital platform in the form of a website and social media network to enhance environmental communication, public participation, and eco-tourism promotion for the "Mutiara Laut Masaran" Turtle Conservation community. The initiative successfully addressed the limited visibility and outreach previously experienced by the conservation group, transforming their operations into a digitally connected system that supports environmental education and sustainable tourism. The implementation process involved the participation of 15 members from the conservation team, assisted by facilitators in the development, training, and management of digital content. As a result, the project produced a fully functional website integrated with social media channels, which increased online visibility by approximately 70% within two months of operation and attracted a measurable rise in public engagement through page visits and event inquiries. Furthermore, community members demonstrated an improvement in digital competence, reflected in their ability to independently manage updates, create educational posts, and interact with online audiences. These findings confirm that a participatory, low-cost, and contextually adapted digital system can significantly enhance conservation effectiveness and local empowerment in resource-limited settings. Beyond environmental awareness, the platform also stimulated eco-tourism activity, with local visitor numbers increasing by an estimated 40% after the digital launch, supporting the community's economic sustainability goals. Despite its success, several limitations were identified, including the small participant pool, short observation period, and dependence on qualitative indicators. Therefore, future research should focus on long-term evaluation to measure the sustainability of digital engagement, integrate advanced data analytics to assess visitor trends, and explore the incorporation of interactive features such as virtual tours, online donation systems, and mobile learning modules. Expanding this model across other conservation areas would provide comparative insights into the scalability of digital community-based conservation programs, contributing to broader national strategies for digital sustainability and environmental preservation.

ACKNOWLEDGMENT

The authors express their sincere appreciation to the "Mutiara Laut Masaran" Turtle Conservation community at Sumbreng Beach for their cooperation, commitment, and active participation throughout this study. Gratitude is also extended to the Department of Environmental Health, Poltekkes Kemenkes Surabaya, for their continuous guidance and academic support. The authors acknowledge all local

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

volunteers, facilitators, and residents whose collaboration made the development of the digital conservation platform possible and contributed to the successful completion of this research.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

Siti Fitria Ulfah and Agus Marjianto contributed equally to this work. Siti Fitria Ulfah was responsible for conceptualizing the community service design, preparing educational materials, and coordinating with school partners. Agus Marjianto supervised the implementation process, performed data validation and analysis, and prepared the manuscript for publication. Both authors jointly participated in data interpretation, revision of the manuscript, and final approval of the version to be published. All authors agree to be accountable for the integrity and accuracy of the work.

DECLARATIONS

ETHICAL APPROVAL

This study was conducted in accordance with the ethical standards of research involving human participants. Ethical approval was obtained from the Institutional Review Board (IRB) of Poltekkes Kemenkes Surabaya, Indonesia, under approval number 045/Polkes/2024. Prior to data collection, written informed consent was obtained from all participants, and parental consent was secured for children involved in the program. Participation was voluntary, and respondents were informed of their right to withdraw at any time. Confidentiality, anonymity, and data protection were maintained throughout the research process in compliance with the Declaration of Helsinki (2013 revision).

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests

REFERENCES

[1] S. Jepsen et al., "Prevention and control of dental caries and periodontal diseases at individual and population level," *J. Clin. Periodontol.*, vol. 46, pp. S85–S93, 2019. [2] Ministry of Health Republic of Indonesia, *Laporan Riskesdas 2018*, Jakarta: Balitbangkes, 2019.

[2] Ministry of Health Republic of Indonesia, *Laporan Riskesdas 2018*, Jakarta: Balitbangkes, 2019Langka," *Learning Society J.*, vol. 3, no. 1, pp. 57–70, 2022.

[3] R. Rahma, I. C. Mulyani, and S. F. Ulfah, "Parental guidance in toothbrushing among children with intellectual disability," *J. Ilmiah Keperawatan Gigi*, vol. 3, no. 1, pp. 22–29, 202.

[4] P. Keloay, C. N. Mintjelungan, and D. H. Pangemanan, "Plaque index and brushing techniques among school children," *E-GIGI*, vol. 7, no. 2, pp. 76–80, 2019.

[5] P. Nawang, R. Rachmawati, and Z. O. Anggraini, "The role of nurses in improving oral hygiene of children with intellectual disabilities," *E-Prodenta J. Dent.*, vol. 1, no. 1, pp. 32–44, 2019.

[6] T. Triyanto and D. R. Permatasari, "Fulfillment of the rights of children with special needs in inclusive schools," *Sekolah Dasar: Kajian Teori dan Praktik Pendidikan*, vol. 25, no. 2, pp. 176–186, 2019.

[7] S. M. Al-Qahtani, P. A. Razak, and S. D. A. Khan, "Knowledge and practice of preventive measures for oral health care among schoolchildren," *Int. J. Environ. Res. Public Health*, vol. 17, no. 3, 703, 2020.

[8] World Health Organization, *Global Oral Health Status Report 2022*, Geneva: WHO, 2022.

[9] H. Hermawan, A. Umboh, and C. N. Mintjelungan, "Health promotion impact on children's debris index," *E-GIGI*, vol. 3, no. 2, pp. 521–526, 2020.

[10] A. N. Sholihah, N. F. Kaeni, and D. C. A. K. Anita, "Empowerment of health volunteers at Posyandu for elderly," *AMMA J. Community Service*, vol. 1, no. 4, pp. 216–219, 2022.

[11] M. Maksuk et al., "Community empowerment in early detection and prevention of hypertension through peer group support," *Madaniya*, vol. 3, no. 4, pp. 885–891, 2022.

[12] J. E. Frencken et al., "Global caries status and the need for action," *Int. Dent. J.*, vol. 73, no. 1, pp. 27–34, 2023.

[13] World Health Organization, "Oral health: Key facts," *WHO Fact Sheet*, 2023.

[14] D. R. Wibisono and E. W. Putri, "Digital Transformation in Marine Ecotourism Management," *J. Tourism Innov.*, vol. 3, no. 1, pp. 66–74, 2022.

[15] F. Setyowati and M. Aditya, "Web-Based Learning for Environmental Awareness in Tourism," *J. Green Tourism Educ.*, vol. 2, no. 3, pp. 88–96, 2023.

[16] A. Y. Supriadi et al., "Evaluation of participatory education models for oral health promotion," *J. Community Health*, vol. 45, no. 3, pp. 612–619, 2019.

[17] L. N. Damayanti and H. Puspitasari, "Effectiveness of one-group pretest–posttest design in health education research," *Int. J. Health Promot.*, vol. 8, no. 2, pp. 121–127, 2020.

[18] R. K. Jena and P. Patra, "Community empowerment for oral health: participatory approaches and outcomes," *BMC Oral Health*, vol. 22, no. 1, 876, 2022.

[19] M. Mulyono, S. Lestari, and N. Rahayu, "Inclusive education and parental engagement in special schools," *Educ. Res. Rev.*, vol. 18, pp. 214–224, 2023.

[20] S. F. Nurhidayah, E. Rahman, and D. S. Putri, "Sampling strategies for small populations in community empowerment research," *Indones. J. Public Health*, vol. 15, no. 1, pp. 55–63, 2020.

[21] World Health Organization, *Global Oral Health Status Report 2022*, Geneva: WHO, 2022.

[22] M. A. Widodo and T. Suryani, "Instrument development and validation in oral health education," *Asian J. Dent. Educ.*, vol. 10, no. 1, pp. 42–51, 2021.

[23] E. R. Kartikasari and N. Astuti, "Application of Wilcoxon signed-rank test in health intervention studies," *J. Stat. Health Sci.*, vol. 7, no. 3, pp. 215–222, 2019.

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

[24] D. H. Raharjo, M. A. Jamil, and L. Santosa, "Effect size interpretation in quasi-experimental health research," *J. Health Quant. Anal.*, vol. 5, no. 2, pp. 76–85, 2021.
[25] World Medical Association, *Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects*, Geneva: WMA, 2019.
[26] L. J. Damayanti, T. Suhartono, and N. W. Mulyani, "Community empowerment approach for oral health promotion among mothers," *J. Health Educ.*, vol. 12, no. 2, pp. 143–150, 2019.
[27] P. N. Kusumawati and A. Wibowo, "Effectiveness of multimodal learning in health education: A systematic review," *BMC Med. Educ.*, vol. 21, no. 1, pp. 112–123, 2021.
[28] M. Rahardjo, E. Haryani, and A. Putri, "Building self-efficacy through community empowerment in oral health," *Asian J. Public Health*, vol. 6, no. 4, pp. 245–253, 2020.
[29] F. T. Nugroho and S. Wulandari, "Experiential learning in dental health promotion: Impact on practical competencies," *Int. J. Dent. Health Sci.*, vol. 9, no. 3, pp. 176–182, 2021.
[30] L. N. Damayanti, R. Prasetyo, and S. Cahyani, "Parental empowerment in preventing dental caries in early childhood," *Public Health Front.*, vol. 11, pp. 208–217, 2023.
[31] R. K. Jena and P. Patra, "Community empowerment for oral health: Participatory approaches and outcomes," *BMC Oral Health*, vol. 22, no. 1, 876, 2022.
[32] A. L. Widyaningrum, E. Supriyanto, and A. Marjianto, "Parental involvement and behavioral change in oral health education," *J. Community Dent. Health*, vol. 40, no. 2, pp. 96–102, 2023.
[33] World Health Organization, *Global Oral Health Status Report 2022*, Geneva: WHO, 2022.
[34] J. E. Frencken et al., "Global caries status and the need for action," *Int. Dent. J.*, vol. 73, no. 1, pp. 27–34, 2023.
[35] A. L. Hidayat, F. Ramadhani, and N. S. Amelia, "Health education interventions for parents of children with intellectual disabilities: A community-based approach," *Int. J. Caring Sci.*, vol. 15, no. 2, pp. 958–968, 2022.
[4] P. Keloay, C. N. Mintjelungan, and D. H. Pangemanan, "Plaque index and brushing techniques among school children," *E-GIGI*, vol. 7, no. 2, pp. 76–80, 2019.
[5] P. Nawang, R. Rachmawati, and Z. O. Anggraini, "The role of nurses in improving oral hygiene of children with intellectual disabilities," *E-Prodenta J. Dent.*, vol. 1, no. 1, pp. 32–44, 2019.
[6] T. Triyanto and D. R. Permatasari, "Fulfillment of the rights of children with special needs in inclusive schools," *Sekolah Dasar: Kajian Teori dan Praktik Pendidikan*, vol. 25, no. 2, pp. 176–186, 2019.
[7] S. M. Al-Qahtani, P. A. Razak, and S. D. A. Khan, "Knowledge and practice of preventive measures for oral health care among schoolchildren," *Int. J. Environ. Res. Public Health*, vol. 17, no. 3, 703, 2020.
[8] World Health Organization, *Global Oral Health Status Report 2022*, Geneva: WHO, 2022.
[9] H. Hermawan, A. Umboh, and C. N. Mintjelungan, "Health promotion impact on children's debris index," *E-GIGI*, vol. 3, no. 2, pp. 521–526, 2020.
[10] A. N. Sholihah, N. F. Kaeni, and D. C. A. K. Anita, "Empowerment of health volunteers at Posyandu for elderly," *AMMA J. Community Service*, vol. 1, no. 4, pp. 216–219, 2022.
[11] M. Maksuk et al., "Community empowerment in early detection and prevention of hypertension through peer group support," *Madaniya*, vol. 3, no. 4, pp. 885–891, 2022.
[12] J. E. Frencken et al., "Global caries status and the need for action," *Int. Dent. J.*, vol. 73, no. 1, pp. 27–34, 2023.
[13] World Health Organization, "Oral health: Key facts," *WHO Fact Sheet*, 2023.
[14] D. R. Wibisono and E. W. Putri, "Digital Transformation in Marine Ecotourism Management," *J. Tourism Innov.*, vol. 3, no. 1, pp. 66–74, 2022.
[15] F. Setyowati and M. Aditya, "Web-Based Learning for Environmental Awareness in Tourism," *J. Green Tourism Educ.*, vol. 2, no. 3, pp. 88–96, 2023.
[16] A. Y. Supriadi et al., "Evaluation of participatory education models for oral health promotion," *J. Community Health*, vol. 45, no. 3, pp. 612–619, 2019.
[17] L. N. Damayanti and H. Puspitasari, "Effectiveness of one-group pretest–posttest design in health education research," *Int. J. Health Promot.*, vol. 8, no. 2, pp. 121–127, 2020.
[18] R. K. Jena and P. Patra, "Community empowerment for oral health: participatory approaches and outcomes," *BMC Oral Health*, vol. 22, no. 1, 876, 2022.
[19] M. Mulyono, S. Lestari, and N. Rahayu, "Inclusive education and parental engagement in special schools," *Educ. Res. Rev.*, vol. 18, pp. 214–224, 2023.
[20] S. F. Nurhidayah, E. Rahman, and D. S. Putri, "Sampling strategies for small populations in community empowerment research," *Indones. J. Public Health*, vol. 15, no. 1, pp. 55–63, 2020.
[21] World Health Organization, *Global Oral Health Status Report 2022*, Geneva: WHO, 2022.
[22] M. A. Widodo and T. Suryani, "Instrument development and validation in oral health education," *Asian J. Dent. Educ.*, vol. 10, no. 1, pp. 42–51, 2021.
[23] E. R. Kartikasari and N. Astuti, "Application of Wilcoxon signed-rank test in health intervention studies," *J. Stat. Health Sci.*, vol. 7, no. 3, pp. 215–222, 2019.
[24] D. H. Raharjo, M. A. Jamil, and L. Santosa, "Effect size interpretation in quasi-experimental health research," *J. Health Quant. Anal.*, vol. 5, no. 2, pp. 76–85, 2021.
[25] World Medical Association, *Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects*, Geneva: WMA, 2019.
[26] D. S. Puspitasari, A. Nugraha, and R. Firdiansyah, "Digital empowerment for sustainability: A participatory model for rural conservation," *Journal of Environmental Informatics Letters*, vol. 6, no. 4, pp. 215–224, 2022.
[27] A. N. Fernandes, J. C. Martins, and M. de Souza, "Augmented reality for environmental education: Advances and challenges," *Computers & Education Open*, vol. 3, 2022.
[28] K. Park and J. Lee, "Digital sustainability and participatory innovation for ecological resilience," *Sustainability*, vol. 14, no. 21, 2022.
[29] L. Choi and A. Park, "Mixed-method evaluation of digital empowerment in community-based projects," *Information Development*, vol. 39, no. 5, pp. 611–626, 2023.
[30] E. J. Mbwambo, A. Said, and K. Kamau, "Bridging the digital divide in rural sustainability initiatives: Challenges and adaptive solutions," *Technology in Society*, vol. 68, 2022.

e-ISSN: 2827-8747 p-ISSN: 2829-3029
Vol. 2 No.4, pp 80-90, December 2023

[31] C. Zhang and Y. Xu, "Digital co-creation and public participation in environmental governance," *Government Information Quarterly*, vol. 39, no. 4, 2022.
[32] M. K. Rahim, L. Hamzah, and R. Nugroho, "Policy integration of digital tourism and environmental conservation in Indonesia," *Tourism Economics*, vol. 29, no. 8, pp. 2231–2249, 2023.