# The SolarSPELL Offline Digital library

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## Abstract:

*The role of technology and the Internet has significantly influenced learning opportunities and environments. However, for resource-constrained regions that lack reliable access to the Internet, or the electricity needed to power their devices, a striking disparity in access to educational resources emerges. This paper introduces SolarSPELL, a solar-powered offline digital library, designed to provide localized open-access educational content to the communities most at-risk for experiencing an educational divide. Through in-person interviews with the Peace Corps Volunteers utilizing SolarSPELL digital libraries in their sites, this study obtained qualitative data demonstrating the impact of SolarSPELL libraries in the field. Findings reflect the efficacy of SolarSPELL learning libraries in expanding access to the quantity and quality of resources available to these communities, the importance of providing digital content in a self-sustaining offline platform, and the ability of the SolarSPELL project to foster both information and technological literacy.*

**Keywords:** Offline digital library, Pacific Islands, information literacy, school libraries, information access

## Introduction

The rapid expansion of technology and the Internet has demonstrated the power of connecting individuals with access to the ocean of information available online. This access can facilitate capacity building, improve the quality of educational resources available to teachers and learners, and increase opportunities for students to imagine and actualize futures for themselves far beyond what they might have seen first-hand in their local communities. However, the International Telecommunication Union (2017) estimates that only 48% of individuals around

the globe are using the Internet. Conversely, this statistic illuminates the 52% of the world's population that are not actively engaged in the Internet, which is a primary source for educational content in the current information age. This not only isolates offline communities from an increasingly technologically-connected world, but it also causes the educational disparity between those with access, and those without, to steadily grow. To address this challenge, an adaptive solution is required that fosters both information literacy and technological literacy to instill in users the skills necessary to thrive in an increasingly digital learning society.

This paper presents SolarSPELL (Solar Powered Educational Learning Library), which is an easy to use, offline digital library designed to simulate an online experience. SolarSPELL digital libraries were created to overcome existing barriers to accessing high-quality, reliable educational content in resource-constrained regions lacking consistent, affordable access to the Internet and electricity. Furthermore, the educational resources available to learners in resource-constrained regions are frequently limited, outdated, and often, are donated from countries whose curriculum and culture is not representative of the recipient populations. To address this challenge, SolarSPELL learning libraries are localized to contain regionally-relevant content, providing teachers and students with the knowledge and skills most pertinent to their communities. This content is compiled into a Local Topics category on the SolarSPELL libraries, complementing the open-access resources available across six additional categories, including: Creative Arts, Environment, Health and Safety, Language Arts, Math, and Science.

In addition to gaining unprecedented access to the vast resources available in the library, individuals also gain the opportunity to develop technological literacy. To enable users to connect to the digital library, SolarSPELL generates an offline Wi-Fi hotspot that any Wi-Fi capable device (smartphones, tablets, or laptops) can connect to, allowing students and teachers to surf the library's resources for free. Through the devices used to access the digital library, novice technology users increase their familiarity with various technologies and develop increasing competency navigating smart devices. Simultaneously, the process of connecting wirelessly to the SolarSPELL server creates opportunities for teaching the nuances of Wi-Fi technology, connectivity, and the Internet. Although smart devices have reached resource-constrained locations, the lack of affordable Internet connectivity in these regions has offered limited opportunities for individuals to view technology as an informational platform. However, SolarSPELL introduces a platform for learners to access educational content in a digital format, and to expand their individual knowledge sets. Furthermore, users are able to download the PDF documents or MP4 videos directly onto their devices, for use when no longer connected to the SolarSPELL server. This function extends the potential reach of SolarSPELL libraries by empowering individuals to begin curating their own individualized libraries and to share this information with anyone, at any time.

**SolarSPELL in the Pacific Islands**

The SolarSPELL project was initiated in the Pacific islands, and since 2015, has deployed over 200 digital libraries across the Federated States of Micronesia, Samoa, Tonga, and Vanuatu. The remote nature of the Pacific Islands, combined with the unique infrastructural and environmental challenges that Pacific Islanders face, necessitated an innovative solution. In addition to infrastructural challenges that place limitations on maintaining an ideal state for schools and classrooms, environmental challenges (such as the year-round heavy rain and high humidity experienced in the Pacific Islands) also present unique challenges to maintaining the

quality of print resources. This reality has profound implications for the individuals living in these regions, and often renders traditional brick-and-mortar libraries unattainable.

However, since many of these communities have had limited to no previous exposure to libraries, delivering a digital library without a thorough implementation strategy would be inadequate on many levels. First, SolarSPELL users must understand the potential use of the digital library. Next, users must be comfortable connecting to and navigating the offline library server. Finally, these individuals must familiarize themselves with the scope of provided content and, perhaps most importantly, learn how to meaningfully make use of that information. With these goals, the SolarSPELL project extends beyond solely providing the technology and educational content, toward responsibly implementing this resource in a capacity that fosters information literacy. The American Library Association (1989) defined information literacy as being "able to recognize when information is needed and hav[ing] the ability to locate, evaluate, and use effectively the needed information." Amongst novice library users, developing such skills requires a facilitator.

To achieve this objective, SolarSPELL is committed to partnering with development-minded organizations that have a strong presence in the regions where SolarSPELL digital libraries are deployed. Within the Pacific Islands, SolarSPELL has collaborated with the United States Peace Corps over the last three years to ensure individuals using the digital libraries are afforded the guidance necessary to meaningfully use this resource. Employing a train-the-trainer model, the SolarSPELL team trains the Peace Corps Volunteers (PCVs), who remain on-site for two years, and can continue to support local community members in navigating the digital library. The Peace Corps Volunteers serving on these islands have been individually trained in the use of SolarSPELL libraries and given their own units to use in their schools, health care centers, and other community settings as applicable. This paper reports on a study conducted in Vanuatu, to measure the impact of SolarSPELL libraries in the field.

## Methodology

This study was conducted in December of 2017, across two islands in Vanuatu where Peace Corps Volunteers are stationed: Efate (where the national capital, Port Vila, is located) and Malekula, which is more rural in terms of infrastructure and population size. Given the nature of SolarSPELL's work in regions with limited Internet connectivity, it is crucial to conduct in-field research to obtain reliable data. Other methods of data collection, such as online surveys, have yielded lower response rates and, we feel, have not produced an accurate contextual understanding of the environments in which SolarSPELL libraries are being used. Thus, data informing this paper was obtained through in-person interviews and printed surveys collected on-site. This paper will report exclusively on results from the in-person interviews, as these in-depth accounts uniquely portray the scope and depth of SolarSPELL's use in the field.

Participants were selected using purposive sampling, a non-probability sampling technique. This selection method was chosen to address the driving purpose behind this study, which was to collect data on SolarSPELL's use for impact assessment and ongoing process improvement. The study's participants were all Peace Corps Volunteers, who had received formal SolarSPELL training and had been given a digital library for use in their communities. Since the Peace Corps Volunteers were technology and Internet savvy, they were asked to report on both their own use of SolarSPELL, and their observations of SolarSPELL use by the local community. The volunteers interviewed served in both education and health care capacities.

All Peace Corps Volunteers that the researcher was able to meet with in-person, were asked to take part in the study. Participants were provided a written consent script explaining the purpose of the study, the data collection methods, the way their responses would be stored, and the potential uses of the information obtained. Participants were then asked if they consented to participation in the interview. The interviews ranged in duration from roughly ten minutes to an hour and varied based on the level of detail participants reported and the degree of uptake by their community. Interview questions were separated into categories, including: demographics (population served, site location), resources (accessibility of Internet and electricity), SolarSPELL content and implementation (how SolarSPELLs were being used), technology (prevalence and perception of technology), and job satisfaction (measuring potential impact of SolarSPELL on the PCV's quality of life). Audio recordings were collected of the interviews and transcribed into written documents following completion of the study. From the written transcriptions, data was manually built into a database. Initially, responses were organized according to the sections of the interview. Following completion of inputting all feedback into the database, the researcher continued to analyze the data and to identify consistent themes or categories that emerged from the responses. The data was then further coded to reflect these categories, and ultimately, to enhance understanding of SolarSPELL's impact in the field.

## Results

Anecdotal evidence informed the following key areas for data analysis: improved access to both the quantity and quality of educational resources, importance of having a reliable offline source of information, fostering the initial stages of developing information literacy, instances of SolarSPELL use by local communities beyond PCV initiated activities, and unrivaled enthusiasm for locally-tailored content.

### Improved Access to the Quantity and Quality of Resources

Peace Corps Volunteers consistently reported one of the greatest outcomes of having a SolarSPELL was the unprecedented access to information offered on the digital library. When asked about the frequency of use, one participant reported: *"The teachers use it all the time! I focus on English, but the other teachers use it for science and they use it for math. I like that it has a diverse amount of information. A lot of what they have in their textbooks is quite limited."*

In addition to providing content on a broad range of topics, the SolarSPELL has also provided local teachers with new options for supplementing their lessons. When asked about the greatest outcome of having a SolarSPELL, another PCV stated, *"I think teachers realizing that there are resources for them out there in the world… sometimes teaching can feel like a lot and when they see this whole wealth of resources, they are like 'I can use this to help me figure out how to teach this, rather than having to go and figure it out on paper by myself.'"* Similarly, a third participant reported the greatest outcome was *"providing resources to a teacher who otherwise might not have had access to them, or who is maybe not regularly going to browse our [unreliable] Internet connection for teaching resources, nor know the websites to go to."*

In addition to equipping local teacher counterparts with a greater quantity of resources, the PCVs also frequently mentioned the usefulness of having reliable resources to reference when advising community members. During the interview, one participant shared their experience, saying they use the SolarSPELL *"when people have questions and I'm like let me look this up, because I don't know the answer. I don't have the Internet, I don't have network here, so the*

*closest thing I have to network/Internet is the SolarSPELL."* This sentiment was echoed by a fellow volunteer, who shared *"as a volunteer, it helps to feel like everything is not coming from me… it's here on the SolarSPELL and accessible for you."*

This approach to not only sharing reliable information with local community members, but encouraging these individuals to use the SolarSPELL themselves to seek information, highlights the importance of SolarSPELL's train-the-trainer model. Collaborating with local implementation partners creates a supportive environment for transferring the skills necessary to navigate a library. Further illuminating the strength of this approach, a Peace Corps Volunteer explained, *"as a Peace Corps Volunteer, we are here as capacity builders. I think the SolarSPELL has a lot of potential to get that job accomplished. There's only so much that I can teach in two years, but there's so much on the SolarSPELL, that if people learn to use it proficiently, that's more capacity building than I could ever accomplish."* This statement demonstrates SolarSPELL's ability to complement and extend the impact of Peace Corps Volunteers' efforts, and to collaboratively foster lasting impact.

**Importance of Self-Sustaining, Offline Educational Resources**

SolarSPELL was founded to address frequent barriers to accessing quality educational content. In regions where Internet access and sources of electricity are intermittently available or cost-prohibitive, unique obstacles persist. This reality was conveyed through several of the interviews in this study. A Peace Corps Volunteer succinctly summarized this challenge, stating *"even though I do have Internet, [SolarSPELL] is still really helpful because Internet service is not reliable."*

In other instances, volunteers reported frequent barriers to using technologies that require a source of electricity. For example, when asked about the community's perception of technology, one volunteer explained *"We really want technology, but the power situation is hard right now, everything just feels expensive."* In the event that the power source stops functioning, the remote nature of these villages presents additional complications to fixing the issue. One participant shared how when their generator breaks, they are required to *"carry it over a really big hill and down into the village"* for repairs. The portable, solar-powered, offline design of SolarSPELL assists in reducing these limitations and increases reliable access to the library's content.

**Developing Information Literacy**

As the aforementioned American Library Association (1989) definition explained, information literacy encompasses multiple skills sets, from being able to find the information individuals are seeking, to knowing how to meaningfully apply that knowledge to an intended objective. For communities whose resource-constraints have previously limited the scope of information available to them, developing information literacy skills is a crucial necessity once their access has been expanded. A key theme that emerged throughout the interviews was the potential for SolarSPELL to teach users how to search for content to address their questions. When asked about the best outcome of having a SolarSPELL, one Peace Corps Volunteer immediately responded, *"I think the best outcome is being able to familiarize students with how to find what they're looking for,"* which the Peace Corps Volunteer felt *"has been fueling the kids' curiosity."* The volunteer further explained, *"They don't have to just ask somebody and believe whatever somebody tells them, but they can actually go find out for themselves."*

In addition to learning how to search for information, individuals must also learn how to assess the credibility of their sources. A Peace Corps Volunteer shared, *"fake news is becoming a very big thing here"* and explained *"they've never been taught to check their sources, or to check the validity of articles."* Although learning to critically analyze the source of information is a valuable skill, it is also a skill that takes time to refine. The SolarSPELL offers a safe solution to this challenge by providing an offline platform for learners, who can engage with content covering a broad range of topics, but the available content has been vetted and verified as a reliable resource. As SolarSPELL users become comfortable navigating the library to search for content, it provides *"a good way to ease into the World Wide Web because it's a soft way to practice the skills to use technology to find out what you want to find"* without immediately introducing the challenges that accompany having access to all of the Internet's sources-reputable or otherwise.

**Use of SolarSPELL by Community Members Outside of Structured Settings**

Although Peace Corps Volunteers were provided SolarSPELLs to use in their service roles on-site, volunteers were also encouraged to introduce the SolarSPELL in additional settings where the entire community could benefit from access to the library's resources. Multiple Peace Corps Volunteers recounted times when the SolarSPELL was integrated in diverse settings. In one village that did not have a local school, the Peace Corps Volunteer was approached by a group of students for assistance on an assignment. The volunteer realized *"they had no resources to do any type of research"* in their village, and reached out to a nearby village's volunteer to ask *"them to pass me the SolarSPELL because we have no resources in the village to help with homework."* Although this volunteer was assigned to be a health volunteer, they were able to borrow a SolarSPELL and help the students with their educational endeavors.

In another instance, a Peace Corps Volunteer relayed their experience using a SolarSPELL for parents' night at their school. The volunteer explained, *"We invite parents to see what students are learning and teach them how to help their students. The teachers were really excited to use the SolarSPELL to get some of the resources, so they felt like they were better equipped to teach the parents."* In preparation for parents' night, this volunteer recalled a time when *"we were all gathered around my computer hooked up to the SolarSPELL, watching videos on lattice multiplication, and then going to try it on the board, and coming back to the videos before going to try it on the board."* Ultimately, they shared this technique with the parents as well, enabling them to continue supporting and teaching their children at home.

**Appreciation of Locally-Relevant Content**

Providing regionally-tailored content is central to SolarSPELL's goal for engaging learners with resources that reflect their local environments. Reports from interviews in this study consistently cited the Local Topics category of the library as the section that drew the most excitement from SolarSPELL users. One Peace Corps Volunteer explained, *"I think [SolarSPELL] has made education a lot more realistic to them. A lot of times things are brought in from Australia and New Zealand and the kids don't understand a lot of it. It's just hard for them to relate and then they don't have an interest in it… whereas with the SolarSPELL, it's them wanting to learn it and not us pushing it on them."* Other volunteers reported similar enthusiasm for local topics: *"It was cool to watch them get really excited because there was something in Bislama. A lot of people have liked watching the videos on Cyclone Pam because that was a huge deal here… they really liked watching other kids talk about what it was like."*

When asked to describe how SolarSPELL is integrated into an average day, one Peace Corps Volunteer said *"The students go on it and browse through it and look for videos. They love videos related to Vanuatu- I think that's the majority!"* A different volunteer reported, *"They love when there's a video on there about Wala, a small island, and the tourism there. It's cool for them to watch a video that has their area in it."* Prioritizing the inclusion of locally-tailored topics and resources sparks excitement within local communities and encourages these individuals to continue engaging with the digital library to explore additional content.

## Limitations and Suggestions for Future Research

The use of in-person interviews to collect data allowed the researchers to obtain detailed feedback, first-hand accounts, and suggestions based on in-field experience. Although this qualitative data proved informative, the responses were received through a single session. Thus, the collected data relied on self-reported responses from participants and was limited to the information participants thought to share during the one-time interview. To diversify data collection methods for ongoing program evaluation, the SolarSPELL team has installed an automated usage tracking system on the most recent deployment of SolarSPELLs and will standardize this software on all future SolarSPELL units. The usage tracking software continuously collects data on which files are being accessed, the frequency of use for each resource, and the type of browser used to connect to the SolarSPELL server. Using these qualitative and quantitative methods, SolarSPELL will continue to collect diverse datasets to measure long-term impact as additional data becomes available. With SolarSPELL's recent expansion to primary schools in Rwanda and South Sudan, future research will also prioritize a cross comparative study of SolarSPELL use in the two regions (East Africa and the Pacific Islands) and beyond, as the project continues to expand.

## Discussion and Concluding Remarks

This paper presents valuable insight gained on the use and impact of SolarSPELL digital libraries in the field. Although this study focuses on the use of SolarSPELL digital libraries in Vanuatu in particular, the key trends that emerged from participant responses offer broader implications for the role of digital libraries in addressing the unique educational needs of resource-constrained regions. Most notably, the need for prioritizing locally relevant content, for implementing digital libraries with an on-site collaborator who can facilitate developing information literacy skills in novice library users, and the need for an innovative technological solution that can offer all of the resources of a traditional library, through a self-powered, offline platform. With these three factors in place, the digital libraries were able to overcome pervasive challenges faced when seeking (or providing) access to quality educational content in low-resource settings. Furthermore, in eliminating the most prevalent barriers to providing educational content in these contexts, the SolarSPELL libraries have already demonstrated the potential to foster lifelong, intergenerational learning.

The findings of this study have exemplified the efficacy of SolarSPELL digital libraries in adapting a traditional library framework into an offline, digital format that can reach even the most remote regions. Making use of open-access educational materials, SolarSPELL libraries have formed a collective space for sharing thousands of documents, books, and videos, highlighting the profound impact of making open access content readily available to the global community. Leveraging these resources and pioneering the design of a simplified technology that remains intact and effective in the field, resulted in a comprehensive project that extends

the power libraries hold for transforming people's lives, to previously unconnected populations. Addressing this paramount need has limitless implications for improving individuals' quality of life and for empowering populations that are most at-risk for experiencing an educational divide.

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