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## Exploring the Potential of Social Media for Science Learning in Palestine: Educators' Perspectives

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### Abstract:

This article reports on the findings of a study that explored educators' use of social media in formal and informal science education in Palestine, and their perceptions of the integration of the available tools and resources into their formal teaching and learning. The study used semi-structured interviews with 18 educators at three Palestinian educational institutions providing different teaching modes, specifically: formal campus learning, formal blended learning, and informal community learning. The findings of the article indicate that educators place a clear value on the potential of social media to improve many aspects of formal and informal science education. The findings suggest that social media tools, by virtue of their informal and social character, can offer rich venues for effective interactions among different communities, which can be applied as a response to challenges that currently confront the Palestinian educators, students and the community, including a lack of science resources and mobility restrictions. The study provides a foundation for future thinking about the possibilities of investing in informal modes, tools, and structures as viable solutions to address educational challenges in regions experiencing instability.

**Keywords:** Connectivism, Citizen Science, Digital Learning, Decolonizing Science, Informal Learning, Palestine, Educators' Perspectives, Social Media, Science Education, Science Literacy

### Highlights

What is already known about this topic:

- Social media tools provide educators and learners with a diverse range of science-related resources and tools.
- Social media offers rich venues for effective interactions among various communities, and it can be integrated into formal learning environments in a way that enriches discussion, increases engagement and forms broad connections.

What this paper contributes:

- Educators acknowledge the potential of social media to enhance student collaboration and engagement, which prompts them to adopt new roles and exert additional efforts to integrate these tools into their teaching practices.
- Educators have implemented social media in addressing the prevailing challenges that currently confront the Palestinian education, yet they identify a set of challenges and limitations.

Implications for theory, practice and/or policy:

- Educational institutions need to implement various procedures to support educators' use of social media platforms for educational purposes, such as reforming and updating existing policies on digital learning.
- Greater attention must be paid to teacher education in Palestine, enhancing their knowledge of digital technologies and their use in educational contexts, as well as the potential of social media to promote informal learning and connect HEIs in Palestine.



## Introduction

A report (DataReportal) estimates that 86% of Palestine's population, or 4.33 million people, had mobile connections in January 2020. There were 2.70 million social media users in Palestine at the same time, a 20% increase from April 2019. Social media is characterised by allowing content sharing, participation, interaction, and connectedness (Ansari et al., 2020). This broad ecosystem encompasses a variety of platforms, including widely-used ones like YouTube, WhatsApp, and Facebook, as well as specialized applications for science education, such as robotic telescopes and citizen science apps. Many social media tools, such as Edmodo, offer platforms for interaction within learning environments, allowing educators to define or generate content, build learning paths, and design and support interactions (Anderson & Dron, 2011).

Increasing contributions to literature explore how educators, researchers, and scholars have used social media tools to enhance student learning experiences (Holder-Ellis, 2015; Gruzd et al., 2018; Sietto, 2020; Rahman et al., 2020; Schmidet al., 2022), while some studies focus on their implementation in various informal contexts (e.g., Chen & Bryer, 2012; Drlik & Beranek, 2016; Greenhow & Lewin, 2016; Wu & Shih, 2017; Lundgren & Crippen, 2019; Morrison and McCutcheon, 2019). The literature reveals only a few studies focusing on the use of digital technologies in education in Palestine, which emphasise e-learning or mobile devices or artificial intelligence in HE (e.g., Shraim, 2010; Shraim & Khlaif, 2010; Rabaya'h, 2013; Abu-Naser et al., 2014; Shraim and Crompton, 2015; Shawahna 2017; Bakeer 2018; Shraim & Crompton, 2020; Al Rajab et al., 2023; Abdelmoneim et al., 2024). The continuous development and growing number of tools highlights the need for exploring the teaching and learning opportunities offered when social media tools are applied in formal and informal learning contexts in Palestine, particularly in light of the unique challenges and political circumstances that significantly impact education in Palestine.

### The Palestinian Context

Palestine is a country in the Arab world with particular political circumstances, Palestinians live in divided areas, primarily East Jerusalem, Palestine 48 areas, the West Bank, the Gaza Strip, refugee camps in Palestine, and camps in Jordan, Syria, Lebanon. Various challenges confront contemporary education in Palestine, including lack of support, lack of infrastructure, especially for scientific laboratories and science equipment (like telescopes), lack of informal learning venues, such as science museums and science centres, political instability, and the digital colonization by global corporations (Wahbeh, 2006; Robinson, 2010; Wahbeh, 2015; Traxler, 2023).

The Israeli occupation immediately impacts on Palestinian life, including restrictions on privacy, movement, freedom of speech, and assembly. A UNESCO report, *National Assessment for Education for All 2000-2015*, describes how Israeli violations of the right to education affect educational staff and infrastructure, students and the curriculum (UNESCO, 2014). The Ministry of Education and Higher Education's latest strategic plan refers to Israel's withholding of electronic equipment that are donated or imported from abroad, adding that Israel's control over imports and exports is a major obstacle to promoting modern tools and equipment in education (Ministry of Education and Higher Education, 2017, p131). Saffarini (2010) describes how the Israeli military has strongly interfered in the Palestinian higher educational process since 2000, imposing frequent prolonged curfews, military roadblocks and checkpoints, and regular city closures, preventing thousands from reaching universities. Itmazi & Khlaif (2022) report Israeli restrictions on imports of information and communications technology (ICT) equipment and hardware. This affects the MoE's capacity to provide schools with the necessary tools for science education (especially for Chemistry and physics). Furthermore, Israel's control of the Palestinian ICT infrastructure has allowed it to subject Palestinians to mass surveillance, through monitoring and censorship of Palestinian content online (AbuShanab, 2018; Taha, 2020; Itmazi & Khlaif, 2022). In terms of using social media for educational purposes in Palestine, the nature of learning at each institution engaged in this study implies different forms of using social media tools and resources,

for example, social media can be used as a research tool, dissemination tool, virtual science labs, interactive science simulations, collaboration tool, and a means for data collection and sharing.

### **Purpose of the study**

This study explores how Palestinian educators view the use of the available social media tools and resources in formal and informal science learning contexts, and their potential to enhance educational experiences. The purpose of the study is to highlight how social media presents educators working in difficult constraints with alternative modes and sources of teaching and learning. It accordingly identifies three educational institutions that apply different teaching modes, specifically formal campus learning, formal blended learning, and informal community learning. In practical terms, there are similarities and differences between the modes of teaching and learning, and educators have different interests and motivations.

A closer examination of the perceptions of educators who are engaged with different modes of science education can enhance our comprehension of the factors influencing their choice of particular tools and resources. For instance, the regulations associated with formal learning (assessment, attendance, curricula) might limit educators within traditional campus settings, potentially influencing their choice of particular educational tools and resources. Additionally, their lack of awareness of existing opportunities is another factor that could be considered. On the other hand, educators within informal community learning have more diverse learners and face fewer restrictions, enabling them to explore a broader range of informal science learning tools and opportunities. These informal settings often prioritize different aspects of science education, such as the promotion of science literacy, science communication, and fostering public engagement.

## **Literature**

### **Social Media Use in Formal Learning Contexts**

In the last few years, a significant number of studies have focused on the use of social media in formal learning settings (e.g., Zgheib, 2014; Won, 2015; Evans, 2017; Latif et al., 2019; Mpungose, 2020; Koehler & Vilarinho-Pereira, 2021; Barrot & Acomular, 2022; Frohock et al., 2022; Erhel et al., 2022). Numerous studies focus on how educators and students view the use of social media in formal and informal learning in higher education (Evans, 2017; Stathopoulou et al., 2019; Ashour, 2020; Lacka et al., 2021; Lambton-Howard, 2021). Most of the reviewed studies support the claim that social media can potentially enhance teaching and learning by facilitating various aspects of learning, both inside and outside the classroom (Garcia et al., 2011; Kutbi, 2015; Abdulkareem, 2015; Alsolamy, 2017; Alghizzawi et al., 2019; Sharma, 2019; Aburagaga et al., 2020). Some studies show students do not effectively use available tools and resources (Alsurehi et al., 2014; Alabdulkareem, 2015), and others identify challenges that confront students and faculty (Garcia et al., 2011; Alsurehi et al., 2014; Kutbi, 2015; Alenezi & Brinthaup, 2022). Recent studies have explored issues connected to the changes in education due to the pandemic and explored how social media was utilised for educational purposes during the lockdown (Al Lily et al., 2020; Sobaih et al., 2020; Danjou, 2020; Shraim & Crompton, 2020).

Some studies highlight social media's role in developing social interactions between students and society and extending student learning experiences beyond the classroom (Battrawi & Muhtaseb, 2012; King & Sen, 2013; Alsolamy, 2017). Alabdulkareem (2015) highlights the important role of social media in promoting science literacy, facilitating peer learning, teacher-student discussions and scientist-public interactions. He concludes that while the infrastructure was available and accessible, both teachers and students were not sufficiently aware of the educational benefits of social media.

### **Social Media Use in Informal Science Learning**

Informal science learning takes place at home, in the community, and as part of the university experience and other informal, out-of-school contexts (Krishnamurthi & Rennie, 2013). It presents science knowledge in different ways than it is presented in formal structures, and it is supported/organized by educators from formal and informal institutions. It includes activities connected to the public use of science, such as visiting science centres, attending science events, watching science videos, and using mobile applications to reach science resources in nature.

A survey of the literature has revealed a limited number of studies available focusing on social media use in informal science learning compared to studies focusing on formal learning contexts, and none of the studies found took place in Palestine. The current studies focus on many aspects of the implementation of social media in various informal contexts, including the use (and potential use) of social media tools to integrate formal and informal learning and support formal learning (Chen & Bryer, 2012; Drlik & Beranek, 2016; Greenhow & Lewin, 2016); the role of social networks in science communication and public engagement (Wu & Shih, 2017); the use of social networks to crowdsource citizen science projects (Robson et al., 2013); the role of the scientist in science outreach conducted through social media; the challenges of science outreach conducted through social media (McClain & Neeley, 2014); the incentives and motivations that guide learners' use of informal online learning resources (Song & Bonk, 2016); and the use and potential use of social media in informal learning spaces (McPherson et al., 2015; Lundgren & Crippen, 2019).

McClain and Neeley (2014) discuss the literature on science outreach through social media, and highlight the various opportunities that this resource offers to scientists and science communicators who wish to connect with other scientists (inreach) and the public (outreach). They present several applications that enable research programs to be integrated with science outreach through social media, including creating blog posts on scientific literature, launching crowd-funding campaigns and publishing online content that includes the products of classroom activities. Robson et al. (2013) use the 'Creek Watch' citizen science project as a case study to examine the potential of social media and compare it against traditional media channels, with the aim of assessing its ability to recruit and promote crowdsourced citizen science projects. The authors find that social networks can make a worthwhile contribution by increasing awareness of the project and by increasing the conversion rate from browsers to participants.

Many researchers acknowledge the growing potential of social media to support and bridge formal and informal learning (e.g., Greenhow & Lewin, 2016; Drlik & Beranek, 2016; Mpungose, 2020). Chen and Bryer (2012) propose using social media as learning tools could connect informal learning to the formal learning environment and enable students to connect to educational contexts in new and meaningful ways. They add that interactions through social media enable learners to increase connections with content and peer-networks, as related tools can include members outside the class beyond the one-semester time duration; in addition, they can connect learners with communities, experts in the field and peers across the world (also see Czerkawski, 2016; Lewin & Charania, 2018).

## **Connectivism**

Connectivism is a learning theory which, grounded in the work of George Siemens and Stephen Downes, seeks to explain complex learning in the digital world. It emphasizes the importance of non-human appliances, hardware, software, and network connections for human learning (Couros, 2009). Downes (2022) posits that knowledge is made up of sets of connections between entities, and learning is the expansion, development, alteration, or strengthening of those connections. According to Bell (2009), learners use technology to build networks in connectivist learning environments. In these networks, knowledge is shared among a range of nodes, which can be individuals, groups, systems, resources, or communities. The interaction with and learning from people and objects leads to an ongoing process of knowledge expansion. This expansion is enhanced by making connections between new and existing acquired knowledge. Anderson and Dron (2011) highlight the vital role of teachers

extends beyond defining or generating content to building learning paths, designing, and supporting interactions, such as making connections with existing and new knowledge resources.

Connectivism, as proposed by Siemens (2005), encapsulates a holistic approach to learning in the digital era. Siemens suggests that connectivism is characterized by eight principles that reflect the interconnected, networked nature of learning in the digital age:

1. Learning and knowledge rest on a diversity of opinions.
2. Learning is a process of connecting specialized nodes or information sources.
3. Learning may reside in non-human appliances.
4. Capacity to know is more crucial than what is currently known.
5. In order to facilitate continual learning, it is necessary to nurture and maintain connections.
6. The ability to see connections between concepts, ideas and fields is a core skill.
7. Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
8. Decision-making is itself a learning process.

Connectivism has the potential to improve social media-related learning activities, as it acknowledges the teaching and learning opportunities that social media creates in formal and informal learning environments. Downes (2008) suggests that social media are used extensively in Connectivism since the theory proposes that knowledge is distributed across networks of connections. In this context, learning becomes a process of navigating these networks to access and co-create knowledge. By examining educators' practices and use of social media in the educational landscape of Palestine, this study contributes to the discourse surrounding Connectivism and its potential applications for science education and communication, specifically highlighting its relevance and adaptability in areas of conflict such as Palestine.

## Methodology

### Research Design

This research refers to the case of Palestine to explore the use of social media in formal and informal science education, offering insights from the views of Palestinian educators, a perspective which has not been extensively studied. It employs an interpretive multiple case-study methodology and draws on data from semi-structured interviews. According to Baxter and Jack (2008), multiple case study examines several cases to understand similarities and differences between cases, the authors note that evidence collected from multiple case studies is robust and reliable. Certain procedures are taken to ensure that the highest possible ethical standards are met, including confidentiality, ethical approval, institutions' permission to conduct research, informed consent, anonymity, and integrity (See Muhtaseb, 2022).

### Data Collecting Tools

This research investigates educators' viewpoints on the integration of social media into different teaching modes, and this renders personal interviews as the most appropriate tool. Semi-structured interviews with open-ended questions are used in this study to allow participants to discuss their experiences, perspectives, and concerns. The formulation of interview questions was informed by the research objectives and existing literature (Appendix A). The interviews looked into how educators view social media technologies and the factors influencing their use of available resources and tools.

### Sampling

In this study, 18 semi-structured interviews are conducted with open-ended questions, enabling participants to talk about their experiences, perceptions and concerns. The research participants are

educators who work in formal and informal science education in Palestine. Six participants from each institution are selected, considering diversity in background, and age (see Table 1).

Table 1: Demographic Information of Participants

Age	Number of educators
o Up to 30 years	1
o 30-39 years	3
o 40-49 years	7
o 50-60 years	4
o Over 60 years	3
<b>Teaching experience</b>	<b>Number of educators</b>
o 1-5 years	2
o 6-10 years	5
o 11-15 years	3
o 16-20 years	2
o More than 20 years	6

The study identifies and selects three educational institutions that apply different teaching modes, specifically formal campus learning, formal blended learning, and informal community learning (see Table 2). The three case studies are situated in the city of Ramallah, a central Palestinian city. The lead author, a Palestinian individual residing in East Jerusalem, is affiliated with an informal learning institution based in Ramallah. Positioned in the West Bank, where the Palestinian Authority controls most affairs, Ramallah, like other Palestinian cities, grapples with significant obstacles, including travel restrictions, lack of informal learning venues, and political issues arising from Israeli control.

Table 2: The Three Institutions

	Formal Campus Learning	Formal Blended Learning	Informal Community Learning
<b>Teaching mode</b>	Face-to-face (Campus)	Face-to-face & Distance (Blended). Students can choose to study on campus, or as distance, or the blend of two.	-Workshops & training courses -Teacher professional development tracks -Community-oriented projects -Public events & activities (e.g., science festivals)
<b>Assessment</b>	Exams	Exams	-Assignments and projects for teachers' professional development tracks. -Activity evaluation forms (audience feedback)
<b>Students/learners</b>	Post compulsory education. Majority of undergraduate students are between 18-23 years-of-age.	Post compulsory education. The ages, academic abilities and professional backgrounds of students vary widely at this institution.	Community based learners, students, teachers, families.

## Data Analysis

According to Cresswell (2007), qualitative researchers employ qualitative approaches when that data is sensitive to the people and places being studied and that data analysis tends to be inductive and orientated towards establishing patterns or themes. With inductive coding, a researcher reads and interprets raw textual data to develop concepts, themes or a process model (that draws on data-based interpretations) (Corbin & Strauss, 1990; Boyatzis 1998; Thomas 2006; Chandra & Shang, 2019). Data are analysed using inductive coding methods that identify, analyse and compare open codes before grouping them into categories. The data analysis is conducted in three phases, and this makes it possible to identify and define common themes that will contribute to a better and deeper understanding of participant perspectives.



## General observations and impressions

Data analysis starts with listening to the recordings, reading the transcripts and noting observations and impressions. The choice of whether to code the transcripts in Arabic or English was made before qualitative analysis commenced. Since the majority of the literature on the research topic is written in English, transcripts were translated into English. Attempts to code one page of the transcript in each language were undertaken to confirm the validity of the results; and, upon comparing the resulting codes from the two transcripts, no discernible differences were detected. Once the transcripts were translated into English, the transcripts were read through several times in order to document general observations and impressions. During this period, the transcripts from each institution were read separately to ensure accurate capture of the respondent comments. Some observations are generic, while others are institution specific.

## The first treatment of data

This phase begins with open coding and the documenting of reflective memos. According to Yin (2014), memo writing begins during fieldwork and continues into the analysis stage. Memos may include hints, clues, and suggestions that expose any part of the data to preliminary interpretation. In open coding, data are segmented into meaningful expressions that describe them in a single word; a short sequence of words is known as 'codes' (Flick, 2014). After generating initial codes, we establish categories and then compare them: this makes it possible to organize and group some subcategories under main categories, then into major themes. Microsoft Word documents were used for the analysis and adding codes, categories and interpretations as comments. Table 3 shows a sample organisation of the codes into categories and subsequent themes.

Table 3: Illustrating the Process of Moving from Transcripts to Themes

Quotes	Code	Category	Main Theme
"This communication is neither considered part of the formal work nor part of the informal learning within the official work."	Teacher has concerns about lack of acknowledgment	Impact of institutional policies	Educator concerns & limitations
"I prioritize the privacy of my family and their personal news and information."	The teacher prioritizes privacy.	Privacy concerns	
"Students are used to get information as copy-paste from some resources such as Wikipedia, they even don't paraphrase sentences"	Students lack research skills	Lack of digital literacy skills	
"The ability to explain the science concepts and process is amazing, for example, when you use videos for teaching Biology courses, you can visualise the digestive system, some videos show you the blood circulation, it is like you are travelling through the arteries, or see the Amoeba through microscopic animation."	Utilizing videos to explain science	Videos & Visualization tools	Social media use in science education
"Students can't easily imagine how to turn a rectangle into a cylinder, I share with them resources that include animations which help students who may have difficulties with imagination. I also share with them videos about anything I find difficult in each unit"	Teacher utilizes animation and videos to explain math	Videos & Visualization tools	
"I think social media is indispensable to keep me well-acquainted with science updates in my specialization. It helps me stay connected with my friends and colleagues"	Staying well-acquainted with science using social media	Access to science resources & to the scientific community	

## The second treatment of data

After two weeks, a second treatment resumed, where codes and categories were generated. Comparisons were made from the resulting categories following the second coding, which allowed grouping of some categories into major categories and the identification of key themes. In this phase, a detailed analysis of significant themes was conducted that have the strongest connections to the study

to make sure those themes were not excluded. For instance, when investigating respondents' concerns, educators' limitations were identified as a central phenomenon and all pertinent codes and memos were collected. The analysis process continues until it reaches a saturation point where no further coders or categories emerge from the data analysis and no further analysis is required. Corbin and Strauss (2008) describe the saturation point as "the point when all the concepts are well defined and explained" and no new data emerges. They reported that saturation denotes the development of categories in terms of their properties and dimensions.

### **Validity and Reliability**

In the process of data collection and analysis, several procedures are taken to ensure the validity of the interviews. These include having two research colleagues review the interview protocol and questions to make sure that the data collection method appropriately addresses the research questions. The interview protocol is then piloted with three educators from the three institutions prior to the commencement of the actual study. A primary objective of the pilot study is to assess the cultural appropriateness of the interview questions. The analysis of the pilot interviews and in-depth discussions of the results comes next. The pilot interviews afford us the opportunity to refine the interview procedure, including the identification of potential obstacles, leading to adjustments based on these insights.

Prior to conducting interviews, we provided participants with an explanation of our research goals, as well as an opportunity to review and sign the informed consent form and the working definitions. Following the interviews, we send an email transcript to every participant asking them to verify that our interpretation of their words or opinions was accurate. We conduct the interviews in Arabic, translate the transcripts into English and then ask two colleagues who are fluent in both languages to confirm their accuracy while maintaining the confidentiality and anonymity of participants.

### **Presentation of the Findings**

Four themes emerge during data analysis, specifically; educator perceptions of social media affordances; the use of social media in science education in Palestine; educator concerns and limitations; and cultural aspects that influence the use of social media in science education in Palestine. This article focuses on educators' perceptions of the impact of social media on science education, including fostering student learning, improving teacher efficiency, utilizing research tools and resources, and communicating science through social media. Other themes that emerged from the thesis where the study was situated are explored in a separate paper (See Muhtaseb et al., 2023).

#### **1. The Impact of Social Media on Science Education in Palestine**

The interviews aim to explore how Palestinian educators perceive the use of available social media tools and resources in science education. Four categories are identified, including:

##### **Fostering student learning**

The educators who participate in this study value the richness of resources offered on social media and describe how it supports teaching and learning, expands student research options, fosters self-learning opportunities, and creates possible access to alternative resources and tools. They note that social media offers diverse tools that help explain science concepts using visual illustrations and simulation tools.

A significant 94% of study participants mention using videos and visual tools for educational purposes. For instance, Respondent M3 illustrates, "When you use videos for teaching Biology courses, you can visualise the digestive system, some videos show you the blood circulation, it is like you are travelling through the arteries". Similarly, Respondent F15 shares, "Students can't easily imagine how to turn a rectangle into a cylinder, I share with them resources that include animations which help students who



may have difficulties with imagination". This finding echoes Won's (2015) observation that undergraduate biology students significantly benefit from engaging with visual media, including interactive videos and animated posts, due to its capacity to deepen engagement and understanding. In line with this, Holder-Ellis (2015), who refers to physics education, emphasizes the necessity of visual reinforcements when experiments cannot be effectively demonstrated in the classroom, while Wen et al. (2023) highlight how interactive videos and animations promote students' understanding of scientific concepts.

Respondents from both formal and informal institutions have noted a shift towards personalized learning, meaning that students can learn anytime and anywhere and in ways that correspond to their capabilities. For instance, Respondent F14 describes how social media helps to make learning more personalized: "I think the available tools give students the possibility to learn according to their own capabilities, they can also rearrange the material as they desire, they can easily access electronic resources, develop their skills using the available tools, and enhance their academic abilities". Similarly, Respondent M7 observes, "Students are no more passive recipients of information, perhaps this is the worst learning method, but if you offer students different resources, including teachers, Wikipedia, YouTube, or whatever, and allow them to seek out information and to connect these resources, they are able to construct their own knowledge". This is consistent with the principles of Connectivism, which emphasize how students operate within their knowledge networks, changing from being passive recipients of knowledge to active participants who responsibly synthesize, create, and share new knowledge by drawing on multiple dissemination technologies and applying them across multiple networks (Dunaway, 2011).

### **Improving teacher efficiency**

Analysis of participant perceptions shows that educators place a clear value on the potential of social media to improve the efficiency of science education. This includes facilitating communication and data sharing and making blog-based documentation of experiments easier. Respondents (e.g., M2, M5 and F18) promote practical work by posting lab experiments for students and using lab/fieldwork applications. Each lab has a session where a video is displayed, the Respondent (M2) notes.

Some educators connect workgroups in different geographic locations by using social networks and chat groups. Respondent M5 observes that he uses academic and professional social networks such as LinkedIn and ResearchPad to connect with students, and Respondent F9 observes that "another positive role is the group work via the Social Networks; it allows large groups to work together while being at their homes". Respondents M3 and M16 observe that instant communication over social media helps to overcome some difficulties caused by the occupation, who observe how continual closures impact the ability of a group of teachers to access their schools. Respondent M3 describes how the university developed the Ritaj LMS platform to overcome some of the challenges connected to occupation:

Since the year 2000, we launched the "Ritaj" platform, and the reason behind developing this platform was that many students were unable to access the university through the second intifada [uprise], Surda road has been closed by the Israeli soldiers, so we found this platform in which the lectures were uploaded as videos where all students can watch them, and when students can meet their educator, they discuss what they watched and cover what was missing.

Some respondents use social media to initiate discussions, share visual content as part of the course content; and prepare lessons and workshops. Respondent M16 notes the potential time-saving benefits of utilizing available tools. He observes, "You may find a simple tool online developed by another university; although this tool may not be professionally created, it can help students in understanding the topic". Respondents from the campus and blended learning institutions describe changes in lecture

delivery. For example, Educator M5 observes: "All of the courses I teach involve a YouTube component because we get case studies, I send the link and ask my students to watch it." And Respondent F15 notes: "Sometimes I use videos as an inverse classroom. I ask students to watch it before the lecture, and to come to the class to turn the class into a discussion panel about the video". These changes in traditional teaching methods can also make a significant contribution to overcoming some challenges that confront the education system in Palestine. For example, the *2014 Palestine Human Development Report* identifies many limitations connected to traditional teaching methods, and specifically notes that school subjects cultivate extensive passive memorization, and the education system focuses on teaching ideas often without discussion, critical analysis, or problem-solving skills ("The 2014 Palestine Human Development Report", 2015).

Siemens (2005) highlights the critical role of nurturing and maintaining connections with information sources to facilitate continual learning in the digital age. This concept is mirrored in the actions of educators in this study, who extend their engagement with learners beyond traditional working hours, sharing science topics and scholarship opportunities on their profiles, and even maintaining active connections through Facebook pages dedicated to their courses, engaging with students from across the Arab world. These pages often remain vibrant communities of learning even after course completion. Siemens' later work (2010), discusses the roles of teachers within a Connectivist learning environment, noting that these roles encompass high drawing attention to content elements, ideas, and thoughts; providing learners with various information sources; and guiding students through their learning journey. Correspondingly, many interviewees gave examples of embracing new roles, such as suggesting online resources to their students and offering them guidance through digital means. For instance, participant F8, a Mathematics educator, endorses videos by a renowned MIT lecturer, Thomas, to aid students' understanding of complex concepts.

### Research tools and resources

Nearly two-thirds (66 percent) of respondents value the richness and diversity of resources available on social media. They provide many examples of the use of available tools for promoting science education. For example, Respondent M2 encourages students to apply social media tools to science. He recalls: "We motivate students to look for videos on animal behaviour, and encourage them by giving bonus grades". Respondent F12 uses mobile applications in science festivals. Respondent M10 identifies an opportunity to ensure students are not limited by curricula. He observes: "Because the school curricula are decided by the ministry of education and the educator, but with the internet world and social media, now, students can go wherever they want with one click". Respondent M11, when asked about social media opportunities for informal science learning, observes that social media has made knowledge accessible to everyone. He notes: "children can access information, see science experiments and apply these experiments at home". This could increase opportunities to interact with science content and compensate for the lack of informal science learning venues in Palestine.

Many educators use different social media tools and resources for academic, personal and professional purposes. Respondent F13 uses some tools for professional development: "I use ResearchGate to find scientific papers or to get some references, I also use LinkedIn highly, it is a tool to build academic and professional record, it includes job opportunities, I update it regularly with new courses I attend." McPherson et al. (2015) similarly suggest that social media can be used to build local and global networks of educators; enhance information flows; inspire and motivate academic practice; and engage in meaning-making and knowledge production. However, Luo et al. (2020) suggest that the research on social media's role in faculty development within higher education is still in its early stages.

One respondent expressed, "I think social media is indispensable to keep me well-acquainted with science updates in my specialization." This perspective aligns with Siemens' (2005) assertion that currency (accurate and up-to-date knowledge) is the intent of all connectivist learning activities. Trnova and Trna (2012) note how incorporating connectivist teaching/learning methods into science education

allows teachers to exchange experience and also encourages students and teachers to communicate with colleagues in other countries.

### **Communicating science through social media**

Analysis of the findings reveals the potential to use social media for science communication, promoting science literacy and engaging in public outreach. Some educators use social media to engage outside the classroom, by posting science news and science-related activities on their personal accounts. Respondents frequently spoke of the 'added value' of social media as a tool for science communication, which included using science-related mobile applications for informal science activities and encouraging students to use the available tools for science learning purposes. Two educators (F4 and M7) encourage students to use available social media tools to practise science communication. The former recalls "I encouraged students to create a group for astronomy in which they practise informal science education and communication".

Respondents repeatedly mentioned that social media offers educators various opportunities to connect with scientific communities and experts from across the world. And respondents from the informal community learning context place a high value on using social media for informal learning activities, and especially for connecting with the public community. This is consistent with Alabdulkareem (2015) and King and Sen (2013), who highlight how social media has a role in developing social interactions between students and society and extending student learning experiences beyond the classroom. It also recalls the work of McClain and Neeley (2014), who highlight the role of social media in science outreach by showing how undergraduates use social media to educate the public about specific animals, and enhance their understanding of specific organisms and the scientific process. The aforementioned examples highlight the potential for social media to be used to bridge the gap between formal and informal science education.

The literature shows that many citizen science projects benefit from social media tools and mobile apps to promote crowdsourcing and data sharing (e.g., McClain & Neeley, 2014; Song & Bonk, 2016). However, none of the participants mentioned Citizen Science, and we were unable to find any studies referring to similar examples in the Palestinian context. This could be connected to Palestine's dearth of informal science learning venues, combined with insufficient support for the sector of informal learning in Palestine.

## **2. Limitations and Concerns Surrounding Social Media Use in Science Education**

### **Work-life balance and workload challenges**

66% of participating educators express concern about work-life balance and increased workload due to communication through social media. They cite examples of receiving messages outside working hours, after exams or at inappropriate times. It should be noted that Palestine's informal culture may play a role in this. Some educators assert communication rules to manage this challenge, such as dedicating certain times to interact with students on social media or restricting interactions to a single platform. Some educators refer to difficulties created by continual changes in available tools and platforms. Respondents M2 and F16 claim they are overwhelmed by the number of available tools. Respondent F12 also suggests there is a disparity between changes in digital technologies and their use in education.

### **Institutional policies and practices**

Respondents describe limitations that include institutions not acknowledging online work hours as work time or not giving staff enough freedom to choose teaching methods. Respondents M3 and F14 suggest that formal learning institutions are concerned about student misuse of social media tools. But no respondents mentioned any restrictions on the use of informal platforms for educational purposes by their institutions. Respondents M16 and M17, who are from the blended learning institution, observe

that they have to use the traditional assessment approach, which they view as impeding the initiation of new teaching modes and affecting the willingness of students to follow their recommendations.

### **Concerns regarding content and credibility**

Respondents also mention other concerns connected to available content on social media. Some educators are worried about undesirable adverts, and express concern that some suggestions could be culturally inappropriate and also highlight the possibility that distracting or irrelevant content may appear on some platforms. Respondents also questioned if the scientific sources that students access on social media are credible and trustworthy. Respondents F1 and M3 suggest the lack of science resources in Arabic is a barrier, although respondent F8 (a Maths teacher) recognises this may not apply to all scientific fields. For example, when she was asked if language is a limitation, she observes: "There is no problem with Mathematics because they [students] can comprehend by reading the symbols."

Respondent M17 notes: "I see that most people do not give a concern to the credibility of the content which they find online, I find this a very important issue". Song and Bonk (2016) also identify several obstacles to informal online learning, including a lack of quality resources. Respondent M16 finds it difficult to identify student plagiarism. This is consistent with the findings of Evans (2017), who notes instructors express concerns over their ability to validate the accuracy of the sources and supplemental materials posted by their students, and also a study that explores how Saudi faculty perceive the use of social networks in education, which highlights the large quantity of duplicate or repeated content on platforms, along with a lack of accuracy in dissemination and copyright (Alsolamy, 2017).

### **Digital literacy and research skills**

A number of respondents (including M3 and M16) cite a lack of digital literacy and research skills as contributing to inappropriate student practices. Three respondents (M3, F8 and F18) recommend developing students' digital literacy, and argue this can help them use social media in a way that promotes effective learning. In the same vein, Koehler & Vilarinho-Pereira (2021) recommend that instructors help learners develop their digital literacy skills to effectively use social media for academic purposes. Respondent M3 observes: "One of the challenges is copying content from other sources without giving credit to the source". However, it can be argued that copying content from other sources is a form of digital literacy (i.e., reproduction).

### **Student engagement and interest**

Some participants express concerns about low engagement, and some educators attribute a lack of student interest to the content that educators share or recommend. One educator attributes low levels of student engagement to the fact that students underestimate the value of online content or view content that is not required in the exam as being unimportant. In the same vein, Shraim (2014) describes how some students at An-Najah National University in Palestine who were used to strict, syllabus-directed lecture courses felt confused when they participate in informal activities through Facebook. This may also be due to the fact that students schooled in traditional assessment methods are exam-oriented, and therefore view online activities as optional and/or unimportant. The findings also suggest that levels of interaction could be connected to the topic or teaching method. One Physics teacher (F4) observes: "In physics, we solve problems on board, you read the question, write the inputs and the equation, then do the calculations, if you show them [students] a problem on PowerPoint they don't interact like when you solve it with your hands", she adds: "students prefer solving equations on a board more than viewing the solution on slides". This echoes Holder-Ellis (2015), who quotes a teacher who maintains that some physics experiments cannot be effectively demonstrated in the classroom. Similarly, Danjou (2020) highlighted challenges in the distance teaching of organic chemistry, where a significant constraint was connected to the topic itself since teaching organic chemistry requires the drawing of molecules, electrons' movements, and vectors, which is difficult to convey effectively through digital means. This reinforces the notion that educators should not assume that one tool is appropriate for all scientific fields and topics.

## Discussion

The analysis of participant answers shows that educators recognize the significant role social media can play in enhancing various facets of both formal and informal science education in Palestine. Many educators highlight the effectiveness of various tools and resources in explaining science-related concepts and phenomena. However, certain educators challenge the assumption that a single tool could be universally appropriate for all scientific disciplines and topics. This has been noted elsewhere in a study undertaken by Traxler et al (2020), who identified that importing solutions from general to local contexts without sight of cultural sensitivity and immediate needs and expertise is inevitably incomplete. This, then, tends to represent only partial successful solutions, often mediated by Western or global understandings and processes.

The study reveals some differences in perception of social media tools among educators from formal and informal institutions. For example, educators from the informal community learning institution highly regard social media's capacity to publicize events and activities and to foster connections with the broader community. On the other hand, some educators from formal educational institutions contend that certain science subjects necessitate face-to-face interactions, collaborative group activities, and explanations on a physical board, as opposed to relying solely on digital platforms and tools. This raises questions about the hegemonic esteem with which science is accorded through formal institutions, normally centred in the Global North and West. Their institutions commonly represent themselves as the vanguard of formal and universal science. This is to the detriment of organizations in, for example, the Global South or peripheral countries, who cannot easily publish or have access to construct knowledge through funded projects. In those cases, informal education, such as through social media or citizen science can support this proliferation (also see the works of Held, 2023, and Melville et al., 2022).

The findings point to the importance of addressing the challenges Palestinian educators and learners face when they use social media for educational purposes. This requires receiving continuous feedback from learners and educators which help educational institutions to develop or make any required changes to the educational policies or plans. Change often comes from instinctive innovation by practitioners based on students' needs, rather than directives from leadership (Scott and Smith, 2024). Existing policies on digital tools also have a number of weaknesses, including the lack of updates or significant changes in policies related to digital learning, and bureaucracy (Wahbeh, 2006), and need to be reformed.

Educators describe forms of digital collaboration and illustrate how they employ social media to reach learners inside and outside institutional boundaries. To harness the full potential of social media in enhancing formal education, it is imperative for educational institutions to recognize and adapt to the evolving classroom dynamics, which must be translated into giving educators more autonomy to host and curate practices in these other spaces. This has been called the 'third space' (Schuck, Kearney and Burden, 2016), mobile learning that exists beyond formal educational remit and which the pandemic or social backdrops like military occupations or education for the displaced have shown to be substitutes, if not always formally legitimised. Institutions can implement various procedures to support educators' use of social media platforms for educational purposes, such as providing support and strengthening their knowledge of digital technologies and their use in education. Additionally, the Palestinian education system continues to adopt teacher-centred methods (Shraim, 2010; Ramahi, 2015), which discourages students from learning independently. More efforts are needed to provide educators with orientation on different digital learning pedagogies and collaborative learning approaches, as shown in more recent projects where local culture and identity is paramount (Scott, Bakeer and Ujvari, 2023).

The findings raise questions about the credibility of scientific sources that students go to in social media. This issue can be addressed by developing Arabic language guidance that teaches students how to identify authentic sources from unreliable ones. Respondent (F13) draws attention to the lack of



guidelines for digital learning in Arabic. Furthermore, educators need to guide students towards using social media effectively, direct them to appropriate and reliable sources (Alabdulkareem, 2015; Shraim & Crompton, 2020). Other limitations include a lack of digital literacy among, which can be most effectively overcome by providing students with training workshops and digital literacy courses at an early stage before they start their undergraduate degrees. This is particularly important because the review of literature reveals that developing students' digital literacy was not among the priorities of the Ministry of Education and Higher Education in the Education Sector Strategic Plan 2017-2022. In this regard, Traxler (2018) suggests that the challenges facing Palestinians in different areas require very specific digital skills, attitudes and choices. The author argues that Palestine needs its own 'version' of digital literacy, one that is critical, activist, culturally specific, and culturally sensitive. Concerns about the dearth of science content in Arabic language could be addressed at the regional level by increased emphasis on the production of approved Arabic language content that can be used for teaching purposes. Supporting collaborative efforts to collate credible science resources is also necessary and may come about through citizen science projects that harness the currency of individual and community contributions through third space forms like social media interfaces (Jopling et al., 2024).

This study examines the applicability of Connectivism —a learning theory proposed in a western context — to the Palestinian context. Numerous instances cited by participants align with the eight principles of Connectivism as outlined by Siemens (2005). Moreover, the study reveals additional factors, including traditional school education and a lack in digital literacy, that influence students' and educators' Connectivist practices. Additionally, the scope of Connectivism's applicability and its relevance to the Palestinian context are clearly constrained by Israeli regulations over Palestinian communications, cyberspace and mobility, which significantly limit Palestinians' ability to freely express themselves and engage in digital activism. Furthermore, it is worth noting that the balance between the physical and the digital realms differs across societies. In contexts where freedom of movement and association in the physical domain is restricted, such as in Palestine, digital spaces become increasingly important avenues for expression and interaction.

### **Conclusion and Suggestions**

This paper reports on the findings of a study that explores the perspectives of Palestinian educators on the use of social media in formal and informal science learning contexts. It reveals a consensus among the majority of participants that social media can positively contribute to both formal and informal science education in Palestine, spanning both structured classroom settings and more flexible, informal learning contexts. However, the research identifies notable variations in how educators use and perceive social media, with these differences being attributed to the nature of learning activities facilitated at each institution, institutional policies, assessment methods, and the particular science subjects being taught.

Social media enhances educational experiences by offering new tools and resources that could be used to introduce and initiate new teaching and learning practices. Palestinian educators have introduced social media in response to the existing challenges that currently confront the Palestinian education, which include a lack of access to resources, lack of advanced science equipment, lack of informal learning venues, and mobility restrictions (Wahbeh, 2015; AbuShanab, 2018; Itmazi & Khlaif, 2022). However, the participants reported some constraints that may prevent the potential of social media from being realised in educational contexts. It is accordingly recommended to investigate the issues and questions raised by the findings by initiating a larger sample of students and educators. In addition, the findings are based on the viewpoints of educators and the perceptions of learners were not explored. Interviews with learners could provide further insight into the findings and will help to establish more generalizable results. Furthermore, including multiple data sources could strengthen the validity of the findings.

While the study centered on three case studies within the city of Ramallah, it presents valuable insights into the dynamics of utilizing social media in science education within Palestinian institutions, and holds



significant implications for other Palestinian educational institutions facing similar political and security challenges. In addition, the study's exploration of the unique socio-political landscape of Palestine provides a rich foundation for understanding the challenges associated with integrating technology in education in societies with comparable political and security situations.

Finally, the continuous escalations in Palestine and their wider implications have profoundly shaped Palestinian society and its cultural and social dimensions. These upsurges negatively impact learners, educators and the education system in Palestine, and also have wider economic implications. Therefore, there is a need for continuous research that explores how digital tools can be applied in formal and informal learning contexts to overcome existing challenges. It is also essential to take different variables (including economic and socio-political ones) into account when studying how digital technology is implemented in formal and informal learning contexts, and to consider the appropriateness and affordability of technology and the technical needs of both learners and educational institutions.

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## Appendix A

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### Interview Questions

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**Basic information:** Introductory questions, basic information about the participants.

**Q1.1:** Tell me about your role in this institution? Which category of learners do you deal with as part of your role at this institution?

**Probe:** Are they distance learners? Have often do you meet them?

**Q1.2:** How often do you use social media tools in your daily life (personally and professionally)?  
→ If the answer is "I don't use" the 'usage' questions will be skipped

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**Social media tools:** Exploring used tools, educational use, extent of use.

**Q2:** Which type(s) of social media sites do you use personally/ educationally?

**Probes:**

What platforms/groups/pages are you active on, and what online resources do you find helpful.

Any other groups you are active in?

What social media tools do you find helpful professionally? For what purposes?

Can you mention some examples?

What kinds of resources do you find helpful?

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**Activities:** Exploring learning activities in which social media tools and resources are utilized, criteria of selection.

**Q3:** Do you use social media for educational purposes?

→ If not, skip to Q5 – selection.

Can you describe a learning activity that you think has enhanced students' learning?

**Q4:** In your view, what value (or affordances) has social media added to science education and communication?

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**Educators Perceptions:** Educators' perception of the impact of social media on teaching and learning, their conceptualisations of learning and teaching that influence their approach to using these tools.

**Q5:** What is your perception regarding the integration of social media for teaching and learning?

**Probes:**

What benefits do you perceive of using these social media tools in teaching and learning?

What challenges do you perceive of using social media tools in teaching and learning?

How can challenges be overcome?

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**Culture-related questions:** Exploring educators' cultural barriers and concerns that influence their utilization of social media? (Discussed in a separate paper (See Muhtaseb et al., 2023))

**Q6:** Could you please describe the influence of culture in Palestine on your utilization of social media tools and resources in formal and informal learning?

**Probe:** Do you face any other cultural challenges or barriers?

**Q7:** What concerns do you perceive of using social media tools professionally/academically?

**Probe:** Do you face any privacy-related issues while interacting with your formal/informal learners?

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