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Exploring the Forms of Online Informal Learning to Develop 21st Century Skills Among Secondary School Students

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Abstract— This study aimed to investigate the acquisition of 21st Century Skills through Online Informal Learning (OIL) among secondary school learners. A mixed-methods approach consisting of questionnaires and focus group interviews was used to collect data from 310 secondary school students in Mauritius. The data was then analysed to draw conclusions. The research shows that students take advantage of digital technologies such as YouTube, online discussion boards, and instant messaging apps for informal education to learn informally and develop their 21st Century skills. They use these resources for a variety of reasons, including to share information, communicate, pursue their own interests, and express themselves. The study demonstrated there were positive impacts of OIL on the development of their critical thinking skills, collaboration, communication, and creativity. Google, YouTube, chat groups, message boards, and YouTube were identified as effective tools to facilitate the development of these skills. Collaboration and critical thinking skills were found to be promoted through the use of these tools, while communication skills were developed through chat groups and message boards. This research highlights how OIL can be used to cultivate 21st Century skills among many different individuals and groups. Educators should consider OIL as an important approach to develop of 21st Century Skills and to bridge the knowledge-performance gap. By leveraging OIL, educators can help students become more self-directed, digitally competent, and more engaged in the subject matter.

Keywords— OIL, 21st Century skills, Secondary School Students, Mauritius.

1. INTRODUCTION

In this technological era, every secondary student is exposed to digital or online tools in one way or another either for academic purposes, for their leisure activities, or for learning something new on a topic of interest. However, what hasn't been explored is the degree to which secondary school students can acquire 21st Century skills through Online Informal Learning (OIL). Moreover, to become a global citizen in the competitive job market, it is imperative for students to develop 21st-century skills such as interpersonal communication, teamwork, creativity, information literacy, and the capacity for critical thought.

Since online tools are used extensively by most students as part of the learning process, these tools have the potential to help students develop skills related to communication, collaboration, creativity, digital literacy and critical thinking (Szymkowiak et al., 2021). However, how these skills are acquired through the use of online informal learning tools is still not well understood.

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The global economy of today demands a distinct set of 21st century skills that were previously not included by educational institutions in the 19th and 20th centuries. As students enter a world where they are required to operate in a globalized, diverse, and networked space, these skills have become imperative (Suto, 2013).

The ability to handle complex integrated circumstances, gather and evaluate data from many sources, and keep up with technological advancements and changes in the workforce require a completely new set of knowledge, skills, and thought processes (Akour and Alenezi, 2022).

With the help of Web 2.0 tools, students can acquire 21st Century skills outside of formal learning approaches. In fact, fostering 21st-century skills like teamwork, the ability to think critically, imagination, and knowledge of technology through the incorporation of Web 2.0 resources in informal learning environments could be extremely successful (Manago and Pacheco, 2019). Student collaboration, critical thinking, and creative expression are developed through Web 2.0 technologies such as websites, wikis, social networking systems, and internet-based discussion boards (Limba, Lelešienė, and Novogreckas, 2022).

Additionally, Web 2.0 tools enable personalised and independent learning, which has become a crucial aspect of education in the twenty-first century. With the aid of these resources, students can follow their passions and participate in project-based instruction, which promotes in-depth comprehension and long-term memory of information (Halim and Hashim, 2019). Overall, utilising Web 2.0 tools in informal learning opens up opportunities to provide students with the skills they need to succeed in the twenty-first century, and it may be a great addition to more conventional educational approaches to acquiring these skills (Sofi, Idhoofiyatul, and Nina, 2022).

Online informal learners are largely aware of increased vocabulary as they watch, memorise, and frequently reuse spoken chunks (Sockett and Toffoli, 2012). It is suggested that engaging in online conversations and hearing stories can help students become more fluent listeners. However, only a few studies have shown the connection between acquiring 21st Century skills through the use of online informal tools. Therefore, this research aims to explore what forms of OIL occur among secondary school learners through online tools.

2. LITERATURE REVIEW

Understanding 21st Century skills

In order to prepare children for the more difficult academic demands of life and career in the 21st century, many countries worldwide have carried out a wide range of content, teaching, and assessment changes. In today's world, which is changing swiftly, students need 21st-century skills to flourish. 21st Century Skills are defined as a vast body of knowledge, skills, behavioural patterns, and personality traits that are thought to be essential for success in the modern environment, particularly in college programs and modern professions and workplaces, and may be utilized in all cerebral areas of study and throughout all academic, professional, as well as social settings (Onbasili, 2020). As a result, 21st-century skills like innovative thinking, innovative thinking, interaction, and social and emotional abilities have become in great need. Global educational goals are incorporating 21st century skills like collaboration, critical thinking, and problem-solving in addition to traditional academic knowledge like reading and math. For the purpose of giving students the skills they need, attempts are being undertaken to

integrate 21st-century capabilities into schools and universities (Hirsh-Pasek et al., 2020). This study will focus on just five skills: collaboration, imagination, electronic interaction, and critical thinking.

Online Informal Learning

Informal learning is defined as anything which involves the acquisition of knowledge, comprehension, or abilities yet doesn't use wholly artificial educational standards (Peters and Romero, 2019). Informal learning is autonomous, takes place beyond school settings, and is unrelated to any specific programs or group of people.

The need for 21st-century skills has been voiced by high-profile groups, politicians, business executives, and educators as far back as 20 years ago (National Research Council, 2012). They argued that the current focus on memory retention and rote learning is insufficient to get students ready for a world that is rapidly changing, and becoming increasingly connected and information-rich (Nye, 2022).

In 2019, Andreas Schleicher, the director of the OECD's Directorate for Education and Skills, said, "Learning is more than simply imparting a product; it is essential to provide students with the resources they must use to manoeuvre one another in an intricate, unstable, and unsure world by means of the creation of an accurate compass and navigating tools."

We have to begin with our creativity, understanding, and abilities, and, ultimately, with our common ideals, intellectual maturity, and moral obligation to make the world a better place. At the moment, people learn formally through various approaches (Lai, 2017). The practice of searching for information online is widespread among secondary-level students.

3. CONCEPTUAL FRAMEWORK

In this section, the conceptual principles that underpin OIL and 21CS research are outlined. This includes Activity Theory and the P21 21st century skills framework.

In addition, an analytical lens of how and why OIL can be used to acquire 21CS is also presented for the study. This chapter, therefore, justifies the use of the conceptual framework used for this research and reviews its interconnectedness and compatibility with the study.

Activity theory (Engeström, 1999; Leont'ev, 1978)is a psychological and interdisciplinary framework useful for Bstudying human behaviours (Heo and Lee, 2013; Bagarukayo et al., 2016).

It does this by integrating both the personal and societal levels. Through the use of social media and online activities, virtual interactive instruction outcomes, particularly through the interaction of human impact within a given space.

Participants of that specific system secondary education students' objectives of acquiring 21st century skills using digital educational components. Online learning tools are interconnected and continually rebuild one another. The schema in Figure 1 depicts how Activity Theory and the P21 21st Century skills Framework were used as theoretical lens in this study.

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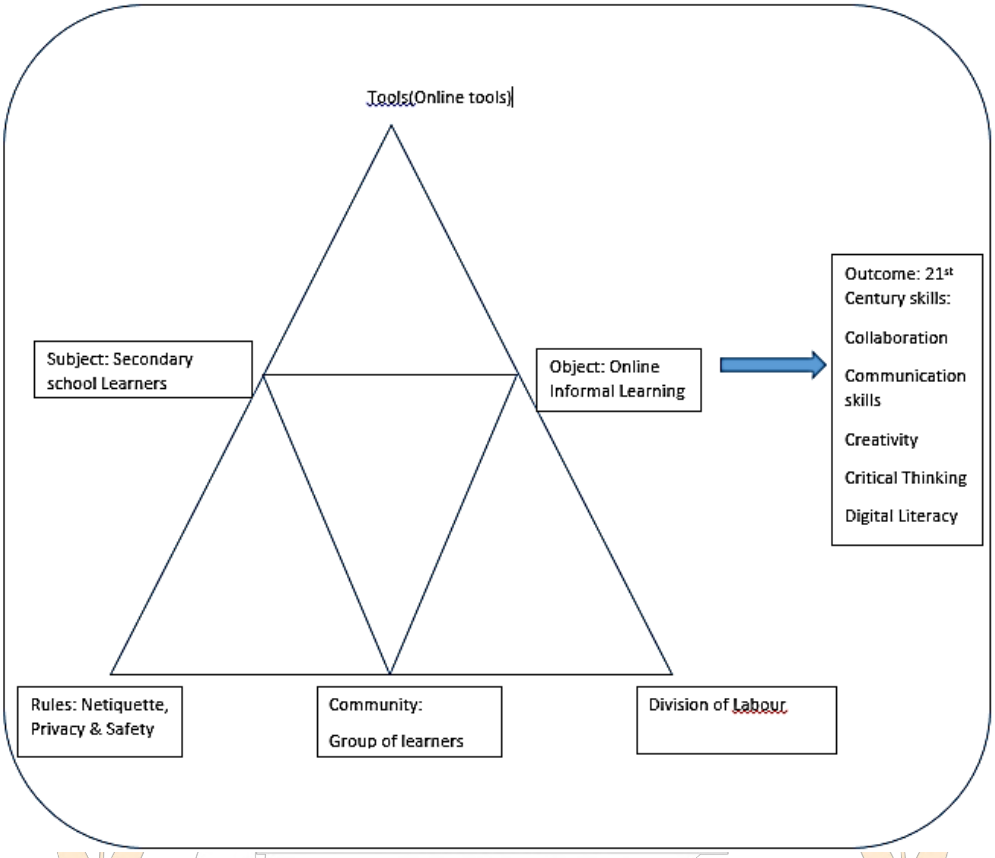

Figure 1. Conceptual framework used in study

In what ways is Activity theory related to OIL and 21st Century skills of secondary school learners?

According to the activity hypothesis, students learn in specific ways as a result of their activities and act within specific circumstances, which ultimately leads to the development of 21st century abilities as a result of their actions. Additionally, using the Activity Theory system, it is possible to analyse and interpret the variables affecting students' acquisition understanding and skills for application as an outcome of the variables affecting the way they grow (Bagarukayo et al., 2016).

Engeström (1999) emphasizes on the mediation elements as well as the communal aspect of the activity throughout his investigation of the human mind in society. Che and Ibrahim (2013) emphasizes the relationship between learners and online tools as mediators for online informal activities as part of their study. They also highlight the significance of internet tools in mediating formal interactions on the internet. One of the most reliable definitions of 21st century talents was created by M.P21 (previously the Alliance for 21st Century talents).

The P21 framework (P21, 2009) and Activity Theory were combined with a theoretical lens for understanding why and how OIL affects secondary school students' 21st century skills. Activity Theory is used to define the learning environment and instructional methods (Hodgkinson-Williams and Deacon, 2013). According to activity theorists, practice should be seen as a systemic change of activities (Bagarukayo et al., 2016). The Activity Theory was employed as a theoretical lens in this study to evaluate how interactions with online technologies contribute to OIL and the development of 21st-century skills. Researchers would therefore benefit from using activity theory

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to better understand the role that online tools play in fostering the development of 21st century abilities through OIL and to assess if learners have undergone any transformations by looking at OIL activities.

4. RESEARCH METHODOLOGY

To carry out this study, a mixed-methods approach was used, consisting of questionnaires, semi-structured interviews, and focus group interviews. Descriptive statistics and SPSS version 27 were used to analyze the data gathered from questionnaires, while thematic analysis was applied to the data from the interviews. Research was conducted over a period of six months to investigate how 21st-century skills were acquired through OIL. Purposive sampling was used to select participants, who were secondary school learners from different age groups ranging from grade 7 to grade 13 that used online media for academic and non-academic purposes. Data was collected through a single survey instrument, which consisted of four sections that collected personal and demographic details, student experiences and perceptions of online tool use, and the acquisition of 21st-century skills through OIL. The Likert scale was used to obtain responses from participants, and the data collection tools were selected based on the conceptual framework, critical questions, and research design.

Results of study

The survey results provided information on the demographic distribution of the participants, including their age group and grade, as well as the online tools used by them for online learning. These results are shown in figure 2

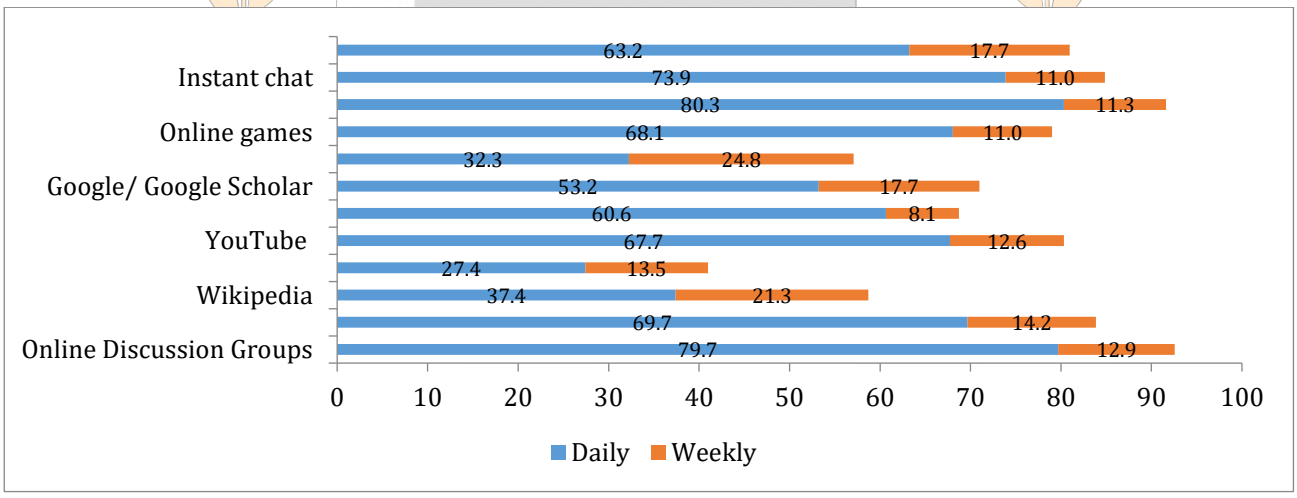

Figure 2. Online Technologies used for OIL

Different online technologies used by secondary school learners used by respondents for Online Informal learning.

The study found that secondary school learners use online tools, such as simulations/games, text messaging apps, internet websites, video/audio clips, and message boards, on a daily basis for informal learning and academic help. YouTube and Netflix were the most popular video/audio platforms, while WhatsApp, Twitter, Snapchat, and Instagram were the most popular text messaging apps. The least popular tools were blogs, Wikipedia, Google, and MP3 players.

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Reasons for using different online Informal technologies

Secondary school learners used OIL tools mainly for sharing information and interpersonal communication, as well as for fun, to pursue their hobbies, develop self-identity, and maintain social relationships, self-expression, and expertise.

Acquisition of Critical thinking skills through OIL tools.

The study sought to investigate whether secondary school learners can acquire Critical Thinking skills through the use of OIL tools. The scale for the acquisition of critical thinking skills through OIL comprised six variables. Figure 3 depicts the frequency of the themes associated with critical thinking skills.

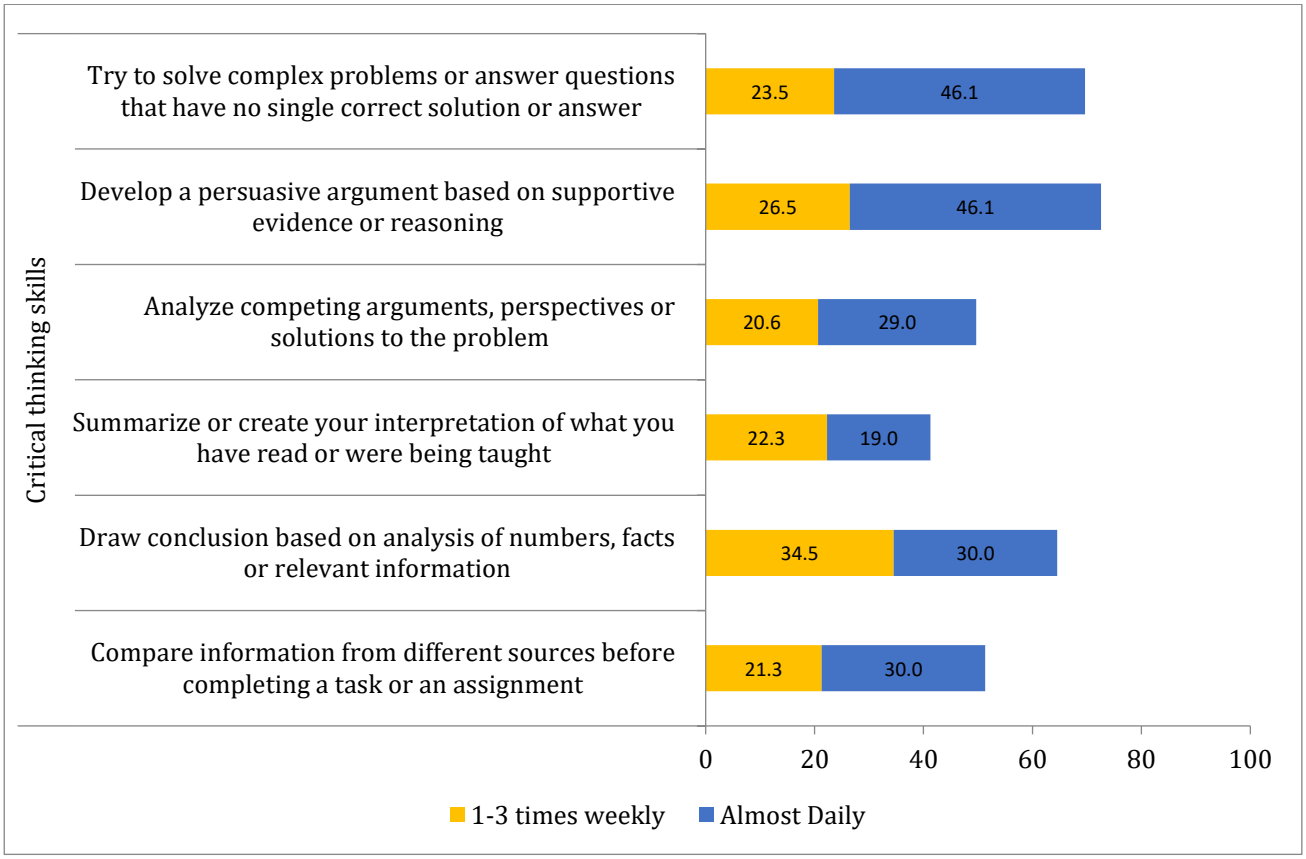

Figure 3. Critical thinking skills through OIL

The study found that online informal tools can facilitate the development of critical thinking skills in secondary school students, such as comparing information, drawing conclusions, summarizing, analyzing arguments, developing persuasive arguments, and solving complex problems. Figure 4 represents the different online tools used for acquiring critical thinking skills.

Online Tools used to acquire critical thinking skills

The analysis revealed that Google, YouTube and Chat were the most popular online tools used by the respondents to acquire critical thinking skills. The least used online tools were Blogs and message boards. Figure 6 shows the tools used for critical thinking skills.

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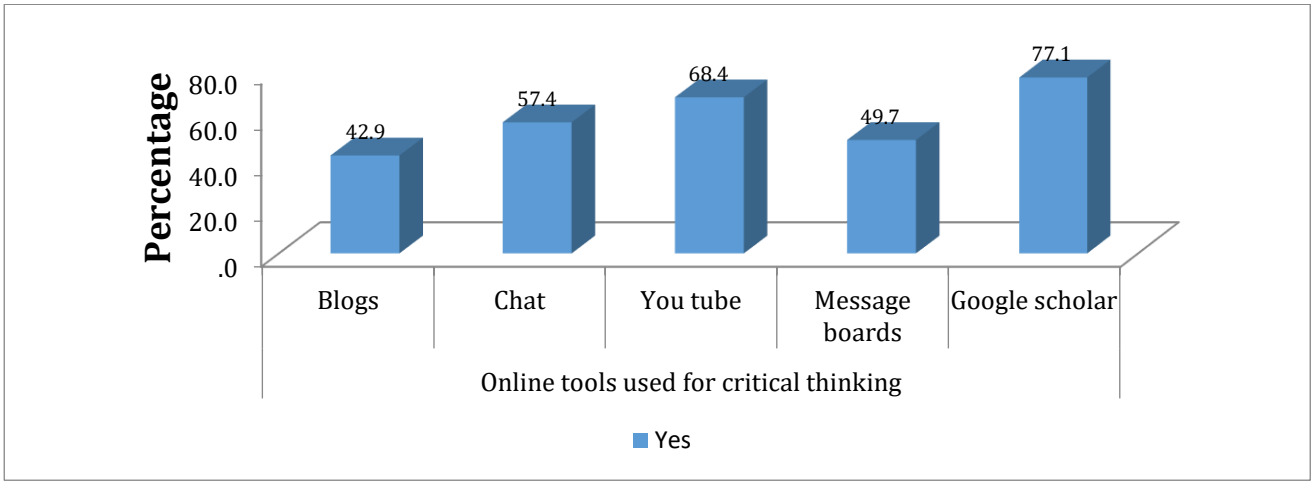

Figure 4. Tools used for Critical thinking skills

Acquisition of collaborative skills through OIL tools

The second research question examined the effects of OIL on the collaborative skills of secondary school students. To measure the acquisition of these skills, five variables were measured using questionnaires. The results indicated that secondary school students could increase their collaborative skills through activities such as working in pairs or small groups (53.2%), solving problems as a team (58.4%), and other activities. The results presented in Figure 5 revealed that secondary school learners can develop their collaborative skills by using online tools daily and weekly to work in pairs or small groups

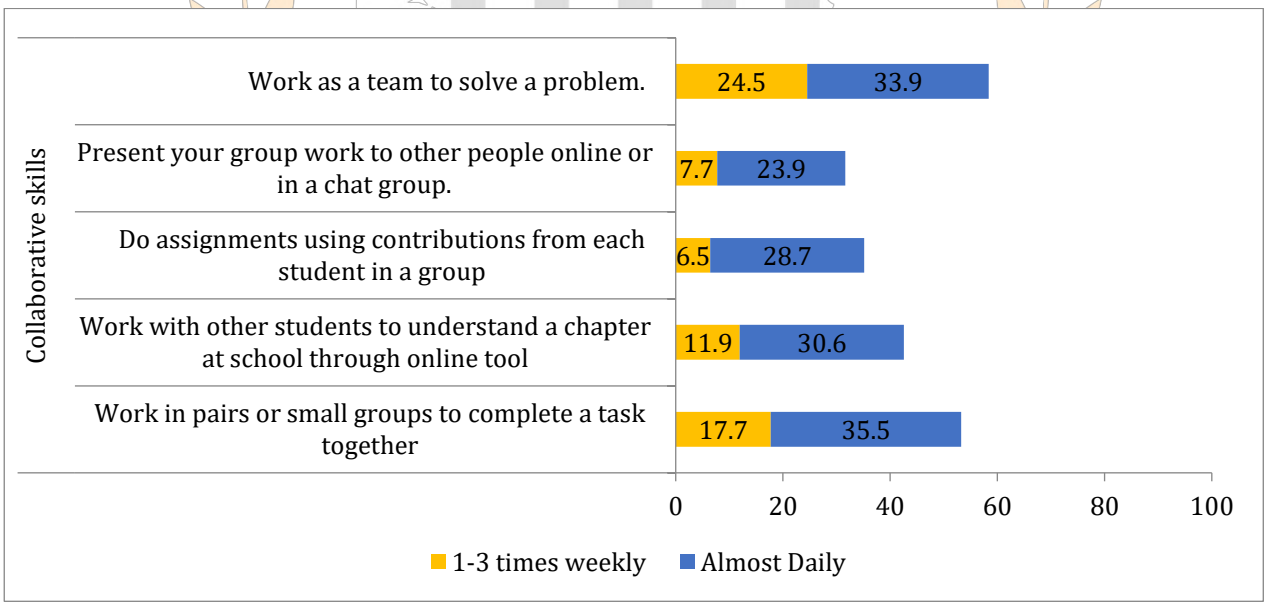

Figure 5. Collaborative skills through OIL

Online Tools used to acquire collaborative skills

The survey revealed that YouTube was the most commonly used online tool for developing collaborative skills among secondary school students, followed by Google, message boards, chat, and blogs.

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Acquisition of communication skills through OIL tools

The study found that most secondary school students have good communication skills when it comes to expressing themselves online, but there is room for improvement when it comes to preparing and submitting work online. Figure 6 illustrates the frequency of the variables associated with communication skills.

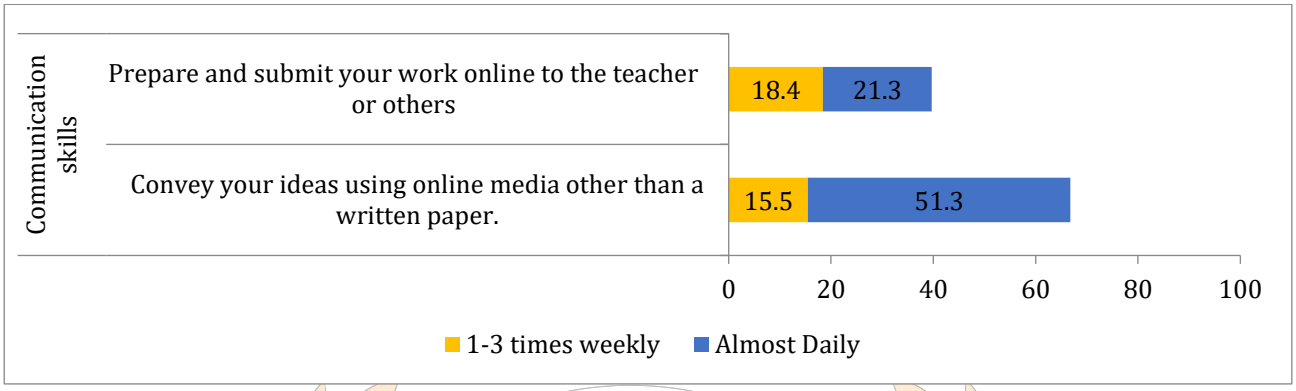

Figure 6. Communication skills through OIL

Online Tools used to acquire communication skills

The analysis showed that chat groups, message boards, and YouTube were the most popular online tools used by respondents to develop communication skills, while Google Scholar and blogs were the least used. Chat groups and message boards were significantly favored for communication over the other tools.

Acquisition of creative skills through OIL tools

The study investigated the effect of OIL on the collaborative, communication, and creative skills of secondary school learners. The analysis showed that a majority of the respondents frequently used online tools and idea creation techniques to find solutions and improve their creative skills. Figure 7 shows the frequency of the variables associated with creative skills

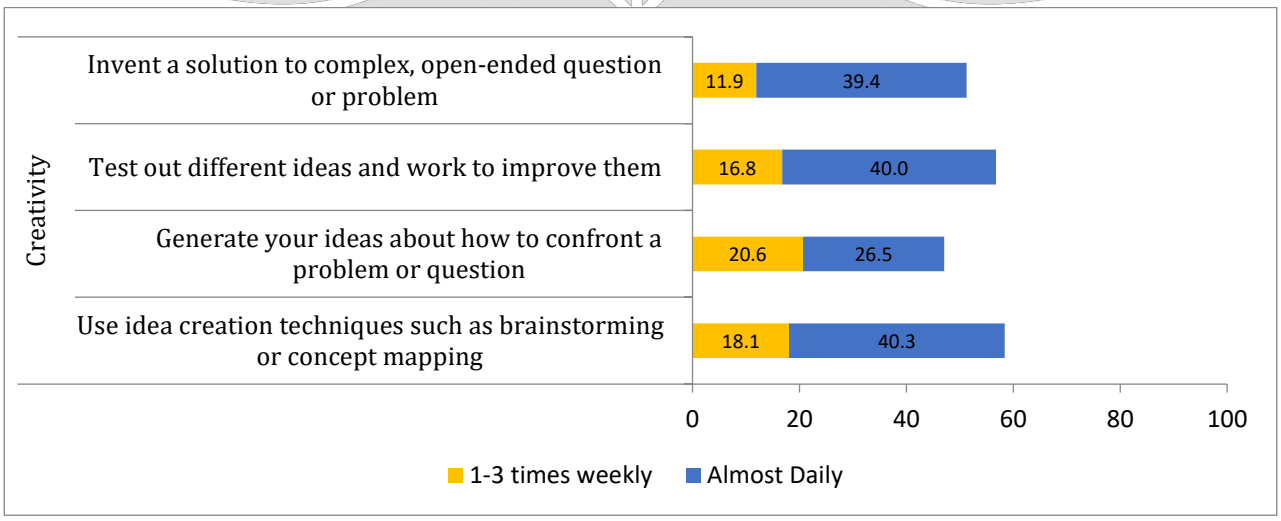

Figure 7. Creative skills through OIL

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Online Tools used to acquire creative skills

The analysis showed that the most common online tools used by respondents to develop creative skills were chat, YouTube, and message boards, while the least used were Google and blogs. YouTube and chat were the only web 2.0 tools used in significant numbers.

Acquisition of 21st Century skills through OIL

This study found that secondary school students can acquire 21st Century skills through OIL. Specifically, critical thinking and collaboration skills were weakly correlated with the use of online discussion groups, Facebook, and online games, while communication skills were associated with high usage of Internet websites and YouTube. Creativity was mainly linked to a high usage of Internet websites and online games.

The interviews conducted uncovered several themes related to knowledge acquisition, communication skills, leadership, creativity development, and productivity. These themes were then categorized and grouped according to the six elements of the activity theory triangle, which include subjects, tools, objectives, outcomes, community, and rules. Additionally, psychological reasons and negative barriers were also taken into consideration. The subjects engaging in informal online activities included secondary school learners, online communities, teachers, and parents, with the tools used such as social networking sites, search engines, and online communities. The objectives for engaging in online activities ranged from learning for fun and personal interest to interacting with peers. These categories and themes were then organized into table 1 for easy reference.

Table 1. Categories and Themes according to the six elements of an Activity system

Categories	Research Questions asked	Themes
Subject	Who is engaging in the activity taking place in an informal online space?	Secondary school learners Online Community Network of learners of similar interest Friends and relatives Teachers Parents Faciltators
Tools	What means are the subjects using to engage in this online informal activity?	Wide availability of various online tools Social Network sites Search Engines WhatsApp groups Online Communities YouTube Use of multimedia tools(Text, images, videos, links, emojies) during OIL Ease of Learning/ Comfortability with online tools

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		Media variety and richness of data
Object(s)	Why are the subjects engaging in the online informal activity?	Sharing information No rigid time for learning like formal Learning for fun Learning for personal interest/ as a hobby Become expert in a field Interest in learning more to improve academic performance Curious to learn something Interaction with peers within non-school settings Socialisation/ Maintain relationships Expressing emotions/ feelings Express views or reflections Portability- Can learn anywhere/ anytime Group/ Team work Flexibility of learning Comfortability in learning online Get peer/emotional support through Online informal Activity Preference to formal learning interest in non- school subjects language learning/writing
Outcome	What is the outcome of their online informal activity?	Improve Academic performance Improve/Deepen relationships Enhance Curiosity Knowledge Acquisition Ability to think critically Improving Media Literacy and Technology skills Flexibility of learning Self-Learning Information Literacy Motivation Self determination Improve Communication Social and collaborative Engagement Non respect of privacy Improve creativity Improve concentration Improve interest in academic / Non-academic subjects

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		Improve language learning/writing Interaction with peers within non-school settings Improved Socialisation Communication skills Leadership Social skills Creativity Development Improvement in Collaboration and teamwork Ability to think critically Improving Media Literacy and Technology skills Improve Productivity Information Literacy More engagement in academic subject Improve/Deepen relationships Lack of parental control Distraction Addiction to OIL Stress due to connectivity problems Non respect of privacy Bullying through communication/ group chat Failure in managing way of learning
Community	What is the environment in which the online Informal activity is taking place?	Online Community Social Networks Blogs, WhatsApp groups
Rules	What are the cultural norms, rules, or regulations, if any, that govern the activity?	Proper use of ethics Use of Copyrights Respecting others' Privacy Use of proper language Respect of peers' emotions and feelings Safety Use of Netiquette when sharing information
Division of Labour	What role does each agent?	Working as a Team, Role of a reader, Role of an online viewer, giving online views/ reactions, writing/posting messages in informal online space, sharing information to other peers on the group->Online Reader, communicator, observer, presenter

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Discussion of Findings

This study explored how secondary school learners develop 21st Century skills by engaging in OIL. A mixed-methods approach was used, beginning with a descriptive analysis of questionnaires completed by learners in grades 7-13, followed by qualitative methods. The research focused on how 21st Century skills are acquired and why learners engage in OIL using online tools and social media. The study results were related to Activity Theory and the P21 21st Century Skills Framework.

What forms of OIL (OIL) occur among secondary school learners through online tools?

The study applied the lens of AT to investigate the forms of Online Informal Learning (OIL) that occur among secondary school learners when they engage with online tools. The results of the study indicated that most secondary school learners were acquainted with online tools on a daily basis, rather than on a weekly or monthly basis by engaging with video/audio clips, online discussion groups, Instant chat, Internet websites, Online games, and YouTube.

This study provided incisive insight into Social Networking Sites (SNSs). It was determined that respondents were most familiar with Online Discussion groups through WhatsApp, YouTube and Instagram. Several online tools were accessed for informal learning, while other tools were utilised for both formal and informal learning. As secondary school learners adapted to new learning environments, social networking tools were used to make new friends and share school notes. This implied that this social aspect of group activities in OIL became an integral part of the learner's experience.

Moreover, this study demonstrated that there was a variation in using online tools for online informal learning across different grades (7-13). Younger secondary school learners used online tools mainly for informal learning to share information, photos, songs and games, whereas older secondary school learners used them mainly to share information but also to compensate for formal learning. Most secondary school learners stated that OIL had become an integral part of their daily lives since whatever was being learnt in their formal settings was not sufficient for them to complete their learning. Also, it emerged that older learners used OIL more formally.

Participants in Grades 10-13 stated that they used different online sites to assist them with self-discovery learning, which applied to schoolwork, to gain additional knowledge, and to listen to music as a hobby. The following online tools were accessed for knowledge acquisition and recreation:

- Google Classroom was used extensively for formal learning;
- Zoom for group classes;
- WhatsApp for chatting;
- Google for information searches related to schoolwork and for self-learning;
- YouTube to watch videos, and listen to music during free time;
- Yahoo, WhatsApp, Facebook and Instagram to look at photos and videos;
- Chat was used to communicate with friends; and
- WhatsApp and YouTube to watch tutorials and videos about subject topics to supplement previous knowledge.

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Both the quantitative and qualitative analysis results concluded that the use of online tools had a positive impact on learners' individual study, group work activities, the development of active and self-regulated study strategies and the development of their 21st Century Skills. Similar findings are supported by Venkatesh, Croteau & Rabah (2014) in a study on understanding learners' perceptions regarding the effectiveness of information and communication technology (ICT) use. The quantitative results revealed that secondary school learners used different OIL tools were for sharing information, interpersonal communication, fun, personal interest, hobbies, developing self-identity, observing other people's lives, maintaining social relationships, self-expression and self-reflection, and developing expertise.

Internet environments not only provided learners with the opportunity to acquire new knowledge but also enabled them to express opinions and share knowledge. The OIL activities helped learners learn how to collaborate, create digital content, reflect on their thoughts, extend the time-space of educational dialogue, and promote trust between learners and teachers. The mixed-method analysis reflected that most secondary school learners used online technologies for OIL and for academic purposes through online platforms.

The analysis phase of the study also revealed that online tools used by secondary school learners were mainly for informal learning outside school settings or simply to complement what they had learnt at school. Participants in Grades 10-13 stated that they used different online sites for informal learning; for example, Facebook for sharing information. Additionally, it emerged that secondary school learners were more comfortable when learning at home. Participants indicated that they preferred to self-learn to use online tools, especially when it concerned the acquisition of general knowledge. Some participants prioritised this as being critical for gaining a deeper understanding of specific school subjects.

Similar to the findings of Yang Yang et al. (2011) in a study on the Development of a Content Analysis Model for Assessing Students' Cognitive Learning in Asynchronous Online Discussions, regarding the type of online learning accessed by secondary school learners using OIL, it was evident that they acquired knowledge through cognitive learning by developing a sense of reasoning, in addition to powers of intuition. It was also found that secondary school students who engaged with multiple forms of content through the use of different online tools could increase their cognitive potential, which included critical-thinking skills. Similar results were supported in a study conducted by Alaraj (2012). Also, since Web 2.0 tools facilitate communication, cooperation and knowledge exchange, rapid communication growth and development are stimulated. The implication of this finding is that Web 2.0 resources in OIL can be used interactively through employing multiple forms of content of different OIL tools to elicit and enhance 21CS.

Other forms of OIL, like self-directed learning, socialisation, and incidental learning (self-discovery) were also evident. This is further supported by several existing studies (Schugurensky, 2000) which promote the mapping of informal learning by identifying three main types of learning by emphasising intentionality and awareness as criteria to differentiate among them. In this map, self-directed learning is at one extreme of the spectrum of informal learning, socialisation is at the other extreme, while incidental learning is somewhere in-between. The results from the study primarily revealed that secondary school learners perform self-directed OIL when they

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learn intentionally and consciously, or unintentionally alone, or as part of a group without the assistance of a teacher, instructor, facilitator. They learn informally but intentionally because they have the purpose and drive for learning something even before the learning process begins; and it is conscious as they are aware that they have learnt something.

Further, other secondary school learners also performed incidental online informal learning when they access online tools and obtain learning experiences that occurred when the learner did not have any previous intention of learning something out of that experience, but after the experience they became aware that some learning had occurred as also supported by Schugurensky (2000). He states that not only do learners have no a priori intention of acquiring them, they are also not aware that they learned something (Schugurensky, 2000). Thus, this type of OIL appeared to be unintentional, but conscious. This was supported by some participants who stated that they preferred to learn about events happening in the country online rather than reading the newspaper. They also learn many new words in English and French. They learn how to cook, listen to music, watch YouTube, check tutorials about different subjects, and watch movies.

Socialisation was one of the primary types of OIL where secondary school learners could develop 21CS when learning through different online tools. Socialisation (also referred to as tacit learning) refers to the internalisation of values, attitudes, behaviours and skills that occur during everyday life while performing OIL. For the purpose of this study, this type of informal learning was mainly called Online Informal Socialisation (OIS) or Online Informal Tacit learning (OITL). All the forms of OIL supported the theory that they can result in the acquisition of new knowledge or skills. The results from the study, therefore, provided a deeper understanding that the different online tools provided different forms of learning and opportunities for learning.

Through the communicative interaction between different secondary school learners, online informal socialisation occurred. The learners also developed personal familiarity, enhanced communication, and applied problem-solving (critical-thinking) skills. These findings are supported by other studies like Gupta & Govindarajan (2000). These skills comprise two of the four Cs (4Cs) of 21CS that were identified in Section 2.3: creativity and critical-thinking (problem-solving); and communication and collaboration. These skills proved too beneficial for secondary school learners as they could use them for their own personal development, and for their future endeavours.

The awareness of learners' unconscious and unintentional learning experiences may occur immediately or many years later. The process of retrospective recognition can come from within or from outside. The results also indicate that informal learning, such as OIL, that uses websites and online tools, is beneficial to learners as stated by Schugurensky (2000). Some previous studies confirm the results of this study by indicating that online technologies, such as watching video clips on YouTube, fosters communication, collaboration, sharing of knowledge, and discourse analysis. Therefore, it was concluded that through different forms of OIL and the use of several online tools, 21CS like communication, critical-thinking and collaboration, can be developed in secondary school learners.

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From a theoretical perspective, the results of both the quantitative and qualitative analyses showed that different forms of OIL occur in an Online Informal Learning (OIL) Activity system. To explore the power of an Online Informal Activity system, all the vertices of the AT were analysed incisively to determine the different forms of OIL that facilitate learning among secondary school learners through the use of online tools. The results of this study also found that all the six elements of the AT as stated by Heo and Lee (2011) in Section 6.3.2.1 are interconnected and work together as a complex system to facilitate the OIL process, which helps in the development of 21CS. The findings of this study supported the data obtained in similar studies conducted by Heo and Lee (2013) and Schugurensky (2000). It was confirmed that the use of online tools by secondary school learners is "a collaborative medium that allows users to communicate, work together and share and publish their ideas and thoughts" (Rollett et al., 2007, pp. 97-98; Heo and Lee, 2013).

In addition, the results of this study provided support for various relevant existing literature sources by proving that different sub-online informal activity triangles work together to help secondary school learners to learn informally through online tools. Hence, different sub-activity triangles were analysed in depth. One of the unique affordances of AT is that it may be "used as a framework for understanding how the different components of the activity impacted each other" (Doubleday & Wille, 2014, p. 367).

For different forms of individual OIL to occur, the study found that the sub-triangle (Subject- tools-Object) shows the systemic relations between a secondary school learner and their online informal learning environment, as stated in a similar study by Heo & Lee (2013). The Subjects, who are the main agents of the OIL, are responsible for activating the OIL environment through which they acquire knowledge and work in an autonomous way and enact self-directed or incidental, informal learning. Tools as another element of the OIL activity are used by subjects to interact with objects for different forms of learning to occur. One of the most crucial elements of the sub-triangle of individual OIL to occur is the object. The Object element in this study is the physical or symbolic move to learn something informally through the use of online tools. The study also revealed that the moves could be driven by curiosity, intentional learning, unintentional learning, learning for fun, or for engaging in formal subjects at school.

Moreover, the study also revealed that different forms of learning occur when secondary school learners learn in groups. In this case, the study supported the findings of Heo and Lee (2013) by revealing the Sub-triangle (Subject-Object-Community). Secondary school learners (subjects) who usually have the same interests and have common objects work in groups or as an online community to learn online informally. The objectives here are mainly to communicate or even socialise with other subjects outside the school setting. This is where OIS or OITL occurs in a setting where several secondary school learners learn informally using different online tools by interacting with each other to communicate and acquire knowledge informally. The results of the study also found that secondary school learners learn better within social groups, rather than individually.

However, for the different forms of OIL to occur, two more elements of the Activity System have to come into play, namely, Division of Labour and Rules. The results of this study revealed that each subject in the Activity System has a role to play in the OIL system. They can participate in the OIL process either as readers or online viewers or

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by expressing reactions, writing/posting messages, or sharing information with other peers in the community. According to Heo and Lee (2013), secondary school learners have three different roles to play in terms of their patterns of behaviours; namely, Knowledge Creators (Writers), Information Organisers (Collectors), and Information Seekers (Readers).

This is in line with Kutti's (1996) view that Objects and Communities are interconnected through the division of labour. The results of this study further support Heo and Lee's (2013) findings by confirming that secondary school learners' roles, tasks and power relationships in the OIA system can also be categorised according to three objectives: Self-reflectors (Presenter), Interpersonal Communicators (Communicator), and Lurkers (Observer).

Furthermore, the results of this study confirm that for OIL to occur, appropriate rules must be followed, which is one of the elements of the Activity System, without which many conflicts may occur in an online Informal Learning Activity System. Therefore, the researcher discovered that norms, conventions and values (Kain & Wardle, 2002) such as ethics, use of copyright, respecting others' privacy, use of appropriate language, respect of other peers' emotions, and etiquette are prerequisites. However, the improper use of follow-up of rules in the system may result in negativity, conflicts, distractions, lack of (or excess) parental control, addiction to OIL, stress due to connectivity problems, disrespect for privacy, and bullying through chats.

Limitations

The findings of research studies are restricted in terms of how it can be applied in the real world. The context, nature and scope of the sample of the study were major limitations. I, as the researcher, recruited secondary school learner-participants (mostly boys) from a state college where I worked as a teacher. The scope of the research, therefore, can only be applied in this context. This means that the results of the study cannot be generalised to learners in other contexts who were not sampled as it may not be relevant to learners who do not have access to internet online learning.

Contribution of the Research

The study contributed to the body of knowledge in several ways. First, it provided valuable insights into the potential of OIL to complement formal education and to promote critical-thinking for lifelong learning. This research investigates how learners can acquire 21st Century Skills (21CS) through OIL, which include critical-thinking, collaboration, communication, creativity, and digital literacy. In addition, it highlighted how OIL provided learners with a flexible, engaging, and meaningful way to acquire 21CS.

Moreover, the research contributed to the body of knowledge by identifying the pedagogical approaches that are effective in OIL environments. The study identifies inquiry-based learning, project-based learning, and problem-based learning as effective approaches to support the development of 21CS in OIL environments. This finding was significant since it provided educators and policymakers with guidance on how to design effective OIL environments that support the acquisition of 21CS.

The research also provided critical insights into the challenges associated with OIL. The study cautions us against misinformation regarding online resources, while emphasising the importance of critical evaluation by learners to

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ensure the quality of online resources. Additionally, the research addressed the lack of formal recognition of learning outcomes in OIL environments, which could hinder the learners' motivation to engage in online learning activities. The research also suggests strategies for recognising learning achievements to overcome this challenge.

Further, the findings of this study help to understand how OIL assists secondary school learners in similar contexts across the world. This research can contribute to enhancing OIL systems to facilitate the development of 21CS in secondary school learners. This made a valuable contribution to existing OIL and 21CS frameworks. The data revealed that learners' use of OIL positively developed 21CS. According to the study's findings, Web 2.0 resources in OIL can be used interactively through employing multiple forms of content of different OIL tools to elicit and enhance 21CS. During this process, secondary school learners can acquire knowledge, skills, and competencies in particular domains such as academic, work-related and everyday activities, based on the first dimension of Fenwick and Tennant's (2004) classification of learning as Knowledge Acquisition to facilitate of 21st Century Skills.

Currently, no study has applied Fenwick and Tennant's framework (2004) regarding secondary school learners. This study has mainly used this framework to analyse how and why secondary school learners acquire 21st Century Skills through Online Informal Learning. The researcher therefore proposed a model to determine how secondary school learners can acquire 21st Century Skills via effective coordination of the six components of the Activity Theory, and through the three dimensions of the Fenwick and Tennant (2004) framework.

Recommendations and Future Directions

Future research should consider diversifying the sample to include learners from a broad range of schools, colleges, and academic settings to increase generalisability. To assess how Online Informal Learning (OIL) impacts 21CS development across diverse populations, it may include learners from various socioeconomic backgrounds, genders, ethnicities, and educational levels. Moreover, a variety of educational settings, including private schools, international schools, and vocational schools, may be used for future studies to gain a more comprehensive understanding of how informal online learning impacts 21CS acquisition. Different educational contexts could be explored to determine the effectiveness of online informal learning.

To examine potential gender differences in 21CS development through OIL, a mixed-gender sample could be included in future research. Both male and female learners will be able to acquire 21CS through online informal learning if nuances related to gender are identified. Additionally, a longitudinal study could be conducted to track the progression of learners' 21CS acquisition over time, given the dynamic and evolving nature of OIL. The OIL can help determine the long-term sustainability of skills acquired while providing insight into long-term effects on skills development. Online informal learning contributes to 21CS acquisition, it may be beneficial to examine the interaction between these factors which may help to identify potential mediators or moderators in the process.

Conclusion to ***the Study***

The potential of OIL as a beneficial source of information and skill acquisition for people outside of conventional educational settings is highlighted by this study. According to the findings, OIL platforms provide a wide variety of

tools and opportunities for self-directed learning, including user-generated information, discussion forums, and online communities of practise. Participants in this study stated that their participation in online informal learning allowed them to pick up new skills, broaden their knowledge, and even discover new interests. However, the study also highlights some challenges associated with online informal learning, such as the potential for misinformation and the lack of formal recognition of learning outcomes. It is important for individuals to critically evaluate the quality of online resources and seek out opportunities for credentialing or recognition of their learning achievements.

This study was conducted by utilising Online Informal Learning as a source to determine how and why learners developed online 21st Century Skills. According to the study's findings, learners acquire these skills through online informal learning, An Activity Lens and Fenwick and Tennant's classification of adult learning was adopted to frame a model for acquiring 21st Century Skills through Online Informal Learning. In order to develop 21st Century Skills and to understand the impact of such approaches on learner achievement, the model was applied to study how activities and informal learning can be utilised for the development of 21st Century Skills. The Activity Lens and Fenwick and Tennant's classification of adult learning allow for a more precise analysis of the different activities that can be conducted to develop the skills. This, in turn, allowed for a better understanding of how different activities can be used to develop the skills, as well as how informal learning can be utilised to help in the development of these skills. The model proposed in this study provided a framework for future research in this area regarding the use of online informal tools as being foundational to promote learning.

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