**Uses of Science Popularization Videos on Social Media and their Effects on Involvement in Science Learning Activities**

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**الملخص:**

تهدف هذه الدراسة إلى اختبار نموذج البحث عن الإشباعات ونشاط الجمهور في سياق التعلم غير الرسمي كما تصفه نظرية الاتصالية للتعلم في العصر الرقمي. افترضت الدراسة تأثيرات مباشرة للدوافع والاتجاهات على اندماج ما بعد المشاهدة في أنشطة تعلم العلوم، كما افترضت تأثيرات غير مباشرة لهم من خلال نشاط المستخدم قبل وأثناء التعرض لفيديوهات تبسيط العلوم على الفيسبوك واليوتيوب.

تم جمع البيانات لهذه الدراسة باستخدام صحيفة استبيان إلكترونية تم توزيعها عبر الإنترنت على عينة عمدية مكونة من 408 مستخدم مصري لمواقع التواصل الاجتماعي ممن يشاهدون فيديوهات تبسيط العلوم بانتظام، وتراوحت أعمارهم من 13 عام إلى أقل من 43 عام.

أظهرت النتائج أن الدوافع النفعية والاتجاه بالأهمية لهم تأثير إيجابي ومباشر على اندماج ما بعد المشاهدة في أنشطة تعلم العلوم، بالإضافة إلى تأثير إيجابي غير مباشر من خلال العمدية والانتقائية. بينما لم يكن للدوافع الطقوسية أي تأثير مباشر على اندماج ما بعد المشاهدة في أنشطة تعلم العلوم، لكن كان لها تأثير غير مباشر من خلال مستويات أقل من الانتقائية.

كان للاتجاه بواقعية تلك الفيديوهات تأثير سلبي مباشر على اندماج ما بعد المشاهدة وتأثير سلبي غير مباشر من خلال مستويات أقل من الانتقائية. لم يكن للاندماج الذهني أثناء المشاهدة أي دلالة إحصائية كمتغير وسيط لتأثير أي من المتغيرات المستقلة على اندماج ما بعد المشاهدة.

وبشكل عام أظهرت الدراسة جودة تطبيق نموذج البحث عن الإشباعات ونشاط الجمهور في سياق التعلم غير الرسمي كما تصفه نظرية الاتصالية للتعلم في العصر الرقمي.

**الكلمات الدالة:** فيديوهات تبسيط العلوم، الدوافع، الاتجاهات، نشاط المستخدم، اندماج ما بعد المشاهدة، الاتصالية.

## Abstract

The purpose of the study was to examine a gratification seeking and audience activity model within an informal learning context described by the connectivism learning theory for the digital age. The study assumed both direct influence of motives and attitudes on post-viewing involvement in science learning activities, and indirect

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influence through users' activity before and during exposure to science popularization videos on Facebook and YouTube.

An online survey questionnaire was used to collect data from a purposive sample of 408 Egyptian social media users who watch science popularization videos regularly, and are aged from 13 to less than 43.

As a result of the structural equation modeling of the data, instrumental motives and affinity attitude had a positive direct influence on post-viewing involvement in science learning activities, and a positive indirect influence through higher intentionality before exposure and selectivity before exposure. Ritualized motives had no direct influence on post-viewing involvement in science learning activities, yet it had an indirect negative influence on it through reduced selectivity. Realism attitude had a direct negative influence on it as well as indirect negative influence through reduced selectivity. Cognitive involvement had no significant mediating effect for any of the independent variables on post-viewing involvement in science learning activities.

Overall, the study largely supported the validity of gratification seeking and audience activity model within informal learning context described by the connectivism. Motives and attitudes significantly predicted post-viewing involvement in science learning activities. The proposition that audience activity is an important mediating variable in media uses and effects was confirmed.

*Keywords:* Science popularization videos, motive, attitude, audience activity, post-viewing involvement, connectivism.

## 1. Study Overview and Theoretical Framework

### 1.1 Introduction

Science pervades people's daily lives and directly affects all the organizations of the society. It is likely for the public to have to grapple with matters of science in dealing with their daily life situations. COVID-19 crisis has revealed the public tremendous need for science information specially in terms of medical and health information. However, scientific information might be complex for the public to understand due to the expanding development of science and the increase of science specializations. Thereby, science popularization plays a critical role as a bridge between science and the public.

The roots of science popularization go back to the early days of human civilization. However, it could not be considered as an independent societal endeavor. The formal first attempts of science popularization started from the 16th century, as a companion factor to the shift toward professional approach of science during that era. Science popularization has continued to evolve until the current era of the 21st century. Science popularization evolved within the context of the continuous development of science itself and its practices, in addition to the constant changes in the relationship between the science, public, and society. While science popularization was developing, media and its role in science popularization was developing too.

Although traditional media has always played a significant role in science popularization, it allows one-way science communication, with relatively lower public interaction and lower audience activity in comparison to new media. Meanwhile, social media sites have interactive features that allow more active role of users. Social media sites offered a variety of new multidimensional ways to share and popularize scientific information to a wide audience, often in real-time, especially with its high accessibility through smartphones and other digital devices.

This study focused mainly on Facebook and YouTube as social media platforms for sharing and viewing science popularization videos. Both sites were the most used social media platforms world widely and in Egypt in 2020 (Hootsuite, & We Are Social 2020). Lately many user-generated and professionally generated YouTube channels and Facebook pages, have begun to create science popularization videos. Examples on these channels and pages are *El-Daheeh*, *El-Espitalia*, *Pharmastan*, *Egychology*, *Khan Academy*, and many more. Considering the widespread of these pages and channels, the increasing popularity of their use among the Egyptian community, along with the revival of interest in uses and effects approach as a result of the growth of new media and its distinctive features, this study aimed to examine how the use of these videos by Egyptian social media users can lead to post-viewing involvement in informal science learning activities in the digital age, as science learning turned into a lifelong process not limited to an age number nor a stage of education..

Users are no longer considered a passive element in using media and information acquirement, instead, they actively choose the media that satisfy their needs and they are self-directed and motivated to know. Studies identified two media use orientations: instrumental and ritualized, based on users' motives, attitudes, and behaviour or activity. Users' activity is a consequence of media use orientations derived by motives and attitudes, but at the same time activity itself is a part of the media use orientation, as activities might influence each other and act as mediators for further media effects.

However, there has been a need to redefine the concept of post-viewing involvement within an informal learning context. This comes in line with Rubin's and Perse's (1987b) suggestion to develop the involvement concept to assess its role in different media uses and effects contexts. The current study redefined the concept of post-viewing involvement from a connectivism learning theory perspective, taking into consideration new trends in learning and the way new media reshaped informal learning in the digital age. Post viewing involvement was considered as both a consequence and effect for the instrumental use orientation of science popularization videos, and as an activity anticipated in the future to act itself as an intervening variable in media uses and effects related to learning and knowledge acquisition.

Furthermore, previous studies identified functional access to digital technology and digital literacy skills as perquisites for science learning in the digital age. So, the study took into consideration their influence on post-viewing involvement in science learning activities.

**1.2 Problem Statement**

Although the concept of audience activity was examined in uses and effects studies on new media, yet there was a little focus on examining it within an informal digital learning context. The intensifying necessity of enhancing public scientific literacy, along with the increasing popularity of the use of science popularization videos on Facebook and YouTube have urged the worthiness of analyzing how the use of these videos can explain post-viewing involvement in science learning activities. Thereby, the research problem of this study is represented in examining a gratification seeking and audience activity model within an informal learning context described by the connectivism leaning theory for the digital age, in an attempt to analyze the role of motives, attitudes, and activity in predicting Egyptian users' involvement in science learning activities after watching science popularization videos on Facebook and YouTube, while taking into consideration the complex role of activity in mediating media effects, and the influence of demographics, viewing level, digital literacy skills, and functional access to digital technology.

### 1.3 Purpose of the Study

The study aimed to:

1. Examine the role of motives (instrumental- ritualized) and attitudes (affinity, realism) in directly predicting post-viewing involvement in science learning activities.
2. Analyze the role of users' pre-exposure activity (intentionality-selectivity) and users' activity during exposure (cognitive involvement) as mediators for the influence of motives and attitudes on post-viewing involvement in science learning activities.

### 1.4 Significance of the Study

This study attempted to move beyond uses and effects research that identified the role of audience activity in facilitating affective media outcomes, to investigate more cognitive and behavioural outcomes within an informal digital learning context. Examining a gratification seeking and audience activity model within an informal learning context from a connectivism leaning theory perspective, allowed to redefine the concept of post-viewing involvement as suggested by previous studies. Furthermore, examining the validity of the model within an informal learning context may open the space for future studies to use it in examining the role of post-viewing involvement itself in facilitating further media effects related to learning and knowledge acquisition.

### 1.5 Theoretical Framework

**1.5.1 Gratification Seeking and Audience Activity Model** (Rubin, & Perse, 1987b)

Communication researchers developed several models to describe the relation between media uses and effects in an attempt to bridge the gap between media effects approach and uses and gratification (U&G) approach (livingstone, 2017).

Gratification seeking and audience activity model was developed by Alan M. Rubin and Elizabeth M. Perse was mainly based on active audience assumption of uses and gratifications theory. aiming to explain the relation between audience activity and media gratification seeking behaviour. Since audience activity was considered as an intervening variable in media uses and effects, Rubin and Perse aimed to examine the predictable links between motives or gratifications sought, attitudes, and audience activity. The model described that the communication behaviour is guided by expected gratifications and attitudes towards a medium and its content. So, motives and attitudes are at the heart of the model affecting different types of audience activity. Audience activity was classified into a) intentionality which is the degree to which using media is planned and purposive behaviour. b) selectivity which is the extent to which using media is non-passive behaviour, it is a nonrandom selection of content from available alternatives. c) involvement which is he active psychological processing of content and cognitive activity, as well as the interpersonal discussions of the content after viewing it. It also resembles less engaging in distractive co-viewing behaviours, however, not all behaviours done while viewing are equally distracting. Some co-viewing behaviours indicate more involvement like discussion about the content. Involvement has been linked to media use motives that are grounded in beliefs about the importance of the content, and reflects a desire to acquire and share information. Rubin's and Perse's operational definition of involvement is limited to one aspect of the concept. They suggested that future studies should develop and refine that concept.

According to the model, uses and effects approach flows from motives and attitudes to behavioural intention, selective exposure to media, attention to content while consuming the messages, and involvement with that content. Then involvement is expected to feedback through attitudes, affecting future gratification seeking behaviour. Furthermore, involvement with media content was assumed to be a necessary former activity for higher cognitive effects.

**1.5.1.1 Applying the Model to the Study**

Since instrumental and ritualized media use orientations can be applied to new media environments, so this model provided a valid theoretical framework for this study. It is worth mentioning that new media is expected to heighten audience activity, especially when used within free choice informal learning contexts. This model helped to explain how motives, attitudes, and user activity can predict post-viewing involvement. However, the concept of involvement was redefined to apply it within an informal learning context, as Rubin and Perse (1987b) suggested to develop, refine, and add new aspects to this concept in further studies.

Involvement is multidimensional and associated with different phases of exposure. The study focused on two manifestations of involvement; cognitive involvement during exposure and post-viewing involvement in science learning activities. Cognitive involvement during exposure precedes post-viewing involvement in science learning activities, and is expected to contribute to predicting it. Defining the concept of post-viewing involvement in science learning activities required to depend on another theory that describes learning activities in a digital age. A theory that takes into consideration the new trends of this era like the existence of numerous information sources and people engagement in connection making processes, particularly that these videos exist on social media sites that enable a high level of communication and connection-making to other information sources and other people.

**1.5.2 Connectivism Learning Theory** (Siemens, 2005)

Connectivism is a learning theory first proposed by George Siemens in 2004, then it was further developed by him and Stephen Downes. Siemens considers it as a learning theory for the digital age. Downes (2012) described the connectivism theory as “the thesis that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks” (p.9). Connections is a key term for this theory, whether it is connecting to a network composed of nodes of specialized information sources or connection between concepts, fields, and ideas.

Siemens questioned the ability of behaviourism, cognitivism, and constructivism learning theories to describe learning in the 21st century, as they do not take into consideration new trends of learning in a digital era. Siemens developed a new alternative theory that explores the way information is acquired in a networked world. Opposing viewpoints sought that connectivism can not be considered as a standalone learning theory, as there is some sort of overlapping in the ideas between connectivism and the established learning theories, in terms of knowledge interconnectivity and complexity (Duke, et al., 2013). However, even if there is a certain amount of core knowledge required for the learner to be able to understand and make use of information presented, as traditional existing learning theories described, connectivism is still considered a valid theory to develop those theories to be applied within a networked world (Ally, 2007).

**1.5.2.1 Principles of Connectivism**

The main principles of connectivism can be summarized as follows:

1. Learning and knowledge rest in 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 more is more critical than what is currently known
5. Nurturing and maintaining connections is needed to facilitate continual learning.
6. Ability to see connections between fields, ideas, and concepts 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. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality.

**1.5.2.2 Applying the Theory to the Study**

Using connectivism as a theoretical framework allowed the researcher to apply the gratification seeking and audience activity model within an informal learning context facilitated by new media and technology. Using the connectivism learning theory helped in:

*Describing post-viewing involvement in science learning activities in the digital age:* The first, second, third, sixth, and seventh principles of connectivism can describe post-viewing involvement in science learning activities. It can be described to include:

- *Interpersonal interaction over the science content presented in media:*
- This can take the form of face to face or online discussions. As the second principle of connectivism describes learning as connecting to other sources of information. Also, the first principle asserts that the process of expressing and exchanging opinions is considered as a form of learning, so expressing opinions and interacting with others opinions regarding the science content, can be a form of learning activities.
- *Following other digital sources of information:*
- According to the second and third principles of connectivism, learning activities include following and connecting to digital sources of information, in an attempt to learn more about the science topic presented in media. It is worth mentioning that evaluating the information found through these sources based on their accuracy and currency, is a must for effective learning, as stated by the seventh principle.
- *Active participation the learning network:*
- Learning is not just connecting to networks to acquire, it also includes users' ability to feedback into this network and to share their own conclusions. This can take place through sharing useful sources of information related to the science topic presented, or even sharing new information after synthesizing knowledge and connecting ideas and concepts, according to the sixth principle of connectivism.

*Identifying variables that might influence post-viewing involvement in science learning activities:* According to the third, sixth, seventh, and eighth principles of connectivism, learning requires digital literacy skills related to the ability to efficiently deal with technology and access digital information sources, ability to reach accurate and up to date information, ability to synthesize the collected information and generate a new one, and ability to make decisions regarding where to search for and how to obtain new information and evaluate them.

According to the fifth principle, learning also requires communication skills related to the ability to build and maintain online connections with other people to facilitate learning. Learner also should have the attitude of a lifelong learner, according to the fourth principle.

*Redefining the concept of selectivity:* Selectivity was redefined to include of the science areas or topics the individuals want or need to learn about, along with the selectivity of science popularization videos. Since the eighth principle states that learners should be able to identify what needs to be learned.

**1.6 Conceptual Framework**

This study was designed to examine a gratification seeking and audience activity model within an informal learning context, described by the connectivism.

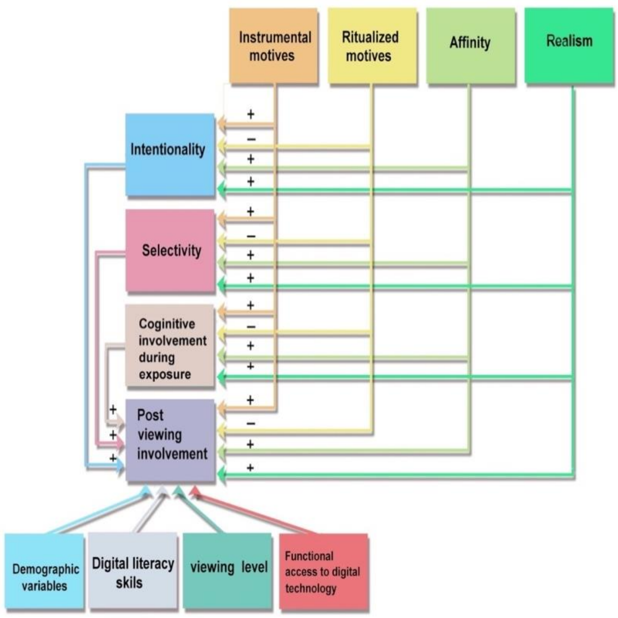


Figure (1.1): *A Diagram Presenting the Assumed Relationships Among the Variables*

Variables were drawn in a hierarchical way based on their time precedence and the causal order among them. The model expected that post-viewing involvement in science learning activities would result from users' motives and attitudes, filtered by users' activity before and during exposure.

***Post-viewing involvement in science learning activities*** was represented in interpersonal interaction over the science content presented in videos, following other digital sources of information, and feeding back into the learning network, in an attempt to learn more about the science content presented in the videos. It was expected to be negatively predicted by ***ritualized motives*** which are diffuse motives related to habitual and time-consuming viewing of science popularization videos content. While it was expected to be positively predicted by ***instrumental viewing motives*** related to goal-directed exposure to science popularization videos content; ***affinity*** or the perceived importance of watching these videos; and ***realism*** or how true to life users find these videos.

This relationship was supposed to be mediated by ***intentionality*** which is the purposive and planned use of videos; **selectivity** which is the tendency to select certain videos or science topics based on personal interests and preferences; and ***cognitive involvement*** which is related to users' cognitive effort during exposure, it involves attention to and elaboration of the science content presented in the videos.

Post-viewing involvement in science learning activities was considered as both a consequence or effect for the instrumental use orientation of science popularization videos, and as an activity anticipated in the future to act itself as an intervening variable in media uses and effects related to learning and knowledge acquisition.

The uses and effects literature indicated that users can differ in media use and effects according to their ***background characteristics*** like demographic variables including gender, educational level, and age (Rubin, 1984; Rubin and Perse, 1987b; Teo, 2001; Metzger, & Flanagin, 2002). Users' age can also be an indicator of their generations, which were proven to affect media use motives and uses (Bondad-Brown, & Pearce, 2012). Researchers classified individuals into generations based on the shaping events of each era, economics and the state of technology. Among these generations are Baby Boomers born post world war two, generation X (1966-1976), generation Y (1977-1994), generation Z (1995- 2012), and generation Alpha born after generation Z (Schroer, 2008; Grail Research, 2011). Thus, several uses and effects studies controlled the effect of those demographic variables on different types of audience activity or media effects. (Rubin & Perse, 1987a; Kim & Rubin, 1997; Godlewski & Perse, 2010; Park & Goering, 2016). Thereby, this study controlled the possible effect of users' age, gender, and educational level on post-viewing involvement in science learning activities.

Moreover, users' level of ***functional access to digital technology*** can also affect science learning in the digital age (Sharpe, & Beetham, 2011), it means having access to technologies, resources, services, networks of people and information; and overcoming issues of time, ownership, and mobility. It was also considered as a control variable that might affect post-viewing involvement in science learning activities. Also, the level of users' ***digital literacy skills*** related to their ability to appropriately use digital tools for science learning activities was controlled for their effect on post-viewing involvement in science learning activities, as the connectivism theory considered it as a prerequisite for learning in the digital age, also Metzger and Flanagin (2002) controlled the effect of users' Internet experience on their media use orientations.

Along with users' background characteristics, ***viewing level*** was considered a control variable that can affect media use and effects (Rubin, & Perse, 1987a), so it was controlled for its effect on post-viewing involvement in science learning activities.

**1.6.1 Research Hypotheses**

**H1:** Post-viewing involvement in science learning activities is positively and directly predicted by:

1. Instrumental viewing motives of science popularization videos.
2. Affinity attitude towards these videos
3. Realism attitude towards these videos

**H2:** Post-viewing involvement in science learning activities is negatively and directly predicted by ritualized viewing motives of these videos.

**H3:** Instrumental viewing motives positively and indirectly predict post-viewing involvement in science learning activities through:

1. Higher intentionality before exposure
2. Higher selectivity before exposure
3. Higher cognitive involvement during exposure

**H4:** Ritualized viewing motives negatively and indirectly predict post-viewing involvement in science learning activities through:

1. Less intentionality before exposure
2. Less selectivity before exposure
3. Less cognitive involvement during exposure

**H5:** Attitudes (affinity - realism) positively and indirectly predict post-viewing involvement in science learning activities through:

1. Higher intentionality before exposure
2. Higher selectivity before exposure
3. Higher cognitive involvement during exposure

## 2. Literature Review

### 2.1 Definitions of Science Popularization

Different scholars applied different definitions from various perspectives to science popularization. Scholars considered it as a form of free-choice learning, an autobiography of science, a bridge between science and public, science communication activities that seek to raise the public's scientific and cultural awareness, a systematic channel to communicate science and technology advances to the lay public, or a diffusion process of scientific and technical knowledge (El-Nemr, 1998; Qinglin, 2002; Bell, 2010; Ren, & Zhai, 2014).

Based on this, science popularization can be defined within the context of this study as an activity to communicate science and technology information in easy ways for the public to understand, accept, and engage in through systematic channels, in an attempt to improve the public scientific literacy. This activity represents a form of free-choice learning.

### 2.2 Media Role in Science Popularization

The role of media in science popularization crystalized with the professionalized development of science since the second half of the 19th century. Scientists played a major role in science popularization, while media played a supporting role through publishing news related to new scientific discoveries and advancements. Scientists began to withdraw from science popularization in the 20th century due to the increasing pressure of the scientific research and the difficulty of communicating professionalized scientific knowledge to the public.

Specialized science journalists began to appear in the 1920s and 1930s. By the the 21st century, media became considered a third party, acting as bridge to link between science and the public (Ren, & Zhai, 2014). There have been different assessments about the relation between science and the media. One view assumes that mass media distorts scientific knowledge. Another opposing view assumes that no particular group should have the monopoly of specialized knowledge. (Weingart, 2014).

### 2.2.1 Science Popularization Videos on Facebook and YouTube

With the fast development of science and scientific knowledge, social media can be an effective way for popularizing information to the public. The role of social media in popularizing science information was crystalized during COVID-19 pandemic. For example, The World Health Organization and the Egyptian Ministry of Health and Population used social media to publish videos popularizing science information related to the virus (Egyptian Ministry of Health and population, n.d; WHO, 2020). However, some scientists and researchers have a misconception that social media is designed for leisurely activities. Also, social media has some drawbacks like the problem of intellectual property ownership (Sekar, & Sudhira, 2017).

This study focused mainly on Facebook and YouTube as social media platforms for sharing and viewing science popularization videos. According to the Global Digital Report, watching online videos was the most common online content activity with a percentage 95% in Egypt in 2019. Also, the report stated that both sites were the most used social media platforms world widely and in Egypt in 2020 (Hootsuite, & We Are Social 2020). Science popularization videos on Facebook can and YouTube can be created by a variety of amateur and professional sources. There are possible differences between user-generated content and professionally generated content in terms of channel resources. These differences might indirectly impact content factors (Welbourne, & Grant, 2015). Professional sources can include nonprofit organizations, *g*overnmental agencies, academic journals, educational institutes, and media networks. *El-Daheeh* is an example of online science popularization programme produced in collaboration with AJ+ Net digital platform. There are many science popularization pages and channels created by users, that compete with the professionally generated ones for audience attention. Some users create science popularization videos on topics related to their expertise or field of study like *El-Espitalia* (Espitalia, n.d), while other users create videos that popularize various science topics not all necessarily related to their main expertise or field of study like *Egychology* (Egychology, n.d.). However, some user-generated pages and channels publish science popularization videos, but without clearly mentioning who created them nor their scientific background like *Ashwaayat* (Ashwaayat, n.d).

### 2.3 Audience Activity and Science Media Gratifications

#### 2.3.1 Instrumental and Ritualized Motives for Using Science Media

Motives are general dispositions that influence people's actions taken to fulfill a need (Papacharissi, & Rubin, 2000). There are two general media use orientations identified by Rubin (1981, 1983, 1984). One of them is the ritualized use that focuses more on the medium and is related to diffuse motives like pass time or habit, companionship, relaxation, and escapism. The other one is the instrumental use that is more goal-directed and characterized by purposive exposure to specific content for arousal and excitement, behavioural guidance, information seeking and learning, entertainment and enjoyment, and social interaction motives. This classification was valid when applied to new media (Metzger, & Flanagin, 2002).

Park and Goering (2016) found that college students' motives for health-related YouTube use were classified into instrumental motives including social utility, convenient information-seeking, and exciting entertainment; and ritualized motives including habit-passing time. Rapp et al. (2016) stated general surgery residents at Carver College of Medicine reported using science videos to prepare for surgical cases. However, few studies focused on identifying users' motives for viewing science popularization videos on social media within an informal learning context.

#### 2.3.2 Attitudes

Affinity is the perceived importance of a communication behaviour or channels. While realism is how true to life media content is. (Papacharissi, & Rubin, 2000). Affinity and realism were significant predictors of all activity types including intentionality, selectivity, and involvement (Rubin, & Perse, 1987b). Rubin (2002) found that more habitual and less active viewers tend to exhibit an affinity with the medium of their choice, whereas more instrumental and active viewers tend to exhibit an affinity with the content selected. Kaye (1998) studied attitude concept in the Web environment. He found that there was a significant correlation between affinity towards the Web and social interaction, entertainment, escape, and information motives. While realism attitude was positively associated with using the Web for accessing information, entertainment, and for satisfying social interaction needs.

### 2.3.3 Audience Activity

New media is expected to heighten audience activity, as new technologies are used to achieve more active goals in comparison with traditional media. Papacharissi and Rubin (2000) study's results indicated a more active orientation toward the Internet, as information seeking was the most salient motivation for using the Internet, reflecting an instrumental orientation. Conversely, Ferguson and Perse (2000) found that entertainment was the most salient motive for using the Web, reflecting a more passive orientation towards the medium. The contradiction may go back to the fact that the first study focused on motives of Internet, while the last one focused on the motives for surfing the Web only. In the same vein, Lin (1993) asserted that motives significantly correlated with audience activity, as audience activity was both a significant effect for gratifications sought and a significant cause for gratifications obtained.

#### 2.3.3.1 Intentionality and Selectivity

According to Levy and Windahl (1984) and Levy (1987), selectivity in exposure seeking is a degree of intentionality in entering the communication settings. It is behavioural planning to use media. Rubin and Perse (1987b), Blumer (1979), and Rubin (1993) made a distinction between intentionality and selectivity, while intentionality is related to purposive and planned use of media itself, selectivity is more related to the degree to which a certain content is chosen selectively according to personal preferences and interests. Similarly, Kim and Rubin (1997) considered selectivity as the tendency of the audience to select certain media content they want to view.

Rubin and Perse (1987b) examined the concept of audience activity on television news viewing, they found out that perceived affinity, selectivity before exposure, and cognitive involvement were positive significant predictors of users' intentionality. They also concluded that pass time motives and perceived realism were significant negative predictors of selectivity, while intentionality was a significant positive predictor of it. When applied to new media, the use of online videos was positively associated with both intentional and selective audience activity, and negatively associated with more passive activity (Bondad-Brown et al., 2012). Conversely, a study on audience activity among users of the World Wide Web concluded that selectivity was not differentiated meaningfully between instrumental and ritualized Web use (Niekamp, 2003).

**2.3.3.2 Involvement**

Involvement can be conceptualized as a sense of connection between the audience and a certain media content, and the extent to which the audience psychologically interact with a medium or its messages (Levy, 1987). Involvement includes affective, cognitive, and behavioural aspects. Affective involvement was defined as affective user involvement resembled in a sense of friendship developed by users towards media personalities (Rubin 1987).

Cognitive involvement was defined as thinking about media messages during and after exposure. It involves attention to the media content, and elaboration as a highly involving cognitive process (Levy & Windahl 1984; Rubin & Perse, 1987a). Rubin and Perse (1987b) and Nikeamp (2003) considered engaging in distractions as a negative indicator of involvement. According to Rubin and Perse (1987b), information seeking motive, realism, and intentionality positively and significantly predicted cognitive involvement with television news. Similarly, Park and Goering (2016) found that instrumental motives including social utility and convenient information seeking motives for using health-related videos on YouTube positively predicted users' cognitive involvement during watching these videos.

Behavioural involvement includes talking about media messages, interpersonal discussions of media content, and talking back to television (Rubin & Perse 1987a, Rubin & Perse 1987b). Behavioural involvement extends to include post-exposure online activity within the context of the Internet and social media. Post-exposure online activity was positively predicted by voyeuristic viewing motive, cognitive elaboration, and dissatisfactions towards watching reality shows programmes (Godlewski, & Perse, 2010). In the same vein, it was found out that users who were motivated to use health-related videos on YouTube for social utility or convenient information seeking purposes, were more involved in post-exposure online activities (Park, & Goering, 2016).

Rubin and Perse (1987a) considered involvement after watching soap operas as a form of media effects. They explored how motives, attitudes, and other activity types would explain three manifestations of post-exposure involvement: para-social interaction, post-viewing cognition, and post-viewing discussion. This view was supported by Kim and Rubin (1997) who considered para-social interaction as a media effect for watching soap operas.

### 2.4 Science Learning in The Digital Age from a Connectivism Perspective

Science learning has a multifaceted nature. It includes the development of a vast array of emotions, interests, attitudes, knowledge, and competencies (Fenichel, & Schweingruber, 2010). Connectivism learning theory was developed to describe learning in a digital networked world, taking into consideration new trends in learning, the use of technology and networks, and the diminishing half-life of knowledge. Several studies showed that connectivism principles can be applied within schools as an environment for formal learning (Miller 2009; Altuna, & Lareki 2015), as well as MOOCs courses as a form of non-formal learning (Espinosa et al., 2015). Rare studies focused on applying connectivism principles within informal learning contexts, although that connectivism views learning as a lifelong process, where informal learning is a significant aspect of users' learning experiences.

Informal learning takes place within free-choice learning environments that may be related or not to the national curriculum (Plakitsi, 2013). It is considered more organic and less structured than formal learning. It is characterized as being contextualized; learner-motivated; voluntary; personal; ongoing; collaborative; interactive;

open- ended; and inclusive of diverse learners. (National Research Council, 2009; Black, 2015).

Science content presented by media is usually accessed on a voluntary basis, thus encouraging positive learning. People usually engage with media and get involved in learning through it as part of their daily routine. (Fenichel, & Schweingruber, 2010). The integration between media and new ICT opened up new spaces for learning, generating, and sharing scientific information (Buntting et al., 2018; TroitZlatkin-schanskaia et al., 2018).

**2.4.1 Requirements for effective science learning in the 21st century**

**2.4.1.1 Functional Access**

Functional access means having access to technologies, resources, services, networks of people and information; and overcoming issues of time, ownership, and mobility (Sharpe, & Beetham, 2011). It is a requirement for effective learning within a digital environment. However, according to Sharpe and Beetham (2011) hierarchy of learning needs within a digital environment, access is only the starting point for meeting other effective learning attributes.

**2.4.1.2 Digital Skills, Competencies and Literacies**

Digital literacy can be considered as the awareness, attitude, and ability of individuals to appropriately use digital tools to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources; construct new knowledge; create media expressions; and communicate with others, in order to enable constructive social action and to reflect upon this process (Martin, & Grudziecki, 2006; Knutsson et al., 2012). Digital literacy is a wide nature term, and it keep stretching with the expanding advancements in new media and ICT to include different modes of literacies including language-focused literacies, information-focused literacies, connections-focused literacies, remix focused literacies, learning focused literacies

Some scholars claimed that there is some sort of digital divide between the Net Generation and older generations. It is assumed that the Net generation are more eligible in using new media (Boyd, 2007; Watkins, 2009; Freitas, & Conole, 2011) However, these claims have been rebutted as Net generation individuals are demographically heterogeneous, so, not all of them can operate effectively within digital environments (Pegrum, 2016). Moreover, Net Generation's informal heavy usage of ICT and new media is usually driven by social and entertainment purposes, so it does not automatically lead them to acquire critical digital literacies (Ryberg, & Dirckinck-Holmfeld, 2011; Walker et al., 2011; Pegrum, 2016).

## 3. Methodology

### 3.1 Procedure and Sample

This study used a descriptive quantitative methodology, specifically a survey method. An online questionnaire designed on google forms was used to collect the data for this study. Data was collected after obtaining a permission to collect the data of the field study from The Central Agency for Public Mobilization and Statistics on 2nd December 2019, and conducting a pre-test of the online questionnaire on a sample of 40 respondents to ensure that clarity and accessibility of the questionnaire. Thereafter, respondents were invited to take the survey by posting the link to the questionnaire on seven Facebook groups created for sharing scientific information. The survey was conducted over one month, between January and February 2020.

Data was collected from a non-probability purposive sample of 408 Egyptian social media users who watch science popularization videos on Facebook or YouTube. Science popularization videos were considered as user-generated or professionally generated videos. These videos are produced exclusively to be published online on YouTube, Facebook.

The respondents were chosen to include a) regular viewers who watch science popularization videos at least monthly. Regularity of viewing was used as an inclusion criterion in various uses and effects studies (Rubin, & Perse, 1987a; Rubin & Perse, 1987b; Godlewski, & Perse, 2010). b) those aged from 13 to less than 43. According the global digital report social media users within this age range were the most active social media users (Hootsuite, & We Are Social 2020). Also, this age range was sufficient to represent different age groups and two different generations which are generation Y (1977-1994) and generation Z (1995- 2012).

Table (3.1): *The Demographic Profile of the Sample*

| Demographics | | Frequency | Percentage % |
|---|---|---|---|
| Gender | Male | 144 | 35.3 |
| | Female | 264 | 64.7 |
| Generation | Generation Z | 251 | 61.5 |
| | Generation Y | 157 | 38.5 |
| Age group | From 13 to less than 18 | 38 | 9.3 |
| | From 18 to less than 25 | 213 | 52.2 |
| | From 25 to less than 35 | 114 | 27.9 |
| | From 35 to less than 43 | 43 | 10.5 |
| Educational level | Basic education | 34 | 8.3 |
| | Secondary or post-secondary | 149 | 36.5 |
| | College | 155 | 38 |
| | Postgraduate | 70 | 17.2 |
| Total | | 408 | 100% |

## 3.2 Scales Construction

All scales were constructed by summing up respondents answers on the items of each scale. The higher the value of each scale, the higher the variable it measures. These indicators were:

### 3.2.1 Viewing Level of Science Popularization Videos

Users' viewing level was measured using three questions related to the frequency of watching these videos per month, the number of hours spent in watching these videos each time, and the number of videos watched each time. The value of the indicator ranged between 3 and 11 (M= 5.28, SD= 1.85, $\alpha = 0.551$).

### 3.2.2 Motives for Watching Science Popularization Videos (Instrumental - Ritualized)

Users' motives for watching science popularization videos were measured using items drawn from previous research that identified instrumental and ritualized motives for watching television (Rubin & Perse, 1987b), Internet and social media sites (Papacharissi & Rubin, 2000; Haridakis, & Hanson, 2009; Whiting & Williams, 2013, Park & Goering, 2016), and science media (Burakgazi, & Yildirim, 2013; Rapp et al., 2016). Some statements were adapted to relate to the topic of the study. On a 3 point Likert scale, respondents indicated their agreement with 15 statements about their reasons for watching science popularization videos. The responses to the statements were subjected to confirmatory factor analysis with rotation to make sure of the categorization of the statements into instrumental and ritualized. The factor analysis results supported the pre-assumed theoretical categorization of motives, except for a statement related to watching these videos for entertainment, it was shifted to ritualized motives indicator. Two indicators were created depending on the factor analysis results as follows:

*Instrumental motives indicator:* It was created by summing up respondents' answers on 8 statements. The value of the indicator ranged between 8 and 24 (M= 16.93, SD= 2.8,$\alpha = 0.637$).

*Ritualized motives indicator:* It was created by summing up respondents' answers on 7 statements The value of the indicator ranged between 7 and 21 (M= 14.43, SD= 2.8, $\alpha = 0.592$).

**3.2.3 Attitudes Towards Science Popularization Videos and Their Content**

Two separate scales were used to measure affinity and realism attitudes. Affinity is the perceived importance of science popularization videos in the lives of the respondents, while realism is the perceived reliability or how true-to-life the respondents perceived science popularization videos' to be. Items of both scales were drawn from Rubin's (1983) scales measuring affinity and realism attitudes towards television. Kaye (1998) used these scales to measure affinity and realism attitude towards the World Wide Web, so they were suitable for this study after adapting some statements to relate to the topic of the study.

*Affinity:* It was measured through a 5 items Likert scale. The value of the scale ranged between 5 and 15 (M= 10.16, SD= 2.41, $\alpha = 0.611$).

*Realism:* It was measured through a 4 items Likert scale. The value of the scale ranged between 4 and 12 (M= 10.17, SD= 1.48, $\alpha = 0.521$).

**3.2.4 Audience Activity Before Exposure**

*Intentionality:* Respondents' purposive and planned watching of science popularization videos was measured using items drawn from previous research related to intentionality in using visual media content (Levy & Windahl's, 1984; Rubin, & Perse, 1987b), as well as items related to intentionality in using the Internet (Niekeamp, 2003). Some statements were adapted to relate to the topic of the. On a 3 point Likert scale, respondents indicated their agreement with three items. The value of the scale ranged between 3 and 9 (M= 5.68, SD= 1.91, $\alpha = 0.62$).

*Selectivity:* Respondents' tendency to select certain videos or science topics based on their personal interests and preferences was measured using 3 items Likert scale drawn from Levy's (1987) selectivity scale of using VCR and Niekamp's (2003) selectivity scale for using the Web. However, a third item (I know in advance the science areas or topics I want to watch science popularization videos about) was added to measure selectivity in choosing science topics respondents want to learn about, as described by the connectivism learning theory (Siemens, 2005). Respondents indicated their agreement with the three items of the scale. The value of the scale ranged between 3 and 9 (M= 5.47, SD= 1.80, $\alpha = 0.524$).

***3.2.5 Audience activity during exposure***

*Cognitive involvement:* Respondents' cognitive effort during exposure was measured using a scale consisted of three attention and elaboration items as a positive indicator of cognitive involvement, and four distractions items as a negative indicator of cognitive involvement. Attention and elaboration items were related to paying attention to the videos' content, concentrating with the videos (Niekeamp, 2003), and thinking about the content of the videos (Rubin & Perse, 1987b; Perse, 1990; Niekeamp, 2003; Park, & Goering, 2016). Distraction items were related to co-viewing behaviours (Levy, & Windahl, 1984; Rubin & Perse, 1987b; Perse, 1990; Niekeamp, 2003). Some statements were adapted to relate to the topic of the study.

A confirmatory factor analysis was conducted to make sure that all the four distraction items in the scale were negative indicators of cognitive involvement. The factor analysis supported the theoretical expectation for all the items. On a 3 point Likert scale, respondents indicated their agreement with the seven items. The value of the scale ranged between 7 and 21 (M= 17.84, SD= 2.31, $\alpha = 0.558$).

**3.2.6 Audience Activity After Exposure**

*Post-viewing involvement in science learning activities:* It was measured using a scale consisted of nine items related to the three aspects of post-viewing involvement in science learning activities. These aspects were following other digital sources of information, interpersonal interaction over the science content, and feeding back into the learning network. These aspects were developed based on the audience activity literature review and the principles of connectivism learning theory (Rubin & Perse, 1987a; Rubin & Perse, 1987b, Niekamp, 2003; Siemens, 2005; Park, & Goering, 2016). On a 3 point Likert scale, respondents indicated their agreement with the nine items. The value of the scale ranged between 9 and 27 (M= 15.96, SD= 4.43, $\alpha = 0.783$).

**3.2.7 Digital Literacy Skills**

Users level of proficiency in using digital technologies for science learning activities was measured with items drawn from a digital literacy skills measure developed by Al Khateeb (2017). This measure was constructed based on the *European Digital Competence Framework for Citizens* (Carretero et al., 2017). This study focused on three main areas of skills that might affect post-viewing involvement in science learning activities, which are information and digital literacy, communication and collaboration, and digital content creation. The scale consisted of five groups of statements. Each group was related to certain skills within a certain area of digital literacy skills. The value of the scale ranged between 5 and 15 (M= 9.05, SD= 2.7,$\alpha = 0.6$).

**3.3 Validity and Reliability**

To ensure content validity scales of the questionnaire were developed after consulting previous research into uses and effects. Since expert judgment is another common way to determine content validity, the whole questionnaire was assessed by 12 subject matter experts in the academic fields of a) curriculum and instruction, b) foundations of education, c) educational media, d) mass communication, and e) educational technology. It was also assessed by statistics experts to make sure that it will yield statistical data suitable for data analysis.

Expert judgment also assured Face validity. Respondents were also involved in testing face validity, as a pre-test of the questionnaire was conducted on 40 respondents to make sure that the questionnaire was relevant, clear, and understandable to them. Confirmatory factor analysis was conducted on the items of motives scale and cognitive involvement scale, as described in the previous scale construction section. This helped to make sure that the items of each scale can be grouped together consistently and coherently, achieving construct validity.

Reliability was measured using the internal consistency coefficient (Cronbach's Alpha). As noted in the scale construction section, the value of Cronbach's Alpha for all the scales was greater than or equal 0.5, which meant that the questionnaire was reliable.

### 3.4 Data Analysis Procedures

*Structural equation modeling (SEM)* was used to test the five hypotheses of the study as the hypothesized relationships constituted path models with direct and recursive relationships among variables. The control variables were first accounted to control their effects on post-viewing involvement. Then a series of regression analysis was used as follows: a) pre-exposure activities and cognitive involvement were regressed on motives and attitudes, b) post-viewing involvement in science learning activities was regressed on motives, attitudes, pre-exposure activities, and cognitive involvement during exposure.

SEM was checked for the efficiency of the model through using the goodness of fit measures through incremental fit index (IFI), relative fit index (RFI), comparative fit index (CFI), normed fit index (NFI), and root mean square error approximation (RMSEA).

## 4. Results of the Field Study

### 4.1 Hypotheses Test Results

The hypothesized multivariate relationships concerned the direct and indirect influence of motives and attitudes on post-viewing involvement in science learning activities. The efficiency of the model was checked using multiple indices of model fit as follows:

Table (4.1): *Fit Indices of the Estimated SEM*

| **Fit Indices of the estimated SEM** | |
|---|---|
| **Chi-square** | **708.102** |
| **Degree of freedom** | **91** |
| **Level of significance** | **0.000** |
| **NFI** | **0.909** |
| **RFI** | **0.850** |
| **IFI** | **0.842** |
| **TLI** | **0.945** |
| **CFI** | **0.927** |
| **RMSEA** | **0.029** |

The results indicated the goodness of fit of the structural model at acceptable limits.

Based on the hierarchal conceptual order of predicted relationships in the path model, the control variables were first accounted to control their effects on post-viewing involvement in science learning activities. Viewing level (β = 0.315, P < 0.001) and digital literacy skills (β = 0.155, P < 0.05) were the only significant control variables. The analysis located several direct and indirect significant paths between the variables, as summarized in table number (4.15).

Table (4.2): *Path Analysis Detailed Results*

| Variables | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|
| Intentionality ← Instrumental motives | *.169**** | *.029* | *5.767* | *0.000* |
| Intentionality← Ritualized motives | *-.019* | *.029* | *-.638* | *.524* |
| Intentionality← Realism | *-.013* | *.058* | *-.223* | *.823* |
| Intentionality← Affinity | *.295**** | *.036* | *8.205* | *0.000* |
| Selectivity← Instrumental motives | *.141**** | *.030* | *4.630* | *0.000* |
| Selectivity← Ritualized motives | *-.093*** | *.030* | *-3.064* | *.002* |
| Selectivity← Realism | *-.143** | *.061* | *-2.346* | *.019* |
| Selectivity← Affinity | *.136**** | *.037* | *3.632* | *0.000* |
| Cognitive involvement← Instrumental motives | *.123*** | *.039* | *3.146* | *.002* |
| Cognitive involvement← Ritualized motives | *-.119*** | *.039* | *-3.058* | *.002* |
| Cognitive involvement← Realism | *.270**** | *.078* | *3.463* | *0.000* |
| Cognitive involvement← Affinity | *.199**** | *.048* | *4.152* | *0.000* |
| Post viewing involvement← Viewing level | *.315**** | *.092* | *3.443* | *0.000* |
| Post viewing involvement← Gender | *.459* | *.354* | *1.297* | *.195* |
| Post viewing involvement← Age | *.288* | *.212* | *1.361* | *.173* |
| Post viewing involvement← Educational level | *-.122* | *.129* | *-.951* | *.341* |
| Post viewing involvement← Digital literacy skills | *.155** | *.063* | *2.476* | *.013* |
| Post viewing involvement← Internet speed | *.079* | *.305* | *.258* | *.797* |
| Post viewing involvement← Internet access | *-.915* | *1.220* | *-.750* | *.453* |
| Post viewing involvement← Available digital gadgets | *.244* | *.412* | *.593* | *.553* |
| Post viewing involvement← Instrumental motives | *.682**** | *.066* | *10.376* | *0.000* |
| Post viewing involvement← Ritualized motives | *-.100* | *.062* | *-1.610* | *.107* |
| Post viewing involvement← Realism | *-.498**** | *.125* | *-4.001* | *0.000* |
| Post viewing involvement← Affinity | *.218*** | *.083* | *2.608* | *.009* |
| Post viewing involvement← Intentionality | *.344**** | *.103* | *3.327* | *0.000* |
| Post viewing involvement← Selectivity | *.249** | *.099* | *2.504* | *.012* |
| Post viewing involvement← Cognitive involvement | *-.143* | *.077* | *-1.846* | *.065* |
| Note: *P<0.05, **P<0.01, ***P<0.001 | | | | |

From the previous table and figure, it can be concluded that:

Instrumental viewing motives (β = 0.682, P < 0.001) and affinity (β = 0.218, P < 0.01) had a positive and direct influence on post-viewing involvement in science learning activities, while realism (β = -0.498, P < 0.001) was negatively and directly linked to post-viewing involvement in science learning activities. Thereby, ***H1*** assuming that "post-viewing involvement in science learning activities is positively and directly predicted by instrumental viewing motives, as well as affinity and realism attitudes", **was *partially supported***. Ritualized motives had no direct significant influence on post-viewing involvement in science learning activities (P > 0.05). Based on this, ***H2*** stating that "post-viewing involvement in science learning activities is negatively and directly predicted by ritualized viewing motives of these videos", **was *rejected***.

Instrumental viewing motives was positively and directly linked to intentionality (β = 0.169, P < 0.001), selectivity (β = 0.141, P < 0.001), and cognitive involvement (β = 0.123, P < 0.01). In turn, intentionality (β = 0.344, P < 0.001) and selectivity (β = 0.249, P < 0.05) were positively and directly linked to post-viewing involvement in science learning activities. However, cognitive involvement had no significant influence on post-viewing involvement in science learning activities (P > 0.05). That meant that instrumental viewing motives were positively and indirectly linked to post-viewing involvement in science learning activities through higher intentionality with a value (0.344*0.169 =0.058136) and higher selectivity with a value (0.249*0.141= 0.035109). Having an overall direct and indirect influence on post-viewing involvement in science learning activities with a value (0.682+0.058136+0.035109 = 0.775245). This analysis provided **a partial support for H3**, which expected that **"**instrumental viewing motives positively and indirectly predict post-viewing involvement in science learning activities through higher intentionality before exposure, higher selectivity before exposure, and higher cognitive involvement during exposure".

Ritualized viewing motives was negatively and directly linked to selectivity (β = -0.093, P < 0.01), but it had no significant influence on neither intentionality (P > 0.05) nor cognitive involvement (P > 0.05). Hence, ritualized viewing motives had an indirect negative influence on post-viewing involvement in science learning activities through lower levels of selectivity with a value (0.249*-0.093 = - 0.023157). Consequently, ***H4 was partially rejected***, as it assumed that “ritualized viewing motives negatively and indirectly predict post-viewing involvement in science learning activities through less intentionality before exposure, less selectivity before exposure, and less cognitive involvement during exposure”.

Affinity had a positive direct influence on intentionality ($\beta = 0.295$, $P < 0.001$), selectivity ($\beta = 0.136$, $P < 0.001$), and cognitive involvement ($\beta = 0.199$, $P < 0.001$). Realism had also a positive direct influence on cognitive involvement ($\beta = 0.270$, $P < 0.001$), however, it was negatively and directly linked to selectivity ($\beta = -0.143$, $P < 0.05$), while it had no direct influence on intentionality ($P > 0.05$).

Since cognitive involvement had no significant influence on post-viewing involvement in science learning activities ($P > 0.05$), affinity had an indirect influence on post-viewing involvement in science learning activities through higher intentionality with a value (0.344* 0.295 = 0.10148) and higher selectivity with a value (0.249* 0.136= 0.033864). Affinity overall direct and indirect influence on post-viewing involvement in science learning activities was estimated by (0.218+ 0.10148 + 0.033864= 0.353344). Similarly, realism had an indirect influence on post-viewing involvement in science learning activities only through selectivity with a value (0.249* -0.143= -0.035607), however, it was a negative influence, against H5. The overall direct and indirect influence of realism on post-viewing involvement in science learning activities was estimated by (-0.498-0.035607= - 0.533607). The analysis then ***partially rejected H5*** which expected that “affinity and realism attitudes positively and indirectly predict post-viewing involvement in science learning activities through higher intentionality before exposure, higher selectivity before exposure, and higher cognitive involvement during exposure”.

## 5. Discussion

### 5.1 Discussion of the Findings

The results of the study supported the general assumption of Rubin’s and Perse’s (1987b) gratification seeking and audience activity model, that audience activity relates in largely predicted way to motives and attitudes. As motives and attitudes were significant predictors of all activity types during different phases of exposure to science popularization videos on Facebook and YouTube, including intentionality and selectivity, cognitive involvement during exposure, and post-viewing involvement in science learning activities.

Consistent with previous research, the classification of media use orientations into instrumental and ritualized use orientations was valid when applied to new media (Metzger, & Flanagin, 2002; Niekamp, 2003). Users were motivated to watch science popularization videos on Facebook and YouTube for both instrumental and ritualized purposes. The mean score of both instrumental and ritualized motives was slightly above moderate, which meant that media use orientation among the sample in total was saturated by both instrumental and ritualized motives in relatively close proportions. This comes in line with Metzger, & Flanagin (2002) study's result that new media usage seemed to be motivated by relatively equal levels both orientations. Though, it was against Papacharissi's and Rubin's (2000) conclusion that Internet use was more actively orientated. This inconsistency may be due to the entertaining nature of social media sites.

The confirmatory factor analysis of motives revealed that entertainment was considered a ritualized motive for watching science popularization video, against the study's theoretical supposition. This result is in agreement with Perse's (1990) findings, while it contradicts with Rubin's and Perse's (1987a), Rubin's and Perse's (1987b), and Godlewski's and Perse 's (2010) classification of entertainment as an instrumental motive for using media.

As proposed by previous studies, the results supported that instrumental orientation was linked to more active use of media, in contrary to the ritualized orientation (Rubin, 1981; Rubin, 1983; Rubin, 1984; Rubin & Perse, 1987b; Lin, 1993). Ritualized motives for viewing science popularization videos were significant negative predictors of selectivity and cognitive involvement. On the other side, instrumental use motives and affinity were significant positive predictors of intentionality, selectivity, and cognitive involvement. Similarly, realism attitude was a significant positive predictor of cognitive involvement.

Contrary to the expectations, realism was a significant negative predictor of selectivity. A possible explanation for this might be that a new dimension related to credibility can be added to selectivity within social media context, as information on social media sites suffer from relative lack of professional gatekeepers, and it is open for all users to be content generators. Respondents seemed aware of this defect as they considered the significance of scientific information from credible sources as the most important evaluation criteria of these videos. Selectivity was operationalized as the tendency to select certain videos or science topics based on personal interests and preferences, however, selection criteria on social media may expand to include credibility of the videos along with personal interests and preferences. Especially that the sample of the study was limited to those who already watch science popularization videos regularly, so selectivity is not just about the selectivity of science popularization videos over other types of content, but the selectivity of video sources. Thereby, higher user's realism attitude towards science popularization videos led to less selectivity and more reliance on Facebook and YouTube random suggestions.

Although this result is against the general classification of media use orientation, supposing that realism is part of the instrumental use orientation as identified by Rubin (1981, 1983, 1984), yet it came in line with the results of the hierarchal regression of Rubin's and Perse's (1987b) study, showing that pass time motives, and perceived realism were significant negative predictors of selectivity before exposure to television news.

The mean of respondents' realism attitude towards science popularization videos was quite high. This is consistent with their reported preference to watch professionally generated science popularization videos, in compare to user-generated ones, as *El-Daheeh* and *El-Espitalia* were sequentially the top two most preferred pages/ channels for watching science popularization videos, which were affiliated to a media network, at the time of conducting the survey. It can be expected that users might had higher levels of realism attitude towards professionally generated videos by media sources, in comparison with user-generated ones, however, this does not guarantee the total credibility of these sources.

The hypotheses of the study assumed direct and indirect influences of motives and attitudes on post-viewing involvement in science learning activities. Users' activity before and during exposure was expected to be significant mediating variables for the influence of motives and attitudes on post-viewing involvement. As expected, the results of the SEM revealed that instrumental viewing motives and affinity attitude positively and directly predicted post-viewing involvement in science learning activities. This accords with previous literature, which showed that affinity attitude and instrumental motives like voyeuristic viewing, social utility, convenient information seeking, and exciting entertainment were among the factors positively predicting post-viewing involvement or post-exposure online activity (Rubin, & Perse, 1987a; Godlewski, & Perse, 2010; Park, & Goering, 2016).

One unanticipated finding was that realism attitude negatively and directly predicted post-viewing involvement in science learning activities. As mentioned previously, this result contradicted the general classification of media use orientation, supposing that realism is a part of the instrumental use orientation identified by Rubin (1981, 1983, 1984). A possible explanation for this might be that the most prominent aspect of post-viewing involvement in science learning activities among respondents was following other digital sources of information for acquiring knowledge and checking the credibility of the mentioned information. Consequently, it is logical that the more the respondents perceive the content to be realistic, the less likely they are to engage in post-viewing involvement in science learning activities, including checking sources mentioned through the videos.

Also, another aspect of post-viewing involvement in science learning activities was interpersonal interaction over the science content. Rubin and Perse (1987a) found out that viewing soap operas for social utility but not for voyeurism, and the lack of realism were related to post-viewing discussion but not to para-social interaction. So, it can be concluded that not all forms of post-viewing involvement require the content to be seen as realistic. Thereby, ***H1*** assuming that "post-viewing involvement in science learning activities is positively and directly predicted by instrumental viewing motives, as well as affinity and realism attitudes", was ***partially supported***.

On the other side, ritualized motives had no direct significant influence on post-viewing involvement in science learning activities, therefore, ***H2*** stating that "post-viewing involvement in science learning activities is negatively and directly predicted by ritualized viewing motives of these videos", **was *rejected***. This supports Kim and Rubin (1997) supposition that the motivation state is not always sufficient to produce the effect. As Blumler (1979) stated, audience activity plays an important intervening role in the media effects. Audience activity before exposure was a significant mediator for the influence of motives on post-viewing involvement in science learning activities. Post-viewing involvement in science learning activities was considered as both a consequence or effect for the instrumental use orientation of science popularization videos, and as an activity anticipated in the future to act itself as an intervening variable in media uses and effects related to learning and knowledge acquisition.

Instrumental viewing motives positively and indirectly predicted post-viewing involvement in science learning activities through higher intentionality and higher selectivity. While ritualized viewing motives had an indirect negative influence on post-viewing involvement in science learning activities only through lower levels of selectivity.

Since ritualized viewing motives had no direct influence on post-viewing involvement in science learning activities, as mentioned previously, this meant that selectivity fully mediated the relationship between them. This result does not nullify the role of motives, but the role of motives on post-viewing involvement is not always straight forward.

This analysis provided **a partial support for H3**, which expected that **"**instrumental viewing motives positively and indirectly predict post-viewing involvement in science learning activities through higher intentionality before exposure, higher selectivity before exposure, and higher cognitive involvement during exposure". Also, ***H4*** assuming that "ritualized viewing motives negatively and indirectly predict post-viewing involvement in science learning activities through less intentionality before exposure, less selectivity before exposure, and less cognitive involvement during exposure", ***was partially rejected***, on the grounds that cognitive involvement was not a significant mediator in the relationship between motives and post-viewing involvement in science learning activities, and that selectivity was the only significant mediator in the relationship between ritualized motives and post-viewing involvement.

The role of intentionality and selectivity as mediators was also crystallized in the relation between attitudes and post-viewing involvement in science learning activities. Affinity had an indirect influence on post-viewing involvement in science learning activities through higher intentionality and higher selectivity. Similarly, realism had an indirect influence on post-viewing involvement in science learning activities but only through reduced selectivity, however, it was a negative influence, as explained previously. Consequentially, ***H5*** which expected that “attitudes (affinity - realism) positively and indirectly predict post-viewing involvement in science learning activities through higher intentionality before exposure, higher selectivity before exposure, and higher cognitive involvement during exposure”, was ***partially rejected.***

Cognitive involvement was the only variable that did not perform as expected. Even though it was significantly predicted by motives and attitudes, it had no influence on post-viewing involvement in science learning activities, and was not considered as a significant mediator for the influence of motives and attitudes on post-viewing involvement. This outcome is contrary to that of Godlewski and Perse (2010) who found that post-exposure online activity was positively predicted by cognitive elaboration during watching reality shows, among other factors. This can be explained by what previous uses and effects studies referred to, that gratification sought from viewing may be satisfied by lower levels of activity for some users. In other words, audience activity is multidimensional, users can show characteristics of both instrumental and ritualized media use orientations during the different exposure phases of the same session of media use (Levy & Windahl, 1984; Rubin & Perse, 1987b, Kim & Rubin, 1997; Niekamp, 2003). As Rubin (1984) stated there is no strict dichotomy of instrumental and ritualized media use. The mean score of instrumental and ritualized motives among the respondents of this study supported the previous assumption. Since the media use orientation among the sample in total was saturated by both instrumental and ritualized motives in relatively close proportions, that meant viewing motives of a user does not necessarily have to be exclusively instrumental or ritualized.

Another possible explanation of this result may relate to the way cognitive involvement was operationalized to include co-viewing distraction as a negative indicator of cognitive involvement, however, some distractions may be beyond the users' control. Also, since cognitive involvement is concerned with users' activity during watching the videos, respondents may inaccurately self-report their actual behaviour during watching unintentionally. Self-reporting of audience activity scales is one of the criticisms of uses and effects approach (Bryant et al., 2013).

Regarding the control variables, digital literacy skills and viewing levels were the only significant control variables. Previous studies found that instrumental use of media is positively correlated with higher levels of media viewing or usage (Rubin, 1983; Haridakis, & Hanson, 2009; Bondad-Brown, & Pearce, 2012; Chen, 2013), thereby this finding broadly supports why viewing level was considered as a significant control variable positively influencing post-viewing involvement in science learning activities.

In accordance with the principles of connectivism stating that learning requires digital literacy skills (Siemens, 2005), the results showed that digital literacy skills had a positive influence on post-viewing involvement. This result is contrary to Metzger and Flanagin (2002), who found that Internet experience was not related to the instrumental use of new media, as new media is easy to use and do not require much experience to use it for seeking information. This discrepancy could be attributed to the difference of learning activities from the regular instrumental use. Post-viewing involvement in science learning activities as a higher-order process requires skills related to the ability to access digital information sources, reach accurate and up to date information, synthesize the collected information and generate a new one, make decisions regarding where to search for and how to obtain new information, as well as how to evaluate this information, and build and maintain online connections with other people to facilitate learning.

Based on the previous findings, the following diagram can be proposed to describe the tested relations between the variables of the study, after removing the variables with an insignificant influence on the main dependent variable.

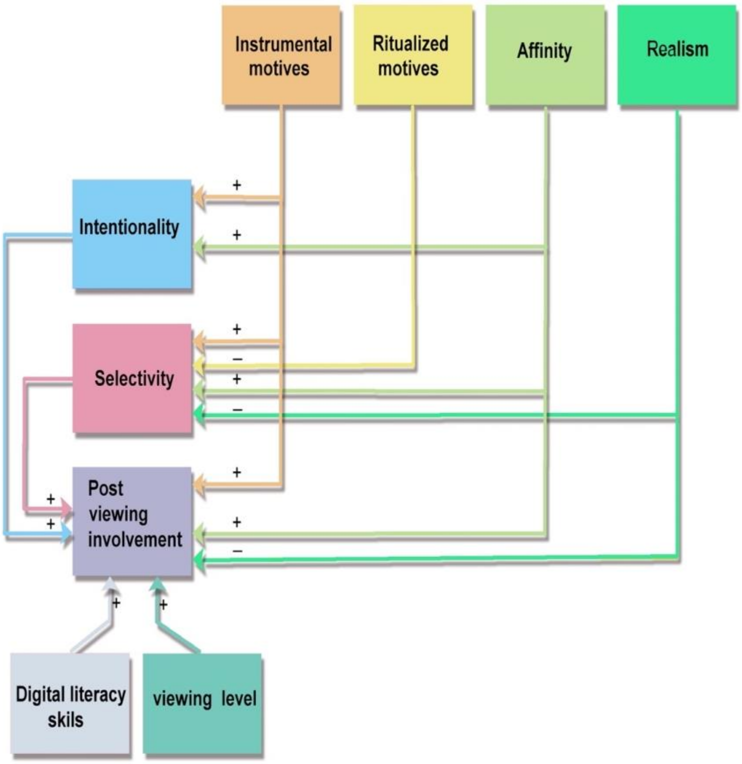


Figure (5.1): *A Diagram Presenting the Tested Relationships Among the Variables*

## 5.2 Limitations and Future Research

The study involved some limitations that should be addressed in future research. The first limitation deals with the sample, as the study was conducted on a purposive sample. Purposive samples introduce problems with external validity. However, with the lack of a comprehensive list of the population, the usage of the purposive sample was justified, especially that the study aimed mainly to test co-relations instead of generalization to the population. Future research can use a probability sampling technique to assure better external validity and more generalization of the results. However, a comprehensive list of the population of science popularization video viewers in Egypt should be provided first by research centers.

The second limitation is related to measurement issues. There is a lack of items that describe motives of watching science popularization videos on social media in previous research. Thereby, there is a need in the future to further develop items for measuring motives for watching science popularization videos from more open-ended responses by focus-group interviews with viewers of science popularization videos on social media. Another measurement issue concerned the digital literacy skills scale, as responses to this scale were based on the respondents' self-report. Future research using this scale should measure respondents' levels of social desirability as well to control the possible effect of social desirability on self-report of digital literacy skills.

The cognitive involvement scale represented another issue related to self-report, as respondents might inaccurately report their actual behaviour while watching science popularization videos. Self-reporting of audience activity scales is one of the criticisms of uses and effects approach, as self-reports might be affected by individual interpretations and perceptions (Bryant et al., 2013). Using the experimental method might be a way to overcome this issue in the future.

The third limitation deals with unexamined variables. The study found that post-viewing involvement is positively predicted by motives and attitudes directly and indirectly through users' activity before exposure. So, post-viewing involvement was a consequence for media use orientations, however, post-viewing involvement itself is an activity and part of the general media use orientations that might help to explain further media effects related to learning and knowledge acquisition, as Rubin and Perse (1987b) suggested that involvement is antecedent to higher-order cognitive effects. The study did not examine how post-viewing involvement in science learning activities might lead to further media effects. Future studies can examine its role as an intervening variable that might yield further effects related to learning and knowledge acquisition.

Finally, the study found that realism was a significant negative predictor of selectivity, that shed light on the future possibility to reexamine the concept of selectivity within social media context to include credibility of the videos, along with personal interests and preferences as a basis for users' selectivity.

**5.3 Conclusion**

The study largely supported the validity of gratification seeking and audience activity model within an informal learning context described by the connectivism leaning theory for the digital age. Motives and attitudes significantly predicted post-viewing involvement in science learning activities. The proposition that audience activity is an important mediating variable in media uses and effects was confirmed. Audience activity before exposure (intentionality-selectivity) was a significant mediator for the influence of motives and attitudes on post-viewing involvement in science learning activities. Selectivity even fully mediated the relationship between ritualized motives and post-viewing involvement. However, realism attitude had a direct negative influence on post-viewing involvement, as well as indirect negative influence through reduced selectivity. Cognitive involvement had no significant mediating effect for any of the independent variables on post-viewing involvement in science learning activities.

## References

1. Ally, M. (2007). Foundations of educational theory for online learning. The Theory and Practice of Online Learning(2nd ed., pp. 15-44). Alberta: Athabasca University Press. http://www.aupress.ca/index.php/books/120146.
2. Altuna, J., & Lareki, A. (2015). Analysis of the use of digital technologies in schools that implement different learning theories. *Journal of Educational Computing Research, 53*(2), 205-227. https://doi.org/10.1177/0735633115597869
3. Ashwaayat. (n.d.). *About* [YouTube Channel]. YouTube. Retrieved January 14, 2020, from https://www.youtube.com/channel/UCe1m3ZH68Q8314yqulWHTcw/about
4. Bell, A. (2010). Popular science, overview. In S. H. Preist (Ed.), *Encyclopedia of science and technology communication* (pp. 586-589). SAGE. http:// doi.org/10.4135/9781412959216.n202
5. Black, J. (2015). Introduction. In *Youth practices in digital arts and new media: Learning in formal and informal settings* (1st ed., pp. 1-12). Palgrave Macmillan. http:// doi.org/10.1057/9781137475176
6. Blumer, J. G. (1979). The role of theory in uses and gratifications studies. *Communication Research*, 6(1), 9-36. https://doi.org/10.1177/009365027900600102
7. Bondad-Brown, B. A., Rice, R. E., & Pearce, K. E. (2012). Influences on TV viewing and online user-shared video use: demographics, generations, contextual age, media use, motivations, and audience activity. *Journal of Broadcasting & Electronic Media, 56*(4), 471-493. http:// doi.org/10.1080/08838151.2012.732139
8. Boyd, D. (2007). ‘Why youth (heart) social network sites: the role of networked public in teenage social life.’ In Buckingham, D. (ed.), *MacArthur Foundation Series on Digital Learning – Youth, Identity, and Digital Media Volume.* (pp. 119-142). MIT Press. http://www.danah.org/papers/WhyYouthHeart.pdf
9. Buntting, C., Jones, A., & Cowie, B. (2018). Using a digital platform to mediate intentional and incidental science learning. In D. Corrigan, C. Buntting, A. Jones, & J. Loughran (Eds.), *Navigating the changing landscape of formal and informal science learning opportunities* (1st ed., pp. 171-182). Springer. http:// doi.org/10.1007/978-3-319-89761- 5
10. Downes, S. (2012). *Connectivism and connective knowledge* (Vol. 1). National Research Council. https://www.downes.ca/me/mybooks.htm
11. Duke, B., Harper, G., & Johnston, M. (2013). Connectivism as a digital age learning theory. *The International HETL Review*, 4-13. https://www.hetl.org/wp-content/uploads/2013/09/HETLReview2013SpecialIssueArticle1.pdf
12. Egychology. (n.d.). *About* [YouTube Channel]. YouTube. Retrieved January 14, 2020, from https://www.youtube.com/user/TheAsead/about
13. Egypt Ministry of Health and Population. (n.d). [Facebook Page]. Facebook. Retrieved December 11, 2020 from https://www.facebook.com/egypt.mohp
14. El Nemr, A. M. (1998). *Dor Bramg El Televizion Fi Tbset El Olom Llatfal* [Role of Television Programmes in Popularizing Science Information for Children] [Unpublished master's thesis, Faculty of Mass Communication, Cairo University]

15. Espinosa, B. J., Sepúlveda, G. C., & Montoya, M. S. (2015). Self-motivation challenges for student involvement in the open educational movement with MOOC. *Universities and Knowledge Society Journal*, *12*(1), 91-103. http:// doi.org/10.7238/rusc.v12i1.2185
16. Espitalia. (n.d.). *About* [YouTube Channel]. YouTube. Retrieved January 14, 2020, from https://www.youtube.com/channel/UC07e1ZK4KWoDWnCN-z6VUiA/about
17. Fenichel, M., & Schweingruber, H. A. (2010). *Surrounded by science: Learning science in informal environments*. National Academies Press. https://doi.org/10.17226/12614.
18. Ferguson, D. A., & Perse, E. M. (2000). The World Wide Web as a functional alternative to television. *Journal of Broadcasting & Electronic Media*, 44(2), 155-174. http:// doi.org/10.1207/s15506878jobem4402_1
19. Freitas, S. D., & Conole, G. (2011). The Influence of pervasive and integrative tools on learners' experiences and expectations of study. In R. Sharpe, H. Beetham, & S. D. Freitas (Eds.), *Rethinking learning for a digital age how learners are shaping their own experiences* (pp. 15-30). Routledge. https://doi.org/10.1111/teth.12011
20. Godlewski, L. R., & Perse, E. M. (2010). Audience activity and reality television: identification, online activity, and satisfaction. *Communication Quarterly*, *58*(2), 148–169. http:// doi.org/10.1080/01463371003773358
21. Grail Research (2011). *Consumers of tomorrow insights and observations about Generation Z*. http://goo.gl/7qYuWt.
22. Haridakis, P., & Hanson, G. (2009). Social interaction and co-viewing with YouTube: Blending mass communication reception and social connection. *Journal of Broadcasting & Electronic Media*, *53*(2), 317-335. http:// doi.org/10.1080/08838150902908270
23. Hootsuite & We Are Social (2020), "*Digital 2020 Global Digital Overview*," https://datareportal.com/reports/digital-2020-global-digital-overview
24. Kaye, B. K. (1998). Uses and gratifications of the World Wide Web: From couch potato to web potato. *New Jersey Journal of Communication, 6*(1), 21-40. http:// doi.org/10.1080/15456879809367333
25. Kim, J., & Rubin, A. M. (1997). The Variable Influence of Audience Activity on Media Effects. *Communication Research, 24*(2), 107-135. http:// doi.org/10.1177/009365097024002001
26. Knutsson, O., Blåsjö, M., Hållsten, S., & Karlström, P. (2012). Identifying different registers of digital literacy in virtual learning environments. The Internet and Higher Education, 15(4), 237-246. http:// doi.org/10.1016/j.iheduc.2011.11.002
27. Levy, M. R. (1987). VCR use and the concept of audience activity. *Communication Quarterly*, *35*(3), 267–275. http:// doi.org/10.1080/01463378709369689
28. Levy, M. R., & Windahl, S. (1984). Audience activity and gratifications: A Conceptual clarification and exploration. *Communication Research*, *11*(1), 51–78. http:// doi.org/ 10.1177/009365084011001003

29. Lin, C. A. (1993). Modeling the gratification-seeking process of television viewing. *Human Communication Research*, 20(2), 224-244. http:// doi.org/10.1111/j.1468- 2958.1993.tb00322.x
30. Livingstone, S. (2017). *Making Sense of Television: The psychology of audience interpretation (*2nd ed.). ROUTLEDGE.
31. Martin, A., & Grudziecki, J. (2006). DigEuLit: Concepts and tools for digital literacy development. *Innovation in Teaching and Learning in Information and Computer Sciences, 5*(4), 249-267. http:// doi.org/10.11120/ital.2006.05040249
32. Metzger, M. J., & Flanagin, A. J. (2002). Audience orientations toward new media. *Communication Research Reports*, 19(4), 338-351. http:// doi.org/10.1080/08824090209384862
33. Miller, R. D. (2009). *Developing 21st century skills through the use of student personal learning networks.* [Unpublished doctoral dissertation, Northcentral University]. ProQuest Dissertations & Theses Global. https://pqdtopen.proquest.com/doc/305177755.html?FMT=ABS
34. National Research Council. (2009). *Learning science in informal environments: people, places, and pursuits*. P. Bell, B. Lewenstein, A.W. Shouse, and M.A. Feder (Eds.). The National Academies Press. https://doi.org/10.17226/12190.
35. Niekamp, R. A. (2003). *Audience activity among users of the World Wide Web* [Unpublished master's thesis, The Pennsylvania State University]. Electronic Theses and Dissertations. https://etda.libraries.psu.edu/catalog/6157
36. Papacharissi, Z., & Rubin, A. M. (2000). Predictors of Internet use. *Journal of Broadcasting and Electronic Media*, 44(2), 175-196. https://doi.org/10.1207/s15506878jobem4402_2.
37. Park, D. Y., & Goering, E. M. (2016). The health-related uses and gratifications of YouTube: Motive, cognitive involvement, online activity, and sense of empowerment. *Journal of Consumer Health on the Internet*, *20*(1-2), 52–70. http:// doi.org/ 10.1080/15398285.2016.1167580
38. Pegrum, M. (2016). Modified, multiplied, and (re-)mixed: Social media□and digital literacies. In M. Thomas (Ed.), *Digital education: Opportunities for social collaboration* (1st ed., pp. 9-36). Palgrave Macmillan. http:// doi.org/10.1057/9780230118003
39. Plakitsi, K. (2013). *Activity theory in formal and informal science education* (1st ed.). Rotterdam: Sense. http:// doi.org/10.1007/978-94-6091-317-4
40. Qinglin, Y. (2002). *An outline of science popularization*. China Science and Technology Press. http://www.bkjpress.com
41. Rapp, A. K., Healy, M. G., Charlton, M. E., Keith, J. N., Rosenbaum, M. E., & Kapadia, M. R. (2016). YouTube is the most frequently used educational video source for surgical preparation. *Journal of Surgical Education*, 73(6), 1072-1076. http:// doi.org/10.1016/j.jsurg.2016.04.024
42. Ren, F., & Zhai, J. (2016). *Communication and Popularization of Science and Technology in China*. Springer. http:// doi.org/10.1007/978-3-642-39561-1_1

43. Rubin, A. M. (1981). An examination of television viewing motivations. *Communication Research*, 8, 141–165. https://doi.org/10.1177/009365028100800201
44. Rubin, A. M. (1983). Television uses and gratifications: The interactions of viewing patterns and motivations. *Journal of Broadcasting*, 27(1), 37-51. http:// doi.org/10.1080/08838158309386471
45. Rubin, A. M. (1984). Ritualized and instrumental television viewing. *Journal of Communication*, 34(3), 67-77. http:// doi.org/10.1111/j.1460-2466.1984.tb02174.x
46. Rubin, A. M. (1984). Ritualized and instrumental television viewing. *Journal of Communication*, 34(3), 67-77. http:// doi.org/10.1111/j.1460-2466.1984.tb02174.x
47. Rubin, A. M. (1993). Audience activity and media use. *Communication Monographs*, 60(1), 98-105. http:// doi.org/10.1080/03637759309376300
48. Rubin, A. M. (2002). The uses-and-gratifications perspective of media effects. In J. Bryant & D. Zillman (Eds.), *Media effects: Advances in theory and research* (2nd ed.), 524–548. Mahwah, NJ: Lawrence Erlbaum Associates. http://psycnet.apa.org/record/2002-00742- 020
49. Rubin, A. M., & Perse, E. M. (1987a). Audience activity and soap opera involvement a uses and effects investigation. *Human Communication Research*, 14(2), 246-268. http:// doi.org/10.1111/j.1468-2958.1987.tb00129.x
50. Rubin, A. M., & Perse, E. M. (1987b) Audience activity and television news gratifications. *Communication Research*, 14(1), 58-84. http:// doi.org/10.1177/009365087014001004
51. Ryberg, T., & Dirckinck-Holmfeld , L. (2011). Analysing digital literacy in action: A case study of a problem-oriented learning process. In R. Sharpe, H. Beetham, & S. D. Freitas (Eds.), *Rethinking learning for a digital age how learners are shaping their own experiences* (pp. 170-183). Routledge. https://doi.org/10.1111/teth.12011
52. Schroer, W. (2008). Defining, managing, and marketing to generations X, Y, and Z. *The Portal*, 10 (9). https://s3.amazonaws.com/rdcmsiam/files/production/public/newimages/portalpdfs/20 08_03_04.pdf
53. Science in 5: WHO's series on science and COVID-19. (2020, September 25). Retrieved December 10, 2020, from https://www.who.int/news-room/events/detail/2020/09/25/default-calendar/science-in-5-who-s-series-on-science- and-covid-19
54. Sekar, S., & Sudhira, H. (2017). Using social media for research and reaching out. In P. Bagla & V. Binoy (Eds.), Bridging the communication gap in science and technology: Lessons from India (pp. 231-242). Springer. http:// doi.org/10.1007/978-981-10-1025-5_17
55. Sharpe, R., & Beetham, H. (2011). Understanding students' uses of technology for learning: Towards creative appropriation. In R. Sharpe, H. Beetham, & S. D. Freitas (Eds.), Rethinking learning for a digital age how learners are shaping their own experiences (pp. 85-99). Routledge. https://doi.org/10.1111/teth.12011

56. Teo, T. S. (2001). Demographic and motivation variables associated with Internet usage activities. Internet Research, 11(2), 125–137. http:// doi.org/10.1108/10662240110695089
57. TroitZlatkin-schanskaia, O., Schmidt, S., Molerov, D., Shavelson, R. J., & Berliner, D. (2018). Conceptual fundamentals for a theoretical and empirical framework of positive learning. In O. Troitschanskaia, G. Wittum, & A. Dengel (Eds.), Positive learning in the age of information: A blessing or a curse? (1st ed., pp. 29-50). Springer Fachmedien Wiesbaden GmbH. http:// doi.org/10.1007/978-3-658-19567-0
58. Walker, S., Jameson, J., & Ryan, M. (2011). Skills and strategies for e-learning in a participatory culture. In R. Sharpe, H. Beetham, & S. D. Freitas (Eds.), Rethinking learning for a digital age how learners are shaping their own experiences (pp. 212-224). Routledge. https://doi.org/10.1111/teth.12011
59. Watkins, S. C. (2010). The young and the digital: What the migration to social-network sites, games, and anytime, anywhere media means for our future. Boston: Beacon Press.
60. Weingart, P. (2014). The lure of the mass media and its repercussions on science. In S. Franzen, M., Weingart, P., & Rödder, S. (Eds.), Sciences media connection: Public communication and its repercussions (pp. 35-58). Springer. http:// doi.org/10.1007/978- 94-007-2085-5
61. Welbourne, D. J., & Grant, W. J. (2015). Science communication on YouTube: Factors that affect channel and video popularity. Public Understanding of Science, 25(6), 706–718. http:// doi.org/10.1177/0963662515572068
62. Whiting, A., & Williams, D. (2013). Why people use social media: a uses and gratifications approach. Qualitative Market Research: An International Journal, 16(4), 362–369. http:// doi.org/ 10.1108/qmr-06-2013-0041
63. Burakgazi, S. G., & Yildirim, A. (2013). Accessing science through media. Science Communication, 36(2), 168-193. http:// doi.org/10.1177/1075547013505847
64. Perse, E. M. (1990). Audience selectivity and involvement in the newer media environment. Communication Research, 17(5), 675–697. http:// doi.org/10.1177/009365090017005005
65. Al Khateeb, A. A. M. A. (2017). Measuring digital competence and ICT literacy: An exploratory study of in-service English language teachers in the context of Saudi Arabia. International Education Studies, 10(12), 38–51. https://doi.org/10.5539/ies.v10n12p38
66. Bryant, J., Thompson, S., & Finklea, B. W. (2013). Uses and gratifications. In Fundamentals of media effects (2nd ed., pp. 122–134). Waveland Press, Inc.
67. Chen, X. (2013). The influence of social media use on knowledge gaps about science and technology among Chinese audiences. Graduate Theses and Dissertations. https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=4491&context=etd
68. Siemens, G. (2005, January). Connectivism: A learning theory for the digital age. International Journal of Instructional Technology & Distance Learning. http://www.itdl.org/Journal/Jan_05/article01.htm

69. AJ+ Arabic. (n.d.). About. Retrieved January 3, 2020, from https://www.ajplus.net/arabi
70. Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use, EUR 28558 EN, http:// doi.org/10.2760/38842