Development and Use of Social Media-Based Mathematics Instructional Module for Grade 7 Students of Geras Integrated School

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Abstract
The purpose of the study was to develop a Social-Media Based Mathematics Instructional Module (SMBMIM) for the Grade 7 students. Specifically, it answered the questions: 1) what are the desirable characteristics of the module in terms of validity and reliability; 2) what are the pre-delivery appropriateness of the SMBMIM in terms of learning objectives, lesson content, language used, and evaluation activities; and (3) what is the educational use of the SMBMIM in meeting the learning competencies of students in Mathematics as revealed in their Pre-Post-test results? The process of module development was anchored on ADDIE Model by McGriff (2000). The validity of the module was determined using Kappa statistics with Pairwise Agreement, while Cronbach's alpha was used to determine module's reliability and pre-delivery appropriateness. In terms of educational use, the learning gains of students measured in terms of Pretest and Posttest scores for every learning competency was used as indicator for the variable module use. As for the validity and reliability of the SMBMIM an inter-rater fair agreement ($k = .024$) and an alpha value of ($\alpha = .90$) described as acceptable and very highly reliable respectively were obtained, while the pre-delivery appropriateness of the SMBMIM showed an alpha ($\alpha = 0.78$) and (x=4.71) described as highly reliable and strongly acceptable respectively. In terms of educational use, results revealed a positive mean gain in 3 out of 4 learning competencies. These findings imply that the SMBMIM is valid, reliable and effective for use as instructional material. However, it is recommended that a further study be done adopting a quasi-experimental method to further validate the effectiveness of the developed module as an instructional tool in meeting the grade 7 Mathematics learning competencies.
Keywords: social media, mathematics achievement, mathematics instructional module, module development, social media-based mathematics instructional module

I. Introduction

The quality of teaching and learning Mathematics has been one of the major challenges and concerns of educators (Saritas & Akdemir, 2009). Ganal & Guiab (2014) describes Mathematics as a subject which many students find most difficult, obscure, and of little interest and according to Ogochukwu (2010) it can be due to the fact that the process of learning Mathematics is a very complex cognitive task that can be very imposing on students since it requires a lot of effort from them. Zin, Zaman & Noah (2002) conclude that most observed failures and substandard performance in Mathematics are due to insufficient teaching-learning environment. Thus, students need a lot of motivation to cope with the subject.

In Isabela City Division, one of the schools which can be considered less competitive in the field of Mathematics is the Geras Integrated School. According to teachers who are handling the subject at school, students' performance in the subject has persistently been poor as manifested by the mastery level obtained from the formative and summative evaluations in class as well as in the local and national examinations or competitions in the learning area. This observation is confirmed by a Test Result and Item Analysis conducted by the Division Public Schools District Supervisor (Secondary) for Math 7 Third Quarterly Examination SY 2015-2016, in which results revealed that a class of 33 students has only achieved 3 items mastery level, while a class of 46 students only achieved 1 item mastery level. These results indicated that students have poor mastery in the preceding lessons taught considering that test items included in the Third Quarterly Examination were built upon previous knowledge and skills acquired by students. On the other hand, in a report made by Rimando (2011), generally, public high school students in Region 9 have been found academically weak in Mathematics. This was revealed in a Regional Secondary Achievement Test (RSAT) conducted in 2011 by the Department of Education (DepEd) in the Western Mindanao schools divisions of Zamboanga del Sur, Zamboanga del Norte, Zamboanga Sibugay, Zamboanga City, Pagadian City, Dipolog City, Dapitan City, and Isabela City (Basilan) wherein the sophomore examinees recorded the lowest Mean Percentage Score (MPS) of 33.0 and the seniors with MPS of 32.55 in Mathematics. These findings are in accordance with the findings made by Uchechi (2013) that despite the introduction and implementation of different teaching methods/strategies suggested by researchers, the achievements of students in mathematics have persistently been poor, hence the need to explore different instructional approaches.

According to the Department of Education (2013) Mathematics is one subject that pervades life at any age and in any circumstance and therefore, must be learned comprehensively and with much depth. In order to realize this idea, the National Council of Teachers of Mathematics stresses the essential use of technology in teaching and learning the subject as it influences what is taught and enhances students' learning (NCTM, 2000). Tolhurst (1995) suggests that it is pertinent that Mathematics educators examine the opportunities and challenges of new technologies in order to enhance their teaching styles; and innovative instructional approaches and techniques should be developed to ensure that students become successful learners (Saritaas & Akdemir, 2009). Kim (2001) affirms that meaningful learning occurs when individuals are engaged in social activities, and one of the technological innovations nowadays which promote this is social media.

Social media has become considerably a topic of interest in education over the years. With the rapid increase in social media participation due to broadband availability and increasing affordability of computers and software as cited by Dewing (2010), and its improved accessibility feature through mobile phones as reported by Mingle & Adams (2015), more and more educators and experts around the world have started to regard it not merely as a social environment which is used to stay connected with friends and family but also for academic purposes (Salvation & Adzharuddin 2014, & Bharti n.d.). According to Tarantino and McDonough (2013), social media for educational purposes can be beneficial for student learning in multiple ways. Aside from it can make classrooms more engaging, relevant and culturally diverse (Davis, 2014), it can also provide many opportunities for students to acquire the necessary 21st-century skills to prepare them for their future (Hyde, 2014). It also allows students and teachers to connect and interact, and share ideas and discuss school related issues in a new, exciting, collaborative, and fluid ways (Lederer, 2012; Fisher, 2011; Gregor, 2014; & by Alexander & Salas, 2008 in Flad, 2010); and improve students' over-all GPA (Junco, 2012). In addition, Wankel (2011) in McCarthy & McCarthy (2013) stated that when social media is used to enhance learning outcomes, the context of the learning extends beyond the classroom into any learning environment that the student participates in. This idea is backed up by Lederer (2012) who reasoned out that the integration of social media in the classroom can enrich the learning experience by fostering collaboration and discussion, and social media can be an effective way to increase student engagement and build better communication skills. Furthermore, according to Casey (2012), by integrating social media into the classroom and by designing creative learning activities, teachers become merely facilitators, and students become teachers for their peers, designers, creators, and publishers, and they have an audience beyond their teachers, which is necessary for the 21st century education. This helps educators build a culture that may help contribute to the reform of school systems (Social Media in Learning & Education, 2013). Moreover, according to Dixon (2011), and Luckin *et al.* (2009) and Mazman & Usluel (2010) in Prescott, Wilson & Becket (2013), Facebook, a type of social media, should be used in the class. Dixon (2011) stated that when using Facebook in class, students are simply more connected, calendars and events are easy to share, and students will learn 21st century skills. Facebook also encourages collaboration, interaction, and information and resource sharing (Luckin *et al*., 2009 & Mazman & Usluel 2010 in Prescott, Wilson & Becket, 2013; & Dixon, 2011; Mbati, 2013). In addition, Ronan (2015) asserted that instead of being seen as a possible distraction, the use of social media in the classroom should be considered a vehicle for driving engagement and learning. Cook (n.d.) in Bolkan (2015) responded that for teachers to achieve this, it is important for them to acknowledge the influence of social media and understand how to use it to the benefit of their students. Churcher, Downs, and Tewksbury (2014) also emphasized that educators' primary goal should be to make the technology such as social media function properly and effectively, and not to think of issues such as student learning outcomes or best teaching practices.

In Mathematics education, the works of Daraei (2015) revealed that Facebook helps students not only to improve their satisfaction about the course and what they learn during of it, but also it would improve their exam's grades. Also, a similar study conducted by Gregory & Eddie (2014) revealed that students who actively participated in the Facebook group were more engaged and satisfied with the course, and performed at a higher level in the course than students who did not actively engage in Facebook. Furthermore, Bacon (2012) reported that using Facebook in Mathematics would benefit both the student and teacher alike as it allows for a large increase in interaction with a student outside the classroom and is versatile with its ability to pass educational resources quickly and efficiently.

Although numerous studies have already been conducted about the benefits of social media on students' learning as cited from the researches above, however, there has been no study conducted yet that examines the educational use of social media on students' Mathematics achievement through a direct utilization of an instructional material that incorporates social media in teaching Mathematics. Thus, the researcher in this study strongly believes in the need to conduct a research on the development of a Social Media-Based Mathematics Instructional Module in order to have an in-depth grasp on the educational influence of social media platforms on learning Mathematics.

Statement of the Problem

The study aimed to develop Social Media-Based Instructional Modules in Mathematics for the Grade Seven students of Geras Integrated School. Specifically, it sought to answer the following questions:

1. What are the desirable characteristics of the Social Media-Based Mathematics Instructional Module in terms of:
   a. validity
   b. reliability
2. What are the pre-delivery appropriateness of the Social Media-Based Mathematics Instructional Module in terms of the following:
   a. learning objectives
   b. lesson content
   c. language used
   d. evaluation activities
3. What is the educational use of the Social Media-Based Mathematics Instructional Module in meeting the following learning competencies of students in Mathematics as revealed in their Pre-Post-test results?
   a. performs fundamental operations on integers
   b. expresses rational numbers on the number line
   c. performs operations on rational numbers
   d. solve problems involving operations on rational numbers

II. Literature review

Social Media and Social Media Platforms

Social media is defined as (a) a web-based application, (b) for people, (c) to exchange information (d) and build relationships as well as maintain their collaborative communication and cooperation (Ebersbach 2008 in Uitz 2012). Uitz (2012) & Kietzmann *et al.* (2011) in Hashim, Abdullah, & Ali (2015), Dewing (2010) & Safko and Brake (2009) in Olmsted, Cho and Lee (2013) implied that social media refers to Internet-based technologies that allow participants to create, discuss, and modify user-generated content. The use of social media is associated with some tools which include social networking sites, blogs, wikis, social tagging or bookmarking (Dewing 2010, Tiryakioglu & Erzurum 2011). According to Boyd & Ellison 2007 **(a)** social networking sites refer to web-based services that allow individuals to (1) construct a public or semi—public profile within a bounded system, (2) articulate a list of other uses with whom the share a connection, and (3) view and travers their list of connections and those made by others within a system The most popular social networking sites are Facebook, LinkedIn, Pinterest, Instagram, and Twitter (Pew Research Center, 2014).

However, according to Lampe, Wohn, Vitak, Ellison, & Wash (2011) Facebook is another informal system equipped with tools designed for social interaction that students are re-appropriating for academic uses; Rowse (2005) defined **(b)** blog, a type of website that is usually arranged in chronological order from the most recent 'post' (or entry) at the top of the main page to the older entries towards the bottom. A weblog is a hierarchy of text, images, media objects and data, arranged chronologically, that can be viewed in an HTML browser (Winer, 2003); and Estellés, Moral, & González (2010**)** defined social bookmarking systems as web 2.0 tools that allow users to store, classify, organize, describe, and share links to interesting web sites, blogs, pictures, wikis, videos, and podcasts. Social bookmarking sites include StumbleUpon, Digg, Reddit and Delicious (Aronica, 2012); and (d) Media-sharing sites refer to websites hosting and allowing media or resources such as digital pictures and videos clips to be shared by users. Typical examples are Flickr and YouTube (IGI Global, 1988).

Social Media Preferences

According to El-Badawy & Yasmin (2015), social media has been utilized in so many different ways throughout the years. In the Philippines, Filipinos use social media to keep company, share new experiences to friends and followers, have fun, and meet new people. These findings were revealed by the global survey called Wave7 conducted in 2014 by UM as cited by GMA News Online, showing that Filipinos spend 53 hours socializing in a week, 11 hours more than the global average of 42 hours.

As for the social media platform preference among active users, Kuhanesan (2014) stated that Facebook is on lead in the social media race with more active users' worldwide. Pempek, Yermolayeva, & Cavert (2009) as cited by Iproject (2016) that Facebook is one of the world's most populated social media networks with no less than 400 million users and the most popular social networking site which allow users to post information, chat with others, and collaborate within the system (Stellar, 2008 in Suthiwartnarueput & Wasanasomsithi, 2012). Ijeoma & Burke (2013) also added that Facebook growth has been rapid to the extent that it now has over 22 Million unique strangers with above 15 billion viewed pages which has become one of the most frequently accessed website present. In a study conducted by Ijeoma & Burke (2013), results showed that many students use social media especially Facebook, MySpace, and Twitter during academic classes. This agrees with Mbodila, Ndebele, & Muhandji (2014) findings that 90% of social media users had a Facebook account and 10% did not have and did not use Facebook for personal reasons. Munkaila & Iddrisu (2015) further added that for the use of social network sites, most of the students made use and that Facebook is the most commonly used SNS (89.3% of SNS users) (ECAR Research, 2008).

Furthermore, according to the We Are Social's Digital Report as of January 2015 as cited by Revesencio (2015), survey shows that among the total Philippine population of 100.8 million (with urbanization at 49%), there are 44.2 million active Internet users. Of these 44.2 million Internet users, 90% have active social media accounts.

Figure 1. Social Media Use in the Philippines

In addition, according to the same study, the Philippines leads in average "Time Spent on the Internet" through laptop and desktop, and one of the highest via mobile worldwide. Mehmood & Taswir (2013) 80% also revealed that students reported that they used a social networking site on phone because of its approachability and flexibility features.

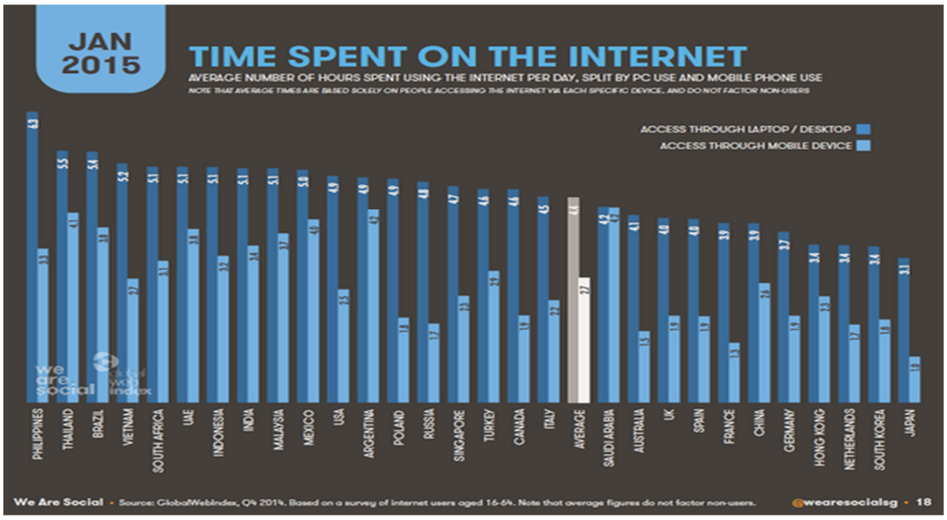

Figure 2. Time Spent of the Filipinos on the Internet

Furthermore, Philippines also leads in social media penetration particularly on Facebook with over 94% of its Internet users using the popular social network, 40% more than the users in the United States; and 42% of total screen time spent in social networking, which records the highest figure among other countries (Revesencio, 2015).

According to the report released by OECD (2007) in Dewing (2010), among the factors that have contributed to rapid growth in social media participation include technological factors such as increased broadband availability, the improvement of software tools, and the development of more powerful computersl and mobile devices; social factors such as the rapid uptake of social media by younger age groups; and economic factors such as the increasing affordability of computers and software, and growing commercial interest in social media sites.

Meanwhile, Helou & Ab.Rahim (2014) reported that students use social media for making friends, receiving and sending messages, chatting with friends, playing games, sharing files, and communicating with lecturers or teachers. However, Lenhart (2015) in Underwood & Faris (n.d.) refuted that adolescents are not only using social media for posting, sharing, and tweeting, they are also constantly receiving massive feeds of their friends' online content.

Social Media and Academic Achievement

In a study conducted by Abrahim and Helou (2014) entitled "Influence of Social Networking Sites on Students Academic Performance", they found out that the majority of respondents agreed that social networking sites have a positive impact on their academic performance. In addition, in an effort to improve the teaching of mathematics, Ng & Latif (2011) and Prasad & Prasad (2013) conducted a study on social media and mathematics teaching, and their study concluded social media enhances learning and teaching experiences of the learners and caused a significant change in their behavior in the classroom.

In a similar study conducted by Tayseer, Zoghieb, Alcheickh, and Awadallah (2014) using GPA as an indicator, their study revealed that there is a correlation between the students GPAs and their usage of social network. Therefore, based from their study, the students with high GPAs spend more time using social networks, while students with low GPA spend less time.

However, Skiera, Hinz, & Spann (2015), Bedassa (2014), Morallo (2014), El-Badawy & Hashem (2015), and Asemah, Okpanachi, and Edogoh (2013) revealed in their study on the impact of social media sites on students' academic performance, that social media activities and addiction to it negatively affect students' academic performance. El-Badawy & Hashem (2015) and Asemah, Okpanachi, and Edogoh (2013) also reported in their study that Facebook is the most used social media site by students. Furthermore, similar study was conducted by Kalra and Manani (2013) on the "Effect of Social Networking Sites on Academic Achievement Among Introverts and Extroverts, and they found out that there was no significant difference between academic achievement of users and nonusers of Social Networking Sites (SNS) based on the grades obtained in the previous class which served as the indicator of academic achievement of the students. Meanwhile, after employing a survey on university students in Saudi Arabia in regards to social media usage and their academic performance, Alwagait, Shahzad, & Alim (2015) study found that results demonstrated that there was no linear relationship between social media usage in a week and GPA score. Students highlighted that besides social media use, time management is a factor which affects students 'studies negatively.

Moreover, Ebele & Oghenetega (2014) conducted a study on Academic performance of University students in Nigeria using a causal-comparative research design among the four tertiary institutions used for study. Their study found out that Facebook 40(40.81%), WhatsApp 20(20.40%) 2go/Skype 14(14.28%) and while Myspace, Twitter, badoo, Blogs/web scholars, Google+/ Social bookmarking are not often used by undergraduates in the four universities for the study. Another finding showed that students in the four universities use social media for reaching out to close/distance friends and general information about life.

According to Tham & Ahmed (2011) though there are negative perceptions about the possible effects of social networking sites on students' academic performance, however, Baran (2010) in Tham & Ahmed (2011) contradicted that some studies showed that students found it quite appropriate for a teacher to use Facebook, and for teachers and students to socialize by this means. Students also believed that such tools could allow them to share knowledge in formal education contexts. Churchill's study (2009) in Tham & Ahmed (2011) showed that the use of weblogs or "blogs" (social publishing) in education facilitated a useful learning atmosphere. Ozkan and McKenzie (2008) in Brady, Holcomb, and Smith (2010) contended that educators need to engage students with a more 21st century approach to teaching and social networking technologies can provide such a venue. Gregor (2014) further added that social media can provide the building blocks for a learning environment powered by multiple forms of support, allowing learners to connect, interact, and share ideas in a fluid way.

Causey, Rivera, Saldana (n.d.) reported that students who used social media in academic way had a higher GPA than those who did not. Moreover, according to Lederer (2012), "as an educational tool, social media enriches the learning experience by allowing students and teachers to connect and interact in new, exciting ways. He asserted that web sites such as Facebook, Twitter, and LinkedIn provide a platform where users can dialog, exchange ideas, and find answers to questions. These sites are designed to foster collaboration and discussion.

Moreover, Lederer (2012) also cited the benefits of social media when integrated in the classroom. These are: Social media can enrich the learning experience by fostering collaboration and discussion, create meaningful dialogue, exchange ideas, and boost student interaction; Social media is an effective way to increase student engagement and build better communication skills; Social media like Facebook and Twitter can enhance communication among students and teachers. Educators can answer students' questions via a Facebook page or Twitter feed, post homework assignments and lesson plans, send messages and updates, schedule or announce upcoming events, and share interesting Web sites and multimedia content. Meanwhile, Marin (2015) on his study of "Enhancing Learning With The Social Media: Student Teachers' Perceptions On Twitter In A Debate Activity" results showed that positive perceptions towards the use of social media in education and students' willingness for future use, learning opportunities from Twitter and the use of mobile technology were also envisioned. In addition, according to Tom Murray (n.d.) in Stevens (2013), social media is high interest for most students; collaboration, communication, and global connections are possible. This is because, according to Mingle and Adams (2015) an interesting aspect of social media is that, it is not limited to desktop or laptop computers but could be accessed through mobile applications and smart phones making it very accessible and easy to use.

Davis (2014) also added that social media is another tool that teachers can use to make classrooms more engaging, relevant and culturally diverse. Furthermore, Ronan (2015) asserted that instead of being seen as a possible distraction, the use of social media in the classroom is now a vehicle for driving engagement and learning. According to him, educators are beginning to see how connecting with students, parents, and other classrooms in social online settings can positively impact learning. According to Fisher (2011) in Ng & Latif (n.d.), the use of social network has big influence on teachers and learners compared to traditional educational system due to the opportunities provided to connect and collaborate in a much easier manner.

Among other social media sites, Pempek, Yermolayeva, & Calvert (2009) in Burke (2013) reported that Facebook is one of the world's most populated social media networks with no less than 400 Million users. Dixon (2011) pointed out top reasons why Facebook should be used in the class. These include: students are simply more connected, calendars and events are easy to share, students will learn 21st century skills, students want to share beyond the classroom, Facebook encourages collaboration rather than cliques, there's an opportunity to discuss appropriate use, and students can learn about social media in a safe environment.

Furthermore, according to Ng and Latif (2011) sharing information and connecting with others has proven to be a powerful tool in education. Stephens (2011) in Ng & Latif (2011) noted that more and more students are glued to social network especially Facebook to socialize, to catch up one another, share events and popular causes, news, pictures and hold discussion. Teachers need to know how to integrate social media effectively in the classroom. This concurred with the research conducted by Lee and McLoughlin (2010) in Ng & Latif (2011) that with appropriate learning designs and pedagogical strategies, the social networking tool can enhance, enrich, and extend traditional distance education paradigms and increase connectivity and engagement of learners.

As noted by Al-Tarawneh (2014), the human nature is keen on interacting with people and finding common areas, Stollak et al. (2011) in Ng and Latif (2011) noted that with the emergence of smart phones, netbooks and tablets today the involvement of students in the social network will increase greatly not only for communication and entertainment but also for education.

Thuseethan & Kuhanesan (2014) explained social networking sites allow students to express themselves, communicate, and collect profiles that highlight their talents and experience. According to them, students reportedly use Facebook for: making connection with friends, time passing, collaborative study, distributing information and good content to batch mates, publishing life events, posts any photos and videos, reducing the stress, and discovering and exploring the interests in both academic and personal interest.

On the other hand, while Osborne (2012) in ZDNet (2015) suggested ways to use Facebook effectively in class such as set up a dedicated Facebook group for class, use Facebook Apps, follow newsfeeds, practice foreign languages, use Facebook questions and polls, use the Facebook timeline for class projects, follow figures of interest, use Facebook to send messages, communicate and collaborate, and share multimedia, Mallia (2014) suggested that when using Facebook in mathematics instruction, the moderator (teacher) should always integrate social and cultural talk to help learners with mathematical content. Thus, in his experiment on the use of Facebook as an educational environment in mathematics, he used the following strategies: (1) Models for using social networking site in mathematics education; historical mathematicians and mathematical phenomenon; (2) Using the social potentiality of the sites, as well as the cultural aspect of mathematical phenomena and mathematics history, to encourage, facilitate and move towards mathematical discourse; (3) The need for preparing pre-service and in-service teachers for teaching using social networking sites; and (4) The importance of involving students in learning mathematics on social networking sites.

Definition of Module and its Components

Module as defined by Russell (1974) in Parsons (1975) is an instructional package dealing with a single conceptual unit of subject matter. Likewise, Sejpal (2013) says that a module is a unit of work in a course of instruction that is virtually self-contained and a method of teaching that is based on the building up skills and knowledge in discrete units. A module is a set of instructional materials and procedures that contains within it the basic elements of instructions: objectives, learning activities and evaluation. Latter definition had been stressed in various texts Carter (1973) in Magsino (2013) ; Iqbal (n.d.) ; & Balu (1978) in Bedaure (2012) as cited in Zaldivar (2013).

Different modules use different names, such as the teacher's handbook, the teacher's guide or the teacher's manual. Sies (n.d.) states that teaching modules are usually conceptualized as self-contained "units" of content or technique. A unit can cover just one class or more (in which latter case, the module usually specifies day 1, day 2, etc.). Modules can also teach techniques.

Lardizabal, et. Al. (1995) in Magsino (2013) stated that the following are the essential parts of the module: (1) statement of the purpose or rationale of the module, (2) the pretest which will show how prepared or unprepared the student is for the module, (3) the objectives, which state what the students are expected to know, do or feel after accomplishing the module, (4) the instructional activities, which serve as study guide and which may enable the student to meet the objectives, and (5) The posttest, which measures what the students have acquired from the module or if they have mastered the lessons. Moreover, Balu (1978) in Bedaure (2012) as cited by Zaldivar (2013) averred that a module contains a set of learning opportunities organized around a well-defined topic, which contains the following: elements of instruction; specific objectives; teaching-learning activities; and evaluation. Furthermore, the works of Behlol, Gulam (2010) in Zaldivar (2013) suggested that similar principles of modular components include: Title, Pre-requisite knowledge or skills; method of study; instructional; objectives content; learning activities; pretest; posttest and feedback.

According to SEAMEO Regional Center for Instructional Innovation and Technology (1981) as cited by Samson and Guiab (2002) in Magsino (2013), the following are the general characteristics of a module, although no single module may contain or possess all the characteristics: (1) it contains a set of well-defined systematically organized learning opportunities, and it is a self – contained, independent instructional materials; (2) the objectives are clearly defined so as to give direction and focus to the accomplishment of the teaching-learning process, and its objectives and activities are properly sequenced. Properly sequenced activities are necessary because they inculcate the knowledge and skills, which are prerequisites for specific learning tasks; (3) it has a means of evaluating the work since it requires mastery of the subject matter and the achievement of objective set, the clientele must have understood the material before moving on to the next lesson; (4) it is written in clear, correct language suited to the level of the target learner. It is oriented to the real world; (5) the learning activities suggested in a module involve the learners in real life situations, encourages individuals to learn independently, by pacing themselves or progressing at their own rate, it is an opportunity to educate the most general sense, and a good module aims not only for cognitive and psychomotor results, but also for affective learning to achieve a fuller, richer and more refined quality of life; it also develops the individual's attitude, appreciation and values.

Development of a Multimedia Module

Magsino (2013) describes module development as a science and an art. It requires sustained practice to plan and develop modular materials. According to Frey & Sutton closely related to the multimedia development process are the instructional design (ID) models that offer guidance to practitioners. ID models help developers focus on the learning content and establish a vision that breaks the materials into manageable chunks of instructional content. In general, ID models focus on the design and development of learning content, and not on larger administrative or management issues such as budgets and staffing (Frey & Sutton, 2010).

Moore & Kearsely (1996) in Martin et.al. (2013) further added that an instructional Design is a system of developing well-structured instructional materials using objectives, related teaching strategies, systematic feedback, and evaluation (Moore & Kearsley, 1996). It can also be defined as the science of creating detailed specifications for the design, development, evaluation, and maintenance of instructional materials that facilitate learning and performance.

Lux & Davidson (2003) stressed that the first step in module design is to define the learning objectives; these objectives should then drive the design of the final application. In this case, the goals for the module are for users to learn the general method for obtaining reaction forces on a statically determinant rigid body subjected to a set of known loads and boundary constraints, and then to demonstrate the ability to apply this knowledge in a variety of applications.

According to APEID (1978), the process of module development includes: (1) identifying the needs of the target population and choosing the topic; (2) collecting relevant information on the topic and verifying the necessity for developing a new programme or module; (3) making plans for developing the module; (4) formulating objectives of the module based on the results of an assessment of needs; (5) selecting the learning experiences that can best achieve the objectives and arranging them in logical order; (6) deciding the format and components of the module; (7) writing a draft module; (8) reviewing the draft module and make revisions; (9) selecting at least three students from the target population and testing the module on them. Revise the module according to the results obtained from the test; (10) conducting further small-scale or large-scale try-outs and making suitable revisions, if and when necessary; and (11) printing the manuscript.

Consideration of Social Media Platform for Module Development

Martin et.al. (2013) pointed out that selecting the appropriate media and technology to use in the instructional material is extremely important. Care should be taken not to select media just because they are available. Media should be selected based on different criteria such as learning outcome, instructional strategy, learner characteristics, and instructional setting. Therefore, aligning the media based on the other instructional elements is important. According to Loyola (2016) when instructional media are appropriately selected, these can facilitate the effective learning acquisition of the students. These can uphold their active participation in the classroom tasks and activities. These may further enhance their comprehension of the subject matter when, of course, chosen and utilized appropriately.

According to Seth (2009) instructional media provide the sound basis on which concepts and ideas can be concretized. Moreover, the more interactive the teaching and learning process the more effective the creation of meaning in whatever is taught. Azikiwe (2007) in Adeniregun (n.d.) stated that an instructional media facilitate teaching and learning activities and, consequently, the attainment of the lesson objectives. However, this depends on the adequacy and appropriateness of materials so selected. Thus, Smith & Ragan (1999) emphasized that the media selection decision should be made after the instructional analysis and at the same time that the instructional strategy is being developed. Likewise, Adeniregun (n.d.) averred that an important criterion for selection and use of resource materials is availability of the needed materials.

Smith and Ragan (1999) enumerated factors to consider when selecting instructional media: learning task and conditions, learners, context, and media attributes. The instructional media to be selected must be relevant to the objectives as well as to the target population (i.e. learners) for whom the materials are to be used. Being relevant to the learner means that the characteristics of the learner such as the age, level of attainment or maturation, ability, aptitude and capability, should all be borne in mind to enable the teacher to select relevant materials for their needs, interest and aspirations.

Social Media in a Formal Learning

In an article entitled "*How to Effectively Use Social Media in Formal Learning"*, E-learning (2013) cited the following ways when selecting social media as an instructional material: (1) design and implementation of a solid instructional plan, aligning social media to learning objectives; (2) social media include a variety of tools, applications and platforms that can provide a wealth of resources and materials to support any course. Choose the ones that will back up your course's content; (3) before the beginning of the course, find out about the likes and interests of your students, as well as which social media they are already using; (4) use all the resources social media offer to fire up discussions, fora, conversations, comparisons, collaborations, opinion-sharing and networking; (5) use social media not only to share links and resources, but also to stimulate audience's interest and participation; (6) find those social media applications that will generate the desirable content in minimum time and reduce time spent in traditional classrooms; (7) use social media to encourage audience to attend discussions, webinars, and groups and ask them to provide feedback and generate new ideas; (8) the social media platforms can be used for an introduction to the course, for pre and after class activities, as well as for questionnaires, where mood, style and methods can be determined by the instructor; (9) blogging is one of the most powerful social media. Start a blog for your course, module or domain and encourage people to post, respond, share and critique; (10) since not all audiences are technology and social media enthusiasts, make sure that all the resources are easy to share, like or re-tweet, convert your content into appealing graphic visual representations, upload your lectures or presentations in YouTube and generally facilitate those who are more reserved, uncommunicative and reluctant.

Validation and Evaluation of a Module

Macarandang (2009) in Zaldivar (2013) stressed that a module once it is developed cannot be given right away to students for utilization. It has to be validated to ensure the reliability and effectiveness of its use and that it possesses desirable and technical characteristics of a good and working module. Such process has to pass the critique of subject specialists who are experts on this field and be tried-out with possible target students.

Cuellar (n.d.) added that any instructional module should be evaluated by the learning goals it is designed to achieve. The method of evaluation is to 1) define the learning goals; 2) define how to measure learning; 3) teach the module; 4) collect data and assess the learning.

APEID (1978) pointed out that the evaluation of a module should begin with a check of the components. The following components of the module need to be examined: (1) the title, (2) the overview, (3) instructions to the user, (4) the objectives, (5) the learning activities, (6) evaluation, and (7) the format.

Cennamo & Kalk (2005) in Frey & Sutton (2010) also added that evaluation examines the effectiveness of the instruction by considering how well the outcomes, assessments, and activities are aligned within the instruction and whether they are appropriate for the needs and characteristics of the learners. A well designed evaluation can confirm the value and validity of the tool. Pretesting, embedded testing, and post-testing are strategies to determine the effectiveness of any learning experience. By assessing the same skills with different questions at three different points in the learning process, an educator can determine the effectiveness of the teaching model. The pre-test determines current understanding and stimulates prior knowledge, and the embedded test can help the learner practice and transfer knowledge to confirm that learning is taking place.

Review of Related Studies

Martin et.al. (2013) in their study entitled *"Development of an Interactive Multimedia Instructional Module"* found an improvement in students' learning for all of the four objectives based on pretest and posttest results.

In a study conducted by Hutchinson et.al. (1992) entitled *"Development and Evaluation of an Instructional Module to Promote Career Maturity for Youth with Learning Difficulties"* found that the students in the intervention group improved significantly from pretest to posttest on a measure of career maturity whereas the students in a control group did not show similar improvement.

Yusof (2010) in his study entitled *"The Development of Instructional Module of Hybrid Approach Using Collaborative and Metacognitive (HybCoMet) Strategy as an Alternative Approach to Help Improving Generic Skills among Students in Malaysian Polytechnics"* revealed that the module helped students to establish an atmosphere in which they felt more valued and comfortable, gave them the opportunity to contribute in solving problems, provided them with a meaningful context for learning fundamental concepts, and most of all helped them think critically, sole complex problems, write and speak effectively, have respect for others and be able to adapt to change and be ready to engage in lifelong learning.

Aggabao (2002) in Macarandang (2009) made a study aimed at developing individualized self-instructional modules on selected topics in Basic mathematics for instructional use at the Teachers College in Isabela State University. After making use of the experimental method, concluded that instructional materials used at the college for Basic Mathematics are inadequate and are not designed for selfinstruction; that instruction through selfinstructional materials is as effective as the prevailing teaching method of instruction; and students as well as teachers generally have a positive attitude toward the use of individualized, self-instructional materials as a mode of instruction in Basic Mathematics.

Aquino-Danganan (2001) in Macarandang (2009) proposed instructional modules in developing computational skills in College Algebra. She concluded that the proposed instructional modules had titles, instruction to the learners, rationale, objectives, pretest with answer keys, worksheet assignment, progress check with answer key and post-test with answer key. The format and language of each were properly organized, clear and simple. The objectives of each module were specific and were based on the course syllabus. The topics were properly developed and explained and the activities and exercises facilitated student learning in College Algebra.

Shimamoto (n.d.) in his study entitled "Implementing a Flipped Classroom: An Instructional Module found that the developed web-based instructional module was effective in delivering an overview of the required material and was useful for a majority of the participants, and most of all had improved students' knowledge upon completion of the module.

Theoretical Framework

According to Frey & Sutton (2010), designing instruction can be a monumental task, and a model would provide a systematic structure for the process. Magsino (2013) stressed that there should be a framework for the design and development of modular materials. There is also a scientific way to design and certain skills are necessary in the writing of modules.

Bucjan (2011) stated that the most common model used for creating instructional materials is the ADDIE model; these acronym stands for five phases of the material development; **A** stands for Analyze - analyze learner characteristics, and task to be learned, **D** for Design - develop learning objectives and choose an instructional approach, **D** for Develop - create instructional or training materials, **I** for Implement - deliver or distribute the instructional materials and **E** for Evaluate - make sure the materials achieved the desired goals.

Furthermore, Davis (2013) elaborated the steps in the ADDIE model as: (1) in the analysis phase the instructional problem is identified along with learner characteristics; what do you want the learners to learn, and how will you define instructional goals and learning objectives? This step will provide you with a blueprint for the whole ID process and guide you in the following processes. In the analysis phase, a timeline may be established to complete the instructional module; (2) the second step is *design*, where an outline of instructional strategies is created or and learning activities and assessment are determined; (3) next is *development*. In this phase you are going to build your learning content, learning assignments, and assessment. You will also need to identify which technologies should be chosen to enhance your learning experience. Storyboards are used and help create a sample of the instruction module; (4) the *implementation* phase includes the testing of prototypes where training for the instructor happens followed by learners participating in the instruction; and (5) *Evaluation* consists of two parts: formative and summative. Formative evaluation is a measurement of learning outcomes during the instruction process, and summative evaluation—measurement of learning outcomes after instruction—is the final stage.

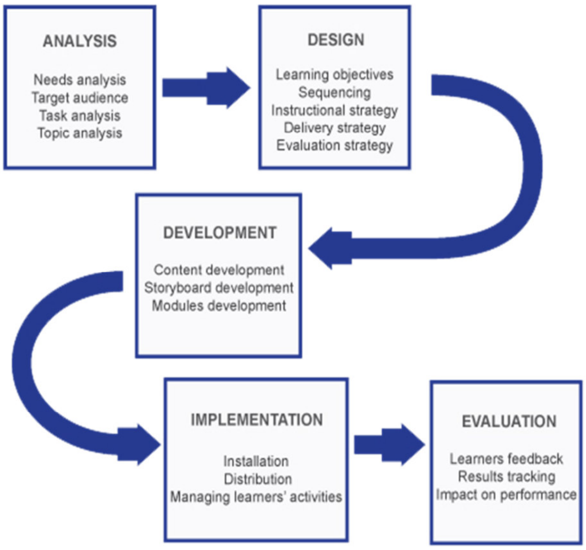

Figure 4. The ADDIE Model (The Executive Way, 2013)

Conceptual Framework
Based on the theories cited in the review of literature and related studies, the conceptual framework of the study is formulated and anchored on ADDIE Model by McGriff (2000) that served as the research guidepost in its development.

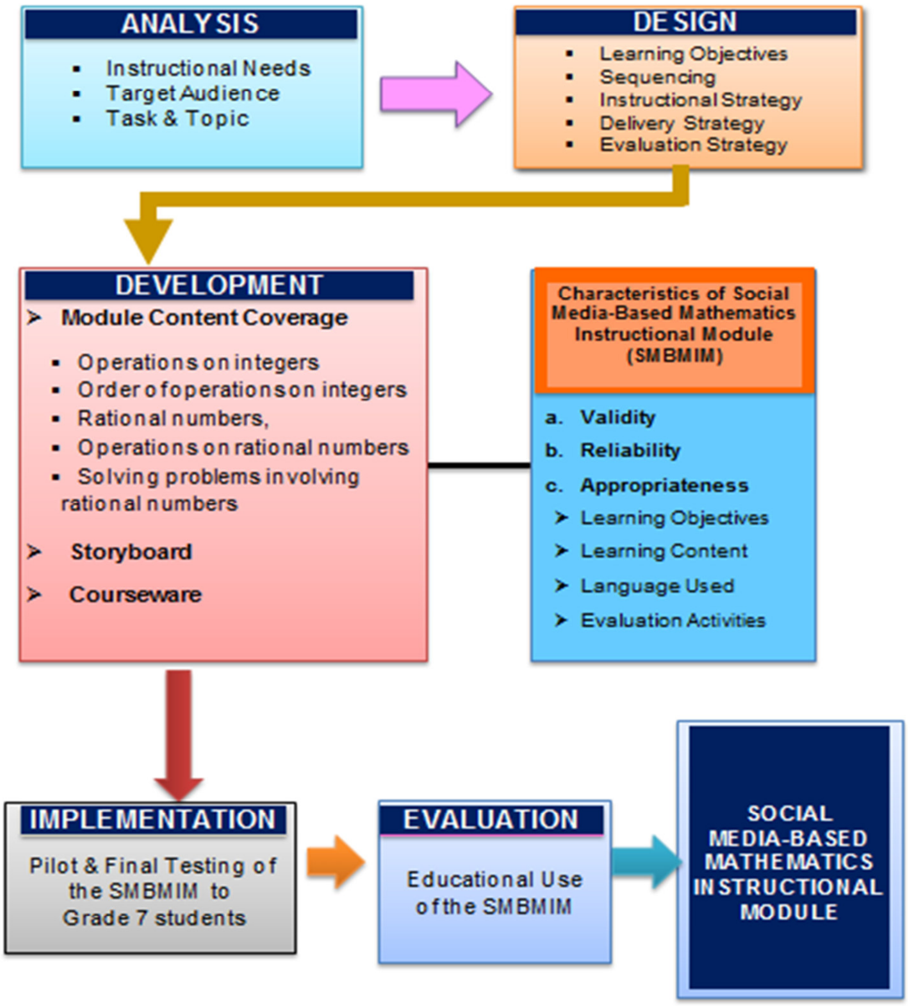

Figure 5. Conceptual Framework of the Study

The study is concerned about the development of Social Media-Based Mathematics Instructional Module with content coverage on Fundamental Operations on Integers, Operations on Integers, Rational Numbers in the Number Line, Forms of Rational Numbers and Addition and Subtraction of Rational Numbers, Division and Multiplication of Rational Numbers, and Solving Problems Involving Rational Numbers. This developed SMBMIM had undergone an expert validation in terms of validity and reliability. The development and validation served as the independent variables.

The desirable characteristics of Social Media-Based Mathematics Instructional Module is measured based on the following criteria: *Learning Objectives, Lesson Content, Language Used, and Evaluation Activities.*

III. Methodology

This chapter presented the research design, research locale, the population and sampling, the instruments used to collect data, the development of the Social Media-Based Mathematics Instructional Module, and the methods to be implemented to maintain validity and reliability of the instrument.

Research Design

The researcher made use of the descriptive design involving qualitative and quantitative approach in answering the research questions. The qualitative aspect of the study pertained to the description of the module development while validation process and the use of the module generated the quantitative data of the study.

Research Locale

The study was conducted in a public school located in Sumagdang, Isabela City, Basilan, Region IX, Zamboanga Peninsula. The school is approximately three (3) kilometers away from the city proper and was established in 2011 by the Department of Education and the local government unit of Isabela City.

The school offers elementary and secondary basic education from Kinder to Grade Ten (10). It has a total of 1,179 students enrolled for the School Year 2015-2016 which comprises: 449 secondary students and 730 elementary pupils. Majority of the students are Muslims. It comprises 85 percent of the total student population, while 15 percent are Christians. It has one Principal for both elementary and secondary, 20 secondary teachers, 25 elementary teachers, and five Madaris teachers. At present, there are only three teachers handling mathematics classes of which two are professional mathematics teachers, while one is a non-math major.

In terms of physical facilities, the school, just like other newly established public schools in the country, has been experiencing shortages in the number of classrooms, chairs, tables, as well as learning and teaching materials for the students and teachers. Presently, it has only 11 standard classrooms and 8 temporary classrooms for elementary and secondary respectively, and without any science and computer laboratories.

On the other hand, students enrolled in the school came from the 18 municipalities in Basilan whose majority of the socio-economic status were on the average. Students were equipped with trendy gadgets such as laptop, smartphones, or tablets and even aware with the different innovations happening in the market be it social media applications or search apps. They are also able to join co-curricular activities being held in and outside school; and together with their parents, they actively help the school in terms of financial contributions needed for school improvements.

As for the teaching staff of the school, 95 percent of teachers are already in the 21st century when it comes to the technical know-how they possess. Roughly 99% of the secondary teachers including Mathematics teachers and the School Principal have access to social media particularly Facebook and YouTube but these platforms are mainly used for uploading personal and family photos, exchanging personal messages with their friends, students, and colleagues, and for updating status about their whereabouts. Although some download YouTube videos for academic purposes which are shown during classes, however, this teaching strategy is not sustained because of the much needed teaching materials needed to prepare such as speakers, projectors, whiteboard, extension wires, and laptops which mostly consumes a lot of time before the lecture video can be viewed by the class. Thus, as a consequence, teachers most likely resort to the traditional methods in teaching mathematics which usually results in students' low achievement and loss of interest in the subject.

Respondents/Participants

The respondents of the study were the grade seven students of Geras Integrated School enrolled for the School Year 2015-2016. There were a total of 28 students coming from Grade 7 Carnation who participated in the pilot testing of the validated modules, while a total of 58 students coming from the two sections of 38 and 20 students participated in the Social Media-Based Mathematics Instruction.

A purposive non-random sampling was used to determine the sample size. This method was used because the participants of the study were selected based on the interest of the study.

TABLE 1
DISTRIBUTION OF THE PARTICIPANTS IN THE
SOCIAL MEDIA-BASED MATHEMATICS INSTRUCTION

Grade VII Sections	Number of Students		Total Number of Respondents by Section
	Male	Female	
Sampaguita	11	27	38
Daisy	8	12	20
Total	**19**	**39**	**58**

Instruments
The following instruments were developed in this study: Social Media Usage & Literacy Survey, Achievement Test, and the validation instruments for the SMBMIM, survey and Achievement Test.

Social Media Usage & Literacy Survey (SMULS)
In designing the module, the SMULS was used to gather data to determine the students' level of exposure to social media, extent of use of social media, and social media preferences. The results were used to determine the social media platforms to be considered for the module design. The questionnaire which consisted of two parts: **Part I. Demographic Information of Respondents** asked for the students' name, age, birthdate, sex, and parents' occupation; and **Part II Social Media Usage and Literacy** generally asked questions about students' level of exposure to social media platforms, extent of use of social media platforms, and the social media preferences of students.

Achievement Test
To determine the educational use of the SMBMIM on grade seven students, a 40-item Achievement Test in the form of Pretest and Posttest was used. This was given to the participants before they were exposed to the SMBMIM and after they were exposed to it.

The development of the Achievement Test involved the application of the general steps in test construction: (1) outline (2) produce a Table of Specification (T.O.S) (3) draft (4) order (5) test and (6) analyze. During the first step, the lessons covered in the test with its learning competencies as prescribed in the curriculum guide were considered. This became the guidepost in the production of the T.O.S. The T.O.S was presented using a table showing the lessons and learning competencies, the number of hours each lesson is taken, the total number of items and the number of items per lesson, item placement, and the Bloom's Cognitive Level Assessment. After making the T.O.S, a draft of the test items was made. Then these items were ordered logically, placing the easy items at the beginning and the difficult ones at the last part. The final form of the test **(see Appendix J)** was validated by five Math Professors from the Higher Education Institution to ensure that its objectives were met.

Development and Validation of Research Instruments
Achievement Test Validation Instrument
This validation instrument used for the validation of the developed Achievement Test was adapted from Zaldivar (2013). It consisted of two parts: (1) Information on Validator and the (2) Validation Procedure with three criteria indicated: (1) Content-Lesson Congruency, (2) Test Items Effectiveness and (3) Item Construct specified **(see Appendix B)**. The Achievement Test which came with Table of Specifications were validated by five competent Professors to include three from WMSU and two from Basilan State College (BaSC) before it was given to students. Each test item was checked against the K-12 Curriculum Guide to ensure that all test items were congruent to the learning competencies as prescribed in the grade seven curriculum guide.

After validation, results were statistically analyzed using Cronbach's alpha to determine internal consistency. An alpha of .900 was obtained for which according to Wells & Wollack (2003), for a classroom exam, it is desirable to have a reliability coefficient of .70 or higher. High reliability coefficients are required for standardized tests because they are administered only once and the score on that one test is used to draw conclusions about each student's level on the trait of interest.

Revisions based on validators' suggestions and recommendations were made.

SMULS Validation Instrument
The instrument used for validating the Social Media Usage & Literacy Survey was the "Survey Questionnaire Validation Rubric for Expert Panel - VREP©" adapted and modified by Simon (n.d.) with input from White (n.d) **(see Appendix C)**. It was used to measure the level of exposure of students to social media, extent of use of social media, and social media preferences. It used a 4-point scale in rating the 13 criteria.

The 20-item instrument was validated by three experts from WMSU to include one Doctor of Philosophy, one Doctor of Education, and one Graduate of Masters of Education; and one Education Program Specialist from Isabela City Division using the adapted Survey Questionnaire Validation Rubric for Expert Panel by Simon (n.d.) with input from White (n.d.). Revisions were made based on experts' suggestions and recommendations. The final form of the instrument is in **Appendix K.** Furthermore, the instrument was statistically analyzed in terms of its effectiveness in measuring students' level of exposure, extent of use of social media, and social media preferences using Cronbach's Alpha. Results revealed an alpha of .979 greater than 0.80 which Salvucci, et.al. (1997:115) concluded as highly reliable.

SMBMIM Validation Instrument

The module validation tool was adapted from *"Thesis from Evaluation on a Proposed set of Modules in Principles and Methods of Teaching"* (Macarandang, 2009) for which the researcher modified to make it more appropriate to be used for the validation of the developed SMBMIM on aspects: validity, reliability, and appropriateness in terms of learning objectives learning content, language used and evaluation activities. The final form of the instrument is in Appendix A.

Development and Validation of SMBMIM

In developing the Social Media-Based Mathematics Instructional Module, the ADDIE Model by McGriff (2000) was used. It involves five phases: Analysis, Design, Development, Implementation, and Evaluation.

Analysis

The development of the SMBMIM began by analyzing the instructional needs, the users of the module, and the learning contents to be included in the module design.

The researcher identified two major concerns why SMBMIM was needed to be developed. The first one was the low achievement and poor performance manifested by the participants in the following areas: Fundamental Operations on Integers, Operations on Integers, Rational Numbers in the Number Line, Forms of Rational Numbers and Addition and Subtraction of Rational Numbers, Division and Multiplication of Rational Numbers, and Solving Problems Involving Rational Numbers was identified as one of the problems encountered by the Mathematics teachers of Geras Integrated School mainly because these concepts are fundamental in learning higher Mathematics. Students' poor mastery about these concepts can affect their understanding of the succeeding lessons in the same grade level or even in their higher years.

Second was the lack of interest of students towards learning Mathematics because of the conventional method used by their teachers in teaching Mathematics. Thus, during the instruction, it could be seen that many of the students were only busy tapping on their cellphones to check their Facebook accounts instead of listening to their teacher for the lecture.

Design

The Social Media-Based Mathematics Instructional Module underwent five steps as part of its design phase. These include determining the learning objectives, sequencing of the lessons, instructional strategy, delivery strategy, and evaluation strategy.

Learning Objectives

The learning objectives for each lesson in the SMBMIM were based on the learning competencies prescribed in the K to 12 Mathematics Curriculum Guide December 2013 which include: perform fundamental operations on integers; expresses rational numbers from fraction form to decimal form and vice-versa; arranges rational numbers on a number line; and solve problems involving rational numbers.

Sequencing of the Lessons

In the design phase, sequencing of the lesson was considered to ensure that lessons included in the SMBMIM are delivered according to the K to 12 Mathematics Curriculum Guide December 2013. Thus, lesson 1 started with an introduction to integers and ended up with solving problems involving multiplication and division of rational numbers.

Instructional Strategy

To determine the most appropriate social media platform to be used in designing the SMBMIM, a 20-item Social Media Usage and Literacy Survey (SMULS) was used. The survey was conducted among the participants before the administration of the Pretest. Based from the results, the most preferred and most used social media platform among the grade seven students was the one considered as an instructional tool to be integrated in the SMBMIM for teaching Mathematics. The results of the survey are presented in Tables 2-8.

Level of exposure of grade seven students to social media

Table 2 presents the level of exposure of male and female students to social media measuring the use and familiarity of students with the term social media platforms and the length of time of using social media. Based on the data shown below, a total of 51 students to include 17 males and 34 females out of 58 students stated that they are exposed to social media while nine (7) students to include 2 males and 5 females said they have never been exposed to it **(see Appendix M)**.

TABLE 2
LEVEL OF EXPOSURE

Gender	Mean	N	Std. Deviation	Low	Ave	High
Male	2.41	17	.939	9 (42.9%)	10 (47.6%)	2 (9.5%)
Female	2.86	34	1.150	17 (43.6%)	18 (46.2%)	4 (10.3%)
Total	2.71	51	1.096	26 (43.3%)	28 (46.7%)	6 (10%)
Criteria: 1.00-2.99 Low, 3.00-4.99 Average; 5.00-6.00 High						

Also as shown above, 47.6% of male and 46.2% of female both have an average level of exposure to social media. However, after getting the means of level of exposure, it is found out that both male and female have a low level of exposure to it.

Extent of use of Social Media by the grade seven students

Table 3 presents the extent of use of grade seven students to social media measuring the frequency of visits to social media sites, the number of hours a week spent on social networking sites, and the amount of time spent on each visit to social media site.

TABLE 3
EXTENT OF USE TO SOCIAL MEDIA

Gender	Mean	N	Std. Deviation	Low	Ave	High
Male	2.39	17	1.061	10 (47.6%)	8 (38.1%)	3 (14.3%)
Female	2.50	34	1.001	18 (46.2%)	19 (48.7%)	2 (5.1%)
Total	2.47	51	1.012	28 (46.7%)	27 (45%)	5 (8.3%)
Criteria: 1.00-2.88 Low, 2.89-4.78 Average; 4.79-6.67 High						

Based on the data shown, the means for the extent of use of social media for male is 2.39 and for female is 2.50. This implies that there is a little difference on the extent of use of social media among male and female, and the difference is insignificant. This agrees with the studies reviewed by Bonds-Raacke & Raacke (2008) in Flad (2010), that the amount of teenage girls and boys using social networks are equally divided. Furthermore, as shown above, male and female have a total mean of 2.47 which falls within 1-2.88. This implies that both male and female have a low extent of social media. It further implies that male and female rarely visit social media and only spends less time each visit.

Social media preferences of grade seven students

Based from the data collected, the social media preferences of grade seven students are summarized in Tables 4-8 respectively. In terms of social media platforms, both male and female students showed greatest preference to Facebook as the website they are most familiar with (74%), has account with (74%), and most visited (70%), followed by Google+ and YouTube. This agrees with Kuhanesan (2014), Pempek, Yermolayeva, & Cavert (2009) Ijeoma & Burke (2013), and Munkaila & Iddrisu (2015) who stated that Facebook is on lead in the social media race with more active users worldwide and the most commonly used by students.

TABLE 4
SOCIAL MEDIA MOST PREFERRED BY G7 STUDENTS

Social Media Platform	Percentage of Grade 7 Students		
	MOST FAMILIAR WITH	HAS ACCOUNT	MOST VISITED
Facebook	74%	74%	71%
Twitter	7%	3%	0%
Google+	40%	26%	22%
Wikipedia	7%	2%	2%
Instagram	7%	3%	3%
Yahoo Groups	9%	3%	3%
Blogs	2%	0%	0%
LinkedIn	0%	0%	0%
YouTube	41%	22%	14%
Others	2%	2%	5%

Using multiple-response questions, grade seven students were able to point out the different opportunities they access social media. Table 5 presents that 76% of the total number of grade seven students use social media at home; 19% use social media at school; while 14% did not specify.

TABLE 5
OPPORTUNITY TO USE SOCIAL MEDIA

Opportunity to Use Social Media	Percentage of Grade 7 Students
At Home	**76%**
At School	**19%**
Others/Do not Use/Do not Have	**14%**

In terms of social media usage at school, Table 6 shows that 9% of students reported that they use social media during some classes to include 21% male and 3% female; 55% use social media not in class but only outside of class of which 37% of the responses came from male and64% from female, while 36% of students said they do not use social media at school.

TABLE 6
USE OF SOCIAL MEDIA AT SCHOOL

Questions	Frequency			Percentages		
	Male	Female	Total	Male	Female	Total
During every class	0	0	0	0%	0%	**0%**
During some classes	4	1	5	21%	3%	**9%**
Not in class-only outside of class	7	25	32	37%	64%	**55%**
Not at all	8	13	21	42%	33%	**36%**
Total	**19**	**39**	**58**	**100%**	**100%**	**100%**

Table 7 presents the technology being used by the grade seven students in accessing social media. It shows that 60% of students use smartphones, 26% use tablet, 12% use laptop/netbook, and 7% use their personal computer. These data show that students have a great preference in using their smartphones over any technology to access social media platforms.

TABLE 7
TECHNOLOGY USE TO ACCESS SOCIAL MEDIA

Questions	Percentage of Grade 7 Students
Personal Computer	**7%**
Laptop/Netbook	**12%**
Smartphone	**60%**
Tablet	**26%**
Others/Do not Use/Do not Have	**5%**

Table 8 presents the most used data connection being used by the grade seven students in accessing social media. It shows that 74% of students to include 68% male and 77% female use Free Data, while 10% to include 16% male and 10% female are connected to social media through Wi-Fi. These data imply that most students are connected to social media at no cost using free data.

TABLE 8
MOST USED DATA CONNECTION

Data Connection	Frequency			Percentages		
	Male	Female	Total	Male	Female	Total
Free Data	13	30	43	68%	77%	**74%**
Broadband	0	0	0	0%	0%	**0%**
Wi-Fi	3	3	6	16%	8%	**10%**
DSL	0	0	0	0%	0%	**0%**
Others	3	6	9	16%	15%	**16%**
Total	**19**	**39**	**58**	**100%**	**100%**	**100%**

Table 9 presents the top reasons why students visit social media platforms. As shown from the data below, the number one reason for visiting social media is for sharing photos, video and music (50%) while the least is for finding information and share feedback about school-related activities and to communicate with teachers and classmates (33%). This implies that although many students use social media platforms mostly for social interaction however they also regard its use for educational purposes. This conforms to the study reported by Helou & Ab.Rahim (2014) that students use social media for making friends, receiving and sending messages, chatting with friends, playing games, sharing files, and communicating with lecturers or teachers.

TABLE 9
TOP REASONS FOR VISITING SOCIAL MEDIA PLATFORMS

Questions	Percentage of Grade 7 Students		
	Male	Female	Total
It's used by most of my friends.	42%	46%	**45%**
It allows me to share photos and videos instantly.	37%	41%	**40%**
It allows me to send messages to my family and friends instantly.	42%	49%	**47%**
It enables me to watch and download educational videos.	47%	33%	**38%**
To keep in touch with friends and family.	42%	51%	**48%**
To meet new friends.	37%	36%	**36%**
To share photos, videos, and music.	47%	51%	**50%**
To find information and share feedback about school activities	21%	38%	**33%**
To communicate with teachers and classmates.	21%	38%	**33%**

Delivery Strategy

All lessons in the Social Media-Based Mathematics Instructional Module were presented graphically in class using Facebook. A specialized computer programs such as MS PowerPoint and Publisher were used to create lesson graphics.

The delivery and presentation of each lesson was done by first uploading or posting a lesson graphic on Facebook. Each student or class group was tagged and some motivational questions were posted alongside the lesson graphics to arouse students' interest about the lessons. Students could answer the questions along the post through comments. Discussions, group and individual activities, and exercises were also uploaded and posted via Facebook.

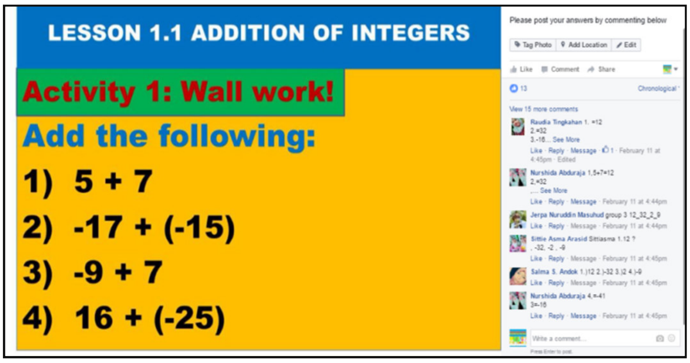

Figure 6. Sample screenshot of Lesson Graphic

Evaluation Strategy
To ensure that the designed SMBMIM was valid, reliable, and appropriate for use on the grade seven students, the researcher adapted from Macarandang (2009) a validating instrument to validate the SMBMIM in terms of validity, reliability, and appropriateness. The instrument used a 5-point Likert Scale with 5-Very Strongly Acceptable, 4-Strongly Acceptable, 3-Acceptable, 2-Moderately Acceptable, and 1-Least Acceptable.

The SMBMIM underwent an expert validation of six experts in the field of Mathematics and Information Technology to include: two Professors from WMSU-College of Science and Mathematics, two Professors from Basilan State College-Mathematics Department, one Education Program Specialist from Isabela City Division, and a MISTO-Director of WMSU.

To determine whether there is an agreement among the raters on the items in the SMBMIM, Fleiss Kappa was utilized. Table 10 shows the K values. At the same time the internal consistency or reliability of the SMBMI was determined using Cronbach's Alpha where the reliability coefficients are shown in Table 11.

TABLE 10
KAPPA COEFFICIENT OF AGREEMENT VALUES & ITS INTERPRETATION

Kappa Value	Interpretation
<0	Poor Agreement
0 – 0.20	Fair Agreement
0.20 – 0.45	Moderate Agreement
0.45 – 0.75	Substantial Agreement
0.75 – 1.00	Almost Perfect Agreement
(Adapted from Muñoz and Bangdiwala 1997 in Benjamin et al; licensee BioMed Central Ltd. 2007)	

TABLE 11
RELIABILITY COEFFICIENTS (ROVAI, BAKER, & PONTON 2013)

Alpha Values	Interpretation
.90 and above	Very high reliability
.70 to < .90	High reliability
.50 to < .70	Moderate reliability
.30 to < .50	Low reliability
< .30	Little if any reliability

Development
The development of the SMBMIM comprised of three main steps: content development, storyboard development, and courseware development.

Content Development
The content development of the SMBMIM included the writing of the lesson objectives, title, prerequisites, lecture duration, learning competencies, rationale, module description, author's note to students, instructions for teachers on how to use the module, the lesson procedures, important tips in making lesson graphics, and references. All lesson contents included were checked against the Learning Competencies as prescribed in the K-12 Mathematics Curriculum Guide December 2013.

The final form of the module is packed with grade seven lessons and is divided into the following: Lesson

1- Introduction to Integers; Lesson 2- Operations on Integers; Lesson 3- Order of Operations on Integers; Lesson 4- Introduction to Rational Numbers; Lesson 5- Forms of Rational Numbers; Lesson 6- Addition and Subtraction of Rational Numbers; Lesson 7- Solving Problems Involving Addition & Subtraction of Rational Numbers; Lesson 8- Multiplication and Division of Rational Numbers; and Lesson 9- Solving Problems Involving Multiplication & Division of Rational Numbers.

Lesson 1: Introduction to Integers
This 1-hour lesson provides students with an overview about Integers. It includes discussions on the definition of Integers, how to recognize Integers from other numbers, examples of Integers, and the important application of the concept in daily life.

Lesson 2: Operations on Integers
This lesson covers the four fundamental operations on Integers which include Addition, Subtraction, Multiplication, and Division of Integers. It provides students with an in-depth understanding of the concepts particularly the rules when adding, subtracting, multiplying, and dividing Integers. Students after this lesson are expected to be able to perform the operations on Integers individually or within group.

Lesson 3: Order of Operations on Integers
This lesson requires an in-depth understanding about the key concepts on Lesson 2: Operations on Integers, and evaluating expressions such as exponents, roots of a number (i.e, square root, cube root), and groupings such as ( ), {}, [ ]. Students after this lesson are expected to demonstrate a thorough understanding of the concept.

Lesson 4: Introduction to Rational Numbers
This lesson covers an Introduction to Rational Numbers which includes illustrations and discussions on the definition of rational numbers, positive and negative rational numbers, equivalent rational numbers, and how to express rational numbers in their standard form.

Lesson 5: Forms of Rational Numbers
This lesson provides students with ample knowledge and techniques on expressing rational numbers from fraction form to decimal form (terminating and repeating and non-terminating) and vice-versa. Students' prior knowledge and understanding about decimals, fractions, and how to operate decimals and fractions are important in this lesson.

Lesson 6: Addition and Subtraction of Rational Numbers
This lesson enables students to demonstrate understanding of key concepts on the Addition and Subtraction of Rational Numbers. It provides students with important rules to ponder and the necessary techniques to use when adding and subtracting rational numbers. The in-depth understanding of concepts presented in Lesson 4: Forms of Rational Numbers is important for the success of this lesson.

Lesson 7: Solving Problems Involving Addition & Subtraction of Rational Numbers
The objective of this lesson is to enable students solve problems involving addition and subtraction of rational numbers. It provides students with the necessary tips and techniques on solving word problems by applying the concepts learned from Lesson 6: Addition and Subtraction of Rational Numbers, and the steps in solving math problems.

Lesson 8: Multiplication and Division of Rational Numbers
This lesson enables students to demonstrate understanding of key concepts on the Multiplication and Division of Rational Numbers. It provides students with important rules to ponder and the necessary techniques to use when multiplying and dividing rational numbers. The in-depth understanding of concepts presented in Lesson 4: Forms of Rational Numbers is important for the success of this lesson.

Lesson 9: Solving Problems Involving Multiplication & Division of Rational Numbers
The objective of this lesson is to enable students solve problems involving multiplication and division of rational numbers. It provides students with the necessary tips and techniques on solving word problems by applying the concepts learned from Lesson 8: Multiplication and Division of Rational Numbers, and the steps in solving math problems.

All these lessons come with specific, measurable, and realistic objectives, activities and an evaluation exercise at the end of each lesson. In addition, all activities and exercises are presented through graphics and an electronic format of it is made readily available on CDs (Compact Discs) for an actual teaching. See Appendices

O and J for the final form of the SMBMIM and Achievement Test respectively.

Storyboard Development
The Social Media-Based Mathematics Instruction was conducted following the storyboard below.

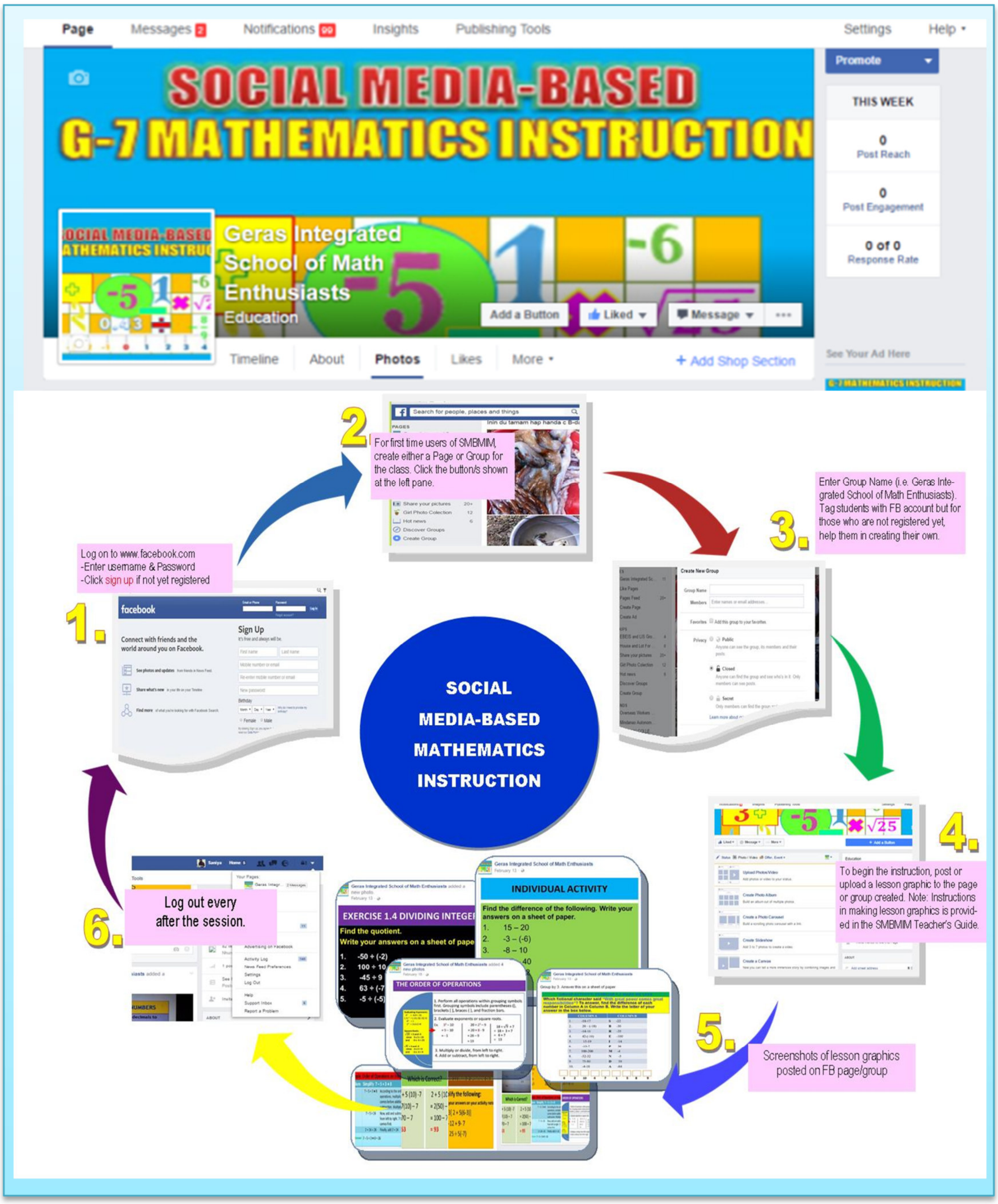

Figure 9. Storyboard of the Social Media-Based Mathematics Instruction

Courseware Development
Lesson graphics which were uploaded on Facebook during the implementation of the Social Media-Based Mathematics Instruction and the electronic copy of SMBMIM Teacher's Guide were burned on a compact disc (cd) to be used for future reference.

Implementation
To ensure the pre-delivery appropriateness of the validated SMBMIM to the grade seven students, a pilot testing was carried out before it was administered to the participants. Prior to the pilot testing, a permission letter was sent to the Principal of Geras Integrated School informing about the module administration to the selected pilot

group consisting of 28 students to include 16 males and 12 females. During the pilot testing, the pilot group took the 40-item Achievement Test before and after they were exposed to SMBMIM. Revisions and corrections on the SMBMIM were made for some inconsistencies and errors encountered during the process.

In the actual delivery of the SMBMIM, a similar procedure to that in pilot testing was carried out by the researcher. First a permission letter was sent to the Principal of the same school then upon receiving the approval, the researcher administered during Mathematics class the modified 40-item Pretest to the two Grade 7 classes considered in the study, the 7-Sampaguita and 7-Daisy. Out of 46 grade seven students enrolled in 7-Sampaguita, and 36 students enrolled in 7-Daisy, only 38 and 20 students respectively were able to take the Pretest. Thus, only these students were exposed to the SMBMIM and allowed to take the Posttest.

The Social Media-Based Mathematics Instructional Module was employed in teaching Mathematics to the grade seven participants. All lessons included in the module were uploaded via Facebook through researcher-made graphical lessons, activities, and exercises. During the Social Media-Based Mathematics Instruction (SMBMI), all participants were advised to bring their own devices such as laptop, tablet, smartphone, or any Facebook-enabled device. A Wi-Fi Internet connection was provided so that the participants could connect their devices anytime during every lecture. The SMBMI lasted for 12 hours then a Posttest was administered to determine students' Mathematics achievement after they were exposed to SMBMIM.

Figure 9. Sample Screenshot from the SMBMIM

Evaluation

In this phase, the educational use of the SMBMIM was evaluated in terms of the results obtained from the Pretest and Posttest given during the implementation phase. Scores were analyzed using Mean to determine whether there was a difference in the mathematics achievement of students before and after they were exposed to the SMBMIM and whether learning competencies for each lesson were met.

Pretest & Posttest Administration

Prior to the implementation of the SMBMIM, the researcher administered a 40-item Pretest to the participants of the study. They were given only one hour to take the test and they were not allowed to use calculator, cellphone, or any computing device during the test. After an hour, the researcher collected the test questionnaires and checked to determine the results.

A similar procedure to that of Pretest was done for the Posttest administration after the participants were exposed to the SMBMIM. Results from the Posttest were compared with the results obtained from the Pretest using Mean to determine the educational use of the SMBMIM as a teaching material for Mathematics. Table 12: Mean Percentage Scores (MPS) with Descriptive Equivalent taken from DepEd Memorandum No. 160, s. 2012 was used to interpret the results of the test.

TABLE 12
MEAN PERCENTAGE SCORES (MPS) WITH DESCRIPTIVE EQUIVALENT

Mastery/Achievement Level	
Mean Percentage Score (MPS)	**Descriptive Equivalent**
96-100%	Mastered
86-95%	Closely Approximating Mastery
66-85%	Moving Towards Mastery
35-65%	Average
15-34%	Low
5-14%	Very Low
0-4%	Absolutely No Mastery

Data Gathering Procedures
A permission letter to gather data and conduct the Social Media-Based Mathematics Instruction was sent to the School Principal of Geras Integrated School. The adviser of each grade seven section and the Mathematics teachers were also informed through the School Principal about the conduct of the study.

After approval, a set of survey questionnaires were handed out to all grade seven students to gather data on the students' level of exposure, extent of use and the social media preferences of students. The instructions on how to answer each item were explicitly explained and for some questions which required an additional explanation, further assistance was provided so as to guide the students in answering. The survey questionnaires were then collected from students. Out of 82 total enrolment for the two classes, only 58 were able to take the survey.

After taking the survey, all the 58 students took a 40-item Pretest on the lessons taught during the First Quarter of School Year 2015-2016. Following the test, students were exposed to a Social Media-Based Mathematics Instruction utilizing the developed SMBMIM. Students were then given the Posttest to determine whether there was an improvement in their mathematics achievement.

Data Analysis Procedures
To determine the desirable characteristics of the developed Social Media-Based Mathematics Instructional Module measured in terms of validity and reliability, and the pre-delivery appropriateness as to learning objectives, learning content, language used, and evaluation activities, Fleiss Kappa and Average Pairwise Agreement, and Cronbach's Alpha were used respectively.

Furthermore, Mean was used to determine the educational use of the SMBMIM measured in terms of the learning gains of students from Pretest and Posttest for every learning competency which include perform fundamental operations on integers, expresses rational numbers on the number line, performs operations on rational numbers, and solve problems involving rational numbers.

RESULTS AND DISCUSSIONS
Prior to the final administration of the SMBMIM, all the preliminary processes were carried out that include: a) development of the instrument for module design; b) development of the instrument for validating the module and research instruments; c) expert validation of the research instruments; d) pilot testing of the module.

Desirable Characteristics of the Social Media-Based Mathematics Instructional Module (SMBMIM) in terms of:

a. Validity
b. Reliability

Validity of the SMBMIM
Table 13 presents the results of the validity of the SMBMIM employing Kappa statistics agreement and Average Pairwise Agreement validated by the panel of six experts.

TABLE 13
RESULTS ON THE VALIDITY OF THE SMBMIM

Average Pairwise Agreement	Interpretation	Fleiss' Kappa	Interpretation
51.2%	Acceptable	0.024	Fair Agreement

Based on the results, the developed Social Media-Based Mathematics Instructional Module showed an acceptable and fair agreement with 51.2% and k=0.024 respectively among the panel members. These results are in accord with Webb (2005) in Martone (2007) that an average pairwise coefficient between 50% and 60% is acceptable while a kappa value of more than 0 according to Chen (2014) shows an agreement, which means that consistency exists if the value is more than 0. These findings imply that the SMBMIM has met the criteria set forth as to: learning objectives, learning content, evaluation activities, and language used and therefore is acceptable and valid as an instructional material.

Reliability of the SMBMIM

Table 14 presents the result of another measured desirable characteristic of the SMBMIM which is internal consistency or reliability using Cronbach's alpha.

TABLE 14
RESULTS ON THE RELIABILITY OF THE SMBMIM

Case Processing Summary			
		N	%
Cases	Valid	12	100.0
	Excluded	0	.0
	Total	12	100.0
a. Listwise deletion based on all variables in the procedure.			

Cronbach's Alpha	N of Items	Interpretation
.90	34	Very High Reliability

Result reveals that as to internal consistency the SMBMIM showed an $\alpha = .90$ interpreted as very high reliability. This result conforms to the findings of Zwier (2013) that the alpha values above .80 signify a very high reliability. This finding implies that the SMBMIM indicates a good internal consistency or reliability. This finding is supported by Bland (1977) in Zaldivar (2013) in which he stated that an alpha value falls within the range of 0.84-0.92 has excellent internal consistency (reliability). Likewise Steyn, Rensburg, & Juul (2012) stated that a cronbach's alpha of different domains should be more than 0.70 to indicate good internal consistency or reliability. Thus, above findings show that the SMBMIM is theoretically valid and has a very high reliability.

TABLE 15
SUMMARY OF THE VALIDITY & RELIABILITY OF SMBMIM

Degree of Agreement (Average Pairwise Agreement & Fleiss Kappa)				Internal Consistency (Cronbach's Alpha)	
% Agreement	Interpretation	Kappa	Interpretation	Alpha	Interpretation
51.2%	Acceptable	0.024	Fair Agreement	.90	Very High Reliability

Based on the results, the developed SMBMIM have met the criteria set forth on the desirable characteristics of the module in terms of validity and reliability where an acceptable and fair agreement, and a very high reliability or internal consistency among panel members evolved respectively. This can be concluded that the developed SMBMIM is acceptable, valid, and very highly reliable as an instructional material for teaching Mathematics on the grade seven students.

Pre-Delivery Appropriateness of the SMBMIM

The pre-delivery appropriateness of the SMBMIM was assessed by the panel of experts in the field of Mathematics and Information Technology based on the following categories: learning objectives, learning content, language used, and evaluation activities using a 5-point Likert scale. The results of the responses are presented in Table 16.

TABLE 16
RESULTS ON THE PRE-DELIVERY APPROPRIATENESS OF THE SOCIAL MEDIA-BASED MATHEMATICS INSTRUCTIONAL MODULE

Categories	Alpha coefficient	Interpretation	Mean (x)	Interpretation
Learning Objectives	0.533	Moderate Reliability	4.72	Strongly Acceptable
Learning Content	0.908	Very High Reliability	4.68	Strongly Acceptable
Language Used	0.833	High Reliability	4.80	Strongly Acceptable
Evaluation Activities	0.827	High Reliability	4.63	Strongly Acceptable
Mean	**0.78**	**High Reliability**	**4.71**	**Strongly Acceptable**

Results show that in terms of learning objectives, the SMBMIM showed an α=.533 and x=4.72 which are described as moderately reliable and strongly acceptable respectively. This means that the SMBMIM in terms of learning objectives is acceptable and reliable. This result conforms to the idea of Cronbach (2006) & Helmstater (1964) in Sheppard (2011), and Nunnally & Bernstein (2010) in Pillay, Viviers & Mayer (2013) that cronbach's alpha coefficient value between 0.5 and 0.6 is considered to be acceptable. This implies that the learning objectives are specific, stated in behavioral terms, clear and easily understood, realistic, time-bound, measurable, and attainable. These results agree with APEID (1978) that instructional objectives should be well stated; should specify the learning outcomes in expected, observable and measurable changes; should be stated clearly and precisely; should be stated in behavioral terms;

For the learning content, the SMBMIM was rated as very highly reliable and strongly acceptable with an α =.908 and x=4.68. This means that the SMBMIM in terms of learning content is highly reliable and strongly acceptable. This finding conforms with Nunnally (1967) in Fan & Lê (2011), Sreedhar (2016), Buchanan (2005), Carmines (1979) in Shi, Al Qudah, & Cristea (2013) that an alpha higher than 0.8 has high reliability. This implies that the SMBMIM on learning content meets the criteria which are: reflects the most important aspects of what is being taught, lessons are presented at a pace that allows for reflection and review, with adequate provision for supplementary activities/exercises, leads to the attainment of the objectives of the course, with supplementary activities that enhance understanding of the content, with adequate presentation/discussion of content, the information about the different topics is accurate and precise, there is a variety of supplementary activities, the ideas, concepts and points presented are well-expressed, and the examples presented are current, accurate and defensible.

In terms of language used, the SMBMIM showed an α =0.833 and x=4.80 interpreted as highly reliable and strongly acceptable respectively. This means that the SMBMIM in terms of language is highly reliable and strongly acceptable. This implies that the words used in the SMBMIM are correctly used, suitable to the reading and understanding level of students, with clear instructions to the students, unambiguous and easy to follow, and lessons are presented in sentences/paragraphs that are grammatically correct. This result conforms to the general principles by CDC (2011) which states that e-learning instructional material should be written in a simple, concise, and consistent way; should be written in a clear, correct language suitable to level that is appropriate for the target learners (APEID, 1978).

As for the evaluation activities, the SMBMIM showed an α = .827 and x=4.63 which is described as highly reliable and strongly acceptable. This implies that the SMBMIM on evaluation activities have met the criteria which are: items in the evaluation are congruent to the specific objectives and learning competencies, items are arranged sequentially, tests are easy to score, with pretest and posttest provided in the module, easy to understand, each item has a definite answer, items help increase understanding and retention of the content covered, and has provisions for self-assessment. These results are in accord with APEID (1978) that a module should have activities which are properly sequenced and relevant to the developmental themes (competencies) and objectives; should have pretest and posttest with answer keys provided; the scoring of test items should be easy and as objective as possible.

In summary, the pre-delivery appropriateness of the SMBMIM in terms of learning objectives, lesson content, language used, and evaluation activities are highly reliable ($\alpha = 0.78$) and strongly acceptable (x= 4.71) as an instructional material. These results are in accord with Garillos (2012) in Zaldivar (2013) that the quality of a good module must possess a highly acceptable and appropriate objectives, evaluation, content, learning activities, skills, time frame and references.

Educational Use of the SMBMIM in Meeting the Learning Competencies

The educational use of the SMBMIM in meeting the learning competencies was assessed during the final administration of the module employing an Achievement Test in the form of Pretest and Posttest. The result of the test is presented in Table 17.

TABLE 17
RESULT ON THE EDUCATIONAL USE OF SMBMIM

Learning Competencies (LC)	No. of Items	PRETEST			POSTTEST			Mean Gain Percentage (%)
		Mean (n=58)	Mean %	Interpretation	Mean (n=58)	Mean %	Interpretation	
1. Performs fundamental operations on Integers	25	10.00	40%	**Average**	11.09	44%	**Average**	**11%**
2. Expresses rational numbers on the number line	4	1.29	32%	**Low**	1.38	35%	**Average**	**8%**
3. Performs operations on rational numbers	9	2.48	28%	**Low**	2.40	27%	**Low**	**-3%**
4. Solve problems involving operations on rational numbers	2	0.40	20%	**Low**	0.60	30%	**Low**	**52%**

Based on the results, the SMBMIM measured in terms of educational use showed a mean gain of 11% for LC#1, 52% in LC#4, and 8% in LC #2. This implies that the mastery level of students from pretest to posttest has improved in terms of the mean gain percentage. Furthermore, using the DepEd MPS as cited by Fernandez (n.d.), the result of LC#2 with 32% MPS in the Pretest and 35% in the Posttest reveals that the mastery level of students has improved from Low Mastery to Average, in contrary to LC#3 which shows a negative gain in the MPS of students. This one point decrease in the MPS from 28% to 27% in pretest and posttest respectively is due to the difficulty encountered by students on dealing with mathematical symbols such as radical signs and exponents, and representing numbers in fraction form on Facebook. This implies that the SMBMIM needs to be improved further especially in areas covering LC#3: Perform Operations on Rational Numbers.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In the light of the findings derived from this study, the following conclusions are presented:

1. The Social Media-Based Mathematics Instructional Module is valid and reliable and is acceptable as an instructional material.
2. It has met most of the pre-delivery appropriateness criteria of the required learning competencies and skills of grade seven students on aspects of lesson objectives, lesson content, language used, and evaluation activities are relatively highly reliable.
3. In terms of educational use, the Social Media-Based Mathematics Instructional Module has minimally met the learning competencies.

Recommendations

Based on the findings and conclusions, the following are the recommendations:

1. It is recommended that the developed Social Media-Based Mathematics Instructional Module be used in Mathematics class for grade seven students especially in Geras Integrated School.
2. The Social Media-Based Mathematics Instructional Module shall be tried out or field tested in other secondary schools.
3. A further study on the use of the Social Media-Based Mathematics Instructional Module as a lesson intervention vis-à-vis effects on students' mathematics achievement is greatly recommended.
4. Mathematics teachers are encouraged to develop modules of a similar nature using other social media platforms.
5. In line with the K-12 curriculum for grade 7, it is highly recommended that the SMBMIM be used as instructional material and be used for grade seven students in order to determine its effectiveness and impact on students' achievements.
6. On the validation of the SMBMIM regarding consensus or agreement among experts, it is recommended that the level of validity be improved from fair agreement to substantial agreement for the next research study.

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