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The banner features a decorative border at the top with a repeating pattern of small triangles in blue, yellow, and red. On the left, the ECS logo is displayed in green and blue. To its right, the text 'The Electrochemical Society' is written in a serif font, with the tagline 'Advancing solid state & electrochemical science & technology' in a smaller, sans-serif font below it. The main text of the banner reads '240th ECS Meeting' in a large, bold, sans-serif font, followed by 'ORLANDO, FL' in a smaller, blue, sans-serif font. Below this, 'Orange County Convention Center' is written in a smaller, orange, sans-serif font, and 'Oct 10-14, 2021' is written in a smaller, black, sans-serif font. On the right side of the banner, there is a photograph of a large, ornate building, likely the Orange County Convention Center. At the bottom of the banner, there is a blue bar with the text 'Abstract submission due: April 9' in white, and a red bar with the text 'SUBMIT NOW' in white.

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240th ECS Meeting ORLANDO, FL
Orange County Convention Center Oct 10-14, 2021

Abstract submission due: April 9 **SUBMIT NOW**

The Affect of The Internet and Social Media: Mathematics Learning Environment Context

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Abstract. Mathematics as one of the lessons in school has quite complex problems, it is often labelled as a difficult subject, poor in innovation and bored. Various methods has been used to make mathematics easier to learn. While on the other hand, the development of the communication industry revolution has changed community's thinking style, learning style, and lifestyle. More specifically, the development of social media, which has an impact on mathematics learning. Students who are classified as millennial, learn more about mathematics using audio visuals such as on YouTube or Instagram. The existence of social media has raised a new form of teacher relations with students. This article discussed and described about how social media has an impact on mathematics learning. The existence of internet social media made the task of the teacher lighter. However, learning mathematics in this era of social media has challenges, advantages, and disadvantages. In this literature study, it will also be explored how social media distorts the role of teachers as educators.

Keywords: Media Social Era, Mathematics Learning

1. Introduction

Mathematics as learning in schools has complex problems, the easiest way taken by parents so that their children can more love and understand mathematics is by providing additional learning through courses, or private lessons. However, it gets several children become dislike mathematics more. Many factors which can influence it are unattractive learning systems, conventional learning media, and too difficult material.

In the learning mathematics process, children often have difficulty in carrying out the abstraction process and difficulty in understanding the basic logics of mathematical concepts. Mathematics is often labelled as difficult, and boring, so that children have negative perceptions. From this negative perception, the students' attitude is unhappy with mathematics, this is become their internal factors. Even though they have good cognitive abilities, but often gets poor mathematical perception from outside pressure, it make them unhappy to learn mathematics. In addition, there are external factors as said Bol & Berry, which make students unhappy with mathematics such as teachers who do not trust their abilities, parental support, curriculum shifts, the ratio of students are more than teachers, and unprofessional teacher.

While in this latest development, communication industry revolution gives enough opportunity for children to learn various things more easily. One of revolution in communications industry is social



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media. Facebook, You Tube, Whatsapp, Line, Path, and other media open up many opportunities and also shift thought patterns and learning styles. This situation by some experts is called millennial era. As Mucharomah said Millennial era is the digital and online era. In this era, students are very dependent on social media. Social media users has been increased every year, based on statistical data, Indonesia is a country with the fourth social media Facebook user after China, India, America. This shows that Indonesian people are an active user of social media.



Figure 1 Facebook User Rank Based on Countr

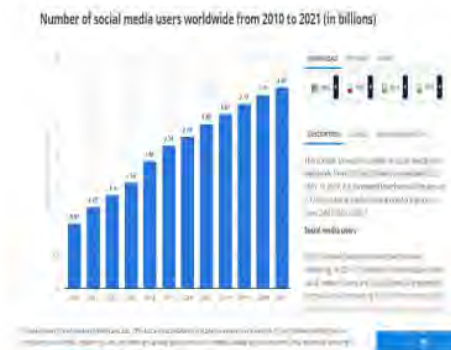


Figure 2. Statistics and prediction of Internet Social Media User in the world from 2010 to 2021

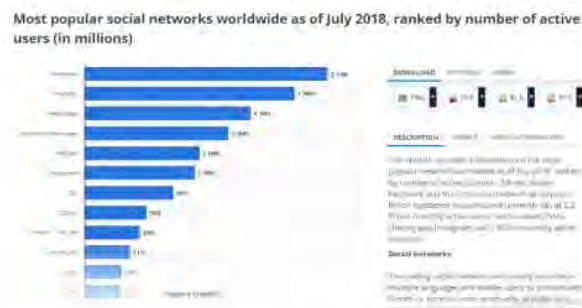


Figure 3. Statics of The Most Popular Social Media in the World

Another example of social media media is in business, many online-based businesses have sprung up, while on the other hand many business¹² are bankrupt because of online systems existence. The use of the internet in business changes from function as a tool to exchange information electronically into a tool for business strategy applications, such as: marketing, sales and customer service. Of course, its impact has also entered to school influenced on policy, learning process, and evaluation of mathematics learning process. Those advances have a fundamental influence, from paradigm to knowledge to teach material. In addition, it has the influence on teacher, such as teacher competence must be oriented towards information technology development.

There is a new relationship established between teachers and students, or lecturers and college students caused by the existence of social media in an effort to transform knowledge of mathematics.

The learning process no longer requires physical meetings, in order to transform knowledge, it is enough to use social media on lessons as it will be more accepted and easier to understand. Media plays an important role to build student's understanding. although what meant by Sudjana was props or learning media, but his statement was quite relevant with social media existence played important role. The term used to describe it has been called the Industrial Revolution Era 4.0. The term illustrates that information technology has entered into all aspects of life and changed people's lifestyle.

Many new professions which are not exist before emerge such as youtuber, Instagramer, selebgram, and others. Social media also build easier and more intimate relationship between teachers and students. The term suitable to describe children who are closer to information technology today is millennial. Millennials get and search for any information by using internet. They are no longer confused to find information or to solve a problem. It is not only for general lessons but also for religious studies. They can watch YouTube or quest Google to fulfil their spiritual needs and study religion.

If students use social media a lot as a main source to understand mathematics in the learning process, actually teacher's role is distorted by YouTube, Instagram etc. Therefore, what is the role of mathematics teachers in the future? Social media is an inseparable tool for students' lives, how does it affect mathematics learning? Because mathematics still gets a negative stigma, how can social media be used so that mathematics becomes a necessity for children? These questions will be the main focus in this article. In order to discuss paradigm this article would be more in-depth discuss about how social media influence mathematics learning from various theoretical perspectives related to learning.

2. Methodology

Since this study would explained about how social media influence on mathematics learning, the data presented was explorative. So, the method used in this study was a descriptive qualitative approach. The approach in this study was a literature study. In this case, the researcher tried to describe the phenomenon or a reality that occurs in real life. In addition, to strengthen this research, it would also be explained about several cases viewed from various theoretical perspectives. This research hoped that the phenomenon revealed in this study could be more profound from relevant theory point of view so that the facts revealed could truly be accounted for. Hopefully this approach could reveal social media phenomenon and its influence on learning mathematics in detail and in depth.

3. Discussion

3.1. Learning Mathematics of Millennials Generation

Before discussing how to learn mathematics with all its complexity, it needs to be explained a little about millennial generation. This is necessary, because the subjects of learning in the social media today are millennials. Thus, learning mathematics for students in the 21st century is nothing else about mathematics learning for children as millennials generation. Since learning in this social media era is very different from the past decade, the subject is in a different era. The average student is currently born under 1998, therefore they belong to millennial children. After World War 2, cohorts were divided into four generations: baby boomers, generation X (Gen-Xer), millennials and generation Z. The baby boomer generation is a generation born after the second world war (currently 51 up to 70 years). It was called baby boomer generation because there were very high baby birth. Generation X was a generation born in 1965 to 1980 (currently aged 35 to 50 years).

Millennials are generations born between 1981-2000, or those currently aged 15 to 34. Millennials (also known as Millennials or Y Generation) are demographic groups after Generation X, while generation Z is born after 2000 until now. They also always use instant communication technologies

such as email, SMS, instant messaging and social media such as Facebook and Twitter, in other words generation Y is the generation that grew in the booming internet era. For generation Z information and technology are things that have become part of their lives, because they are born where access to information, especially the internet has become a global culture, so that it affects the values, views and goals of their lives.

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So from the definition above it can be concluded that millennials are those who were born between 1981-2000, also known as generation Y, they consider internet as unfamiliar thing in their life, which has an impact on their outlook and purpose in life. They always use email, SMS, instant messaging and social media such as Facebook and Twitter, YouTube, Line, WhatsApp, Instagram etc. They prefer to use cell phones than TV, they like streaming YouTube a lot instead of TV. They regard social media as an obligation, even they use it for actualization and self-expression. For reading activities, they prefer to read messages or brief information rather than read books or conventional. Even though books still have important function, they prefer to search information instantly by googling.

Bloom classified mathematics learning outcomes into cognitive, affective and psychomotor abilities. The formation process is carried out in the learning process. Therefore, mathematics learning belongs to mental proses to understand the facts, skills, and mathematical concepts. Indicators of someone learning mathematics can be seen from the changes that consist of affective and psychomotor abilities. The process of learning mathematics has a different development from time to time to the current digital era.

Seeing the subject of such learning processes, it becomes a challenge in the process of learning mathematics. What the influence of social media era for student classified as millennial. They prefer to use instant methods. Many mathematical applications that exist today are able to solve math problems faster. Millennial student in the learning process will feel bored with conventional methods. Using their application can instantly solve mathematical problems complete with the steps to complete them. For example, Photo math, this application is provided in the Play store and App Store. With this application, the cell phone just opens the application, then the camera is directed towards the problem, and just press enter. So in a short time the answer will be obtained along with the steps. Of course, this was a challenge by the mathematics teacher. In addition there are many other applications that can answer math problems more easily, for example Mathway.com, Socratic etc.

Another method used is surfing on social media, to solve mathematical problems. They will easily send their school assignments to related accounts to find a solution. Of course, they will avoid asking to their teacher directly, it will be worse than to cyberspace. Their way to sincerely work has shifted. In the previous decade, people need to solve problems by thinking seriously, trying to solve problems repeatedly by doodling or looking for references to textbooks. But today it is different, student can work fast by asking questions, sending questions to other people with social media, opening YouTube, and other ways by utilizing social media.



Figure 4. An Example of Mathway Mathematics Application. <https://www.trishtech.com/2015/10/solve-mathematics-problems>

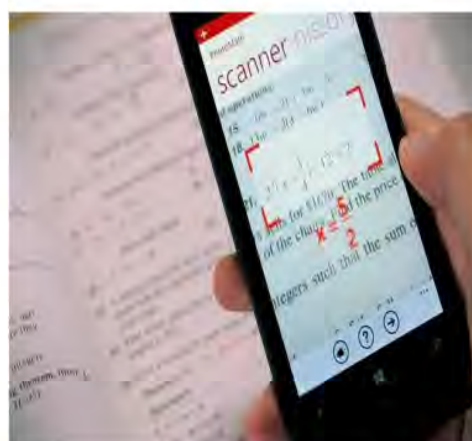


Figure 5. An Example of Photomath Mathematics Application. <https://www.engadget.com/2014/10/21/photomath/>

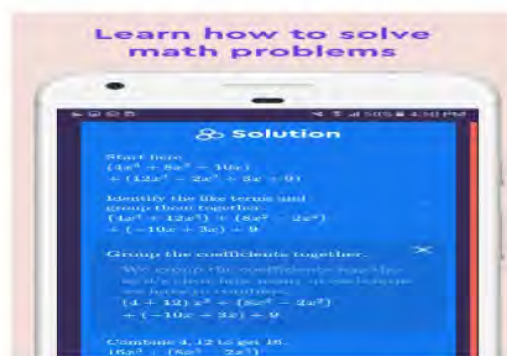


Figure 6. An Example of Socratic Mathematics Application <https://www.androidpolice.com/2017/05/06/hands-socratic-launches-android-app- homework-answers/>.

3.2. Social Media and Teacher Role Distortion

To make it easier about how social media influences the teaching patterns of teachers, it is necessary to define social media understanding in advance. Its definition aims to find teacher's role influence. Since social media had never existed in the past decade, roles and responsibilities of teachers or mathematics lecturers has still used old paradigm. Theoretically, the definitions or meanings are bound by time and space so that it is important to understand the definition of social media and

teacher responsibilities. From those understanding, the influence of social media rooted and changed learning techniques will be determined and students' learning strategy will be also more realized.

⁹ Social media is a new set of communication and collaboration tools that allow many types of interactions previously unavailable to ordinary people. Social media also known as social networking is part ⁵ new media. It is clear that the interactive content in new media is very high. Wikipedia defined social media as an online media which its users can easily participate, share and create content including blogs, social networks, wikis, forums and virtual worlds. Blogs, social networks and wikis are the most common forms of social media used by people around the world. Social media is online publishing and communication tools, sites, and goals of Web 2.0 rooted in conversation, involvement, and participation. Social media is a software collection that allows individuals and communities to gather, share, communicate, and in certain cases collaborate or play together.

So social media is an online media, in the form of software that helps individuals to communicate, share documents in audio visual form, and can even communicate in groups on a topic. In addition, social media can make group of people communicate collaboratively with many people, online and through territorial boundaries. Therefore, communication of this model will be difficult to do in the real world, besides requiring a large amount of space, it also requires expensive costs. This social media get people to be able to interact and discuss more effectively. Social media has had an impact on community involvement in current issues. This involvement includes active abreast of current issues through blogs, online form groups to express their aspirations, creating a blog about current issues, giving comments in online news, articles / blogs, participate in online discussions, uploading or disseminating news related to current issues.

Teaching and learning activities through face to face interaction between lecturers and student is still meaningful in formal classes. As a result, the model provides opportunities for lecturers or teachers to be more dominant in the learning process. In fact, the concept of meaningful learning is that students process, and the main criterion is the learning process itself so that students discover for themselves what they are learning. The learning referred to, in fact, is an old paradigm that illustrates the dominance of lecturers in using various methods in giving lectures in college.

Teachers not only have scientific and academic qualifications, but more importantly must have good character. The task of the teachers in learning in the old era is to transform learning so that they had a dominant role in the class. This learning process gets criticism later on. In the latest era, learning is more focused on individual processes, or student-centred learning. The teacher is the facilitator. However, in this era of social media - the digital era, the role of the teacher is again distorted because millennial generation prefer to learn instantaneously. They often do a search for what they want to know through social media, like Facebook and YouTube.

In such situations, Mathematics teachers cannot play around if they do not want to left behind by students. In fact, the latest literature shows digital media and communication technology have had an impact on the learning styles and behaviour of today's youth who prefer to receive information quickly, capable at processing information quickly, prefer multitasking and nonlinear access to information, kinaesthetic learners, experience, and involved directly in learning process, learning through games, simulations, and role playing. They also rely heavily on communication technology to access information and to engage in social and professional interactions.

Lots of content in social media such as YouTube, Facebook, and Instagram that provide mathematics as knowledge. Mathematical content provided by social media, also supports audio visuals, so that it becomes the main choice for teachers. It is because sometimes students better understand mathematics through audio visual contained in YouTube, or in Instagram. So they use a lot of social media to help

them learning mathematics. In turn, learning by using cyber, gives an idea of the way how students change their thinking, act, and learning in social media era, especially those whom born and raised in the internet era. Learning patterns in the cyber world, allow them not only to absorb mathematical information, but they also have a new literacy style, by producing information through social media. As Burclaff said, they learn by exploring and doing, thus they create opportunities to make new information, for example by creating new films or videos which can be uploaded then. Here are some examples of math channels on YouTube :

1. The Map of Mathematics (All fields of mathematics are summarized in one map. This shows how pure and applied mathematics relate to each other and all sub-topics are made)
2. Michael Van Biezen (This is the channel you should visit on a lazy day when you don't have motivation anymore. The videos are very beautiful. The channel contains lectures on Physics, Chemistry, Astronomy, Mathematics, and Mechanical Engineering)
3. Socratica (Our channel is for everyone who wants to learn. It contains high quality educational videos for people of all ages. From science and mathematics, to arts and humanity).
4. Yaymath (consist of algebra and computation, etc)
5. Tecmath (in this video, we can see how to multiply two digit of numbers as many as eleven instantly – it's much faster than calculator! This multiplication is much faster and easy with this mathematics trick from the video)
6. Etc.

Another method used by students in the social media era is the process of sharing data and information. In this context, they utilize social media networks to solve problems. They easily make discussions on math topics through whatsapp group, facebook, or Instagram. Thus, the discussion of mathematical topics like this method will be difficult in real life. The discussion of mathematics in social media is more effective, overcoming the limitations of space and costs though it does not use physical meetings. In addition, there are examples of cases, students will try to find math problems given by the teacher by asking through social media.



Figure 7. Example of case how student use social media to solve mathematics problem



Figure 8. Example of case how Teacher use social media to solve mathematics problem

From those several phenomena above, the role of the mathematics teacher gradually begins to be distorted in the aspect of conveying mathematical insights. However, it is not entirely the duty of the

teacher to be replaced. Mathematical teachers have an obligation to direct students to be critical on social media. Not all math content on YouTube, or Instagram matches the child's abilities, or the level of thinking. So in this aspect, the teacher has a role to direct, which learning resources or channels are suitable for students. Therefore the math teacher is forced to always update information on the development of mathematical knowledge on the internet. The ability of teachers to use social media networks, updates on the development of mathematical research plays an important role as facilitators for students, so that the resources they use are truly suitable and good to use.

The role of mathematics teacher is actually not much different¹¹ from the role of the teacher in general, in teaching and learning activities, can be briefly mentioned as follows: (a), Information provider (b) Organizer, (c), Motivator (d), Director (e), Initiator (f), Transmitter (g), Facilitator (h), Mediator (i), Evaluator. In the explanation above, the role of the teacher is changing in the terms to become information provider because the information given is not learning material but in the form of good and suitable sources for students. Therefore, teachers as a source of information in the social media era are no longer relevant. In addition, the materials in the cyber world are more complete. Their ability to filter information or learning mathematics resources in social media needs to be trained. However, in the case of students using social media networks, in order to find mathematical problem solving for certain related accounts, it is part of the effort of communication and hard work. This means that in this case the child really tries to find problem solving, even though he does not use his own abilities, but there is a shift from the use of methods, they prefer to use social media networks.

Learning is meaningful, has a clearer orientation, allows one to get more meaning in the world around them, learning is more active, constructive, intentionally authentic and cooperative. The ability of students to learn mathematics by opening social media such as YouTube, asking related certain accounts, is part of the effort to build constructive understanding. Although there is a shift from conventional constructive ways to constructive with cyber assistance. Since by searching for information from social media, it is part of a deliberate effort. This cannot be avoided. Therefore it is a challenge for the mathematics teacher to combine the student's ability as a millennial with the aim of learning mathematics. The teacher's burden in preparing teaching materials becomes easier, but on the other hand they must have the ability to do a combination of learning mathematics resources that already exist in cyberspace.

The task of the teacher in conveying mathematics material began to be replaced, but the task as an educator cannot be replaced with technology. The effort to educate, to build character, to accompany, to give attention certainly will not be obtained on social media. There are at least five competencies that need to be guided by teachers as educators such as the ability to think critically as in the existence of social media make information can be so easily obtained. There are several criteria for critical thinking according to Fahim. Elementary Clarification, basic support, inference, advanced clarification, strategies and tactics. Even though the information could not search for its source and truth level. Therefore, it needs critical thinking in the social media era. Mathematical learning is arranged to build student's critical thinking. In order to become critical thinkers, they must develop attitudes to make reason, to be challenged, and to seek truth. Not all answers or mathematical references obtained from social media can be accounted for. But the ability to reason, find the truth by comparing sources with one another will help children to think mathematically.

Second, a creativity in this context is about how social media can make children think creatively with mathematics learning. As it is known, children's creativity is not awakened because there is no opportunity to be honed. Children¹⁰ are more preoccupied with understanding mathematics in cognitive areas. Creative definition, the type of thinking that leads to the acquisition of new insights, new approaches, new perspectives, or new ways of understanding something. In the above case (Figure 4), the way students get answers by asking questions about the related account is a part of the creative

effort. They are out of habit, they are looking for ways in other ways. In this context, the mathematics teacher needs to direct students to be creative in dealing with all problems. While Arvyati defined mathematical creative thinking abilities as the ability to find solutions to a mathematical problem easily and flexibly. Challenging habits in solving mathematical problems have implications for children's creativity. So as difficult as any child faces a mathematical problem, they will easily use creative ways to find solutions. In addition, the role of the teacher in building this creativity can be realized with a mathematical audio visual product that is easily understood by students. Thus, the teacher will easily guide students to understand mathematics, by using audio visual that can be uploaded on social media such as YouTube, or Instagram.

Third, the ability to communicate well is also needed in the current era, communication is often a barrier for students to do relationships with teachers. The meaning of mathematical communication according to Armiati is the skill of expressing mathematical ideas coherently to friends, teachers, and others through spoken and written language. While Ramellan revealed that without communication in mathematics, the teacher would have little information, data, and facts about students' understanding of the process and application of mathematics. Teachers have an obligation to give examples of how to build good communication and are able to encourage students to communicate well in the era of social media. In this context, the role of the teacher is to arouse the spirit of students to express mathematical ideas through audio visual images. This ability will encourage students not only to get information but also to produce mathematical ideas. The existence of social media also addresses the gaps of teachers and students and also makes communication between people easier.

Fourth, the ability to work collaboratively used to train students to have a spirit of togetherness is by creating groups. Dillenbourg and Tchounikine defined collaborative learning as a process that emphasizes the interaction between students is the most important part of the learning process without ignoring other factors such as learning material and interaction with the teacher. The ability to work as a team determines students' fate in the future. From this definition, the ability needed to train students when study mathematics in teams is class conditioning. However, in this social media era, collaborative can be done in the cyber world so that students can study easier, more effective and efficient. The ability of team work in learning mathematics determines children's future. With a strong character embedded in the usual collaborative process, students will be able to face various challenges outside the formal education scheme.

The fifth is confident. It becomes a competency that students must possess. Therefore, mathematics learning needs to be directed to produce students who have the ability to be brave and to be confident in facing problems. Self-confidence is a strong belief in oneself in the form of feelings and assumptions of good condition in order to enable individuals to appear and to behave confidently. In this social media era, the ability needed by teacher to encourage is confidence. The habit of using social media sometimes makes children less confident in their abilities. Therefore, the teacher has an important role in this section.

4. Conclusion

Social media era changes lifestyle and interaction in society which has an impact on mathematics learning. In addition, this era made the teacher's role distorted. Although the habits of students classified as millennials, they use social media more as a reference, but in reality their efforts to obtain information on mathematical problems faced is part hard work and earnestly. Students prefer to surf in cyberspace, while learning becomes more expanded and without wall or time restrictions. The existence of YouTube, Instagram, Facebook and other popular social media makes students to be more active in learning at all times. Some of them prefer to find solutions of math problems they get by asking the group or related accounts. Even though mathematics learning can be accessed easily, not all of teacher roles can be replaced by social media. There are several challenges that must be

faced by teachers in social media era such as critical thinking about the learning mathematics source and creative thinking. They are not only required to solve problems but also to produce audio visual of mathematical ideas through social media as well as the ability to communicate well. Social media era helps students and teachers to solve communication gaps and create new relationships in the cyber world. They can study with other cross-territorial scholars. In addition, the ability formed that become teachers' responsibility is to work collaboratively and confidently.

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