How Social Media can contribute to increased motivation and engagement in learning mathematics

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ABSTRACT

This research paper aims to contribute to the discussion of how to create learning environments that motivate the new learner, as they have new preferences when it comes to working, focusing and learning. Social incentives are discussed as one way of extrinsically motivating students in learning mathematics. Based on the literature reviewed it is proposed a framework that detects features in Social Media that can contribute to a more motivating learning environment though social incentives.

KEYWORDS: Social Media, Motivation, Intrinsic and extrinsic motivation, Social motivation, New learner, Learning mathematics

1. INTRODUCTION

Norwegian mathematical skills are a well-discussed subject, as the competence level in the education system is found to be too low. Through media we get to know that every other teacher student is failing the math exam [16], that the average grade in mathematics in high school is decreasing [18], that three of seven second-year high school students fail the exam [19] and that both students and teachers are suffering from math anxiety [17]. Researchers, politicians and educators are discussing the cause of the low results and they all state that there is a need for a change to improve the mathematical skills of the Norwegian people [18][20][21].

Another emerging trend among young people today is the increased popularity of Social Media, in which people are spending hours every day on chatting, sharing, collaborating and competing with strangers and friends. Educational leaders are observing how networked social media (e.g. Social network sites, blogs, RSS technologies) are positively transforming practices in other fields such as business, journalism and politics, and some are now inquiring how education can similarly transform by taking advantage of technologies that students already use in their daily lives [1].

The goal of this research is to contribute to this discussion and to find out how, and if, Social Media, or mechanisms used in Social Media, can contribute to increased motivation and engagement in a learning environment. Research from three fields is reviewed: academic motivation, mathematical learning and Social Media. Based on the literature study a framework that detects features in Social Media that can contribute to increased motivation and engagement is proposed. In addition some of the
most common features detected through a case study will be discussed as motivation incentives in mathematics.

2. MATHEMATICS AND OUR SOCIETY

It is apparent that good mathematical knowledge is fundamental in our technology-based society, and that is why it is important and necessary for the society to motivate and engage students in learning mathematics. The first sentence in the official Norwegian curriculum in school mathematics states that mathematics is a part of our cultural heritage [2]. This applies not only to Norway; the field of mathematics has an ancient history around the world as it is used to explore and to describe the universe and to make systematic models of the nature and society. Today mathematics intervenes in many sectors, like medicine, economy, technology and communication [3]. Mathematical skills are considered so important to the industry that the industry is willing to found learning institutions and universities to secure students skills and knowledge in the field [22].

All though the field of mathematics is necessary to our technology based society; the education system seems to lack good examples of applications of mathematics. Research across studies about motivation in mathematics claims that the student must understand that the instruction they receive is useful before they can start to develop intrinsic motivation in mathematical learning [4]. Real-life problem situations in which the use of mathematics facilitates uncovering important and interesting knowledge is therefore highly important for the student motivation and engagement in the field [4].

Existing research examining the effect of engagement on achievement demonstrate a strong positive relationship between engagement and performance across diverse populations [5]. A student being engaged is therefore more likely to achieve good results, which again gives confidence and motivation to learn more, as research claims that mathematical confidence “is an affective dimension closely associated with mathematics achievement” [6]. Engagement with intellectual work of learning does also contribute to students’ social and cognitive development and is therefore an important goal for education in general [5].

The new learner

The contexts for teaching and learning today have become increasingly complex as students learn across a range of physical and cyber spaces. Out of the context a new generation of learners are raising with new ways of working, focusing and with new learning preferences [7][1]. The new learner is cradled in technology; they are intuitively tech-competent, exploring and trying things out. They are very social and constantly communicating through phone, chat, Twitter, Facebook and other digital media, and they switch between them seamlessly. Some dubs the young generation as the “Digital Natives” generation, a generation that never has experienced the world without Internet [8]. A consequence of this and the new digital platforms (portable tablets and Smart-Phones), is that the new learner learn “on the go”, in multitasking mode, on the bus, while walking to school, while watching TV and while chatting with friends. Another consequence is that they are very social as they are constantly communicating [7]. The large number of friends and contacts they keep through social media as Facebook and Twitter makes a great resource to mobilize in the purpose of solving a problem or reaching a goal [7]. This new behaviour requires new methods of teaching and motivating the students, as the school should prepare the students not only as professional individuals, but also of social situations and behaviour. As the new students are living their life highly social and “on the go”, there exist a need for new learning strategies. In the United States research show that in contrast to other school objects (e.g. social studies), math instruction provides students with only one way of learning: teacher explanation followed by student practice [9].
Such static teaching strategies and closed classrooms do not reflect the dynamic and social daily life that the students are living. A consequence of this gap could be decreased motivation, as the student cannot see the relevance of what they learn when the teaching environment is so different from “real” life.

Vassileva (2008) claims that the new learner’s motivation for learning is to satisfy a short-term-goal, this means that the student is “solution driven” rather than “learning on principle”. She also states that the motivations for learning often are social, in search for recognition and rewards from teachers and friends. [7]

3. ACADEMIC MOTIVATION

As the new learner requires a new learning context and strategy that reflect their daily life, there is a need to understand the basic motivations for learning. In this part of the article the contrast between the motivation and the “Digital Natives” behaviour is explored, with a goal to identify ways of motivating the new learner.

3.1 Motivation

Ryan and Deco (2000) defines motivation as:

“To be motivated means to be moved to do something. A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated.” [10]

A person can have different amounts of motivation and the amount of motivation for the same task can be different from person to person. Further does motivation not only vary in level (how much motivation), but also in orientation (different kinds of motivations). The orientation of the motivation concerns the underlying attitudes and goals that give rise to a certain action. Thus, people have both different levels and different kinds of motivation. [10]

There are two distinct types of academic motivation that interrelate in most academic settings - Intrinsic and extrinsic motivation [4]. A student can be interested to learn a new skill because he or she understands the potential utility or value of it (intrinsic), or because learning the skill leads to a good grade and the privileges a good grade affords (extrinsic) [10]. In both cases the student can have the same amount of motivation, but the orientation is different. According to Ryan and Deco (2000) intrinsic motivation was first acknowledged within experimental studies of animal behaviour, where it was discovered that many organisms engage in playful and curiosity-driven behaviours even in the absence of rewards or reinforcement. Today there exist different definitions of the two types of motivations [10]. Some authors have defined intrinsic motivation in terms of the task being interesting, while other have defined it in terms of the satisfactions a person gets from doing a task with intrinsic motivation [10]. These definitions derive from the viewpoint that intrinsic motivation can exist within individuals, but in another sense, intrinsic motivation exists in the relation between the individuals and activities [10]. Ryan and Deco (2000) points out that people are intrinsically or extrinsically motivated for some activities, and not for others, and that not everyone is intrinsically or extrinsically motivated for the same task.

3.2 Motivation for learning mathematics

Research examining recent research in the area of motivation in mathematics education is said to be in its infancy and the discussions and results seems to be going in many directions [4]. According to Middleton and Spanias (1999) “few researchers have attempted to extend current theories of motivation in ways that are consistent with the current research on learning and classroom discourse.” [4]. They propose that researchers interested in studying motivation in the domain of school mathematics need to examine the relationship that exist between mathematics as a socially constructed field and students’ desire to achieve [4]. However, some
consistencies are evident across existing studies, and knowing about these is an important step in understanding how to improve students’ motivation in learning mathematics.

Being motivated in school mathematics is highly related to personal beliefs; students’ self-confidence in mathematics is critical to their achievement. Further is the effort a student is willing to expend on a task determined by the expectation that participation in the task will result in a successful outcome. What the individual value as a successful outcome may vary, some value the participation in the task itself while other value the extrinsic rewards that are associated with it, or even a mix of both [4]. Another finding across studies about student motivation in school mathematics is that providing opportunities for students to develop intrinsic motivation in mathematics is found superior to providing extrinsic incentives for achievement. Research claims that when individuals engage in activities with intrinsic motivation they tend to spend more time on the task, they are more persistence of failure and they take more risks. It is found that intrinsic motivation result in high-quality learning and creativity and it is therefore desirable in learning practices. [4].

The ultimate situation is therefor that the student engages in mathematical activities with intrinsic motivation. It is believed that humans are curious in nature and that students start their education career with an innate motivation to learn. This motivation often diminishes or gradually disappears, because the students have to participate in routines and activities they find boring [6]. Finding a teaching strategy, which would engage twenty individuals in a classroom to participate with intrinsic motivation, is problematic, if not impossible. At some point some students loose interest and motivation. Because of this is it important to know how to promote more active and volitional (versus passive and controlling) forms of extrinsic motivation [10]. Ryan and Deco (2000) claims that this is essential in forming a successful teaching strategy. They point out that there exist different types of extrinsic motivations and the importance of understanding them, as educators cannot always rely on intrinsic motivation to foster learning. One student may engage in a certain activity with intrinsic motivation, while another one can be unmotivated for the same task. Ryan and Deco (2000) state that students can perform extrinsically motivated actions with a willingness of learning and with an inner acceptance of the value of the task and that most of the activities people do are not intrinsically motivated. In schools it appears that intrinsic motivation becomes weaker with each advancing grade [10].

3.3 Social motivations in the learning process

Social interaction with other people through communication as actions, gestures and language is an important part of the learning process, as learning is influenced by the interaction between the individual and the external environment [3]. Research shows that apart from being intrinsically motivated to learn new knowledge through personal interests, learners may also be extrinsically motivated by social reasons- to seek social contact. Learners can be driven to achieve by the wish for recognition from the teacher or the peer, by the goal to help others or to build new relationship through collaboration with them [7]. It is argued that individuals’ actions are socially embedded and cannot be understood properly without considering the social motivations that underlie them [12]. These motivations represent a person’s perception of how her/his actions are viewed by others and how her/his behaviour influences others utility and welfare [12]. As the new learner is highly motivated by social reasons, detecting motivations related to social behaviour can be useful in the case of improving the new learner’s motivation in a learning situation.

Hernandez, Montaner, Sese and Urquizu (2011) proposed a conceptual model to identify social motivations relevant to understanding attitude, usage, and intentions to continued use of ICT
interactive tools in e-learning. These motivations include aspects such as social influence, altruism, social recognition by peers and the teacher and sense of community. Prior studies had provided insights in which intrinsic and extrinsic motivations that lead to successful design of e-learning tools, but they had typically adopted an individual-focused approach, neglecting social pursuits, influences and interdependencies [12]. The conceptual model, which Hernandez, Montaner, Sese and Urquizu (2011) proposed, distinguished between two groups of social motivations [12]:

- Anticipated reciprocal relationships
- Anticipated extrinsic rewards

### 3.3.1 Anticipated reciprocal relationships

Boch, Zmud, and Kim (2005) defines anticipated reciprocal relationships as a capture of a socio-psychological explanation of social actions, a learner’s desire to maintain on-going relationships with others and establish new relational bonds to increase group welfare. Hernandez, Montaner, Sese and Urquizu (2011) identified three major social motivations as pertaining to anticipated reciprocal relationships:

- Sense of community
- Social influence
- Altruism

Sense of community refers to a person’s belief that he is an important part of a social group. Social influence refers to the degree a person believes people in their social circle perform a particular action or show a certain behaviour. Lastly, altruism is the act of doing something for others to increase their wellbeing, without anticipating personal rewards. [12]

### 3.3.2 Anticipated extrinsic rewards

Anticipated extrinsic rewards refer to motivations based on rational and self-interested incentives. People are motivated by the personal benefits, for example better grades or teacher recognition that they can obtain by engaging in social behaviour. Recognition is the value that a participant derives from gaining acceptance and approval from other members. The way people value self-enhancement in a social environment varies and learners that value self-enhancement higher perceive more benefits from engaging in activities that lead to recognition from peers than those who do not. [12]

### 3.4 Social motivations and the new learner

From the literature it can be concluded that extrinsic incentives to motivate students in mathematical learning is important, as the student being intrinsic motivated cannot be relied upon, especially in classrooms with many students. Extrinsic incentives can be used to create engagement and to help the students achieve success in mathematical problem solving. As expectation of success is necessary for development of intrinsic motivation in mathematical learning, providing the students with extrinsic incentives first can result in more engaged students, more success, and as a result of this; more intrinsic motivated students. Use of social incentives to trigger motivation can be one way of extrinsically motivating the students in learning mathematics as the new learner is highly motivated by social reasons. The social motivations provided in the model by Hernandez, Montaner, Sese and Urquizu (2011) are examples of social behaviour that people strive for and are motivated by and they can be used as incentives for learning and engagement in education. Figure 1 provides the relationship identified between the new learners behaviour and the need for more extrinsic forms of motivation in the education.
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  collaborative
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Andreas
  M.
  Kaplan
  and
  Michael
  Haenlein
(2010)

4.1 Definition
  and
classification

Andreas M. Kaplan and Michael Haenlein (2012) found that a formal definition of the term Social Media requires drawing a line to two related concepts: Web 2.0 and User Generated Content.

Web 2.0 is a term first used in 2004 and it describes a change in our use and development of the World Wide Web. Andreas M. Kaplan and Michael Haenlein (2010) describe Web 2.0 “as a platform whereby content and applications are no longer created and published by individuals, but instead are continuously modified by all users in a participatory and collaborative fashion”. They mention personal web pages and encyclopaedia Britannica Online as static pages belonging to the era of Web 1.0, while blogs and Wikipedia are examples of dynamic pages belonging to the era of Web 2.0 [14]. Some researchers claims that Web 2.0 means putting the user in the centre – designing software that critically depends on its users since the content, as in Wikipedia or YouTube, is contributed and shared by millions of users [7].

The term User Generated Content (UGC) achieved broad popularity in 2005, and it is described as “the sum of all ways in which people make use of Social Media. The term is usually used as the media content that is created by the end-user and publicly available.” [14]

Based on the definition of Web 2.0 and User Generated Content Kaplan and Michael Haenlein (2010) propose a formal definition of Social Media:

“Social Media is a group of Internet-based applications that build on the ideological and
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The technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content”. [14]

With this general definition they use concepts from the field of media research and the field of social process to further distinguish between different types of Social Media and to make a classification system (Table 1).

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<thead>
<tr>
<th>Social presence/media richness</th>
<th>Self-presentation/ Self-disclosure</th>
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<tbody>
<tr>
<td>Low</td>
<td>Collaborative projects (Wikipedia)</td>
</tr>
<tr>
<td>Medium</td>
<td>Content communities (Youtube)</td>
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<tr>
<td>High</td>
<td>Virtual Game Worlds (World of Warcraft)</td>
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*Table 1: Social Media Classification [14].*

### 4.2 Social Media satisfies basic needs of belonging and social support

Peoples increased and consistent use of Social Media could partly, because of the social needs it provides, be explained through Marlow’s hierarchy of needs. The hierarchy were proposed in 1943 by the psychologist Abraham Marlow and the idea behind it is that people are not motivated to pursue the higher level needs in the pyramid until the lower needs are satisfied (Figure 2) [15]. Social Media creates a space for people to bond and maintain friendships, to collaborate, solve problems and build self-esteem through recognition. Schell (2008) discuss the hierarchy in the book “The art of game design”:

“If someone doesn’t feel love and social belonging, they aren’t going to pursue things that will boost their self-esteem. And if they don’t have good self-esteem, they will not be able to pursue their talents to do what they were born to do”. [15]

Schell (2008) argues how the model can explain player’s motivation in multiplayer games as it fulfils more basic needs than single player games. A result of this is its appeal and staying power. He states:

“All game that connects you with other people, lets you feel a sense of accomplishment, and lets you build and create things that let you express yourself fulfils needs on the third, fourth, and fifth levels.” [15]

These characteristics can be found not only in social games, but also in the other types of Social Media. Games as EVE Online contribute to our need of belonging to a community through providing the gamers with membership both in the game in general, but also in smaller groups (alliances and cooperation). Facebook contribute to the same need through providing us with friend-requests, group membership, invitations to events and more. Finding these functions and knowing how to use them, can be powerful interactive tools to extrinsically motivate people to certain behaviour through social incentives, for example in a learning situation.
Vassileva (2008) drew some implications regarding the design of social learning environments. She proposed that social learning environments could make learning more gratifying through [7]:

- Create a feeling of achievement/self-actualization
- Tie learning more explicitly to social achievement related to status/reputation in the peer group
- Tie learning more explicitly to social rewards in terms of marks and credentials

Her proposal holds incentives that fulfil the students’ need on several levels of Maslow’s pyramid, but her focus is on self-esteem and self-actualization. In addition, it can be proposed that learning could be more gratifying through creating a social environment that promotes a feeling of belonging. As achievement in mathematics is highly related to the student beliefs and self-esteem, Maslow’s hierarchy of needs would be a useful model to extract inspiration from when designing learning tools in mathematics and in education systems in general.

### 4.3 Learning mathematics with technology

A question relevant to the discussion about Social Media and mathematical learning is the students’ attitudes towards using computers in mathematical learning. A research regarded learning mathematics with technology found that students with negative attitudes toward mathematics, low mathematical achievement, low levels of mathematical confidence and low levels of affective engagement and behavioural engagement, demonstrated confidence in using computers and positive attitude to learning mathematics with computers [6]. However, strong students with good results and mathematical confidence demonstrated a belief that technology would not affect their achievement in the field [6]. From this research it can be extracted that intrinsically motivated students do not see the value of learning mathematics with technology, while students with low motivation and results sees technology as an extrinsically motivation factor to learn mathematics.

### 4.4 Social Media and learning motivation

From the research conducted on Social Media it can be derived that such applications provides people with basic social needs. The “Digital Natives” are highly motivated by social reasons, which could explain its massive and increased popularity. As research on motivation in a learning situation argue that it is important to know how to promote active and volitional forms of extrinsic motivation, Social Media could provide such motivations through social incentives as membership, collaboration and sharing. Figure 3 shows the relationship identified between Social Media, the new learner and the importance of extrinsically motivations in learning situations.

![Figure 3: Relationship identified between a need for more extrinsically motivated tasks in education and social motivation facilitated by Social Media.](image)

**Figure 4**: Relationship identified between a need for more extrinsically motivated tasks in education and social motivation facilitated by Social Media.
4.5 Case study

In the next part of this article Social Media and the social mechanisms they use to motivate the users to participate is studied, as these elements could be used to increase motivation and therefore achievement in digital mathematical education systems. In the research it was chosen to study popular Social Media sites, as they have proved to engage users over many years and still have a massive and increased number of members. As a framework for the study the social motivations proposed in the conceptual model by Hernandez, Montaner, Sese and Urquizu (2011) is used, together with the six types of Social Media classified by Andreas M. Kaplan and Michael Haenlein (2010), Table 2 shows the framework.

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4.5.1 How Social Media creates a sense of community among the users

Most Social Media sites require that people create a membership. A common feature detected across the different types of Social Media is that such a membership can provide people with a sense of community. The sites do also provide membership in smaller and more specialized groups for people with shared interest. An example of this can be found in the social game EVE online where people can join alliances to withstand common threats. Within these groups people create social structures with each gamer performing a specialized tasks as leaders, producers or warriors. Each player gets to develop skills that are valued as important by the rest of the group and a result of this is close friendships and a feeling of belonging.

4.5.2 How Social Media create social influence

A feature in Social Media that can affect people’s emotions, opinions and behaviour is media sharing. People influence each other through sharing pictures or opinions through status updates on Facebook, videos on YouTube or personal opinions on a blog. With media sharing on Social Media, people have the opportunity to instantly reach out to a great number of people, and the applications have therefor a special power of influencing people. This is a feature that has gained massive popularity in marketing.

Another way Social Media create social influence by is through features that let the members compare themselves with each other. In a social game or a virtual world the appearance of ones avatar can greatly influence other members if the level of achievement is designed as visual elements. Also profiles in other types of Social Media can have the same effect. On Facebook, for example, number of friends, “Likes” and comments lets the members compare themselves with other members.

4.5.3 How Social Media create altruism among the users

As in real life, altruism can also be found in social virtual spaces. However, it can be hard to distinguish between actions that are truly altruistic and those with a personal goal. Game developer Jane Mcgonal [11] argues that people build strong relationship through gaming together, which results in players helping and supporting each other.

Mechanisms as “Likes” and comments on people’s actions (e.g. shared pictures, videos, status updates) can also be used for the purpose of altruistic actions. However, the same mechanisms can also be used to communicate personal interests and to build social identity.

4.5.4 How Social Media motivate the users through providing personal benefits/rewards

Social Media contribute with a range of features that provide the users with benefits/rewards as a result of certain behaviour. From the case study it was found that many Social Media sites let the user build social identity. The sites facilitate a space for people to express themselves and build a character through a personal profile or an avatar. Typical personal rewards can be upgrades of performance (e.g. levels, equipment, avatar, free playtime) or recognition from other members. Through features like “Followers”, “Likes”, number of page views and comments,
people achieve recognition and positive reinforcement on their social behaviour. In addition, the same features can contribute to negative reinforcement by the lack of “Likes” or negative comments.

4.5.5 Features relevant to mathematical education

The framework discussed in chapter four detects features in Social Media that motivate people by social incentives. It can be concluded that a social learning environment can contribute to increased motivation through:

- Creating a sense of community. This can motivate students through adding a social value to the skills they are learning.
- Create a feeling of belonging. Belonging creates a safe environment for the student to achieve, and as a result of this the student gains increased confidence in mathematical learning.
- Create social influence. Could make the students more engaged and motivated to achieve as they can compare themselves with others.
- Tie learning to social rewards. Rewards related to building social identity could increase students’ motivation to achieve.

To get a better idea of how such interactions could be designed into mathematical learning environments more research on the characteristics of mathematics is required. However, as mathematical achievement is highly related to students’ emotions and self-esteem, a social learning environment should facilitate actions that can strengthen students’ self-esteem and prevents negative actions that can result in harassment and lower self-esteem.

5. DISCUSSION AND CONCLUSION

The goal of this research was to contribute to the discussion of how students’ motivation and engagement in mathematics can be improved, as good mathematical knowledge is fundamental to our technology based society. From research on literature about motivation and mathematics it was found that mathematical confidence is an affective dimension closely associated with achievement in the field and that motivated students are more likely to achieve good results [6].

From literature about motivation two distinct types of motivation that interrelate in most academic settings – intrinsic and extrinsic motivation were found. Providing opportunities for students to develop intrinsic motivation has been found superior to providing extrinsic incentives for achievement, as intrinsic motivation result in high-quality learning and creativity. However, using extrinsic incentives to motivate students is very important as we cannot rely on them being intrinsically motivated, especially in classrooms with many students.

The new learners have new ways of learning and behave, as they are cradled in technology. New technology makes them more social and they are constantly communicating through chat, phone, Twitter, and other digital media. One way of motivating the new learner is therefore through social incentives. The social motivations provided in the model by Hernandez, Montaner, Sese and Urquizu (2011) are examples of social behaviour that people strive for and are motivated by. Still, a more extensive research on social motivations relative to learning can provide a better understanding of our social needs and how they can be used as incentives in learning situations.

From research conducted on Social Media we can extract that such applications provides people with basic social needs, which can explain the massive and increased popularity. Andreas M. Kaplan and Michael Haenlein (2010) classified six types of Social Media, which we have used as a framework for our case study. Based on literature research and the case study we propose that Social Media can provide students with extrinsic motivation for learning through social incentives such as membership,
collaboration and sharing. We also suggest that learning environments can be more motivating and gratifying if they create a feeling of belonging, a sense of community, facilitate social influence and provide the students with social rewards. The framework used in the case study detects features in different types of Social Media that motivate the user by social incentives, but more research of how such incentives should be included in learning systems (e.g. social learning games, shared content pages) is necessary. One way of conducting such research could be by identifying learning styles and learning preferences in mathematics in addition to characteristics of the different types of Social Media.

In this research we have found that it is important for the student motivation that the education environment reflects the student’s daily life. We have proposed that Social Media could, by the right use of social incentives create more motivated and engaged students in mathematical learning.

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