

Science Students' Motivational Orientations of EFL Reading through the Lens of Self-Determination Theory

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Article information	Abstract
Article history: Received: 8 Aug 2022 Accepted: 5 Apr 2023 Available online: 28 Apr 2023	<p><i>This mixed-method study aims to investigate science students' motivational orientations and their self-perceived experiences contributing to self-determination in EFL reading at a secondary school in Thailand. Drawing upon the questionnaire and semi-structured interviews, the findings revealed that the overall science students' EFL reading motivations were moderate. Each of their motivational orientations was ranked as follows: identified regulation (ID), intrinsic motivation (IM), external regulation (ER), introjected regulation (IJ), and amotivation (AM), accordingly. ID, a motivational orientation with regard to autonomous motivation, seemed to best correspond with the science students' perceptions. They also valued the influence of social-contextual variables (i.e., families, peers, and teachers) as relatively important to their behavioural control toward EFL reading (ER and IJ). This study offers pedagogical implications to improve science students' EFL reading motivation.</i></p>
Keywords: EFL reading Motivation Science students Self-Determination Theory (SDT)	

INTRODUCTION

Reading is regarded as a tool for acquiring knowledge, accomplishing academic tasks, and equipping individuals with life-long literacy skills to live and survive in this current data-driven society (Guthrie & Wigfield, 2000; Huang, 2018; Shih, 2019). Students are expected to demonstrate high proficiency and be capable of reading not only in their first language (L1), but also foreign languages, including English, which is used in wider academic and sociocultural contexts (Salikin et al., 2017). According to Zou and Zhang (2011), "English is more than just a school subject, it permeates into many aspects of social life" (p. 191). In the ASEAN Community, English is regarded as a lingua franca for regional socioeconomic development, cultural and knowledge exchange, and intercultural communication for professional and academic purposes (Bolton et al., 2020; Jhaiyanuntana & Nomnian, 2020; Kirkpatrick, 2011; Phumppo & Nomnian, 2019). English literacy, therefore, has become a fundamental means of acquiring regional and global knowledge as well as a tool for L2 acquisition most EFL classrooms around the world often base their input on (Décuré, 2018). In a scientific field of the study where English has broadened its role as a language of science and technology, reading skill has become increasingly significant in empowering students' learning experiences (Grabe & Stoller, 2002).

The promotion of reading habits, especially among school-aged children, is necessary and worth investing in as the children will hopefully develop a learning-for-life mindset (Guthrie et al., 2007). Likewise, in Thailand, the idea of promoting the love of reading among Thais is not new. There have been strategic frameworks, namely the “Reading culture promotion for Thai learning society framework (2017-2021)”, which was launched in order to set guidelines for the cultivation of a culture of learning society prioritizing reading as a core skill.

Despite the long-running effort to deal with this issue, the educational system seems to have failed in driving itself to promoting a habit of lifelong learning among Thai students (Saengpakdeejit, 2014). This view is supported by the data from the latest international assessments, namely Programme for International Students Assessments (PISA) (See Figure 1). It is evident, over the period between 2002 and 2018, that the reading score for secondary school students has fallen to the lowest point, which is far below the international average scores (from 487 to 393).

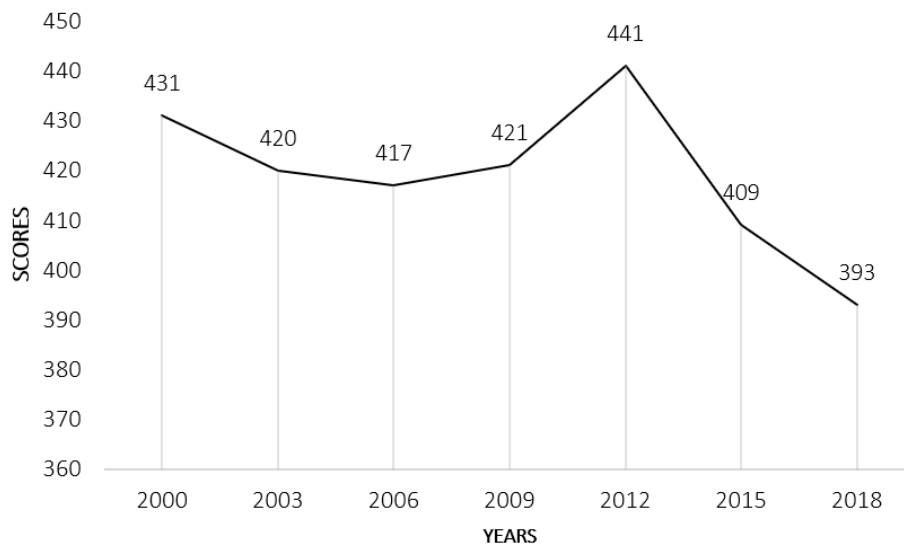


Figure 1 PISA reading scores in Thailand 2000–2018 (OECD, 2018)

Existing challenges related to Thai students’ poor reading performance in English have been drawn from the Ordinary National Entrance Examination (O-NET) (see Figure 2). Despite a gradual increase in average scores of O-NET English for upper secondary education from 2007 to 2020, the overall English scores Thai students remain lower than the national target average of 50%.

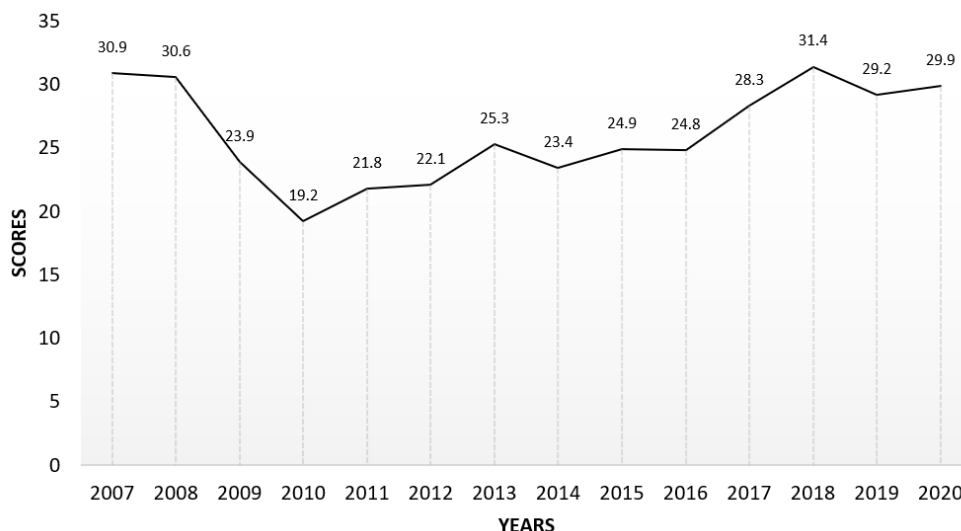


Figure 2 Average scores of O-NET English for upper secondary education 2007-2020 (NIETS, 2020)

O-NET English (upper secondary level) consists of three main parts including language use and usage, writing ability, and reading (Nipakornkitti & Adunyarittigun, 2018). Reading ability is significantly weighted 43.75%, which comprises vocabulary knowledge and reading comprehension (Sritrakarn, 2021). Reading can be considered as one of the most challenging skills as secondary school students are unable to comprehend and identify the components of the passage: topic, main idea, setting, vocabulary, supporting details and summary of the passage; and, thus, their English achievement and proficiency is lower than the Ministry's expected target (Udombua & Phusawisot, 2019). Reading is also a key skill for Thai EFL secondary school students who need to continue their higher education because they must develop reading comprehension abilities that require strategies and motivation to understand academic texts (Imsa-ard, 2022).

Although effective EFL reading skills are vital for Thai EFL learners in order to keep EFL learning process more self-directed and facilitate the flow of EFL learning (Sek et al., 2021), there are a number of factors underpinning these unsatisfactory results. Firstly, the below-average levels of Thai EFL learners' reading performance can be partly attributed to ineffective teaching methods (Kongkerd, 2013; Sitthitikul, 2020). EFL students' poor reading performance was affected by their anxiety that led to their unwillingness and demotivation to read even though they had sufficient skills (Strauss, 2008). Psychological barriers found in language classes in Thailand are caused by a lack of independence or sense of autonomy, anxiety, unsuitable teaching materials, and unsupportive learning environment (Channuan & Wasanasomsithi, 2014; Torudom & Taylor, 2017). In some cases, a sense of boredom possibly influences students to become less motivated even when they read the texts of their interests (Sek et al., 2021). This is because reading, by its nature, is a process that students are required to interact with linguistic challenges (e.g. grammar and vocabulary) and their prior knowledge of L2 contexts and cultural background (Grabe & Stoller, 2002; Salikin et al., 2017; Saemee & Nomnian, 2021a, 2021b).

Studies on EFL reading behaviour and motivation of science students was scarce despite its usefulness in developing qualified scientific personnel and obtaining academic and professional success (Dorkchandra, 2010). Apairach and Vibulphol (2015) pointed out that with considerably limited exposure to English, Thai upper secondary students from regular study programs (science students were included) tended to place less emphasis on EFL learning skills than their peers from English programs. This finding seems to be related to evidence proposed by Akkakoson and Setobol (2009) and Hermida (2009) suggesting that non-English major students often had trouble dealing with specialized texts written in English which require specific knowledge and reading ability, when pursuing specific courses available at higher institutions. Because they were not adequately prepared for the changes in terms of reading skills at the tertiary level, which might hinder their motivation; as a result, they developed a tendency to avoid reading activities (Hayikaleng et al., 2016; Saengpakdeejit, 2014).

Studies conducted in Asian countries where English is generally regarded as a second or foreign language appeared to yield similar findings. According to Thuong and Thuy (2018), non-English major students in Vietnam were found to have poor comprehension skills due to the limited basic reading skills and background knowledge. In support of this view, language learning difficulties this group of students faced was considered in relation to the small amount of English exposure in school curriculum (Kurniawan, 2018).

Reading is an activity that requires substantial effort and determination. Along with the cognitive process, motivation becomes a parallel force guiding one's willingness to read and determining an approach one will take to the reading task (Guthrie et al., 2007; Wigfield & Tonks, 2010). To boost students' reading skills, especially for those who are with non-English major background, it is necessary for teachers to understand the students' attitudes and motivation toward learning English (Chairat, 2015). This present study draws attention to the importance of the psychological dimension and motivational dynamic toward EFL reading behaviour as the first step toward boosting science students' effective EFL reading skills. As Komiyama and McMorris (2017) claimed, students' L2 reading motivation can be explored by the framework of self-determination theory (SDT), which can discover the relationships between students' motivation to read and classroom instruction. Yet, little is known about the contributions of SDT on reading research in Thailand. This particular framework was thus employed to conceptualize science students' motivation to read and their perceptions with regard to EFL reading practices they experienced throughout their study of science in a Thai secondary school.

LITERATURE REVIEW

Motivation is a widely used concept in educational psychology, which refers to the disposition to act and direct behavior according to a goal and is associated with the internal and/or the external forces that enable students to engage and persist in doing certain activities (Eccles & Wigfield, 1995). Chang et al. (2017) indicate that motivation is one of the most important factors that determines the approach students will take to learning and how they pursue developing their knowledge. Vansteenkiste et al. (2010) claim that motivation is deeply rooted in an individual's own perceptions and one's surrounding environment, which shape one's conscious decision in achieving target objectives.

The motivation to read was first hypothesized in western context as a psychological construct regarding personal goals, values, and beliefs that influence how one responds to reading (Guthrie & Wigfield, 2000). In Thailand, studies dealing with motivational components underlying EFL reading in secondary school are relatively few in number. One important study was conducted by Pluemsamran and Vibulphol (2015), which revealed some significant findings on upper secondary school students in Bangkok. For instance, the mean scores for EFL reading motivation ranged between 2.37 (Curiosity) and 2.61 (Recognition) confirming a relatively low level of motivation. This seems to contradict to existing studies that suggest a high level of motivation among Thai students to develop EFL skills (e.g., Chomcharoensuk, 2013; Inngam & Eamoraphan, 2014; Kitjaroonchai, 2012; Wimolmas, 2013). However, what is meant by intrinsic motivation is that the students set about their reading tasks with interest and enthusiasm. On the other hand, due to the recognition from socialized persons, as well as the pressure to improve their exam scores, students were rated based on being extrinsically motivated. In a study designed to explore EFL reading motivation among students in one Thai technological institute by Anuyahong (2012), four different dimensions were highly recognized: natural curiosity, challenge, recognition, and good grades. Also, it was recommended that to successfully solve problems concerning students' lack of motivation, EFL reading practices require contextual support from teachers.

EFL reading motivation in Thai students is a result of the perceptions of instrumental value (e.g., Chomchaiya & Dunworth, 2008; Rungrojsuwan, 2013; Torudom & Taylor, 2017). A study worth mentioning is one conducted by Torudom and Taylor (2017) who analyzed the motivational constructs of EFL reading in nearly 500 first-year university students. It was found that the dimensions of 'extrinsic utility value of reading' (p. 56) and 'foreign language linguistic utility' (p. 56) were perceived as instrumental for successful EFL reading. In addition, intrinsic constructs for EFL reading (i.e., intrinsic value of reading and reading efficacy) were also identified among participants.

Reading for knowledge is another factor that is correlated, to a much greater extent, with instrumental (or extrinsic utility) value in EFL reading (e.g., Lin et al., 2012; Mori, 2002). Supporting this view, it was discovered that five hundred students from a university believed that EFL reading would enable them to acquire knowledge and lead them to positive changes in EFL skills. On the other hand, their perceptions toward L1 reading were more affected by personal preference (Rungrojsuwan, 2013). Other reports that confirm the influence of instrumental orientation on EFL reading was from an investigation by Chomchaiya and Dunworth (2008), who discovered that EFL reading behavior of nine university students were more predictable based on the expectation to develop reading skill, which they regarded as a source of new vocabulary. Also, when it comes to L1 reading, their motivation is rooted in the ability to read freely with enjoyment and often with a sense of excitement at feeling involved with the story. The present study offered insights into lack of student's L2 reading interest to EFL teachers in Thailand: students' lack of self-control with their own reading; reading texts given to students in class are complex and irrelevant to students' needs; less favorable learning conditions (e.g., noise, overburden) (Akkakoson & Setobol, 2009; Channuan & Wasanasomsithi, 2014).

Based on the synthesis of motivational theories (e.g., self-efficacy theory, goal orientation theory, self-determination theory), there exist eleven dimensional constructs divided into three groups: competence and efficacy beliefs, achievements values and goals, and social purposes of reading (see Figure 3).

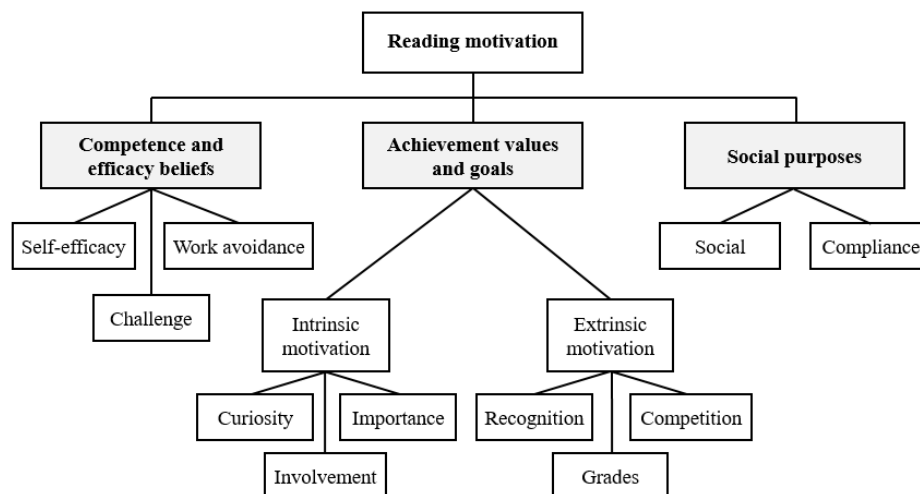


Figure 3 Dimensional constructs of reading motivation (Adapted from Wigfield & Guthrie, 1997)

In a similar way to the ESL/EFL context, motivation is defined as one of the significant psychological factors that encourage students to participate in any reading task (Yamashita, 2013), form effective reading habits (Güvendir, 2014), and eventually develop reading competency (Kondo-Brown, 2006). The initial interest in L2 reading motivation is based on Wigfield and Guthrie's (1997) approach (e.g., Komiya, 2013; Mori, 2002). However, there are some consistent factors that are shown to be a matter of motivational dynamic in L2 reading and remains sufficient to illustrate dominant aspects of L2 reading motivation (Dörnyei, 2001).

Extrinsic utility value of reading

Extrinsic utility value of reading, a term borrowed from the Expectancy-Value Theory (Eccles & Wigfield, 1995), is the perception related to functional or utilitarian purposes of L2 reading for one's personal goal (Mori, 2002). Indeed, it is congruent with Dörnyei's (2001) description of instrumental orientation related to the desire to obtain something that serves the instrumental goal of L2 learning.

Numerous empirical studies have identified extrinsic utility value as a powerful contributor to L2 reading (e.g., Kim, 2011; Lin et al., 2012). Research conducted with 5th grade students in Hong Kong by Lin et al. (2012), for example, showed a distinct pattern for L1 and L2 reading motivation. It is evident that L2 reading seemed to be more strongly oriented toward 'instrumentalism'. L1 reading was based primarily upon intrinsic and social variables (e.g., self-efficacy, curiosity, involvement, recreation, and socialization with peers). The influence of extrinsic utility value on L2 reading motivation was also noted among Japanese university students in Mori's (2002) study. Following Wigfield and Guthrie's (1997) approach, the results

were discussed in terms of hypothesized constructs, including intrinsic value, attainment value, expectancy for success, and extrinsic utility value.

Social dimensions of L2 reading

Social dimensions of L2 reading is the idea concerning social cognition, such as perceptions on how others would feel or involvement from those around one's own sphere, which is linked to decision making in reading behavior (Wang & Guthrie, 2004). Studies on L2 reading have highlighted the importance of social-context variables on students' perceptions. Dhanapala and Hirakawa (2016), for example, indicated that Sri Lankan students responded to L2 reading in a way that is consistent with the cultural orientation of collectivism. That is, since the students were nurtured to be responsive to other people's thoughts and expectations, their L2 reading behavior appeared to be more strongly oriented toward social approval. Evidence also suggested that educated parents tended to provide not only regular reading practices, but also had high expectations for their children's academic performance.

Similarly, Takase (2007) examined the motivation of female high school students toward an extensive reading (ER) course over a one-year period. Although high school students appear to no longer be children, they were still young enough for their parents to remain involved in their learning. Thus, they were more likely to focus their energy on the reading task as long as learning conditions were supported by parents or other family members. This strongly suggested that the relationship between family influence and preferred L2 reading behavior does indeed exist.

Peer influence is another factor that is related to the social dimensions of L2 reading. Particularly, adolescent-age students often behave in such a way as to obtain peer approval, which is why they are more willing to read when they know what their peers are reading (e.g., Huang, 2013). Phan's (2010) study demonstrated that what adolescent students have in common is a tendency to compare themselves to their peers; therefore, they are more likely to engage in L2 learning tasks in order to make themselves feel competent.

Self-determination theory (SDT)

Self-determination theory (SDT) has been well-documented and employed in the area of educational research given it provides a comprehensive approach to the study of motivation (Adams et al., 2017). The theory views human beings as active organisms with an innate tendency to integrate themselves into their living environment. The same is true for the human psyche, which requires motivational nutrients to attain psychological growth and well-being (Ryan & Deci, 2000). According to the theory, three fundamental reasons people make personal decisions were proposed: need for autonomy (individual perspectives to feel a sense of ownership over one's own behaviors and to feel free to make choices), need for competence (individual perspectives to feel effective and masterful in what one has done in order to develop one's own potentials), and need for relatedness (individual perspectives to connect to others and their contextual environment) (Ryan & Deci, 2017; Vansteenkiste et al., 2010). Motivation is the result of the satisfaction of these three needs.

Motivational stages can be classified into three main types, including intrinsic motivation, extrinsic motivation, and amotivation (see Figure 4). Intrinsic and extrinsic motivation both imply the existence of intention that drives one's behavior, while the lack of such intention is represented by the concept of amotivation.

Intrinsic motivation refers to the willingness to engage in a particular activity for one's own inherent satisfaction (e.g., enjoyment, preference, or interest). It demonstrates a fully self-determined behavior that is probably the highest quality of motivation (Noels et al., 2000; Ryan & Deci, 2017). However, in reality, not all behaviors are purely driven by one's own inherent satisfaction. Indeed, there are those that are driven by a broader range of external sources of motivation. For this reason, the focus has been shifted to the term 'internalization', which is central to the reason non-intrinsically motivated behaviors become engaged (Ryan & Deci, 2000, p. 71).

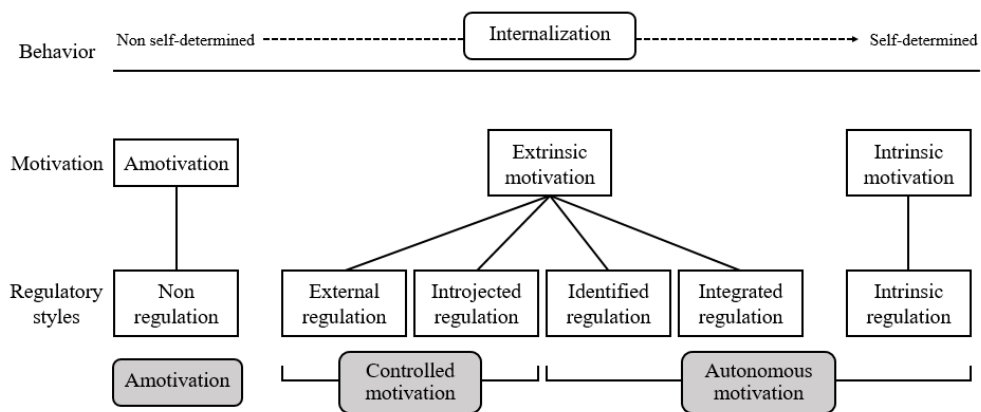


Figure 4 Theoretical framework of self-determination theory (SDT) (Adapted from Ryan and Deci, 2000)

As Figure 4 illustrates, extrinsically motivated behaviors can be internalized due to movement along the continuum toward more self-determined forms of behavioral regulation, whereby that individual is gradually autonomously motivated (Vansteenkiste et al., 2010). External regulation describes the fully controlled type of extrinsic motivation. Depending on this type of regulation, the task is perceived as either something to help one obtain extrinsic rewards (e.g., grades) or something to serve external demands (e.g., competition, punishment avoidance). Introjected regulation is associated with partially internalized behavior driven by personal ego (Deci et al., 1991). Students perform learning tasks in order to avoid the pressure that might emerge from failing to serve external demands (e.g., parents' expectations or standards). On the other hand, others may perform learning tasks in order to experience pride in successfully meeting their internal demands (e.g., recognizable self-image or self-worth). Perspectives along this line seem to be congruent with intrinsic rewards, which reflects extrinsic motivation derived by the outcomes provided by the others (Ryan & Deci, 2000).

Identified regulation refers to behaviors that are performed due to the perceived values of a certain task. For example, students engage in learning because they believe that it is relevant and beneficial for the pursuit of their future goals. Such behavior, however, falls into extrinsic

types of motivation, because it is performed primarily due to the values someone imposed on their own perceptions, not because of inherent satisfaction (e.g., interest, enjoyment). Lastly, the most self-determined type of extrinsic motivation is integrated regulation. It occurs when “identified regulations have been fully assimilated by the self” (Ryan & Deci, 2000, p. 62).

The conceptualization of autonomous and controlled motivations has been relatively well-established in educational research (e.g., Guay et al., 2010; Vansteenkiste et al., 2010). The self-determined source of motivation, including intrinsic motivation and identified regulation, leads students to adopt autonomous motivation as part of their learning behavior. On the other hand, controlled motivation, namely introjected regulation and external regulation, is observed when learning behavior is not initiated and governed by the self. It represents behaviors performed to comply with external demands (e.g., reward, expectation) or to meet some internal rewards (e.g., guilt, pride).

Autonomous motivation serves as a powerful source of energy for learning which will benefit students throughout their education, career, and lives. Students who report a higher degree of autonomous motivation tend to experience positive emotions during the learning process, become more persistent, and show better academic adjustment, as well as better psychological well-being than those whose levels of autonomous motivation are low (Guay et al., 2016; Sert, 2006; Vansteenkiste et al., 2010). Another study conducted by Ratelle et al. (2007) provides evidence that students who regard both intrinsic and extrinsic variables as relatively important to their learning are more likely to perform better in terms of learning achievement and satisfaction than those possessing only autonomous motivation.

Applications of SDT on reading research

The conceptualization of SDT has gradually engaged the interest of reading researchers (e.g., De Naeghel et al., 2012; Komiyama & McMorris, 2017; Tanaka, 2015). Not only does it function as part of motivational theories in mainstream psychology, but it provides an effective framework for interpreting research evidence concerning motivational orientation toward reading (Watkins & Coffey, 2004). Guey et al. (2010), for instance, employed SDT to explore motivational orientations that affect the way elementary-age students adjust to three school subjects (i.e., mathematics, writing, and reading) and learning in general, three motivational orientations were described: intrinsic motivation, identified regulation, and controlled motivation. A similar approach was carried out on 5th grade students in Belgium by De Naeghel et al. (2012), whereby reading motivation was grounded on autonomous and controlled distinction. The researchers further succeeded in matching motivational dimension proposed by Wigfield and Guthrie (1997) to the core concept of autonomous and controlled distinction. They demonstrated that the dimensions of involvement, challenge, and curiosity, strongly correlated with the concept of autonomous motivation. The other three dimensions, including competition, recognition, and grades shared some qualities with controlled motivation.

Although SDT has generated some specific hypotheses relating to the types of motivational orientation toward reading, there has been a limited number of SDT-based studies in the L2 context. One study was carried out by Komiyama and McMorris (2017) who conducted a

mixed-method study on adult ESL learners (aged 21-51) in the US. Participants were characterized as autonomous readers whose perceptions of identified regulation highly influenced their reading behavior. Additional insights were provided to support SDT's point of view that when basic psychological needs, especially autonomy and relatedness, were satisfied, students were more likely to acquire a habit of autonomous reading.

The contributions of SDT to reading practices were also discussed in Asian context by Tanaka (2017). In order to understand what makes university students in Japan become engaged in L2 reading, she conducted short in-class extensive reading (ER) activities and performed path analysis using the collected data concerning antecedents of ER motivation (i.e., perceived autonomy, competence, relatedness, and positive peer influences) and SDT motivational orientation (i.e., intrinsic motivation, identified regulation, introjected regulation, external regulation, and amotivation). Experiences associated with perceived autonomy (i.e., choice-making) and peer influence contribute significantly to autonomous motivation. Thus, students' perceptions of controlled motivation could be predicted based on their beliefs about their own competence.

METHODOLOGY

Research design

Case study was employed as a research design in this study because it addresses issues emerging from a specific research setting that enables in-depth analysis without aiming to generalize results (Stake, 1995). Casanave (2010) states the flexible nature of the inquiry strategy and how such flexibility permits case study researchers to employ various instruments and approaches to research the phenomenon. A mixed-method approach was used to investigate the motivational orientations of EFL reading demonstrated by students, as illustrated in Figure 5.

Quantitative Approach	Qualitative Approach
Which motivational orientations are related to EFL reading behavior of science students?	How do science students experience their EFL reading in and out of classroom and which meanings do they attribute to their EFL reading motivation?

Figure 5 A mixed-method approach of the study

Since the nature of quantitative approach does not provide valid indicators of the internal reasoning underlying human behavior, a qualitative approach helps identify the sort of personal experiences and expressions that the constrained design of the questionnaire survey often neglects (Cohen et al., 2011). Consistent with Ushioda and Dörnyei (2011), the focus on motivation to learn L2 cannot be directly observed. Focus group interview was undertaken because of its practicality and efficacy in gathering responses the participants whose interaction

process often generates a more in-depth understanding of an issue through natural conversation and discussion (Wilkinson, 2003).

Setting and participants

The institutional context for the study was one large public secondary school located in southern Thailand. There were 2,733 students, including 1,608 lower secondary students, and 1,125 upper secondary students. The upper secondary level represented five different academic programs: Science–Mathematics (regular science study program), Science Math Ability (SMA - special science study program), Mathematics-English, English–Chinese, and Thai-Social studies. The school was purposively selected because it met the research criteria, namely, a STEM-based school whose director was willing to grant permission to gain access to a group of students majoring in a science and mathematics program (Science–Mathematics and Science Math Ability (SMA)). A total of 169 upper secondary school (11th grade) students aged between 16 and 18 years were invited to participate in the study due to their interests in learning science, available schedules, and willingness to participate in the study. Of these, 45 (26.6%) were male and 124 (73.4%) were female. The majority of the participants (86.4%) were enrolled in a regular science-mathematics program, while the remaining ones (13.6%) were enrolled in a special science-mathematics program that some participants had a greater access to extracurricular activities related to science learning. They had to take part in field trips, special science classes, and lab trainings with instructors from well-known institutions; and lab trainings with instructors from well-known institutions; and thus, they were specifically trained to be competent science students who were expected to continue their higher education and become scientists upon their graduation.

Data collection

Data collection was conducted during the second semester of academic year 2018, in accordance with the ethical approve by the Institute for Population and Social Research Institutional Review Board (IRB0001007) (COA. No. 2018/07-217), Mahidol University. Prior to the study, an explanatory letter accompanying an informed consent form was sent to all students and their parents or guardians. Brief details of research objectives and approaches were explained with assurance of confidentiality and minimal schoolwork disruption. Specifically, all students' responses were collected and used only for research purposes.

Questionnaire survey

A 29-item questionnaire was developed from previous L2 SDT-based research (e.g., Komiyama & McMorris, 2017; Noels et al., 2000; Tanaka, 2015). Two out of five subscales were designed to capture autonomous types of motivation, including intrinsic motivation (e.g., "I enjoy English reading") and identified regulation (e.g., "English reading is important for my day-to-day life."). Another two focused on controlled types of motivation, introjected regulation (e.g., "I study English reading because I do not want to feel pressured or guilty from poor performance."), and external regulation (e.g., "I read in English to get good grades.") and the last subscale, amotivation ("Nothing motivates me to read in English."). All items were rated on a five-point

Likert scale describing various degrees of motivation, drawn upon SDT, with 5 = strongly agree, 4 = agree, 3 = neither agree nor disagree, 2 = disagree, and 1 = strongly disagree.

The questionnaire was translated into Thai. The validity of the questionnaire was examined by three experts in relevant fields of study. Prior to the main survey, pilot studies were conducted twice on a group of 30-40 students in science-mathematics programs in order to test whether the questionnaire was contextually acceptable.

Focus group interviews

Based on Komiyama and McMorris's (2017) study, focus group interviews were conducted and guided by open-ended questions concerning the students' EFL reading habits, reasons students wanted to read in English, as well as in- and out-of-class reading experiences. In this regard, ten out of the 169 participants volunteered to participate in the interview sessions. They were divided into two groups: five students for each study program. Both groups were interviewed twice for approximately sixty minutes per session. All interviews were conducted in Thai, recorded with a digital voice recorder, and transcribed verbatim. Thai transcripts were then translated and cross-validated by a bilingual Thai-English translator.

Data analysis

The quantitative data were statistically analyzed with SPSS. Descriptive statistics consisting of frequency and percentage were examined to describe the characteristics of EFL reading motivation among science students. In order to evaluate the participants' responses related to their EFL reading motivation, mean and standard deviation were utilized with reference to Kitjaroonchai's (2012) level of motivation criteria (see Table 1).

Table 1
Interpretation of mean score with reference to level of motivation

Score ranges	Degrees of Motivations	Interpretations
4.21 – 5.00	Strongly Agree	Very high
3.41 - 4.20	Agree	High
2.61 – 3.40	Neither Agree nor Disagree	Moderate
1.81 – 2.60	Disagree	Low
1.00 – 1.80	Strongly Disagree	Very low

For the qualitative analysis, Braun and Clarke's (2006) thematic coding and extraction of information methods were employed to explore the meaning students attribute to their motivation toward EFL reading. To deal with the themes, students' responses were sorted into the categories outlined in the motivational dimensions of SDT and integrated with data from the questionnaire survey in order to gain an in-depth analysis of the research findings.

FINDINGS AND DISCUSSION

This section presents and discusses the results based on the quantitative and qualitative data drawn from the questionnaire survey and focus group interviews. The overall results regarding five motivational orientations consisting of intrinsic motivation (IM), identified regulation (ID), introjected regulation (IJ), external regulation (ER), and amotivation (AM), are presented as follows.

Table 2
Characteristics of EFL reading motivation among science students

Motivational orientation	Number of items (Question number)	Cronbach's alpha	M	S.D.	Level
Autonomous					
Intrinsic motivation (IM)	7 (Q1 - Q7)	.919	3.33	0.90	Moderate
Identified regulation (ID)	6 (Q8 - Q13)	.943	3.87	0.87	High
Controlled					
Introjected regulation (IJ)	6 (Q14 - Q19)	.847	3.12	0.77	Moderate
External regulation (ER)	5 (Q20 - Q24)	.860	3.13	0.87	Moderate
Amotivation (AM)	5 (Q25 - Q29)	.870	2.43	0.96	Low
Total	29	.876	3.18	0.87	Moderate

Table 2 shows that the overall mean scores for students' motivational orientation toward EFL reading was moderate ($M = 3.18$, $S.D. = 0.87$), underpinned by mostly moderate motivations, including for IM ($M = 3.33$, $S.D. = 0.90$), IJ ($M = 3.12$, $S.D. = 0.77$), and ER ($M = 3.13$, $S.D. = 0.87$). ID ($M = 3.87$, $S.D. = 0.87$) was the highest and AM ($M = 2.43$, $S.D. = 0.96$) was the lowest of all. The findings show that the students regarded autonomous motivation (i.e., ID) as relatively important to EFL reading. Meanwhile, controlled orientations (i.e., IJ and ER) were also moderately endorsed. The following sections will address each motivational orientation in turn by unpacking their respective components.

Intrinsic motivation (IM)

Intrinsic motivation was examined at a moderate level ($M = 3.33$, $S.D. = 0.90$) (see Table 3). It represented the second highest factor in which each of its item was reported both at a high and moderate level. Similar to the study of De Naeghel et al. (2012), the level of students' intrinsic motivation in this study was influenced by their inherent interest (or curiosity), enjoyment (or involvement), and perceived potential (or challenge).

Table 3
Intrinsic motivation (IM)

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
1. I like English reading.	17.2	25.4	38.5	13.0	5.9	3.35	1.09	Moderate
2. I enjoy English reading.	13.6	24.9	34.9	20.7	5.9	3.20	1.09	Moderate
3. It stimulates my excitement when I discover new things from English reading.	14.2	23.7	42.0	16.0	4.1	3.28	1.02	Moderate
4. I often lose track of time once I start reading something interesting in English.	7.7	17.2	40.2	24.3	10.7	2.87	1.06	Moderate
5. I feel motivated to read more when I perceive I am able to read in English.	29.0	32.5	22.5	11.2	4.7	3.70	1.14	High
6. I feel motivated to read more when the English text is related to my own experience.	23.1	28.4	34.3	7.7	6.5	3.54	1.12	High
7. If the English text is interesting, I will try to read it even when I encounter difficult words or unfamiliar sentences.	20.7	27.2	32.5	14.2	5.3	3.44	1.12	High
Total						3.33	0.90	Moderate

When EFL reading was perceived as a recreational activity and curiosity-driven behavior, students tended to develop pleasure in and a preference for EFL reading as they said.

I read English subtitles while watching online movies, series or TV shows. (Student#2)

What a pleasure to combine English reading and game playing! Reading background stories and characters' dialogues in English is required in the games we play. (Student#3)

In this study, the students enjoyed reading online texts and screen reading has become one of the many channels to EFL reading engagement. However, due to the limited number of L1 content of their interest, students found it easier to rely on searching in English and engaging in EFL reading to better serve their needs. This could imply that this situation may turn into a source of L2 reading motivation (Komiya & McMorris, 2017).

Because the majority of pages on the World Wide Web are in English, you can find what you want to know or are interested in. If you search in English, it can direct you to most content easily. (Student#9)

I begin searching for information, both in Thai and English, to read what I am interested in and then follow the bloggers' practical tips and instructions. (Student#5)

Furthermore, the students were satisfied with EFL reading and expect higher goals for reading task if they perceived their own potential to deal with it and became confident (Li & Wang,

2010; Wigfield & Tonks, 2010). Meanwhile, some of them tended to demonstrate greater effort overcoming difficulties reading English texts and became more self-determined by employing online tools.

I attempt to go deep and detailed into the story of my favourite song by reading the lyrics back and forth. (Student#3)

To overcome language barriers is to use Google Translation. (Student#6)

Online platforms and social media have been rapidly increasing and providing equitable accessibility and opportunities for Thai learners and teachers who can develop a sense of learner autonomy (Inpeng & Nomnian, 2022). The selection of online contents through an English search term, therefore, allows students to access to the powerful learning tools and plays an important part of self-learning and being inspired on learning science. It is a good idea for teachers to base their practices on a wide variety of online reading materials to deal with the satisfaction of students' autonomy (Huang, 2018). Moreover, it would be desirable to integrate the knowledge of scientific disciplines that can enhance the students' EFL reading skills (Stage et al., 2013).

Intrinsic motivation can be conceptualized into SDT's point of view that when students choose to read as a response to their own inherent satisfaction (e.g., enjoyment or interest), it is likely that their perceptions of autonomy would be acquired (Chang et al., 2017; Huang, 2018). This discovery is consistent with Lin et al. (2012) who found that self-selected reading materials allowed EFL students to become self-determined to read both in L1 and L2. Anuyahong (2012) also supports this view in that 'natural curiosity' (p. 174) is a major indicator that leads Thai students to become more engaged with EFL reading. According to Boonkongsaen et al. (2016), intrinsic readers can take initiative on their own reading and tend to use a wide variety of strategies to deal with the texts.

Identified regulation (ID)

Identified regulation was the strongest orientation for EFL reading motivation ($M = 3.87$, $S.D. = 0.87$) (see Table 4), in which each item was rated at a high level. The highest rated item for this orientation is item 10 in Table 4 ("*English reading is important for career success*"; $M = 4.03$, $S.D. = 1.00$). It makes sense that students identified and accepted EFL reading as what could propel their future careers forward.

Table 4
Identified regulation (ID)

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
8. English reading is important for day-to-day living.	33.7	32.0	26.0	6.5	1.8	3.89	1.00	High
9. English reading is important for further education.	37.9	33.1	21.9	4.7	2.4	3.99	1.00	High
Total						3.87	0.87	High

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
10. English reading is important for career success.	40.2	32.5	18.3	7.7	1.2	4.03	1.00	High
11. English reading helps broaden my views.	21.3	36.7	32.5	7.1	2.4	3.67	0.96	High
12. English reading is beneficial for knowledge seeking and self-development.	25.4	39.1	26.0	7.7	1.8	3.79	0.97	High
13. English reading is beneficial for linguistic development.	31.4	34.9	25.4	6.5	1.8	3.88	0.98	High
Total						3.87	0.87	High

The following extracts deal with the extrinsic utility (or instrumental) value of EFL reading emerging from the qualitative analysis. For example, the majority of students believed EFL reading could improve their daily life and future goals.

In a borderless world, whether we are aware of it or not, English is a shared language by native and non-native users alike, and reading is one of the most common ways to obtain information about the world around us. (Student#4)

The students expressed strong views that reading plays a vital role for seeking up-to-date scientific knowledge. Particularly, the use of English to search information through online platforms succeeded in motivating them to read in English.

Reading scientific texts from original sources in English is the best way to introduce us to the nature of science because most scientific knowledge originated in English-speaking countries. (Student#10)

I once wanted to learn about the effects of gravity on plants. But when I googled it in Thai, the search terms could not find an answer to my question. Then, I tried searching in English and found the answers. (Student#6)

Not only is EFL reading important for students' future success and to expand their learning horizon, it is described as a pathway to the development of language skills (Mori, 2002; Rungrojsuwan, 2013; Torudom & Taylor, 2017). As some students revealed, their English skills was gradually developed alongside EFL reading.

I'm encouraged to learn more vocabulary because I have noticed that my English skills are gradually getting better. (Student#10)

When I come across difficult words, such as vocabularies in other areas of my interest, I use English-English dictionary to obtain more comprehensible explanation. I have discovered that my vocabulary grows more extensively with this kind of learning method. (Student#6)

The major findings of this motivational orientation are concerned with the importance of the extrinsic utility (or instrumental) value of EFL reading. This indicates that EFL reading behavior becomes self-determined in terms of being congruent to students' desired goals (Dörnyei, 2001; Kurniawan, 2018). This kind of orientation may actually be adequate in explaining why non-English major students are more likely to endorse instrumental value of EFL reading than English major students (Ngo et al., 2017).

Findings are also consistent with Anderson (1999) suggesting learning to read in English is key to stimulating students' learning skills and self-development in other academic areas. Particularly, 'foreign language linguistic utility' (Torudom & Taylor, 2017, p. 53) is another evidence of extrinsic utility value of EFL reading, which is strongly reflected in this study. That is, students believe EFL reading to be an important part of linguistic skill development. Closely related to the motivational orientation observed in Chomchaiya and Dunworth (2008), extrinsic utility value of EFL reading were found in students' desires to develop reading skills which could build up vocabulary students use in real life.

Introjected regulation (IJ)

Introjected regulation was found to be only a moderate source of motivation for students with respect to their EFL reading ($M = 3.12$, $S.D. = 0.77$) (see Table 5). Almost all items were rated at a moderate level; yet, reading to make parents and teachers proud was scored high ($M = 3.52$, $S.D. = 1.13$) in Table 5 below.

Table 5
Introjected regulation (IJ)

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
14. I read in English in order to gain a good self-image from others.	10.7	25.4	40.2	16.0	7.7	3.15	1.06	Moderate
15. I read in English because others read it as well.	3.0	15.4	43.8	25.4	12.4	2.71	0.97	Moderate
16. I read in English because I do not want to feel under pressured as I perform poorly on it.	8.9	30.2	42.0	13.6	5.3	3.24	0.97	Moderate
17. I read in English because I want others to think that it is what I am able to do.	5.9	26.6	41.4	18.9	7.1	3.05	0.99	Moderate
18. I read in English in order to please my parents, teachers, and others.	7.7	24.3	45.0	13.0	10.1	3.07	1.04	Moderate
19. I want to read in English better to make my parents, teachers and others feel proud of me.	23.7	26.6	33.1	11.2	5.3	3.52	1.13	High
Total						3.12	0.77	Moderate

The motivational orientation of introjected regulation often draws on students' perceived experiences concerning social demands which appear to control their self-determination toward EFL reading and learning (Ryan & Deci, 2000). Consistent with Lin et al.'s (2012) hypothesis, social dimensions of EFL reading motivation in this study could be interpreted in two folds: parental influence and peer influence.

With regard to parental influence, some excerpts indicate that when students sensed that their parents were applying pressure on them to succeed, they decided to engage in reading tasks not because they were driven by their own satisfaction, but just to lessen their parents' concerns about their academic performance, as well as to avoid feeling pressured.

Last year, I got low grades in English. Since then, my parents have become concerned over how well I did in an English class so I would like to do better in my English. (Student#3)

My father asked me take many different intensive courses, like other students whose parents are his friends. It is pretty boring that what is going at my school matters so much to his social life. (Student#5)

These findings are associated with cultural stereotypes which indicate that Thai students are social-oriented learner. According to collectivism, Asian students are raised in an environment influenced by other people's thoughts; and therefore, individual choices and decisions are less likely to be made solely on the basis of personal preference, but rather communal social values and the expectations of others (Salili et al., 2001). As a result, they become socially oriented and less self-determined due to the tendency to judge themselves in comparison to others' standards (Kaplan & Madjar, 2017). This appears to support Dhanapala and Hirakawa's (2016) study which indicated that when demands on the students to meet others' expectations are high, their internal control associated with L2 reading behaviors also rises.

Nevertheless, some students expressed positive attitudes toward parental influence on their EFL reading and learning practices, which enabled them to regulate their own reading and learning goals and to develop a positive self-perception for language learning process on the back of their parents (Dhanapala & Hirakawa, 2016). Students' perceived experiences concerning social demands and values have become increasingly significant for school-aged children to engage in certain activities as part of their personal growth (Takase, 2007).

What keeps me wanting to read and study harder is my father, who is a great role model...He once advised me that reading might help us discover something very interesting in the thoughts of people. (Student#6)

My mother was one of the first to inspire me to learn English. When she was my age, she earned rewards as a school representative participating in English competitions...I know that English is worth a try. If I push hard enough, one day I might be considered as good as her. (Student#1)

Another social demand that plays a role in promoting internalization of EFL reading was derived by peers (Huang, 2013; Lin et al., 2012). To become emotionally connected to their peers, students chose to read what their peers read or recommend. Moreover, EFL reading provided opportunities to discuss different understanding of the story with one another.

My friends are reading the stories about a pirate's diary with many historical details set in Caribbean islands. I then started by reading a line then continued slowly page by page due to my limited knowledge of historical words... By reading the same things, we can share ideas and discussions. (Student#6)

The importance of peers on the internalization process of EFL reading was apparent in this study suggesting that the students put in more effort for EFL reading so as to not feel isolated from the group or lose a sense of belongingness (Huang, 2013). This is because exchanging thoughts and opinions with peers could satisfy students' needs to be part of their social circle and provide them with relatedness support (Komiyama & McMorris, 2017; Phan, 2010; Tanaka, 2015).

However, the other side of introjected regulation provides evidence suggesting the idea of ego-driven behavior, which best expresses students' internal demands for EFL reading (De Naeghel et al., 2012; Vansteenkiste et al., 2010). The students defined EFL reading as a tool that demonstrates their ability to accomplish challenging tasks.

Sometimes I want to prove to myself and others that English reading is something I can do. (Student#7)

Imagine if we were able to reach a satisfactory score or even do a good job in English. It would be possible to attain a positive image in the eyes of others. (Student#10)

The study showed, in line with SDT, that students' decisions toward EFL reading and learning task encompassed not only the beliefs related to perceived social demands but also about notions of internal outcomes emerging in their own self or intrinsic rewards which eventually reflected controlled orientation of self-determination (Ryan & Deci, 2000). Komiyama (2013) argued a similar point in the study on the L2 reading motivation that the desire to demonstrate excellence in L2 reading by gaining recognizable self-image and outperforming peers is one of motivational variables underlying reading behavior of students studying English as a second language. Interestingly, despite the competitive nature of Thai education which could benefit them in terms of opportunities to gain some scholarships or to entrance to elite educational institutions, the students did not express a sense of competition with their peers in EFL courses.

External regulation (ER)

Under controlled motivation, external regulation was a moderate orientation for EFL reading ($M = 3.13$, $S.D. = 0.87$) (see Table 6).

Table 6
External regulation (ER)

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
20. I read in English to get good grades.	28.4	40.8	20.7	6.5	3.6	3.84	1.02	High
21. I read in English just enough to pass exams.	11.2	21.3	37.3	21.3	8.9	3.05	1.11	Moderate
22. I read in English because it is part of a compulsory subject.	7.7	25.4	35.5	20.1	11.2	2.98	1.10	Moderate
23. I read in English because it is assigned as homework.	7.1	24.3	33.7	26.0	8.9	2.95	1.07	Moderate
24. I read in English to avoid being criticized and punished.	9.5	18.9	36.1	21.3	14.2	2.88	1.15	Moderate
Total						3.13	0.87	Moderate

Students' EFL reading behavior was determined by situational demands in the school context (e.g., school assignments, tests). Nevertheless, the students viewed their academic performance as a personal responsibility rather than competition. Some of them attributed their reading habit to the feeling of 'should', in order to avoid blame or punishment.

The main reason we started to engage in reading is because of obligatory school assignments. (Student#1)

I hardly ever read for academic knowledge but do so to obtain vocabulary or grammatical understanding that are required for tests." (Student#4)

Academic compliance was considered as the highest controlling function of L2 learning motivation (Noels et al., 2000). In the study, the students' reading behaviors were due to the atmosphere at school influenced by academic pressure to achieve better exam scores and academic success. Closely related to what Komiyama (2013) pointed out, students whose entire perceptions were determined by the external demands, including school obligation and test compliance tended to become fully controlled readers. Similar findings were found in Thai educational context where grades appeared to be the controlled reason students carry on reading in their English classes (Anuyahong, 2012; Pluemsamran & Vibulphol, 2015).

Amotivation (AM)

The last motivational orientation observed in this study was amotivation ($M = 2.43$, $S.D. = 0.96$) (see Table 7).

Table 7
Amotivation (AM)

Items	Percentage of responses (%)					M	S.D.	Interpretation
	5	4	3	2	1			
25. I do not like English reading	10.1	11.8	27.2	24.9	26.0	2.55	1.27	Low
26. I do not enjoy reading in English.	6.5	10.7	26.6	27.8	28.4	2.39	1.19	Low
27. It is useless to read in English.	1.2	4.7	16.6	26.0	51.5	1.78	0.96	Lowest
28. In my free time, I prefer doing other activities to English reading.	16.6	16.6	33.7	17.8	15.4	3.01	1.27	Moderate
29. Nothing motivates me to read in English.	8.9	8.3	27.8	26.0	29.0	2.42	1.23	Low
Total						2.43	0.96	Low

Amotivation in some students was their lack of enjoyment in classroom reading activities, which were commonly teacher-centric rather than centering on students' determination; and thus, they became discouraged and unsatisfied with reading practices that did not match their interests and language proficiency levels (De Naeghel et al., 2014; Sert, 2006).

We have nothing to read except what our teacher has selected. (Student#10)

I can't give a good reason why we have to read fairy tales like Cinderella or Snow White. It would probably be better to read fiction such as Harry Potter, or something people of our age can easily relate to. (Student#7)

Findings demonstrated that classroom reading practices appeared to promote frustration for this group of students who preferred experiencing self-determined reading activities as well as reading materials that are slightly above or closer to their level of proficiency. Related to self-determined (or autonomous) reading, the more perceived freedom of choice students had for reading tasks, the more emotionally close to the reading they became. This sort of practice may respond to students' need for autonomy (Chomchaiya & Dunworth, 2008; Tanaka, 2017) and reflects what Mante-Estacio (2012) learned from bilingual students in the Philippines, that students mostly preferred reading when classroom materials are relevant to their needs.

PEDAGOGICAL IMPLICATIONS

Based on SDT, teachers' classroom pedagogical practices should accommodate and meet students' psychological needs (De Naeghel et al., 2014). Given that EFL reading practices students encountered are less concerned how to make effective use of their intrinsic interests and that they mentioned English becomes a language of their recreation, as well as curiosity-driven reading, what teachers should learn is to allow their students to express themselves openly and take greater responsibility of their own reading. During the classroom practices, another possible way, for teacher, to support students' relatedness is to comfort them with warm and considerate responses. It is necessary for relieving emotional distress and contributes

a sense of security when students feel nervous and/or worried when making any wrong decisions or mistakes (Ryan & Deci, 2000).

Self-regulated learning is essential for science EFL students. Considering the findings related to autonomous regulation toward EFL reading, not only did students spend their time and energy to the tasks of their interests, they also demonstrated greater effort and strived for challenges when being allowed to regulate their own reading. Once students recognize their own potential, it is easier for them to become confident and expect higher reading goals (Torudom & Taylor, 2017). This practice not only support autonomous readers itself, but sometimes affect ego-driven readers who internally regulate their own reading behavior in favor of being able to breakthrough somewhat difficult in the reading task and demonstrating their competence to acquire social recognition also. For this reason, teachers can support students' needs for competence by providing optimal reading challenges which are contextually relevant and appropriate for their students by providing some helps to their students on how to achieve more effective reading or to help them solve reading problems (Haninah & Lintangari, 2018).

Through the lens of SDT, supporting to Noels et al.'s (2000) hypothesis, in order to sustain long-term motivation, intrinsic motivation is insufficient: the cultivation of personal meaning in L2 learning is also required. Along with changes in terms of cognition, self-perception, as well as contextual demands encountered by a growing adolescent, it is quite apparent that this type of regulation was more closely associated with the perceptions of this group of students than intrinsic motivation. The Thai EFL students in this study shared similar perceptions found by Pasri et al. (2021), who suggested that adolescents in southern Thailand, particularly in Songkhla province had a high self-determination, self-direction, self-esteem, and responsibilities for their lives, that potentially promoted them to become quality Thai citizens. EFL reading is, therefore, more than just a language learning activity; it is also a matter of interpersonal relationship, which fulfills students' perceived relatedness (Ryan & Deci, 2000, 2017).

It is evident that EFL reading experience becomes part of the students' social circle that can provide them a sense of group belongingness. In this respect, learning process should provide practicing collaborative group work. Teachers may gradually increase assigned reading materials that meet students' potential and give them positive feedback through praise in the presence of their peers when they have achieved the target reading goals.

CONCLUSION

Drawing upon the theoretical framework of Self-Determination Theory (SDT), this study addressed science students' motivations towards EFL reading underpinned by the types of regulatory styles distributed along a continuum of self-determination. These science secondary school students were more inclined to be autonomous than controlled readers. They were intrinsically driven when reading activities get in the way of enjoyment and curiosity-driven behavior. The freedom they had regarding their own reading, such as opportunities to choose whether and what to read, evidently served their needs for autonomy. Another sign of

autonomous EFL reading motivation was perceived extrinsic utility value of EFL reading influenced by motivational orientation of identified regulation. The students' reading behavior became self-determined in terms of being congruent to their future goals, demands of self-learning, and expectations to develop their language skills.

The present study also yielded some significant findings discovering that the influence of social-contextual variables in determining controlled orientations toward EFL reading not only encompassed external forces (e.g., social pressures inflicted by others), but also transcended their internal control (e.g., ego-driven behavior) derived by their social context. Partially internalized EFL reading behavior, which was assumed to indicate introjected regulation, was significant as it enabled the students to initiate their reading for the sake of taking intrinsic rewards and played a part in satisfying the need for competence. Additionally, interpersonal relationship influenced EFL reading motivation when EFL reading was experienced as part of the students' social interaction and the need for relatedness appeared to be supported as a result.

Teachers play such an essential role in promoting science students' learner autonomy in EFL reading at a secondary school level. The students' EFL reading achievement requires effective teaching practices, students' self-regulated learning, and their interpersonal relationship with peer groups. These pedagogical implications can promote and sustain the science students' motivation for EFL reading and life-long learning beyond classroom settings. This study not only hopes to shed some light on the enhancement of science students' language learner autonomy at a secondary school level, but also extends the knowledge boundaries and multidisciplinary integration between English and scientific disciplines to meet the future demands of English for science and technology.

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