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ARTICLE

Motivation to Study a Second Foreign Language: A Case of Chinese University Learners of German

Meihua Liu*

Department of Foreign Languages and Literatures, Tsinghua University, China

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ABSTRACT

Not much research has been done on motivation to study a second, third or even fourth foreign language though learners of such languages have been increasing. To contribute to this, the present study examined German learning motivation of Chinese university students at different proficiency levels. A total of 297 German learners at three different proficiency levels at a university in Beijing filled in the questionnaires, of whom 191 answered the open-ended question and 50 were informally interviewed. Analyses of the data revealed the following major findings: (1) most respondents at each proficiency level had limited access to and little chance to use German, liked the language, studied it (very) hard and did not think the language was difficult, (2) students at different proficiency levels studied German for similar reasons such as major study/research, further education, future career, interest in foreign language learning and German, and (3) students at higher proficiency levels perceived German to be more difficult and worked harder on it. Students at higher proficiency levels were both integratively and instrumentally more motivated to study German and had greater motivation intensity as well. It is clear that students at different proficiency levels were motivated to study German and that students at the advanced level tended to be more integratively motivated than those at the beginning level. Based on these findings, some suggestions are discussed.

1. Introduction

The recent decades have witnessed the development of theories related to motivation in second/foreign language (SL/FL) learning, such as the Socio-Psychological Theory (Gardner, 1985),^[12] the Expectancy-Value Theory (Heckhausen, 1991),^[15] the Attribution Theory (Weiner, 1986),^[33] and the L2 Motivational System (Dörnyei, 2005, 2009).^{[6][7]} Though motivation has been linked to various factors such as the context, goals and self-perceptions, the fundamental concepts of motivation theories

are still attitudes, integrative and instrumental motivation and motivation intensity proposed in Gardner (1985).^[12] As showcased in a plethora of empirical studies that pinpoint the importance of motivation in SL/FL learning (e.g., Csizér & Dörnyei 2005,^[4] Dörnyei & Csizér 2006,^[9] Gardner 1985,^[12] Hernández 2010,^[16] Liu 2012,^[18] Wesely 2009),^[34] motivation can be attributed to various factors and often fluctuates from time to time. The current literature also shows that motivation varies as the context changes and the SL/FL that students are learning changes

**Corresponding Author:*

Meihua Liu,

Associate Professor, Department of Foreign Languages and Literatures, Tsinghua University, China;

Email: liumeihua@mail.tsinghua.edu.cn.

(Hernández, 2010;^[16] Liu, 2012, 2019;^{[18][19]} Winke, 2013).^[38] For example, the motivation to learn the target language for at-home students is different from that for study-abroad students (Liu, 2019).^[19] Students' motivation also differs when learning a first, second, or third SL/FL (Csizér & Dörnyei 2005;^[4] Dörnyei & Csizér 2006).^[9] Both theoretical and empirical studies have evidenced that motivation plays an important role in second/foreign language (SL/FL) learning. Nevertheless, most research on motivation focuses on first SL/FL, especially English as a SL/FL. Not much research has been done on motivation to study a second, third or even fourth foreign language though learners of such languages have been increasing, which needs to be researched to better understand how it interacts with students' learning outcomes related to different SLs/FLs in various contexts.

English has always been the major and most important foreign language and dominated FL classroom teaching and learning in China. Nevertheless, because of globalization and the rapid development of China, other foreign languages like German, Russian, Korean, French, Japanese and Spanish have come into university classrooms and are learned by more Chinese students, often as a second or even third foreign language (Liu & Li, 2018).^[20] It is necessary to explore students' motivation to learn these foreign languages, which was the aim of the present paper targeting German.

2. Literature Review

Since the 1950s, the world has witnessed the widespread development of research on SL/FL motivation done within varying frameworks (Deci & Ryan, 1985;^[5] Dörnyei, 2005, 2009;^{[6][7]} Gardner, 1985;^[12] Heckhausen, 1991;^[15] Weiner, 1986).^[33] The Socio-Psychological Model, later expanded to be the Socio-Educational Model (Gardner & Lambert, 1972;^[13] Gardner, 1985;^[12] Tremblay & Gardner, 1995),^[31] claims that SL/FL motivation taps three dimensions: attitudes towards the target language (TL), desire to learn, and efforts expended on learning the TL. This model categorizes the desire to learn the TL into integrative motivation (e.g., internal reasons to learn the language like the desire to be like the target community member and interest in the language) and instrumental motivation (e.g., external/pragmatic reasons to learn the language like getting a certificate and travelling). Integrative motivation plays a more important role in learning the TL. The Expectancy-Value Theory claims that it is the significance of a certain result that determines the level of incentive value (Heckhausen, 1991).^[15] Thus, higher expectancy of learners and higher value will induce greater motivation to perform corresponding behaviors. Therefore, it is assumed that students may dedicate more time and energy to

SL/FL study if they believe that their goal is bound to be fulfilled and that they will achieve a lot from this process. The Expectancy-Value Theory relates SL/FL motivation to such factors as ability beliefs, expectancies for success, and the components of subjective task values (Wigfield & Eccles, 2000).^[37] The L2 Motivational System (Dörnyei, 2005, 2009)^{[6][7]} links SL/FL motivation to the learner self and the learning context and specifies three main components of the L2 motivational self system: Ideal L2 Self, Ought-to L2 Self, and L2 Learning Experience. Ideal L2 Self, similar to traditional integrative and internalized instrumental motives, refers to the L2-specific facet of one's ideal self; Ought-to L2 Self, corresponding to the more extrinsic types of instrumental motives, concerns the attributes that one believes one ought to possess to meet expectations and to avoid possible negative outcomes; L2 Learning Experience involves situated, executive motives related to the immediate learning environment and experience (e.g., the impacts of teachers, curricula, peer groups, and experience of success).

Though different theories have been proposed to explain motivation, the core of motivation is still integrative and instrumental motivation, as discussed above. Propelled by the results of empirical studies, the development of theories on SL/FL motivation in return stimulates more empirical research. Consequently, a plethora of empirical studies can be found in the current literature that showcase the importance of motivation in SL/FL learning and interaction of motivation with various other linguistic, cultural, psychological and affective variables (e.g., Cai & Zhu, 2012;^[11] Dörnyei & Ryan, 2015;^[8] Flemens, 2019;^[11] Grant, Huang & Pasfield-Neofitou, 2018;^[14] Hernández, 2010;^[16] Liu, 2012;^[18] Matsumoto, 2017;^[22] Muftah & Rafik-Galea, 2013;^[24] Morreale, 2011;^[23] O'Reilly, 2014;^[25] Polat, Balog & Mahalingappa, 2013;^[26] Qin & Dai, 2013;^[27] Thompson & Erdil-Moody, 2016;^[30] Ushioda, 2011;^[32] Wesely, 2009;^[35] Winke, 2013;^[38] Xiao, 2011).^[39] For example, Muftah and Rafik-Galea's (2013)^[24] study of 182 Malaysian pre-university students' English learning motivation revealed that the participants had very high motivation and positive attitudes towards learning English and that they were more instrumentally motivated. The study also showed that such orientations as future career development, going abroad for further study, meeting more diverse people from different cultural backgrounds and learning English in order to use the internet properly were very important for the students. To examine motivation in different Chinese EFL (English as a FL) contexts, Liu (2012)^[18] collected 1203 questionnaires and 430 reflective journals from three different Chinese university EFL contexts. She found that

the students in each context were moderately integratively motivated and moderately or even strongly instrumentally motivated, and that the students enjoying the richest English learning resources were the least motivated while those enjoying the poorest learning environment were the most instrumentally motivated. She also discovered that the respondents studied English for such common reasons as finding a good/better job, going abroad, and pursuing further study, but those from the best English-learning context studied the language more for integrative reasons. Liu (2019) also examined Chinese university learners' German learning motivation in at-home and study-abroad contexts. Analyses of both quantitative and qualitative data revealed that learners from both contexts were moderately motivated to learn German and that study-abroad students were significantly more motivated for instrumental and other purposes such as having fun and peer pressure. The study also showed that motivation was significantly correlated with students' test performance in both contexts and affected their learning of German, as found in Hernández (2010),^[16] Liu (2012)^[18] and Winke (2013).^[38]

Believing that motivation is dynamic, Waninge, Dörnyei, and de Bot (2014)^[36] collected 709 questionnaires which measured the participants' attitudes toward language courses, linguistic self-confidence, classroom anxiety and attitudes toward the language teachers who taught them. Coupled with classroom observations of 4 language learners, the researchers demonstrated that motivation changed over time on an individual level characterized by predictable and stable phases, and that student motivation could be successfully explored using a dynamic systems framework. Cruz and Al Shabibi (2019)^[3] examined the L2 motivational self system of four Omani college students. Analyses of interview data showed that the students associated ideal L2 self with obtaining a (satisfactory) job, and that their complacency with their way of life in Oman and convenience in speaking their L1 hindered their motivation to learn English. Meanwhile, the study showed that learning experience did not affect their motivation to learn English and that people around them did not affect their English learning much either. Using Dörnyei's L2 Motivational Self System (L2MSS) framework, Thompson and Erdil-Moody (2016)^[30] examined the relationship between motivation and two operationalizations of multilingualism: (a) any experience with a third language and (b) perceived positive language interaction (PPLI) in the Turkish English as a foreign language (EFL) context. Analyses of 159 questionnaires indicated a significant group effect for multilingual status for both operationalizations of multilingualism with the

ideal L2 self.

Though guided by different motivation theories, these empirical studies, while prompting to expand the motivation construct to subsume various SL/FL learning orientations, further affirm the following core beliefs: (a) integrative and instrumental motivations are key components of SL/FL motivation, and (b) motivation is dynamic and interacts with various factors such as anxiety and language proficiency. Consequently, motivation has always been a topic of research in SL/FL teaching and learning. Moreover, though English has become a lingua franca of the contemporary world and thus often is the focus of research, increasingly more learners become interested in various foreign languages as globalization accelerates. Yet research on the learning motivation of these languages is far from adequate although motivation exerts an important effect of the learning of these languages (Lasagabaster, 2017;^[17] Winke, 2013).^[38] Lasagabaster (2017)^[17] suggested that attitudes played an important role in affecting learners' motivation to study minority languages. Winke's (2013)^[38] research indicated that motivation impacted English speakers' learning of Chinese and predicted their skills of listening, reading, and speaking to varying degrees. As a minority foreign language, German has come into university classrooms in recent years and is studied by more and more students, though often as an optional second or even third foreign language. Thus, it is necessary to explore students' motivation to learn German and the results will not only contribute to the current literature but also help to better understand learners' motivation to study other foreign languages. Guided by Gardner's integrative and instrumental motivation (1985),^[12] the present study aimed to examine German learning motivation of Chinese university students at different proficiency levels and answer the following research questions: (1) How do the students perceive German? (2) What are the students' motivations to study German? (3) What are the statistically significant differences in German-learning motivation among students at different proficiency levels?

3. Research Design

Context. Since the 1960s, English has become increasingly more important in China and the No.1 foreign language for Chinese students at all educational levels. Because of globalization and China's own development, other foreign languages like Japanese, French, Russian, Korean and German have come into university classrooms (they are seldom learned in pre-university school settings) and are learned by students as selective courses in recent years. It was the same in the university where the present research was conducted. In this university, English language

courses were compulsory while those of French, Russian, German and other minor languages were optional to all students. At the time of this study, German was learned by the largest number of students as a second FL: 354 undergraduate and graduate students of the university registered in German language courses for learners at three different German proficiency levels according to their completion of previous courses: 185 level 1 (beginning to learn German), 101 level 2 (having finished level 1 German language courses), and 68 level 3 (having finished level 2 German language courses) learners.

Participants. A total of 297 learners of German at three different proficiency levels (154 level 1, 86 level 2, and 57 level 3 learners) responded to the questionnaires in the present study. With an average age of 20.51 (SD = 2.33) and age range of 16-27, the participants came from various disciplines such as Architecture, Mathematics, International Relationship, Economics and Management, and Philosophy. With an average of .73 years for learning German (SD = 1.05), all these participants had learned English as their first foreign language and were learning German as their second foreign language. Meanwhile, of these survey respondents, 25 level 1, 15 level 2 and 10 level 3 learners were randomly invited to participate in informal semi-structured interviews. In addition, analyses indicated that a total of 121 level 1, 44 level 2, and 26 level 3 learners responded to the open-ended question on the questionnaire.

Instruments. Data were collected via questionnaires and informal semi-structured interviews, as detailed below.

Background Information Questionnaire. This Background Information Questionnaire intended to gather such information about the respondents as gender, age, discipline, year of study, learning German as a first or second FL, and German proficiency level.

The German Learning Motivation Questionnaire. This 15-item German Learning Motivation questionnaire (GLMQ) (see items 9-23 in the Appendix) (the overall Cronbach alpha $\alpha = .849$) was adapted from that used in Hernández (2010).^[16] It had two dimensions: (a) an 11-item integrative motivation scale ($\alpha = .816$), and (b) a 4-item instrumental motivation scale ($\alpha = .876$). This questionnaire was selected mainly for three reasons: (a) the original survey focused on a foreign language other than English, (b) integrative and instrumental motivation proves to be the core of SL/FL motivation, and (c) it still remains unsure what motivates Chinese university students to study German. The complete the survey data, one open-ended question was added to elicit more ideas for learning German: I learn German because _____.

The German Learning Motivation Intensity Scale.

This 7-item German Learning Motivation Intensity Scale (GLMIS) (see items 23-30 in the Appendix) (the overall Cronbach alpha $\alpha = .823$) was adapted from the 9-item Spanish Learning Motivation Intensity Scale designed by Martinsen (2008).^[21] To better suit the present study, two items were excluded due to the overlap with GLMQ items. Then, the word “Spanish” in all items was changed to be “German.”

Placed on a 5-point Likert scale, each GLMQ/GLMIS item had five descriptors ranging from “Not at all important” to “Very important” with values 1-5 assigned to each descriptor respectively. Thus, the higher the GLMQ score, the more motivated a respondent was; the higher the GLMIS score, the greater the motivation intensity.

Informal semi-structured interviews. To elicit more inside views of their learning of German and complement the survey data, as discussed in Spolsky (2000),^[29] informal semi-structured interviews were held for 50 survey respondents during the break in the classroom. The interview questions covered such issues as perceptions of German, reasons for learning German, efforts to learn German and access to German. Examples were “Why do you study German?”, “Is German difficult?” and “Do you often use German?”.

Procedure. The questionnaires were translated into Chinese and German and double-checked by two professors with a doctor degree in German and English respectively, and then were distributed to students of German in class in both languages by their course teachers in week 5 when the students became accustomed to the classroom learning environment, along with a consent form. In the following week, the students were interviewed informally in Chinese, each of which lasted about 3-5 minutes and audio-taped. The questionnaires and the interviews were exercised concurrently to complement each other, as discussed in Creswell (2014).^[2]

Data analyses. The survey data were analyzed using SPSS 20. Descriptive statistics were computed to determine motivation and motivation intensity levels, then one-way ANOVA (Duncan’s) was run to examine any significant differences in motivation and motivation intensity levels among students at different proficiency levels. All the interview data were transcribed, double-checked, and then subjected to open coding of themes, together with the responses to the open-ended question, to identify their attitudes towards, access to, and reasons for learning German (Richards, 2009).^[28] Examples of the resulted themes were reasons for studying German, perceived difficulty of German, access and exposure to German. When coding the qualitative data, a pseudonym

was assigned to each interviewee, and a number was used for each open-ended question respondent.

4. Results

Perceptions and Use of German

To explore students' perceptions and use of German, the interview data were analyzed and the results are presented in Table 1.

Table 1. Perceptions and Use of German (Source: interview)

		Level 1 (N=25)	Level 2 (N=15)	Level 3 (N= 10)
Difficulty of German	Not difficult	12(48%)	1(6.7%)	0
	Difficult	8(32%)	8(53.3%)	4(40%)
	Very difficult	5(20%)	6(40%)	5(50%)
	Neither difficult nor easy	0	0	1(10%)
Liking of German	Like it very much	25(100%)	8(53.3%)	10(100%)
	Neither like it nor hate it	0	7(46.7%)	0
Efforts to learn German	Study it (very) hard	13(52%)	8(53.3%)	6(60%)
	Study it not very hard	12(48%)	7(46.7%)	4(40%)
Access to German	Rather limited	25(100%)	15(100%)	8(80%)
	Very much	0	0	2(20%)

As shown in Table 1, one level 1 learner believed that German was neither difficult nor easy, twelve level 1 and one level 2 learners thought that German was not difficult, in that “German pronunciation is fairly easy, one cluster has only one pronunciation” (Dong, level 1). Meanwhile, mainly because of such reasons as (a) too many words, (b) difficult grammar, (c) difficult pronunciation, (d) rather limited access to German every day, and (e) little/no opportunities to speak or use German, eight level 1, eight level 2 and four level 3 learners commented that German was difficult. Moreover, five level 1, six level 2 and five level 3 learners confided that German was very difficult. For example, “... It is rather difficult to memorize the words” (Guo, level 1), “... I think there are no patterns in German. And German sentence structures are different from Chinese and English sentence structures. I don't know where to put the object and the predicate in German” (Lai, level 1), “... I have never learned any gender language before, so I didn't understand it at all at the beginning. In addition, there are many changes in case” (Liao level 3).

Table 1 also shows that seven level 2 learners neither liked or hated German because they “are not good at

learning languages (Bao, level 2) or were “not much interested in languages” (Yang, level 2), while the other 43 interviewees reported liking German (very much) and believed that German was interesting. Meanwhile, in order to (a) answer questions, (b) study German well, (c) read literature in German, (d) read books in German, (e) understand German, and (f) gain a sense of accomplishment, more than half of the interviewees at each proficiency level remarked that they worked (very) hard to study German well. The other interviewees felt satisfied if they could meet the course requirements because they “don't have time to learn German” (Shi, level 2) and “the workload of major study is too heavy” (Fei, level 3).^[10]

Because of certain reasons, only two level 3 learners reported that they had fairly much access to German and many opportunities to use German in that they formed language partners with exchange students from Germany. As Wang confided, “...There are quite many exchange students from Germany in some schools of the university. ... and they often go to the cafés on campus. Students can ask them whether they want language partners. I became a language partner with an exchange student since he came here from Germany in February. We often share ideas on various things and do many things together ...” The others reported that they had rather limited access to German and little chance to use German except for such resources as classroom materials, textbooks and some internet resources like sports reports and films in German. For example, “... [We have] very little [access to German]. This is mainly because we don't have any channels to access German. We can only rely on textbooks CDs or the materials on Internet to practice listening to German. As to speaking German, few students can speak German, and we don't practice speaking German among ourselves either ... People around us communicate in Chinese, and there is no chance to speak German” (Dong, level 1).

In addition, further examination of Table 1 shows that more students at higher proficiency levels tended to rate German to be difficult or very difficult. This might be because German became more and more complex as the students learned more about the language. Consequently, students at higher proficiency levels worked harder to “understand German” (Tai, level 2) and “communicate with German friends” (Mei, level 3).

Students' Motivation to Study German

To explore students' motivation to learn German, interview transcripts and responses to the open-ended question on the questionnaire were analyzed. The results are summarized in Table 2.

Table 2. Motivation to Study German (Source: Interview and Question Responses)

	Level 1		Level 2		Level 3	
	Responses (N=121)	Interview (N=25)	Responses (N=44)	Interview (N=15)	Responses (N=26)	Interview (N=10)
To meet the need for major study or research	31(25.6%)	12(48%)	8(18.2%)	5(33.3%)	13(50%)	3(30%)
To study in Germany	29(24%)	5(20%)	12(27.3%)	6(40%)	11(42.3%)	4(40%)
To learn/master one more foreign language	24(19.8%)	3(12%)	4(9.1%)	3(20%)	8(30.8%)	1(10%)
Like the German culture	18(14.9%)	0	8(18.2%)	3(20%)	7(26.9%)	2(20%)
To increase job opportunities	16(13.2%)	0	4(9.1%)		3(11.5%)	0
Like German	14(11.6%)	4(16%)	8(18.2%)	4(26.7%)	4(15.4%)	2(20%)
Like Germany	11(9%)	4(16%)	3(6.8%)	0	0	1(10%)
To enhance personal skills	11(9%)	0	0	0	4(15.4%)	0
Like language learning	8(6.6%)	3(12%)	2(4.5%)	0	2(7.7%)	0
To travel in Germany or German-speaking places	5(4.1%)	0	6(13.6%)	0	0	0
To better understand and adapt to this world	8(6.6%)	0	0	0	0	0
To communicate with German friends	2(1.7%)	0	4(9.1%)	0	0	0
To understand sports news (football)	2(1.7%)	0	2(4.5%)	0	0	0
To meet course requirement	0	0	3(6.8%)	0	0	0
Boy-/girl-friend is German	0	0	2(4.5%)	0	0	0
To work in Germany	0	0	2(4.5%)	0	0	0
Like different languages and cultures	0	0	2(4.5%)	0	0	0
German is used sometimes in daily life	2(1.7%)	0	0	0	0	0
Classmates/roommates learn German together	2(1.7%)	3(12%)	0	0	0	2(20%)
It's useful to learn languages	1(0.83%)	2(8%)	1(2.3%)	2(13.3%)	1(3.8%)	0
Have the past experience of studying in Germany	1(0.83%)	0	1(2.3%)		0	0
To live in Europe and German is important there	1(0.83%)	2(8%)	0	0	0	0
Learning foreign languages is a part of education	1(0.83%)	0	0	0	2(7.7%)	0
It's interesting to learn a new language	0	2(8%)	0	0	1(3.8%)	0
Rather few students are studying German	0	0	0	2(13.3%)	0	0
To do business in Germany	0	0	1(2.3%)	0	0	0
To have fun	0	0	1(2.3%)	0	0	0
To kill time	0	1(4%)	0	0	0	0
Failed to register in other foreign language courses	0	1(4%)	0	0	0	0
Boy-/girl-friend is learning German	0	1(4%)	0	0	0	0
Recommended by senior students	0	1(4%)	0	0	0	0

As seen from Table 2, the students at different proficiency levels were motivated to learn German mainly for the following common reasons: (1) the need for major study or research, (2) the desire to study in Germany and learn/master one more foreign language, (3) liking the German culture, (4) the desire to increase opportunities in the future job market, (5) liking German and Germany, (6) the desire to enhance personal skills, (7) liking language learning, and (8) the desire to travel in Germany or German-speaking places.

As described by the students, Germany topped the world in many areas such as law, automobile engineering, architecture, philosophy, medicine and Marxism. If students wanted to improve themselves and gain expertise in these areas, it was necessary for them to read related literature in German. As reported by the respondents, “Germany is well developed in Law. I hope I can learn about it from first-hand resources and enhance my

professional skills” (No.6, level 1, question respondent), “Germany is famous for science of medicine. Many books on medicine are written in German, so [learning German] is helpful for my major study” (Song level 2, interview). Probably because Germany ranked top in many areas, many students studied German so that they could study in Germany in the future. For instance, “... Education in Germany is highly developed, and its education in humanities, history and philosophy is particularly advanced” (Tong, level 2, interview). In addition, because “Germany has a rich culture and is thus very charming” (No.140, level 2, question respondent) and “Germany has no rivals in classic music” (No.55, level 1, question respondent), quite many students chose to study German. Some students studied German because they enjoyed learning languages, in that “... Language itself is an interesting type of knowledge, I enjoy quite much the culture shock and completely new feeling learning a new language brings to me” (No.136, level 2, question respondent). “... I like learning languages and other countries’ cultures quite much. Learning German is an important window to understand and know its culture” (Yu, level 1, interview). Some students felt that “German pronunciation and word formation are cute” (No.152, level 2, question respondent) and considered it “wonderful to speak German” (No.160, level 2, question respondent) and thus were motivated to study German. Some students studied German because they “like and admire German industry and art” (No.99, level 1, question respondent) and “like Germany and the German people are often rigorous in thinking and lead the world in science and technology” (Sun, level 3, interview).

In addition, some students studied Germany in order to enhance personal skills (e.g., increasing knowledge, widening horizon, training way of thinking, accumulating experiences, improving learning ability, learning new knowledge, and changing personality, etc.). Typical remarks were “... Learning many foreign languages enriches and substantiates myself” (No.106, level 1, question respondent) and “... Learning languages can ... train my brain” (Shu, level 1, interview). Some students studied German in order to better understand the world, which helped “open a new window to observe the world” (No.76, level 1, question respondent).

Table 2, coupled with the means of survey items (see Appendix), also indicates that the students at different proficiency levels were generally motivated to study German for similar reasons, which might be because they shared the same big Chinese culture and the school culture.

German Learning Motivation at Different Proficiency

Levels

As reported in the Appendix, the respondents at each proficiency level were (highly) motivated both integratively and instrumentally to study German: they scored 2.98 to 4.21 (level 1), 2.73 to 4.24 (level 2), and 2.80 to 4.60 (level 3) on GLMQ items (items 9-23), respectively. Meanwhile, they had high motivation intensity to study German as well: they scored 2.61 to 4.18 (level 1), 2.70 to 4.18 (level 2), and 3.00 to 4.60 (level 3) on GLMIS items (items 24-30), respectively. In addition, the Appendix shows that students at higher proficiency levels tended to score higher on almost each GIMQ/GLMIS item, indicating that the more proficient a respondent was, the more motivated he/she was to study German, and the greater his/her motivation intensity.

In order to explore the differences in German learning motivation among students at different proficiency levels, one-way ANOVA (Duncan) was conducted on GLMQ and GLMIS. The results are reported in Table 3, which shows that the students at all proficiency levels scored above 3, the scale midpoint, on GLMS and GLMIS, meaning that students at each proficiency level were generally (highly) motivated to study German and made (great) efforts to do it. Meanwhile, Table 3 indicates that level 3 learners scored the highest while level 1 learners scored the lowest on all scales (mean = 3.72-4.13 for level 3 learners, mean = 3.43-3.61 for level 1 learners). And significant difference occurred in integrative motivation ($F = 2.17, p \leq .05$) and motivation intensity ($F = 3.243, p \leq .05$) between level 1 and level 3 learners, though with a small effect size, as evidenced by the ANOVA results presented in Table 3. This suggested that the learners at the highest proficiency level were significantly more integratively motivated to learn German and had significantly greater motivation intensity than their counterparts at the lowest proficiency level.

Table 3. ANOVA Results

	Sum of squares	Mean			F	p	Places of sig. difference ($p \leq .05$)	Effect size ($\hat{\omega}^2$)
		level 1 (N = 154)	level 2 (N = 86)	level 3 (N = 57)				
Integrative motivation	2.018	3.61	3.71	4.13	2.17	.025	Levels 1& 3	0.02 (small)
Instrumental motivation	2.368	3.43	3.52	3.72	.856	.391	/	/
Motivation intensity	2.931	3.52	3.59	4.11	3.24	.041	Levels 1& 3	0.03 (small)

Notes: degree of freedom = 2; Magnitude of effect size of $\hat{\omega}^2$:

small = $\hat{\omega}^2 \leq .01$; medium = $\hat{\omega}^2 = .06$;
 large = $\hat{\omega}^2 \geq .14$ (Field, 2013)

5. Discussions and Conclusions

The present study revealed that most respondents at each proficiency level, although having limited access to and little chance to use German, liked the language, studied it (very) hard and did not think the language was difficult. This might be because although they were at different proficiency levels, they had not studied German for a long time and could easily gain a sense of accomplishment from learning the language.

Meanwhile, the participants at each proficiency level were motivated to learn German, as found in studies on motivation in other SL/FL contexts (Flemens, 2009;^[11] Grant et al., 2018;^[14] Liu, 2012, 2019;^{[18][19]} Liu & Li, 2018;^[20] O'Reilly, 2014;^[25] Qin & Dai, 2013;^[27] Wesely, 2009;^[35] Winke, 2013).^[38] Moreover, their motivation was generally similar: they studied German to do better in their major study or research, to study for further education in Germany, to learn/master one more foreign language, to increase opportunities in the future job market, to enhance personal skills, and to travel in Germany or German-speaking places. Other similar reasons were their liking for the German culture, German, Germany, and language learning. Like their peers who studied English (hard and well) for professional development, future career and further education (Liu, 2012;^[18] Ushioda, 2011;^[32] Wen, 2001),^[34] many of these participants studied German for the same purposes. Meanwhile, like their counterparts in Liu (2019)^[19] and Liu & Li (2018),^[20] these participants studied German more for their internal desires such as their liking and respect for the language, the country and its culture, as evidenced by their remarks and GLMQ item scores. This could be attributed to several reasons. First of all, because of the encompassing power of English as a lingua franca in most areas in the world, no specific requirement was set for non-German majors in study or work in China. Students chose to study German generally not for certificates, high scores, or intellectual competence. Even though some students reported studying German for major study, research and/or further education in Germany, they did it mainly out of their respect for the German culture and Germany's advanced science and technology. They seemed to associate their learning of German to their expectations and perceptions of their future selves, as discussed in Dörnyei (2005, 2009).^{[6][7]} Evidently, they studied German more for internal reasons rather than external reasons, unlike their counterparts when learning English in various contexts (Liu, 2012;^[18] Wen, 2001;^[34] Zhou, Gao & Zang, 2011).^[40] Moreover, as shown in Table 2, the present research revealed that a few students studied German for fun, peer influence, to travel and/or to kill time, as did those learning different

SLs/FLs (Cai & Zhu, 2012;^[1] Dörnyei, 2005;^[6] Dörnyei & Ryan, 2015;^[8] Wen, 2001;^[34] Wesely, 2009;^[35] Zhou et al., 2011),^[40] further affirming the claim that the motivation construct is complex and involves various factors such as the context, the learner and the language (Dörnyei, 2005, 2009).^{[6][7]} The results also indicated that the learners' attitudes seemed to play an important role in affecting their motivation to study German. Yet future research is needed to further examine this and explore the differences in this between the motivation to study English and that to study minority languages or/and between the motivation to study the first SL/FL and that to study the second/third/fourth and nth SL/FL.

In addition, the present research showed that the students at higher proficiency levels perceived German to be more difficult and worked harder on it. This might be because as they became more proficient in German, their learning grew to be more complex and challenging, which required more efforts and investment. Concurrently, the participants at higher proficiency levels were found to be both integratively and instrumentally more motivated to study German and had greater motivation intensity, opposite to the finding in Liu (2012)^[18] which focused on motivation of Chinese university EFL learners in various contexts. The most plausible explanation for this was that the participants chose to study German on their own will and that it is often easier for learners to achieve their goals at the initial stages of language learning. It might also be that as students became more proficient in German, they became more motivated to study the language, which then helped improve their German proficiency. Thus, a beneficial circle was formed. Similar to the findings in Liu's (2012) study,^[18] the participants at higher proficiency levels also tended to be more integratively motivated to learn German. This might be because as they learned more about German, they became more interested in the language or studied the language more for its own sake.

Though the participants in the present study were (highly) motivated to study German and made (great) efforts to learn it well, due to limited access and little chance to use it, it is necessary to maintain and enhance their motivation. It is the same with learners of other second or third foreign languages. To do this, it is useful to maximize the roles of instructors, who can help students set realistic and achievable short-term and long-term goals, explicitly emphasize the role of motivation in language learning, search for meaningful and interesting teaching and learning materials (e.g., good German movies, TV episodes and books, etc.), and frequently praise and encourage students to study harder (Cruz & Al Shabibi, 2019;^[3] Dörnyei, 2009).^[7] On the part of learners,

it is better to have clear perceptions of their present and future selves and then project them to their motivation to study the target language (Dörnyei, 2009;^[7] Dörnyei & Ryan, 2015;^[8] Waning et al., 2014).^[36]

As the world becomes increasingly globalized, learners of various languages like Japanese, Spanish, German, Chinese and Russian have been increasing. Nevertheless, research on the learning motivation of these languages remains inadequate. The present study contributes to the current literature by examining German learning motivation of Chinese university students at different proficiency levels. The findings attest that much work is still needed to examine SL/FL motivation in relation to various factors such as the learning context and the learner, as suggested in Cruz and Al Shabibi's (2019) study.^[3] Meanwhile, a longitudinal approach would help capture the dynamic picture of motivation in various contexts and explain what factors affect motivation (Cruz & Al Shabibi, 2019;^[3] Waning et al., 2014).^[36] In addition, formal interviews will help elicit more definite insider views of various aspects of language learning motivation such as frequency of using the language and reasons for little/much use of the language, which will be employed in future research. Moreover, since the participants were placed at different German proficiency levels according to the previous course they had completed, it would be more valid if they were differentiated according to a standard German proficiency test. This should be an endeavor in future research. Finally, as university students often need to study various subjects, it will be significant to examine and compare their motivation to learn foreign languages and other subjects such as math and psychology. The results will be conducive to the teaching and learning of different subjects as well as a better understanding of motivation.

References

- [1] Cai, S., & Zhu, W. (2012). The impact of an online learning community project on university Chinese as a foreign language students' motivation. *Foreign Language Annals*, 45(3), 307-329. <https://doi.org/10.1111/j.1944-9720.2012.01204.x>
- [2] Creswell, J. W. (2014) *Research design: Qualitative, quantitative, and mixed methods approaches* London: SAGE Publication.
- [3] Cruz, S., & Al Shabibi, N. (2019). The L2 motivational self: A case of college students at Ibra College of Technology. *TESL Reporter*, 52(1), 30-51.
- [4] Csizér, K., & Dörnyei, Z. (2005). The internal structure of language learning motivation and its relationship with language choice and learning effort. *The Modern Language Journal*, 89(1), 19-36. <https://doi.org/10.1111/j.1944-9720.2012.01204.x>

- doi.org/10.1111/j.0026-7902.2005.00263.x
- [5] Deci, E., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum Press.
- [6] Dörnyei, Z. (2005). *The psychology of the language learner: Individual differences in second language acquisition*. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc. Publishers.
- [7] Dörnyei, Z. (2009). The L2 motivational self system. In Z. Dörnyei & E. Ushioda (Ed.), *Motivation, language identity and the L2 self* (pp. 9-42). Bristol: Multilingual Matters.
- [8] Dörnyei, Z., & Ryan, S. (2015). *The psychology of the language learner revisited*. London: Routledge.
- [9] Dörnyei, Z., & Csizér, K. (2006). *Motivation, language attitudes and globalization: A Hungarian perspective*. Bristol: Multilingual Matters.
- [10] Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). London: SAGE Publications Ltd.
- [11] Flemens, K. (2009). *Motivation, language-learning strategies, and course performance among English-speaking college students learning a romance language*. Ann Arbor: ProQuest Dissertations Publishing.
- [12] Gardner, R. C. (1985). *Social psychology and second language learning: The role of attitudes and motivation*. London: Edward Arnold.
- [13] Gardner, R. C., & Lambert, W. E. (1972). *Attitudes and motivation in second language learning*. Rowley, MA: Newbury House.
- [14] Grant S., Huang H., & Pasfield-Neofitou, S. (2018). Engagement in second life: language anxiety and motivation. In S. Gregory & D. Wood (Eds.), *Authentic Virtual World Education* (pp. 95-115). Singapore: Springer.
- [15] Heckhausen, H. (1991). *Motivation and action*. Berlin: Springer-Verlag.
- [16] Hernández, T. A. (2010). The relationship among motivation, interaction, and the development of second language oral proficiency in a study-abroad context. *The Modern Language Journal*, 94(4), 600-617. <https://doi.org/10.1111/j.1540-4781.2010.01053.x>
- [17] Lasagabaster, D. (2017). Language learning motivation and language attitudes in multilingual Spain from an international perspective. *The Modern Language Journal*, 101(3), 583-596. <https://doi.org/10.1111/modl.12414>
- [18] Liu, M. (2012). Motivation in Chinese university EFL learners in varying learning contexts. *TESL Reporter*, 45(2), 17-40.
- [19] Liu, M. (2019). Understanding Motivation for Learning German among Chinese College Students: Comparing in-China and Study-abroad Contexts. *Creative Education*, 10, 163-177. <http://www.scirp.org/journal/ce>
- [20] Liu, M., & Li, M. (2018). A study of changes in German learning motivation by Chinese university learners. *College Student Journal*, 52(1), 49-64.
- [21] Martinsen, R. A. (2008). Short-term study abroad: Predicting changes in oral skills. *Foreign Language Annals*, 43(3), 504-530. <https://doi.org/10.1111/j.1944-9720.2010.01095.x>
- [22] Matsumoto, M. (2017). Learners of English as a second language in Australia: Their perceptions of learning environment and factors having affected their motivation. Paper presented at 6th University of Malaya Discourse and Society International Conference, Kuala Lumpur, Malaysia.
- [23] Morreale, S. G. S. (2011). The relationship between study abroad and motivation, attitude and anxiety in university students learning a foreign language. Ann Arbor: ProQuest Dissertations Publishing.
- [24] Muftah, M., & Rafik-Galea, S. (2013). Language learning motivation among Malaysian pre-university students. *English Language Teaching*, 6(3), 92-103. <http://www.ccsenet.org/journal/index.php/elt>
- [25] O'Reilly, E. N. (2014). Correlations among perceived autonomy support, intrinsic motivation, and learning outcomes in an intensive foreign language program. *Theory and Practice in Language Studies*, 4(7), 1313-1318. DOI: 10.4304/tpls.4.7.1313-1318
- [26] Polat, N., Balog, R., & Mahalingappa, L. (2013). Anonymity and motivation in asynchronous discussions and L2 vocabulary learning. *Language, Learning and Technology*, 17(17), 57-74. <http://llt.msu.edu/issues/june2013/polatetal.pdf>
- [27] Qin, L., & Dai, W. (2013). Construction of self-system model on college English learning motivation based on the activity theory. *Foreign Language World*, 6, 23-31.
- [28] Richards, L. (2009). *Handling qualitative data*. Thousand Oaks, CA: Sage.
- [29] Spolsky, B. (2000). Anniversary article language motivation revisited. *Applied Linguistics*, 2, 157-169. DOI: 10.1093/applin/21.2.157
- [30] Thompson, A. S., & Erdil-Moody, Z. (2016). Operationalizing multilingualism: language learning motivation in Turkey. *International Journal of Bilingual Education and Bilingualism*, 19(3), 314-331, <https://doi.org/10.1080/13670050.2014.985631>
- [31] Tremblay, P. F., & Gardner, R. C. (1995). Expanding the motivation construct in language learning. *The*

- Modern Language Journal, 79(4), 505-518.
<https://doi.org/10.1111/j.1540-4781.1995.tb05451.x>
- [32] Ushioda, E. (2011). Language learning motivation, self and identity: current theoretical perspectives. *Computer Assisted Language Learning*, 24(3), 199-210. <https://doi.org/10.1080/09588221.2010.538701>
- [33] Weiner, B. (1986). Attribution, emotion and action. In R. M. Sorrentino & E. T. Higgins (Ed.), *Handbook of motivation and cognition: Foundations of social behavior* (pp.281-312). New York: The Guilford Press.
- [34] Wen, Q. (2001). Changing patterns and features of English learners' motivation, beliefs and strategy use. *Foreign Language Teaching and Research*, 3, 105-110.
- [35] Wesely, P. M. (2009). The language learning motivation of early adolescent French immersion graduates. *Foreign Language Annals*, 42(2), 270-286. <https://doi.org/10.1111/j.1944-9720.2009.01021.x>
- [36] Waninge, F., & Dörnyei, Z., & de Bot, K. (2014). Motivational dynamics in language learning: Change, stability, and context. *The Modern Language Journal*, 98(3), 704-723. doi: 10.1111/j.1540-4781.2014.12118.x
- [37] Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, 25, 68-81. doi:10.1006/ceps.1999.1015
- [38] Winke, P. (2013). An investigation into second language aptitude for advanced Chinese language learning. *The Modern Language Journal*, 97(1), 109-130. doi: 10.1111/j.1540-4781.2013.01428.x
- [39] Xiao, J. (2011). Tutors' influence on distance language students' learning motivation: Voices from learners and tutors. *Distance Education*, 33(3), 365-380. <https://doi.org/10.1080/01587919.2012.723167>
- [40] Zhou, Y., Gao, Y., & Zang, Q. (2011). Development in motivation of junior and senior university students. *Foreign Language Teaching and Research*, 43(2), 251-321.

Appendix: GLMQ and GLMIS items

Survey items	Level 1 (N=154)		Level 2 (N= 86)		Level 3 (N= 57)	
	Mean	SD	Mean	SD	Mean	SD
9. I want to understand all the German I see and hear.	3.89	1.06	4.24	.85	4.50	.71
10. I want to use German when I travel to a German-speaking region.	4.18	1.01	4.10	.95	4.60	.70
11. I want to be able to converse with German speakers in my country.	3.22	1.24	3.20	1.34	4.10	1.20
12. I am interested in German culture, history, or literature.	3.38	1.20	3.73	1.08	3.50	1.51
13. I feel that German may be helpful in my future career.	3.70	1.23	3.65	1.15	4.20	1.03
14. I want to be able to use German with German-speaking friends/acquaintances.	2.84	1.28	2.73	1.29	2.80	1.48
15. I want to be able to speak more languages than just my mother tongue.	4.21	.97	4.20	.87	4.70	.48
16. I want to learn about another culture to understand the world better.	3.90	1.11	4.08	.84	4.60	.52
17. German may make me a more qualified job candidate.	3.18	1.21	3.35	1.16	3.50	1.51
18. I think foreign language study is part of a well-rounded education.	3.54	1.29	3.67	1.11	3.40	1.43
19. I feel that German is an important language in the world.	3.40	1.13	3.55	1.14	3.80	1.32
20. I feel that knowledge of German will give me an edge in competing with others.	3.16	1.30	3.22	1.09	3.40	1.58
21. I want to be able to communicate with native speakers of German.	3.80	1.09	3.88	1.15	4.20	1.14
22. I feel that German will enhance my resume or C.V.	2.98	1.31	3.12	1.17	3.80	1.40
23. Being a person who knows German is important to me.	3.19	1.29	3.53	1.21	3.90	1.45
24. I learn German by working on it almost every day.	2.61	1.08	2.70	1.23	3.00	1.25
25. When I have a problem understanding something we are learning in a German class, I always try to find the answer (Think back to your most recent class).	3.54	1.00	3.58	.91	4.00	.82
26. I really work hard to learn German.	3.14	.90	3.22	.97	3.80	.92
27. When I am learning German, I ignore distractions and stick to the job at hand.	3.38	.99	3.40	1.05	3.90	.99
28. I intend to improve my German as much as I can.	4.18	.77	4.18	.80	4.60	.70
29. I am willing to dedicate time and effort to learning German even if it is not convenient.	3.61	.89	3.76	.89	4.30	.67
30. I will not stop trying to learn until I reach the skill level in German that I seek.	3.89	.92	4.02	.98	4.50	.71



ARTICLE

Eye Tracking and Learning Predictability

Tiffany McCoy-Thomas*

East Baton Rouge Parish School District, United States

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ABSTRACT

Eye-tracking is a unique research method in education to help understand learners' attention to learning materials, reading struggles, learning strategies, and learning behaviors within the context of multimedia. This study overviews the empirical studies in this field, examines the role of eye-tracking in learning predictability, and discusses the ways that eye-tracking can be used for early intervention..

1. Introduction

Education in the 21st century is marked by the rapid development and deployment of technology applications in the classroom. In an era of Digital Natives, where more than fifty-eight percent of children between ages two to five are able to play a computer game and more toddlers can open a web-browser than can swim independently, there is a requisite that instruction consist of meaningful technology integration. Within the learning environment this integration should be seamless and fluid, not exacting attention drawn to the tools, regardless of their type (tablet, smartboard, mobile devices, etc.). This is essential to the contribution of learning and developing student proficiencies (Lai, 2011).^[18] While technology has provided options to differentiate instruction, engage and address diverse learners, its uses as a predictor of student

learning needs and architype for developing individualized learning plans has been limited. Research seeking to address and inform the existing body of work is being conducted by using eye-tracking. Eye-tracking studies are not new, but new applications are offering findings that have the potential to improve students' learning outcomes.

Eye-tracking research has been conducted to determine language development (Valleau, Konishi, Golinkoff, Hirsh-Pasek, & Arunachalam, 2018),^[30] recognition of types of documents, the need for reading remediation (Sibert, Gokturk & Lavine, 2000),^[26] and impact of multimedia learning (Alemdag & Cagiltay, 2018).^[1] Central to the studies conducted is the ability to use eye-tracking as a predictor of recognition, ability, and processing. While research inclusive of the K-12 environment has been limited, the results have yielded positive outcomes, offering potential for expanded

*Corresponding Author:

Tiffany McCoy-Thomas,

East Baton Rouge Parish School District, United States;

Email: tmccoyt_phd@alumni.lsu.edu.

opportunities applicable to primary and secondary education environments. Existing research lends to the potential to improve students' abilities to engage with complex text, construct new meaning, and produce work reflecting levels of growth and mastery. The results could have profound implications for closing achievement gaps and addressing questions regarding equity and college-career ready curriculum (Catrysse, Gijbels, Donche, DeMayer, Lesterhuis, & Van de Bossche, 2017).^[7]

The role of technology and multimedia instruction is continuously expanding, shaping student learning. Given the implications of one-to-one initiatives, the rapid development and deployment of multimedia platforms, and online statewide assessments, insight into how students process text and the ability to identify academic struggles early are an imperative. Understanding how eye-tracking contributes to these foci offers increased opportunities to improve instructional outcomes, as defined by indices of student engagement and proficiency. The purpose of this study is to explore two questions: (1) Can eye-tracking be used as an early determinant of cognitive abilities? (2) What role can eye-tracking assume in identifying students' learning needs, such as remediation and/or evaluation?

2. Eye-Tracking: Definition and Function

According to Lai et al. (2013),^[19] eye-tracking provides a method to determine what features are being attended to and for how long a subject is attending to a specific feature. Through eye-tracking it has been determined how attention is shifted (Hyönä, 2010),^[15] enabling researchers to deduce the level of interest displayed by a subject (Duchowski, 2003).^[9] A chief concern of parents and teachers is that students often struggle to “focus,” preventing them from gaining the necessary understanding and ability to perform tasks (Taylor & Nutta, 2014).^[27] Eye-tracking can record what items an individual has focused on and the length of that focus. Understanding the association of how eye movement and the creation of mental images are linked enable researchers and educators to use these measures to determine cognitive capacity and the need for intervention strategies (Lai et al., 2013).^[19]

Central to understanding how eye-tracking is measured involves a series of fixations and saccades. Fixation represents the ability to maintain a visual gaze on an isolated location; a saccade denotes the conjugate movement of both eyes between phases of fixation (Purves et al., 2001).^[22] As attention is focused the eye maintains position (fixed), and as the individual tries to process or becomes frustrated the eyes will fluctuate (saccade), looking to other images. These patterns have been linked to further tests in recall and processing that aid researchers in determining whether participants understand and how their under-

standing can be linked to developing skills or providing intervention.

Fixation has been studied in three scales: total fixation duration, average fixation, and time to first fixation (Alemdag & Cagiltay, 2018).^[1] Total duration represents the overall length of time to which one will attend on any one specific item or item set. Average fixation is the mathematical function of how long we attend within a specified time, incorporating the number of times we fluctuate or saccade to other items within that same amount of time. Finally, time to first fixation accounts for the period when an individual first becomes “fixed.” For example, in a study of infant noun vocabulary, infants as young as 22 months when presented with two images would take an initial look at one move to the other and so on, before he/she would maintain attention on one image longer than the other, thereby, fixating or choosing one image on which to attend (Valleau et al, 2018).^[30] The time that lapses between the saccades before becoming fixed is known as time to first fixation. According to Russo and Rosen (1975),^[24] eye-fixations are a reliable measure because they are “unobtrusive, detailed, and difficult to misrepresent” (p. 272). Combined with the quick changes, saccades, studies have been able to link attention, interest, and understanding. These factors resulted in a positive correlation between eye-movements and cognitive processing (Lai et al. 2013).^[19]

How we “attend” to images and texts holds relevance in educational practices by marking interest, time on task, and in the expression of understanding skills and content, factors that are directly correlated to processing and ability to recall and add meaning to what is being taught (Alemdag & Cagiltay, 2018; Valleau, Konishi, Golinkoff, Hirsh-Pasek, & Arunachalam, 2018).^{[1][30]} Though the current research is limited with the K-12 community, the existing research offers relevant results as it pertains to understanding the questions presented for further study of eye-tracking within this environment.

3. Existing Research

Eye-tracking has been used for more than one hundred years. In 1879, ophthalmologist Luis Émile Javal first observed that readers used both short fixations and quick movements while engaging with text (Eyeseer, 2014).^[10] According to Eyeseer (2014),^[10] continued studies led to the development of the first eye-tracker built by Edmund Huey, and even though the device was cumbersome to use it enabled research to be conducted yielding results that were the first findings on eye-tracking research, published in the *Psychology and Pedagogy of Reading*. The publication provided a clear indication of both the need and application of eye-tracking in understanding how the mind

processes information, contributes to the acquisition of knowledge, and influences the individual. The results substantiate that there is potential for pedagogical practices.

Since the publishing of the initial eye-tracking results, studies have been conducted using eye-tracking in business (e.g., developing marketing campaigns), and in education (e.g., with those physically immobile). Each application has drawn on the concept of attracting and maintaining the attention to sway towards a desired end, be it buying cigarettes, defining an intervention, or operating a wheelchair. How then can a continued and expanded use of eye-tracking research improve instructional outcomes? There must be a review of current usage and applications and their success with an understanding of how those findings lend to expanding research that can be generalizable to current considerations. For the purposes of this study, that would mean determining the ability for early identification of cognitive struggles and/or the need to develop instructional interventions that will yield the greatest impact on improved student outcomes within a specified time period. What succeeds is a review of studies that include language acquisition, marketing, diagnosing dyslexia, development of interventions and tutoring tools, cognition, and online assessments. Each study provides data demonstrating the need to understand attention and academic struggle. Collectively, these studies offer support for the use of eye-tracking research to be applied in the education setting with the belief that results will lead to identification, early intervention, and increased levels of student achievement.

Valleau et al, (2018)^[30] conducted a study that focused on language acquisition and development. Language acquisition studies have focused on vocabulary development as determined by a child's ability to recognize nouns. The researchers in this study shifted the focus from the use of noun to verb recognition as a means of understanding developing vocabulary. The study used images to determine if the participants, through monitoring of fixations and saccades, recognized specific actions, i.e., clapping verses stretching. The pictures used in this study contained both static images and those in which motions were mimicked, for example, hand clapping were depicted to determine if verb recognition was present in toddlers. The results show that as early as 22 months old, eye-tracking revealed receptive knowledge of verbs, providing the researchers with a positive correlate in understanding the development of vocabulary in toddlers. This ground-breaking addition, in an area that has long focused only on using nouns as an index of vocabulary can now be broadened to include the recognition of verbs in understanding vocabulary development and their role in

expressive and receptive language.

As previously mentioned, attention is central to cognitive processing. If one cannot maintain the attention necessary, and is without academic support, the task to be mastered is met with frustration (Moore & Wilcox, 2006).^[21] In my educational experiences in and out of the classroom, attention problems are correlated to a lack of proficiency and behavior problems as those students who are unable to attend to a topic for a designated period of time are more likely to engage in off-task and/or risk behaviors that result in removal from the instructional environment (Freeman, Simonsen, McCoach, Sugai, & Lombardi, 2015).^[11] In a culture of high stakes testing, where rigor is a reflection of school performance scores and teacher effectiveness is a direct correlate to students' abilities to perform on assessments, behavior becomes both critical and central to ensuring success. Understanding attention is an inherent factor to learning (Duchowski, 2003).^[9] Eye-tracking has presented the opportunity to identify and determine at what point and how long an individual gives attention to a specific target. Fixations and saccades provide descriptive analytics regarding when and the amount of time the individual gives attention to the targeted stimulus, whether an image or text.

Eye-tracking has also been used to identify academic struggles. Rello and Ballesteros (2015)^[23] used eye-tracking to determine if readers had dyslexia, the most common neurological learning disability that impacts language processing. The key to supporting those with dyslexia is connected to the initial diagnoses of the disability. In this particular study, using eye-tracking the researchers were able to use text presentation and text readability to identify those individuals who presented difficulty in recognizing and/or decoding text. Further, the use of eye-tracking proved to be less intrusive as it provided for reading in silence. The findings of their work note a difference in eye movements of readers with and without dyslexia and indicate the potential for using eye-tracking as a means of diagnosing the disability. Kunze, Utsumi, Ishimaru, and Kise (2013)^[17] sought to examine how eye-tracking could record and quantify reading habits, noting specifically how individuals moved through text, recording fixations and saccades as they pertained to preferences and time to move from one section to another. The researchers determined that eye-movement also revealed frustration levels in readers, offering data that could identify interventions that would support learning needs (Huettig & Brouwer, 2015).^[14] In another study, Anderson and Gluck (2001)^[3] applied eye-tracking to determine if an instructional advantage could be produced

by tracking eye-movement in students who were being tutored in algebra. Anderson, Douglass, and Qin (2013)^[2] used the results in their eye-tracking study to develop interventions to improve performance on algebraic tasks. Similarly, Kaufman, Klein, Koblitz, and Price (2018)^[16] applied eye-tracking to tobacco regulatory science to examine communication and marketing and the impact on consumers, using sales data to determine usefulness of the strategy.

Academic struggles are compounded when there are skills deficits – the result of cognitive anomalies (i.e., learning disabilities) or the result of ineffective instructional practices. Existing research regarding eye-tracking studies has produced results that validate the prediction of abilities and deficits. Coupled with research focused on the impact of early intervention’s role in improving student outcomes, eye tracking could offer a method whereby students who struggle could be identified earlier and intervention offered before deficits widen (Sansosti & Morris, 2017).^[25] The result would offer teachers and administrators an opportunity to see the direct results of the current year’s instruction reflected in the VAM Model (Hermann, Walsh, & Isenberg, 2016).^[13]

With applications across various disciplines, eye-tracking research offers education the significance of understanding how we attend to information. Combined with identifying academic struggles, such as in the role of diagnosing dyslexia, eye-tracking methodology produces data useful to the educational evaluation process that results in the identification and development of instructional support plans for students in the form of individualized accommodation plans (IAPs) and individualized educational plans (IEPs). These studies present collective findings that are directly related to student learning and instructional outcomes, offering a relevant link between eye-tracking research and the K-12 education community.

4. Cognitive Abilities: What and How We learn

Determining cognitive abilities begins at birth, monitoring developmental milestones, and continues throughout our formal education. The point at which a learning deficit is identified offers increased optimization of interventions (Baker, McIntyre, Blacher, Crnic, Edelbrock, & Low, 2003).^[5] Cognition is the process by which new knowledge is acquired and calls for consideration of individual abilities and needs (Butz, 2004).^[6] Early identification of academic struggles provides a window of time, that with the appropriate interventions could promote successful compensation skills or even allow the student to “catch

up,” essentially performing in accordance with development models of their same age peers.

Programs such as Head Start are ideologically intended to provide learners with an opportunity to begin their formal schooling earlier than statutes require (Moore & Wilcox, 2006).^[21] Baker et al, (2003)^[5] note that participation in early academic experiences provide learners with exposure to structured content intended to support their readiness. Accompanying this early learning is the opportunity to identify potential academic challenges. The sooner a classroom teacher is made aware of or identify a struggle, the sooner he/she can begin providing and documenting interventions, noting what worked and what produced no outcome. If educators are to bear the responsibility of academic increase, they must have the ability to recognize and provide interventions, while receiving additional supports for those students for whom interventions have stalled progress. To the extent eye-tracking can provide insight into academic struggles early, it would be a welcomed method for data gathering as an assessment protocol.

Presently eye-tracking research has been conducted in the areas of reading, mathematics, multimedia, speech, and learning strategies. Understanding the ability to learn and how learning is constructed is central to the education profession. There are measures such as Intelligent Quotient (IQ) protocols and learning evaluations (conducted as components of special education programs); however, these usually warrant the ability to perform certain tasks. As mentioned earlier, eye-tracking has been conducted on toddlers, yielding evidence specific to attention, knowledge acquisition, and vocabulary development (Valleau et al, 2018).^[30]

Early identification of cognitive capabilities offers opportunities to inform best practices in education. Best practices shape professional practice, a key component in developing pre-service and in-service education professionals. The extent to which professional practice is improved is directly connected to the opportunity to identify student struggles and address learning needs. As a building level administrator, I have seen students become frustrated with what they define as their lack of intellect or inability, when in most instances their current struggle is the result of an unidentified cognitive issue, which having had the proper identification would have led to interventions, many of which would support the experience of academic success. This reality is not the assignment of blame, nor is it the resignation of responsibility as an educator, merely an immutable fact to which the extent we are able to isolate academic struggles early provides the potential for positive outcomes. The

expansion of eye-tracking as an assessment tool offers the K-12 education community venues to early intervening strategies to support knowledge acquisition and success, the basis for Multi-Tiered Systems of Support (MTSS).

Multi-Tiered Systems of Support (MTSS)

Academics and behaviors are inextricably linked, with both serving as indicators of instructional effectiveness and student proficiency (Arden, Gandhi, Edmonds, & Danielson, 2017).^[4] The Multi-Tiered Systems of Support (MTSS), as noted in Figure 1.1, provides an effective framework for identifying antecedents, defining intervention strategies, and rewarding growth (Freeman et al, 2015).^[11] Formerly known as Response to Intervention (RTI), the framework provides a tiered approach for instructional planning and behavioral modifications. The base of the framework, known as Tier I represents the “core” or 80% of students within schools and the instruction and behavior support attributing to their success. Tier 2 represents those students in need of “targeted” interventions and behavior modification planning. Educators refer to this as “small group” instruction, usually in a 1:5 or 1:8 ratio of teacher to student. This tier represents 15% of students within the school. Finally, Tier III, denotes “intensive” interventions, representing only 5% of students and to the extent possible providing 1:1 supports.

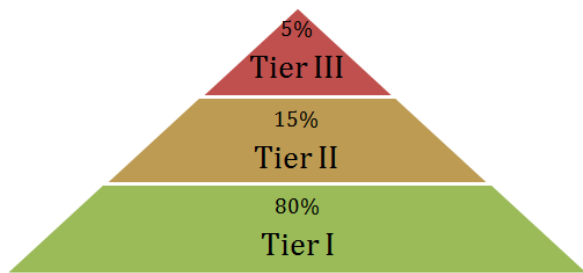


Figure 1.1 Multi-Tiered System of Supports

Multi-Tiered Systems of Support was defined as the requisite to conducting special education evaluations (Arden, Gandhi, Edmonds, & Danielson, 2017).^[4] Areas of concern, academic or behavioral, are identified and students are referred for interventions. Based on preliminary data points, including questionnaires, parent interviews, and testing data, targeted skills are identified. The significance of understanding the model is tied to the procedural requirements within the OSEP provisions; evaluation must proceed placement. The framework provides a model focused on consistent interventions with the intention to prevent disproportionate identification of students (Cowen Institute, 2014).^[8] Because Multi-Tiered Systems of Support requires interventions to be

documented and provided over a specified time period before students can be moved from one tier to another (Appendix 1), eye-tracking can be used to serve as an evaluation component, providing data points that serve in place- or time-bound interventions. As noted in multiple studies, eye-tracking has provided information that informs recognition, patterns, and processing. As in the case of those with dyslexia, if eye-tracking results demonstrate lack of recognition, frustration, or the inability to process text early in the learning continuum, these data could replace the six-week period required to determine intervention.

Studies have garnered supporting results that affirm eye-tracking’s ability to identify deficits and inform learning strategies (Lai et al., 2013;^[19] Rello & Ballestreros, 2015;^[23] Sibert, Gokturk, & Lavine, 2000).^[26] Additional studies inclusive of K-12 education, focused on attention, interventions, processing, reading and math difficulties have potential to provide time saving measures to reduce the amount of time given to providing interventions and when students should enter the evaluation process for either the development of an Individualized Accommodation Plan (IAP), under Section 504 of the Americans with Disabilities Act or services defined by an Individualized Educational Plan (IEP) (Arden, Gandhi, Edmonds, & Danielson, 2017).^[4] Each plan requires supporting data, which can include fixations and saccades, time to first fixation, and first saccade or the inability to fixate as done in eye-tracking data.

Data regarding recognition, processing, and point of frustration are important to identifying the appropriate tier and corresponding interventions. Using eye-tracking in this way serves as an assessment protocol that under Child Find provisions, informs both school readiness and the need for instructional support. With the development and adoption of Common Core State Standards and increased proficiency demands of statewide assessments, readiness requirements for students entering kindergarten have increased, for example, the introduction of algebraic concepts, increased reading (both in volume and complexity of texts), and the expanded requirements for writing in all content-based assessments (English, math, science, and social studies) (Taylor, Watson, & Nutta, 2014).^[27]

According to Toch and Tyre (2010),^[28] these changes are focused on having learners demonstrate less the regurgitation of content and more the analysis and evaluation of the content to enable the explanation of problem solving. For example, math students no longer have to solve the problem showing work; they must now identify the answer and justify the steps taken leading to

the selection of the response. In English, multiple texts are to be analyzed and used to develop a composition, citing evidence from each. In social studies, students need not recall dates and events; they must analyze primary and secondary sources, establish a claim (position) and develop an expository essay citing evidence from the sources to support the claim. While assessments still require knowledge of the content areas, the determinant of proficiency is attributed to the problem-solving and evidence used to reach conclusions. This revision in testing policy is very demanding on student time and attention. In test items released by the Louisiana Department of Education, the social studies assessment included four sources, a combination of texts, maps, and images and required both selected responses and an extended response (essay), all to be completed within 75 minutes (LDoE, 2019).^[20]

Eye Tracking as Intervention

Determining which interventions are to be used and the effectiveness of said interventions can present obstacles. Based on the MTSS model, interventions must be provided consistently for a approximately six weeks, using a continued progression based on student mastery and improvement. Given the importance of time in determining the effectiveness of an intervention and the role of intervention in the evaluation process, the extent to which a targeted discriminant intervention can be applied yields more prescriptive academic supports (Sibert, Gokturk, & Lavine, 2000).^[26] Fixations and saccades allow a pattern to unfold providing information that correlates to attention and understanding (Valleau, Konishi, Golinkoff, Hirsh-Pasek, & Arunachalam, 2018).^[30] According to Sibert, Gokturk, and Lavine (2000),^[26] their study which involved adult readers, shows that fixations and saccades occur in a pattern. Fixations were held as a variable that measured the number and duration, and the specific location (in this case line of text) of the eye (gaze) at a given moment. Saccades were studied for the number of and size (average saccade includes 7-9 characters), determined by the repetitive back and forth movement of eye. The regression of saccades (noted by a size of only 3-4 letters) indicated text that presented difficulty to the reader. Similarly duration of fixation can also be correlated to difficulty comprehending text. McConkie and Zola (as cited by Sibert, Gokturk, & Lavine, 2000)^[26] determined that eye movement offers understanding in the nature of cognitive processes, particular those involved in reading. In a similar study, Anderson, Douglass, and Qin (2013)^[2] determined that eye-tracking, specifically the role of fixations and saccades, revealed their role in brain-mapping activity involved with solving mathematical

equations. The results of their study indicated that the resulting brain pattern imaging and problem solving provided evidence of imaging contributing to improved instruction in math. Collectively, evidence from these studies provides information critical to the understanding the role of eye-tracking and how it can support the identification of academic interventions. Expansion of studies involving students, particularly in the K-12 environment, has the potential to inform the intervention process, noting specifically text that presents difficulty. Of particular significance is identifying early literacy skills.

The work conducted by Greenwood, Carta, Godstein, Kaminski, McConnell, and Atwater (2014)^[12] denotes a prevalence in students who struggle with reading, noting that by grade three, one in three students demonstrates deficits. These deficits are connected to the opportunities to which those who have been impacted had opportunities involving home-based language and literacy exposure and their participation in pre-school programs, with more than forty-percent of students unable to reach levels of reading proficiency by fourth grade (Greenwood, Carta, Goldstein, Kaminski, McConnell, & Atwater, 2014).^[12] Efforts to provide instructional support occur infrequently leading to a widening in the gap of age appropriate skill proficiency. To address this, the use of defined MTSS interventions at the universal (Tier I), small group (Tier II), and intensive/individualized (Tier III) levels were identified and teachers engaged in professional development as an impetus to effective implementation of the defined strategies. Results substantiated a need for differentiated levels of instructional support as currently defined with the MTSS framework.

Reading has not been the only application for eye-tracking studies. Andrà, Arzarello, Ferrara, Homqvist, Lindström, Robutti, and Sabena (Tzekaki, Sakonidis, 2009)^[29] found that students with different background knowledge engage mathematical texts in different ways. Given math often involves visual representation, i.e., formulas, graphs, and words, attempts to make meaning from each involves the employment of various skills. Students present with different competencies in mathematics making it difficult to support how each individual may decode the meanings of mathematical representations (Tzekaki & Sakonidis, 2009).^[29] Andrà et al. (as noted in Tzekaki & Sakonidis, 2009)^[29] divided participants into two groups in the study, based on levels of understanding, being either beginning or advanced. Using a combination of motion graphs and geometry, fixation data supported the inference that beginners and experienced math students have significantly different cognitive processes. Those with more expertise

demonstrated fixations that indicated he/she imagines elements that are not represented in the image, enabling a more involved process to solve problems; whereas, beginners demonstrated a pattern of eye moves that alternated more, allowing the researchers to infer that the task presented more of a struggle.

As an early intervening approach, MTSS provides students with a more explicit, intensive, and personal instructional plan (Greenwood, Carta, Goldstein, Kaminski, McConnell, & Atwater (2014)).^[12] To the extent eye-tracking studies are conducted beginning at age two, there is potential to identify cognitive deficits, build language, discriminate mathematical representations, and provide interventions to minimize and/or prevent pervasive academic struggling (Catrysse, Gijbels, Donche, De Maeyer, Lesterhuis, & Van den Bossche, 2017;^[7] Valleau, Konishi, Golinkoff, Hirsh-Pasek, & Arunachalam, 2018).^[30]

5. Conclusion

Eye-tracking research has been conducted in various fields with the goal to understand how learners pay attention to the multimedia information and how their attention impacts learning. The extant research studies on eye-tracking in K-12 education have revealed that determining academic struggles at an early age would lead to interventions that could improve academic success. This study points out a promising direction for future research on learning predictability, early intervention, and student success.

References

- [1] Alemdag, E., & Cagiltay, K. (2018). A systematic review of eye tracking research on multimedia learning. *Computers & Education*, 125, 413–428.
- [2] Anderson, J., Douglass, S., & Qin, Y. (2013, August). How should a theory of learning and cognition inform instruction?
- [3] Anderson, J.R., & Gluck, K. (2001). What role do cognitive architecture play in intelligent tutoring systems? In D. Klahr & S.M. Carver (Eds.) *Cognition & Instruction: Twenty-five years of progress*, 227-262. Erlbaum.
- [4] Arden, S., Gandhi, A., Edmonds, R., & Danielson, L. (2017). Toward more effective tiered systems: lessons from national implementation efforts. *Exceptional Children*, 83 (3) 269-280.
- [5] Baker, B., McIntyre, L., Blacher, J., Crnic, K., Edelbrock, C., & Low, C. (2003). Preschool children with and without development delay: Behavior problems and parenting stress over time. *Journal of Intellectual Disability Research*. 47, 217-230.
- [6] Butz, M. V. (2004). Anticipation for learning, cognition and education. *On the Horizon*, 12(3), 111-116.
- [7] Catrysse, L., Gijbels, D., Donche, V., DeMayer, S., Lesterhuis, M., & Van de Bossche, P. (2017). How are learning strategies reflected in the eyes? Combing results from self-reports and eye-tracking reports. *British Journal of Educational Psychological*. Vol. 88 (1), 18-37.
- [8] Cowen Institute. (2014). *The 2014 State of Public Education in New Orleans*.
- [9] Duchowski, A.T. (2003). *Eye tracking methodology. Theory and practice* (2nd ed.). London: SpringerVerlag.
- [10] Eye-tracking Through History. (2014). Retrieved from: <http://eyesee-research.com/blog/eye-tracking-history/>.
- [11] Freeman, J., Simonsen, B., McCoach, B., Sugai, G., Lombardi, A., & Horner, R. (2015). Relationship between school-wide positive behavior interventions and supports and academic, attendance, and behavior outcomes in high schools. *Journal of Positive Behavior Interventions*. 1-11. Hammill Institute on Disabilities. Retrieved from: <https://doi.org/10.1177/1098300715580992.jpbi.sagepub.com>
- [12] Greenwood, C. R., Carta, J. J., Goldstein, H., Kaminski, R. A., McConnell, S. R., & Atwater, J. (2014). The center for response to intervention in early childhood: Developing evidence-based tools for a multi-tier approach to preschool language and early literacy instruction. *Journal of Early Intervention*, 36(4), 246-262.
- [13] Herrmann, M., Walsh, E., & Isenberg, E. (2016). Shrinkage of value-added estimates and characteristics of students with hard-to-predict achievement levels. *Statistics and Public Policy*, 3(1), 1-10.
- [14] Huettig, F., & Brouwer, S. (2015). Delayed anticipatory spoken language processing in adults with dyslexia - evidence from eye - tracking. *Dyslexia*, 21(2), 97-122.
- [15] Hyönä, J. (2010). The use of eye movements in multi-media learning. *Learning and Instruction*, 20(2), 172-176. <https://doi.org/10.1016/j.learninstruc.2009.02.2013>.
- [16] Kaufman, A., Klein, E. G., Koblitz, A., & Price, S. (2018). A Vision for Eye-tracking Research in Tobacco Regulatory Science. *Tobacco Regulatory Science*, 4(6), 3-7.
- [17] Kunze, K., Ishimaru, S., Utsumi, Y., & Kise, K. (2013, September). My reading life: towards utilizing eye-tracking on unmodified tablets and phones. In *Proceedings of the 2013 ACM conference on Pervasive and ubiquitous computing adjunct publication* (pp. 283-286). ACM.

- [18] Lai, K-W. (2011). Digital Technology and the culture of teaching and learning in higher education. *Australasian Journal of Educational Technology*, 27(8), 1263-1275.
- [19] Lai, M-L., Tsai, M-J., Yang, F-Y., Hsu, C-Y., Liu, T-C., & Lee, S.W. (2013). A review of using eye-tracking technology in exploring learning from 2000 to 2012. *Educational Research Review*, 10, 90–115.
- [20] Louisiana Department of Education. (2019). Testing guidance. Retrieved from: <http://www.louisianabelieves.com/resources/library/assessment-guidance>
- [21] Moore, H. W., & Wilcox, M. J. (2006). Characteristics of early intervention practitioners and their confidence in the use of assistive technology. *Topics in Early Childhood Special Education*, 26(1), 15-23.
- [22] Purves D, Augustine G J, Fitzpatrick D (Ed.). (2001). *Types of Eye Movements and Their Functions*. Sunderland (MA): Sinauer Associates
- [23] Rello, L., & Ballesteros, M. (2015, May). Detecting readers with dyslexia using machine learning with eye tracking measures. *Proceedings of the 12th Web for All Conference* (p. 16). ACM.
- [24] Russo, J. E., & Rosen, L. D. (1975). An eye fixation analysis of multi-alternative choice. *Memory & Cognition*, 3(3), 267-276.
- [25] Sansosti, F., & Morris, B. (2017). *Eye-Tracking Technology Applications in Educational Research*.
- [26] Sibert, J. L., Gokturk, M., & Lavine, R. A. (2000, November). The reading assistant: Eye gaze triggered auditory prompting for reading remediation. In *Proceedings of the 13th annual ACM symposium on User interface software and technology* (pp. 101-107). ACM.
- [27] Taylor, R. T., Watson, R., & Nutta, J. (2014). *Leading, teaching, and learning the common core standards: Rigorous expectations for all students*. Lanham, MD: Rowman & Littlefield.
- [28] Toch, T., & Tyre, P. (2010). *How Will the Common Core Initiative Impact the Testing Industry?* Thomas B. Fordham Institute.
- [29] Tzekaki, M., Kaldrimidou, M., & Sakonidis, C. (Eds.). (2009). *Proceedings of the 33rd Conference of the International Group for the Psychology of Mathematics in Education*. Thessaloniki, Greece.
- [30] Valteau, M. J., Konishi, H., Golinkoff, R. M., Hirsh-Pasek, K., & Arunachalam, S. (2018). An eye-tracking study of receptive verb knowledge in toddlers. *Journal of Speech, Language, and Hearing Research*, 61(12), 2917-2933.



ARTICLE

Fantastic Educational Gaps and Where to Find Them: LERB – A Model to Classify Inequity and Inequality

Anh-Duc Hoang*

EdLab Asia, Vietnam

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ABSTRACT

In today's world, education is less being considered as an outcome, but more as a journey. As the adventurers, our students are facing more and more complex challenges. Previously, the socio-economic status of a student's family seemed to be one of the biggest factors among inequality causes. Nowadays, the chaotic situation of today's VUCA world (volatility, uncertainty, complexity, and ambiguity) is generating more and more types of inequity and inequality. Thus, the purpose of the study is to develop LERB - a simple model to classify inequity and inequality, as a stepping-stone to build a gap detection framework. Through a structured literature review, the study identified the interconnection between equity and equality, as well as their transition toward students as an individual or as a group(s) and subgroup(s). The study can also be adapted to examine the correlation between different categories of equity, as well as to brainstorm and propose remedies to tackle those gaps.

1. Introduction

In today's world, education is less being considered as an outcome anymore but a journey. Regarding that perspective, the concern of finding sustainable ways to close achievement gaps can be found in most countries (Wagner, 2014).^[92] While the most popular themes of education reforms in previous decades are turning around closing gaps within the category of socioeconomic status among groups or subgroups, the recent reforms are shifting its objects to micro-groups and individuals. On the one hand, policymakers still take the responsibilities to tackle macro-level challenges; on the other hands, from the grassroots, educators and parents are also proactively

contribute to discover and deal with the microscope level issues, such as student's unique psychology or learning needs. The society's focus on educational equity is not limited to unequal background and accessibility but extended to new inequity such as unequal learning needs. For the emerging of new educational gaps, there is a need for developing an inequity/inequality detector tool. Therefore, through implementing a systematic review on educational inequity and inequality research, this study aims to suggest a simple framework to classify different categories of (in)equity and (in)equality in education as well as determine the relationships among those categories. The framework might be the stepping stone for

**Corresponding Author:*

Anh-Duc Hoang,

Principal Investigator, EdLab Asia, Vietnam, and Visiting Scholar, Center for Research and Practice on Education, Phu Xuan University, Vietnam;

Email: ducha.hoang@gmail.com.

inequity/inequality detector tool in the future.

2. Equity and Equality

2.1. The Early and Long Debate

Since very early, a large and growing number discussions and debates on equity and equality have been conducted by scholars (Bourdieu & Passeron 1964;^[10] Bourdieu, Bechelloni, Ciafaloni, Mughini, & Passeron, 1972;^[11] Bourdieu, 1989;^[12] Erikson & Jonsson, 1996;^[30] Sen, 1982^[80]). So, what is this controversial topic actually about? The conversations around equity and equality are not new but always an attractive topic in academic and practical worlds. Should every student be equipped with the same resources and opportunities? Or should we provide the children whose starting points are lower with much more resources and opportunities? These questions are exactly the concern of equality or equity, respectively.

As a popular research topic across numerous fields (e.g., economics, social sciences, political science, education, and education policies), the concept of equality is also varied among scholars in those fields. Although researchers and policymakers are both looking at the same data, there are still turmoil and misconception about the interpretation of (in)equity and (in)equality (Espinoza, 2007).^[29] The social contract theory of Rousseau (1950)^[74] diagnosed two types of inequality: natural and social. When physical inequality might exist between individuals naturally, psychic equality can be established by social contract, such as law to make the individuals, who are naturally unequal, become legally equal among others.

Within the scope of educational study, it's not difficult to conclude that equity is an essential focus for any education system (Bottani & Benadusi, 2006).^[13] Farkas (1996)^[31] tackled equity within the scope of "cultural capital" of learners (which include student's prior skill, behavior, and characteristic) and demonstrated the influence of unequal stratification outcomes over educational outcomes as a loop. To continue that flow, various studies have been implemented to investigate the relationship between educational achievement and social origin (Erikson & Jonsson, 1996;^[30] Goldthorpe, 2000;^[37] Fullan, 2001^[35]). Savage, Sellar and Gorur (2013)^[75] suggested that the influence and the correlation between current market-based reforms and equity can be understood with the support of the social contract theory. The adjustment of individuals' moral and political obligations is correlated with the social agreement among them to form the common society, at both national and institutional level, and individual level.

Empirical studies revealed contradictories between social expectations and perspectives. Cross-cultural

research of Starmans, Sheskin and Bloom (2017)^[82] as well as Vuong (2018)^[91] showed that on the one hand, people do expect to minimize inequity, but on the other hand, they are willing to promote fair inequality over unfair equality. Gillard (2009)^[36] investigated the education reform in Australia and considered the gaps of underachievement in education as the same as the loss for the economy. The impact of a VUCA world, in which the economic context is volatility, uncertainty, complexity and ambiguity would lead to new regional and contemporary types of inequity and inequality. For instance, the rivalry between institutions and countries is rising, regardless the type of markets or geopolitics (Lemoine, Hackett & Richardson, 2017).^[52] Wagner (2014)^[92] also raised the concern of increasing global achievement gaps. While the western countries are trying to close down the gaps of educational outcomes between different students with different races and socio-economics background, many cases in Asia such as India, China, and Singapore are choosing the other vector.

No matter how the debates happen in literature and practices, educational gaps are increasing globally (Simon, Malgozata, & Beatriz, 2007).^[81] According to UNESCO (2015),^[90] the increasing inequality in education oppressed the development gaps and put the poorest and most disadvantaged into the farthest shores. It also has been recorded widely that low socioeconomic background children's tendency to perform below standards are double than normal children (OECD, 2012).^[64] In addition, there is also increasing indications from many countries that the above gap will upsurge under the pressure of globalization (Pickett & Vanderbloemen, 2015).^[66] Besides, the complexity and ambiguity changing nature of the modern world with new technologies enhancement also demand higher status quo from educational institutions towards new targets of innovations (Wihlborg & Robson, 2018).^[96] On one hand, top-tier institutions can achieve new accomplishments; on the other hand, they also generate and maintain new inequity and/or inequality gaps.

At some levels or in some aspects, the governments might provide resources equally, but regarding other levels or aspects, an equity distribution might suit better (Simon et al., 2007).^[81] However, the toughest task is how to find out the turning point to adapt and adjust those actions. Regardless the controversial issues of today's society, scholars' discussion since the 1980s have stated clear boundaries and connections between equity and equality. Equity can be considered as a qualitative property and equality can be named as a quantitative property (Secada, 1989).^[78] While equity covers the range of reasoning justice, equality is closer to the uniformity accessibilities

of groups or subgroups. Within the scope of education, researchers are also aligned on the determination of those terms.

A large volume of studies have been conducted by researchers worldwide on the constructing elements of equity, which indicate that there are many overlaps between (in)equity and (in)equality (Green, 1983).^[38] For instance, Archer (2007)^[3] discussed the Labor Higher Education policy within the UK government's Widening Participation agenda and determined equity using the diversity and mobility of equality. Thus, equity can also be a development form of equality (Benadusi & Bottani, 2006).^[7] The examination on federal policies and programs of Brookover and Lezotte (1981)^[14] categorized three standards of educational equity: access, participation, and outcomes. In particular, the study presented an increasing trend that more and more people are looking at the educational outcomes for major population of students as evidence to evaluate educational equity, rather than just looking at the equality of accessibility and participation. However, the idea of considering educational outcomes as a major standard is also struggling with various direct and indirect stakeholders. There is an escalation in researching the inclusion and overlapping of equity and equality in both theoretical and practical areas (Castelli, Ragazzi, & Crescentini, 2012).^[17]

Uptill now, the questions of providing sufficient access, maintaining stable participation, and generating proper outcomes are still the major concerns of educational systems worldwide. Benadusi, Fornari and Giancola (2010)^[8] proposed that equity indicators should include three primary aspects: inter-individual inequality, inter-category inequality and the segment of students beneath the bottom verge. By way of expressly, the inter-connections between the above three dimensions remind the argument of Martinez and Mead (1988)^[57] that equity may also require inequality. Martinez and Mead (1988)^[57] came up with an example of inequality of access (more in-school access for poor students) is needed to tackle inequity in computer literacy. For instance, Le et al. (2019)^[51] examined the reading habit of 1676 junior high school students and found a positive relationship between book reading and STEM-related subjects' academic performance.

2.2. The Process and Outcome

Green, Preston, and Janmaat (2006)^[40] claimed the decisive role of social cohesion and, in particular, educational equality in every country without exception of political styles regarded the fact of the expanding focus on education and training development across the globe (Green and Preston, 2001).^[39] In their mission, The National Equity

project (n.d.)^[60] declared that equity is providing every child the necessary resources to fulfill their equally high outcomes in education system and community potential. Educating all students to succeed is the goal of equity; the sustainable educational target is to remove barriers and equipping children all they need to be able to master fundamental capabilities, regardless individual demographics. Understanding the movement of divergences in accessibilities and achievements is a must to gear educational gaps. Implicit in the correlation between (in)equity và (in)equality, there is also a line of agreement between researchers that equity is a process, which will lead to equality as the outcome.

Equity can be considered as a flow rather than a fixed status. Simon et al. (2007)^[81] stressed three major areas which need to be focused by each country: the design of education system, the actual implementation of education system and the resourcing. Besides, Simon et al. (2007)^[81] also defined two dimensions of educational equity: fairness and inclusion. In other words, we should parallelly overcome educational deterioration and social destitution. In their classic critique, both Deustch (1975)^[25] and Leventhal (1980)^[53] pointed out an alternative to "equity theory," which is based on two principles: the distribution and the procedure. In particular, the firmness of the equity distributing procedure will forbid individual or subgroup distort and be able to define the status of equity.

The existence of a misunderstanding between equality in education and equal opportunities for education is not new (Ennis, 1976,^[27] Frankel, 1971,^[34] Jencks, 1988).^[46] Whereas since the last century, education has been considered as an outcome by social capitalist (Coleman, 1998),^[22] recent empirical evidences show that education, by leading to better choices (Kenkel, 1991)^[48] will also cause better health (Arendt, 2005)^[4] and better economic growth (Self & Grabowski, 2004).^[79] Thus, one should consider education as both outcomes of an aggregated process and the input or mediator of other processes. Regarding that perspectives, there was a notable shift of educational equality research focus, in which the main research objects have been switched from parity resources, access, fulfillment, accomplishment, and outcomes into self-confidence, such as action or decision (Burbules, Lord & Sherman, 1982).^[16] Within the proposal of "the theory of education effects," Nie, Junn and Barry (1996)^[62] stated a firm correlation amidst years of study and the complex element of 'enlightenment.' Having observed and extrapolated the competition for minor upper positions in community, the theory also suggested that it is very challenging to deduce personal effects to subgroup

and group effect. Hence, while observing and judging educational (in)equity and (in)equality, researchers and policymakers should also put the research (in)equity and (in)equality in a flow of the larger pictures rather than limit within the population of a group or subgroups.

In other words, educational gaps or differences can be named as inequity or inequality; and in most cases, inequity and inequality cannot be separated (Wagstaff, 1994).^[93] No matter in which way we label them, they are just the results of many other causes. Rather than being considered the bad-looking spots in a blame game, inequity or inequality should be acknowledged as the motivation for better collaboration strategies (Ainscow, 2016).^[1] Rethinking the identities of (in)equity and (in)equality, they might not be resulted indexes like GDP but explanatory and predictability indexes like blood sugar levels. By putting (in)equity and (in)equality at the right category, researchers can get advantages from understanding the relationship between those indexes and other moderators and/or mediators during the (in)equity and (in)equality formation process.

2.3. Popular Patterns

Regardless the level of education, educational inequality are recorded globally, among Early Childhood Education (Baggio, Abarca, Bodenmann, Gehri & Madrid, 2015),^[6] K-12 Education (Duncan & Murnane, 2011,^[26] Kuhl, Lim, Guerriero & van Damme 2019^[50]), Vocational Education (Ainsworth & Roscigno, 2005;^[2] Holm, Hjorth-Trolle & Jægeret, 2019^[45]) and Higher Education (Shavit, 2007,^[77] Lesley, 2018^[54]). The partial interchangeable and intersecting nature of equity and equality (Walby, 2007)^[94] causes vague borders between categories when we discuss its related gaps. For example, factors such as gender and race are mostly associated with each other regarding inequity or inequality issues (Ridgeway & Kricheli-Katz, 2013).^[70] This ambiguous character of equity and equality is not a limitation but an interesting challenge which triggered scholars to investigate. Considering teachers and curriculum as important resources to fulfill equity, Cochran-Smith (2010)^[21] proposed that distributing same access to resources to vulnerability students will lead to equity. Tan, Barton, Turner and Gutiérrez, (2012)^[83] shared a similar view and introduced an interesting concept of “equity-as-equality.”

Noltmeyer, Mujic and McLoughlin, (2012)^[63] presented educational inequity issues chronologically with the development of the United States of America: race and ethnicity, linguistic diversity, gender, and disabilities. Throughout the study of history of inequity in education, the research group raised attention that the context which students and teachers are living in is fluctuating

continuously and determines their behavior. Regarding today’s VUCA (volatility, uncertainty, complexity, and ambiguity) global context, the message is not new but still maintains its original value. VUCA – the new turbulent normal also describes the current status of global education. Besides the pressures of speedy advancements in technology and economic, education leaders’ vagueness is also being increased by the tightness of reductions in both human and capital resources (Lemoine, Hackett & Richardson, 2017)^[52]. It is not surprising that longitudinal empirical evidence shows intrinsic disharmony in educational accessibilities and achievements at macro, meso, and micro levels in many countries, regardless the economic development status.

2.3.1. At Macro Level

At the macro level, notable categories are genders (Hausmann, Tyson & Zahidi, 2012,^[44] Li, Sato & Sicular, 2013^[55]; Roos & Gatta, 2009^[72]), the dominant of majority groups (Carter & Welner, 2013)^[18], and immigration status (Arzubiaga, Noguero & Sullivan, 2009).^[5] With reference to the scope of genders, while female disadvantages are not difficult to be seen (Lin, 2000,^[56] Reckdenwald & Parker, 2008),^[68] male, especially black male’s disadvantages are attracting less focus from researchers (Farley, 1987).^[32] Buchmann, DiPrete and McDaniel, (2008)^[15] found out an interesting upturn tendency of gender disadvantages for males who were born after the mid 1960s, notably the ones whose parents are less educated or whose fathers were absent.

The influence of majority group over other minority groups can be seen as the non-stop battles between races, language groups, religious groups, and immigrant status. Various scholars examined gaps in those categories and tried to demarginalize but agreed on the intersectionality between those factors (Enriquez, 2017^[28]; Patterson & Veenstra, 2016^[65]). For example, Crenshaw (1989)^[23] highlighted the multidimensionality of Black women; Guenther, Pendaz and Songora (2011)^[43] explored the constraints based on intersecting dimensions of Eastern African’s identities, which even charged lots of social costs. However, African-Americans are not the only population under the pressure of those gaps. Similar gaps were founded between colonizing groups over indigenous and native populations (Nelson et al., 2009),^[61] or between different language groups (Tupas, 2015,^[86] Cervantes-Soon et al., 2017^[20]), and religious groups (Reitz, Phan & Banerjee, 2015,^[69] Tavits & Potter, 2015,^[84] and Saleh, 2019^[76]).

2.3.2. At Meso and Micro Levels

At meso and micro levels, even though we cannot separate the halo effects of macro-level inequity and inequality, the

work of defining those categories is a must for researchers worldwide. Collectively, distinguished topics include family background, the living area, gifted and talented education, and special education.

Investigating factors related to family background, Roscigno, Tomaskovic-Devey and Crowley (2006)^[73] analyzed the differences in income and parental education between inner-city and rural areas and highlighted the parallel disadvantages of “poor performing children” in each segment, respectively. Sharing a similar perspective, Jolly, Mikolaitis, Shakoor, et al. (2010)^[47] considered zip code as a clustering method to measure family income and also confirmed its effects on health outcomes, which might indirectly associate with educational inequity. Tran et al. (2019)^[87] recognized that besides income and educational history, the way parents splitting and allocating resources to each child is influenced by the child’s birth order.

Reaching out the family scope, school-related issues cover a very large number of discussions. Even within the inequality-easy-detected areas such as gifted and talented education, unrevealed issues are still many. For example, besides the inequality in the access to those programs (Kettler, Russell & Puryear, 2015)^[49], there is also inequality within those privilege programs (Chu & Myers, 2015;^[19] Roda, 2015)^[71]. From the other side, which is not as entitlement as talented education, adapting students with special education student’s needs require government and educators across nation to overcome differences caused by subtraction and apartheid percentage of disabled and disadvantaged students (Powell, 2015;^[67] Tomlinson, 2017).^[85]

Within the school setting, equity issues engage closer with pedagogical issues and lead to higher demand in teaching and managing practices from teachers and school managers (McKinley et al., 2014).^[58] Educator’s behavior might vary due to student’s diversity stratifications (Ainscow, 2016).^[1] For instance, Grissom, Kalogrides and Loeb (2015)^[41] studied micro-politics in education decision-making procedures with the focus on intraorganizational power of experienced teachers and found discrimination toward less qualified teachers. In particular, less-experienced teachers are often assigned to more disadvantaged students. Also, as a consequence of biased contrast, classroom context generates significant educational achievement gaps over children from working-class families and the ones from middle-class families (Goudeau & Croizet, 2017).^[42] Regarding the inter-school context, the educational equity and equality of schools are altered by the school type, the federal policies, enumeration, socioeconomic status, historical and contemporary context of the school’s surrounding

areas (Ainscow, 2016).^[1]

3. Various Approaches toward Equity and Equality Clustering

A considerable number of work has been published on classifying and measuring equity and equality issues. Waldman (1977)^[95] suggested the terms of “relative inequality” and “absolute inequality” when discussing the inequality measurement method. He also proposed three sorts of “relative inequality,” which is limited to the political context of the United States of America, and two sorts of “absolute inequality,” which might be applied into broader contexts. These two sorts are Type A and type B as a function of an immeasurable number of categories or a limited sum of categories, respectively. Both types are minimum only when there is equal distribution over all the categories, but the maximum inequality in type B occurs when any single category acquires all the value, while the maximum gap in type A exist if there is only one category has all the value. Waldman (1977)^[95] also noticed the necessity of choosing the proper index for inequality measurement process. However, the study did not present how to validate the index selection procedure.

Criticizing the narrow perspectives of prior debates on the intricacy of equity, Tyler (1977,^[88] 2012^[89]) proposed a model of five categories to classify the origin as well as the structure of educational inequality: (i) meritocratic, (ii) class conflict, (iii) traditional elitist, (iv) evolutionary liberal, and (v) compensatory liberal. Looking at equality using a longitudinal perspective, Farrel (1999)^[33] explicated equality regarding its accessibility, endurance, result, and impact. With similar approach, Espinoza (2007)^[29] connected equality aspects with distinct phases of the educational flow and proposed three equality categories: (i) equality for opportunities, (ii) equality for all, (iii) equality on average across social groups; and three equity categories for (i) equal needs, (ii) equal potential, and (iii) equal achievement. Also focusing on the causal format of inequity/inequality, these classifying methods advanced valuable pathway to identify inequity and/or inequality, but the intersection between inequity and inequality has not been explained yet.

Berne and Stiefel’s (1984)^[9] view in measuring equity in school finance has been further developed by Demeuse, Crahay and Monseur (2001)^[24] who differentiate types of equity as horizontal equity (based on the treatments for people with the same starting point and treatment), vertical equity (based on the treatments for people with the same concurrent level) and equal education opportunity (based on the thirst for resources or unequal positions which might forbid equal potential outcomes). Mount (2008)^[59] reviewed the development of and

debate on the inequality of scholars since the World War II, and suggested the “five types of inequality” framework, which classified inequality using perspectives of political, income and wealth, quality of life, treatment and responsibility, and membership of faith, family and nation. These horizontal and vertical perspectives elevated prior equity measurement methods. Notwithstanding, the interfering between horizontal and vertical dimensions was not tackled.

4. How Can We Define New Patterns?

Although much more know-how on the topic of equity has been developed over the past 30 years, most of these clustering methods are based on the origin of inequity/inequality only. Even though inequity and inequality gaps have been located and are close to the similar ones, the identity, characteristic of each gap and especially the interconnection of that gap within its related context were not presented well in any of those models. Moreover, the unrevealed complex flow of inequity and inequality will also limit our vision and actions while proposing inequity and inequality remedies agendas.

Throughout this study, the term of equity was founded as a qualitative property and a process, while the term of equality is defined as a quantitative property and an outcome. Standing on that perspective and considering the intersection of equity and equality as a flow of differences, I propose a pattern as an equity/equality valuation framework. First, the framework can help to classify various emerging types of inequity and inequality. Second, it can be used as a stethoscope to probe and examine the development of the gap itself, from its origin to its potential variations. The following LERB chart is synthesized from literature by using four symbols of Leaf buds, Eye, Rings, and Balance scale as metaphors for various categories of inequity and inequality.

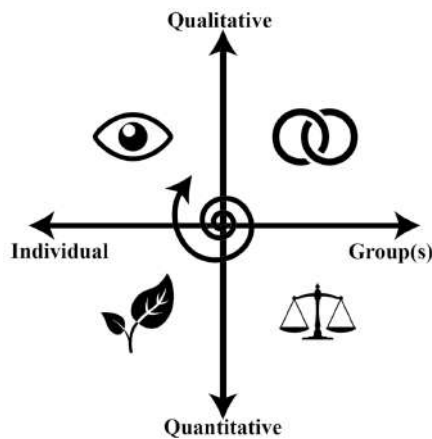


Figure 1. LERB Model of Equity and Equality

“Lerb” has been known as slang for love, the essential for every equity and equality initiative. The LERB model is conducted by two main axes: Qualitative-Quantitative which is the characteristic of the gap itself, and Individual-Group(s), which is the main object(s) of inequity or inequality. Based on the identities of inequity and inequality, the interfering of the two axes divide inequity and inequality’s categories into four major domains: (1) Leaf buds, (2) Eye, (3) Rings, and (4) Balance scale.

Leaf buds: The quarter of quantitative gaps over individuals, which can be fulfilled by providing a proper defined resource to a particular individual. Some examples of inequality in this area are income (primary earnings of individuals) and life inequality (the limitation of opportunities to improve individual’s quality of life (Mount, 2008).^[59] The demand fulfillment process for this kind of inequality is very close to the way ones take care of a small plant, in which both the resources and the objects are clear.

Eye: The area of qualitative gaps over individuals, which can be partially discharged by enhancing an individual’s self-actualization toward the society’s common vision. This area includes many popular inequities in education, such as each student’s learning need, disadvantages, explicit and implicit bias, stereotype threat, oppression (National Equity Project, n.d.).^[60] Those obstacles are clear, but there is no one-size-fits-it-all blueprint. Instead, shared visions among stakeholders might help guide further specific actions.

Rings: The section of qualitative differences caused by lacking engagements between groups or subgroups such as reproductive discourse, microaggression, racist interactions, transferred oppression (National Equity Project, nd),^[60] and belief between different races and religions. This kind of inequity can be accomplished by tackling difficult conversations among its stakeholders.

Balance scale: The domain of quantitative differences between groups or subgroups. In practices, these inequalities might be seen mostly at the institutional or structural levels (e.g., unequal treatment policies in health care, college admission (Mount, 2008).^[59] This kind of inequality can be harmonized by adjusting the social distribution over vast categories of resources.

The critical perspective of the LERB model is the intersectionality between equity and equality. Firstly, the determination of a category among those four areas depends on the qualitative or quantitative identical of the category, as well as individual or group subjects. Secondly, there is a continuous transition of the category itself around those four zones. In particular, whenever a gap is defined and located within any of those four dimensions,

its position is not fixed forever. The spiral symbol in the center of the graph reminds us that, a current gap can turn into another future complex gap, as well as might be the aggregated result of many prior gaps. Thus, while looking at any gap, besides focusing on the narrowed scope of that gap, ones also should broaden their mind by considering the transition of that gap over time, dimensions, subjects, objects, and context. That simple step of generating the big pictures might also help us to understand the nature of the gap, to discover new inequity/inequality or even reaching closer to the remedies.

The distinction among those four quarters in the proposed model could serve as a stepping stone toward inequity and inequality remedies. By putting each inequity/inequality category into the related area, the model may support scholars, policymakers and practitioners to brainstorm ideas to tackle the inequity/inequality status.

5. Conclusion

In today's VUCA world, the global context of internationalization does not expel any countries out of the dramatic scaffolding of inequity and inequality, especially in education. From the top-down level, policymakers have to deal with inequality of resources and accessibility distribution, while middle-level stakeholders such as school managers are confused in the personalized and digitalized education revolution. However, teachers - the most important individuals are not triggered to transform, due to the isolation between them and the context beyond the school (Wagner, 2014)^[92].

Due to the fact that there are gaps that we know or don't know about, and the number of gaps which we don't know might even bigger, this investigation was undertaken to establish an inequity and inequality classifying model. The most obvious finding that emerged from this review is that equity and equality cannot be separated: an inequity status might be the result of inequality but also might be the cause for one or many other inequalities. Understanding the intersection and the movement between equity and equality is essential for researchers and practitioners to examine and resolve inequity or inequality.

The proposed LERB model of equity and equality contributes to existing knowledge by mapping the transition of those terms over time, situations, subjects and objects. While this study did not confirm any solid solution to each equity or equality's area, it did partially sketch the pathway toward remedies. The study is not without limitations. For instance, due to the impossibility of covering huge number of studies over a long period, there might be biases during paper

selection process. Besides, most of selected studies were conducted from the developed and developing countries, in which the idiosyncratic of less economically developed countries might be left behind. Therefore, further studies on this topic should be done to examine the association between equity and equality over the axes of quantitative-qualitative and individual-group(s), as well as the variation of single categories among its spiral development. The limitation of this model can also be determined by additional meta-regressions of empirical studies. The LERB model proposed and discussed in this study provides a new perspective to study the equity and equality issue in education.

Reference

- [1] Ainscow, M. (2016). Collaboration as a strategy for promoting equity in education: possibilities and barriers. *Journal of Professional capital and community*, 1(2), 159-172.
- [2] Ainsworth, J. W., & Roscigno, V. J. (2005). Stratification, school-work linkages, and vocational education. *Social Forces*, 84(1), 257-284.
- [3] Archer, L. (2007). Diversity, equality, and higher education: A critical reflection on the ab/uses of equity discourse within widening participation. *Teaching in Higher Education*, 12(5-6), 635-653.
- [4] Arendt, J. N. (2005). Does education cause better health? A panel data analysis using school reforms for identification. *Economics of Education Review*, 24(2), 149-160.
- [5] Arzubaga, A. E., Noguero, S. C., & Sullivan, A. L. (2009). The education of children in im/migrant families. *Review of Research in Education*, 33(1), 246-271.
- [6] Baggio, S., Abarca, M., Bodenmann, P., Gehri, M., & Madrid, C. (2015). Early childhood caries in Switzerland: A marker of social inequalities. *BMC Oral Health*, 15(1), 82.
- [7] Benadusi, L., & Bottani, N. (2006). *Uguaglianza ed equità nella scuola*. Erickson, Trento.
- [8] Benadusi, L., Fornari, R., & Giancola, O. (2010). La questione dell'equità scolastica in Italia. *Analisi delle performance in scienze dei quindicenni della scuola secondaria superiore*. Programma Education della Fondazione Giovanni Agnelli.
- [9] Berne, R., & Stiefel, L. (1984). *The measurement of equity in school finance: Conceptual, methodological, and empirical dimensions*. Baltimore: Johns Hopkins University Press.
- [10] Bourdieu, P. & Passeron, J. (1964). *Les heritiers*. Paris: Editions de Minuit.
- [11] Bourdieu, P., Bechelloni, G., Ciafaloni, F., Mughini,

- G., & Passeron, J. C. (1972). *La riproduzione. Teoria del sistema scolastico ovvero della conservazione dell'ordine culturale. Introduzione a due voci di Giovanni Bechelloni e Francesco Ciafaloni*. Guaraldi.
- [12] Bourdieu, P. (1989). Paris: Editions de Minuit.
- [13] Bottani, N., & Benadusi, L. (Eds.) (2006). *Uguaglianza ed equità nella scuola*. Trento: Erickson.
- [14] Brookover, W. B., & Lezotte, L. (1981). Educational equity: A democratic principle at a crossroads. *The Urban Review*, 13(2), 65-71.
- [15] Buchmann, C., DiPrete, T. A., & McDaniel, A. (2008). Gender inequalities in education. *Annu. Rev. Sociol.*, 34, 319-337.
- [16] Burbules, N. C., Lord, B. T., & Sherman, A. L. (1982). Equity, equal opportunity, and education. *Educational Evaluation and Policy Analysis*, 4(2), 169-187.
- [17] Castelli, L., Ragazzi, S., & Crescentini, A. (2012). Equity in education: A general overview.
- [18] Carter, P. L., & Welner, K. G. (Eds.). (2013). *Closing the opportunity gap: What America must do to give every child an even chance*. Oxford University Press.
- [19] Chu, Y. H., & Myers, B. (2015). A social work perspective on the treatment of gifted and talented students in American public schools. *School Social Work Journal*, 40(1), 42-57.
- [20] Cervantes-Soon, C. G., Dorner, L., Palmer, D., Heiman, D., Schwerdtfeger, R., & Choi, J. (2017). Combating inequalities in two-way language immersion programs: Toward critical consciousness in bilingual education spaces. *Review of Research in Education*, 41(1), 403-427.
- [21] Cochran-Smith, M. (2010). Toward a theory of teacher education for social justice. In *Second international handbook of educational change* (pp. 445-467). Springer, Dordrecht.
- [22] Coleman, J. A. (1998). Language Learning and Study Abroad: The European Perspective. *Frontiers: The interdisciplinary journal of study abroad*, 4(2), 167-203.
- [23] Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory, and antiracist politics. *U. Chi. Legal F.*, 139.
- [24] Demeuse, M., Crahay, M., & Monseur, C. (2001). Efficiency and equity, enHutmascher, w. CochranBottani, n.(EDI). Dordrecht: Kluwer.
- [25] Deutsch, M. (1975). Equity, equality, and need: What determines which value will be used as the basis of distributive justice?. *Journal of Social Issues*, 31(3), 137-149.
- [26] Duncan, G. J., & Murnane, R. J. (Eds.). (2011). *Whither opportunity?: Rising inequality, schools, and children's life chances*. Russell Sage Foundation.
- [27] Ennis, R. H. (1976). *Equality of Educational Opportunity*. Educational Theory.
- [28] Enriquez, L. E. (2017). A 'master status' or the 'final straw'? Assessing the role of immigration status in Latino undocumented youths' pathways out of school. *Journal of Ethnic and Migration Studies*, 43(9), 1526-1543.
- [29] Espinoza, O. (2007). Solving the equity-equality conceptual dilemma: a new model for analysis of the educational process. *Educational Research*, 49(4), 343-363.
- [30] Erikson, R., & Jonsson, J. O. (Eds.). (1996). *Can education be equalized?: The Swedish case in comparative perspective*. Westview Press.
- [31] Farkas, G. (1996). Human Capital or Cultural Capital? Ethnicity and Poverty Groups in an Urban School District. *Social Institutions and Social Change Series*.
- [32] Farley, J. E. (1987). Disproportionate black and Hispanic unemployment in US metropolitan areas: The roles of racial inequality, segregation, and discrimination in male joblessness. *American Journal of Economics and Sociology*, 46(2), 129-150.
- [33] Farrell, J. P. (1999). Changing conceptions of equality of education: forty years of comparative evidence. *Comparative education: The dialectic of the global and the local*, 149-178.
- [34] Frankel, C. (1971). Equality of opportunity. *Ethics*, 81(3), 191-211.
- [35] Fullan, M. (2001). *The new meaning of educational change*. Routledge.
- [36] Gillard, J. (2009). A new progressive consensus for Australian schools. *Brookings Roundtable on Education Reform*. Retrieved from http://www.brookings.edu/~/media/Files/events/2009/0619_australian_education/0619_education_gillard.pdf.
- [37] Goldthorpe, J. H., & Goldthorpe, O. F. J. H. (2000). *On sociology: Numbers, narratives, and the integration of research and theory*. Oxford University Press on Demand.
- [38] Green, T. F. (1983). *Excellence, Equity, and Equality*.
- [39] Green, A. & Preston, J. (2001) 'Finding the Glue that Can Fix the Cracks in our Society, THES, June 22nd, 2001.
- [40] Green, A., Preston, J., & Janmaat, J. (2006). *Education, equality, and social cohesion: A comparative analysis*. Springer.
- [41] Grissom, J. A., Kalogrides, D., & Loeb, S. (2015). The micropolitics of educational inequality: The case of teacher-student assignments. *Peabody Journal of Education*, 90(5), 601-614.

- [42] Goudeau, S., & Croizet, J. C. (2017). Hidden advantages and disadvantages of social class: How classroom settings reproduce social inequality by staging unfair comparison. *Psychological science*, 28(2), 162-170
- [43] Guenther, K. M., Pendaz, S., & Songora, M. F. (2011, March). The Impact of Intersecting Dimensions of Inequality and Identity on the Racial Status of Eastern African Immigrants I. In *Sociological Forum* (Vol. 26, No. 1, pp. 98-120). Oxford, UK: Blackwell Publishing.
- [44] Hausmann, R., Tyson, L. D. A., & Zahidi, S. (2012, August). The global gender gap report 2012. Geneva: World Economic Forum.
- [45] Holm, A., Hjorth-Trolle, A., & Jæger, M. M. (2019). Signals, Educational Decision-Making, and Inequality. *European Sociological Review*.
- [46] Jencks, C. (1988). Whom must we treat equally for educational opportunity to be equal?. *Ethics*, 98(3), 518-533
- [47] Jolly, M., Mikolaitis, R. A., Shakoor, N., Fogg, L. F., & Block, J. A. (2010). Education, zip code-based annualized household income, and health outcomes in patients with systemic lupus erythematosus. *The Journal of rheumatology*, 37(6), 1150-1157.
- [48] Kenkel, D. S. (1991). Health behavior, health knowledge, and schooling. *Journal of Political Economy*, 99(2), 287-305.
- [49] Kettler, T., Russell, J., & Puryear, J. S. (2015). Inequitable access to gifted education: Variance in funding and staffing based on locale and contextual school variables. *Journal for the Education of the Gifted*, 38(2), 99-117.
- [50] Kuhl, P. K., Lim, S. S., Guerriero, S., & van Damme, D. (2019). Race and education: How inequality matters for learning.
- [51] Le, T.T.H., Tran, T., Trinh, T.P.T., Nguyen, C.T., Nguyen, T.P.T., Vuong, T.T., Vu, T.H., Bui, D.Q., Vuong, H.M., Hoang, P.H. & Nguyen, M.H (2019). Reading Habits, Socioeconomic Conditions, Occupational Aspiration, and Academic Achievement in Vietnamese Junior High School Students. *Sustainability*, 11(18), 5113.
- [52] Lemoine, P. A., Hackett, P. T., & Richardson, M. D. (2017). Global higher education and VUCA—Volatility, uncertainty, complexity, ambiguity. In *Handbook of research on administration, policy, and leadership in higher education* (pp. 549-568). IGI Global.
- [53] Leventhal, G. S. (1980). What should be done with equity theory?. In *Social exchange* (pp. 27-55). Springer, Boston, MA.
- [54] Lesley, P. (2018). *The University Challenge (2004): Higher Education Markets and Social Stratification*. Routledge.
- [55] Li, S., Sato, H., & Sicular, T. (Eds.). (2013). *Rising inequality in China: Challenges to a harmonious society*. Cambridge University Press.
- [56] Lin, N. (2000). Inequality in social capital. *Contemporary sociology*, 29(6), 785-795.
- [57] Martinez, M. E., & Mead, N. A. (1988). *Computer competence: The first national assessment*. National Assessment of Educational Progress at Educational Testing Service, Rosedale Road, Princeton, NJ 08541-0001 (No. 17-CC-01).
- [58] McKinley, E., Gan, M., Jones, A., & Bunting, C. (2014). Towards inclusive STEM education for all students. *The age of STEM: Educational policy and practice across the world in science, technology, engineering and mathematics*, 201-204.
- [59] Mount, F. (2008). Five types of inequality. *Contemporary social evils*.
- [60] National Equity Project (nd). *Why Equity? - National Equity Project*. Retrieved Jul 21, 2019, from <https://nationalequityproject.org/about/equity>
- [61] Nelson, S., Greenough, R., & Sage, N. (2009). *Achievement Gap Patterns of Grade 8 American Indian and Alaska Native Students in Reading and Math*. Issues & Answers. REL 2009-No. 073. Regional Educational Laboratory Northwest.
- [62] Nie, N., Junn, J. and Barry, K. (1996) *Education and Democratic Citizenship in America*. University of Chicago Press, Chicago.
- [63] Noltemeyer, A. L., Mujic, J., & McLoughlin, C. S. (2012). *The history of inequity in education. Disproportionality in education and special education: A guide to creating more equitable learning environments*, 3-22.
- [64] OECD (2012) *Equity and quality in education: Supporting disadvantaged students and schools*. Paris: OECD Publishing.
- [65] Patterson, A. C., & Veenstra, G. (2016). Black-White health inequalities in Canada at the intersection of gender and immigration. *Canadian Journal of Public Health*, 107(3), e278-e284.
- [66] Pickett, K., & Vanderbloemen, L. (2015) *Mind the gap: tackling social and educational inequality*. York: Cambridge Primary Review Trust.
- [67] Powell, J. J. (2015). *Barriers to inclusion: Special education in the United States and Germany*. Routledge.
- [68] Reckdenwald, A., & Parker, K. F. (2008). The influence of gender inequality and marginalization on types of female offending. *Homicide Studies*, 12(2),

- 208-226.
- [69] Reitz, J. G., Phan, M. B., & Banerjee, R. (2015). Gender equity in Canada's newly growing religious minorities. *Ethnic and Racial Studies*, 38(5), 681-699.
- [70] Ridgeway, C. L., & Kricheli-Katz, T. (2013). Intersecting cultural beliefs in social relations: Gender, race, and class binds and freedoms. *Gender & Society*, 27(3), 294-318.
- [71] Roda, A. (2015). Inequality in gifted and talented programs: Parental choices about status, school opportunity, and second-generation segregation. Springer.
- [72] Roos, P. A., & Gatta, M. L. (2009). Gender (in) equity in the academy: Subtle mechanisms and the production of inequality. *Research in Social Stratification and Mobility*, 27(3), 177-200.
- [73] Roscigno, V. J., Tomaskovic-Devey, D., & Crowley, M. (2006). Education and the inequalities of place. *Social Forces*, 84(4), 2121-2145.
- [74] Rousseau, J. J. (1950). *A Dissertation on the Origin and Foundation of the Inequality of Mankind*. The social contract and discourses (GDH Cole, Trans.). EP Dutton, New York, 196-282.
- [75] Savage, G. C., Sellar, S., & Gorur, R. (2013). Equity and marketisation: Emerging policies and practices in Australian education.
- [76] Saleh, M. (2019). Socioeconomic Inequality Across Religious Groups: Self-Selection or Religion-Induced Human Capital Accumulation? The Case of Egypt. In *Advances in the Economics of Religion* (pp. 283-294). Palgrave Macmillan, Cham.
- [77] Shavit, Y. (Ed.). (2007). *Stratification in higher education: A comparative study*. Stanford University Press.
- [78] Secada, W. G. (1989). Educational equity versus equality of education: An alternative conception. In Secada, W. G. (Ed.), *Equity and Education*, pp. 68-88. New York: Falmer Press.
- [79] Self, S., & Grabowski, R. (2004). Does education at all levels cause growth? India, a case study. *Economics of Education Review*, 23(1), 47-55.
- [80] Sen, A. K. (1982). *Choice, welfare and measurement*. Oxford: Basil Blackwell.
- [81] Simon, F., Małgorzata, K., & Beatriz, P. O. N. T. (2007). Education and training policy no more failures ten steps to equity in education: Ten steps to equity in education. OECD Publishing.
- [82] Starmans, C., Sheskin, M., & Bloom, P. (2017). Why people prefer unequal societies. *Nature Human Behaviour*, 1(4), 0082.
- [83] Tan, E., Barton, A. C., Turner, E., & Gutiérrez, M. V. (2012). Empowering science and mathematics education in urban schools. University of Chicago Press.
- [84] Tavits, M., & Potter, J. D. (2015). The effect of inequality and social identity on party strategies. *American Journal of Political Science*, 59(3), 744-758.
- [85] Tomlinson, S. (2017). *A sociology of special and inclusive education: Exploring the manufacture of inability*. London, UK: Taylor & Francis.
- [86] Tupas, R. (2015). Inequalities of multilingualism: Challenges to mother tongue-based multilingual education. *Language and Education*, 29(2), 112-124.
- [87] Tran, T., Le, T. T. H., Nguyen, T. T., Pham, A. G., Vu, T. H., Nguyen, M. H., Vuong, H. M., Vuong, T. T., Hoang, P. H., Ho, M. T. & Vuong, Q. H. (2019). The Relationship between Birth Order, Sex, Home Scholarly Culture and Youths' Reading Practices in Promoting Lifelong Learning for Sustainable Development in Vietnam. *Sustainability*, 11(16), 4389.
- [88] Tyler, W. (1977). *The sociology of educational inequality*. London: Methuen
- [89] Tyler, W. (2012). *The Sociology of Educational Inequality*. London: Routledge.
- [90] UNESCO (2015) *Education for All 2000-2015: achievements and challenges*. Paris: UNESCO.
- [91] Vuong, Q. H. (2018). The (ir) rational consideration of the cost of science in transition economies. *Nature Human Behaviour*, 2(1), 5.
- [92] Wagner, T. (2014). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need and what we can do about it*. NY: Basic Books.
- [93] Wagstaff, G. F. (1994). Equity, equality, and need: Three principles of justice or one? An analysis of "equity as desert." *Current Psychology*, 13(2), 138-152.
- [94] Walby, S. (2007). Complexity theory, systems theory, and multiple intersecting social inequalities. *Philosophy of the Social Sciences*, 37(4), 449-470.
- [95] Waldman, L. K. (1977). Types and measures of inequality. *Social Science Quarterly*, 58(2), 229-241.
- [96] Wihlborg, M., & Robson, S. (2018). Internationalisation of higher education: drivers, rationales, priorities, values and impacts. *European journal of higher education*, 8(1), 8-18.



ARTICLE

Keeping in School Shape (KiSS): A Program for Rehearsing Math Skills over Breaks from School

Carla C. van de Sande*

School of Mathematical and Statistical Sciences, Arizona State University, United States

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ABSTRACT

If you don't use it, you lose it. School breaks, during which students do not regularly participate in instruction, can therefore have negative consequences on learning. This is especially true for mathematics learning since skills build progressively on earlier materials. How can we bridge these gaps in formal instruction? The Keeping in School Shape (KiSS) program is a mobile, engaging, innovative, and cost-effective way of using technology to help students who have time off between related math courses stay fresh on prerequisite knowledge and skills. Founded on learning theory and designed on a model of behavioral change, the KiSS program embodies retrieval practice and nudges by sending students a daily multiple-choice review problem via text messaging over school break. After rating their confidence in solving the daily problem students receive feedback and a solution. This study explores measures of participation, accuracy, and confidence in an implementation of the KiSS program over winter break between two sequential introductory engineering courses at a large state university in the Southwest United States. Results indicate that careful attention should be paid to the construction of the first few days of the program, and that encouragement, additional resources for review and practice, and an increased breadth of problem difficulty may improve participation.

1. Introduction

Just like physical skills, cognitive skills grow rusty over time unless they are regularly used and practiced. This means that school breaks when students do not regularly participate in instruction can have negative consequences for learning. For instance, by a conservative estimate, summer vacation sets K-12 students back by one month of instruction; that is, it causes them to lose one month of grade-level equivalent skills relative to national norms^[1]. Although this “summer gap” effect or “slide” has been documented for many

school subjects, it is most pronounced for mathematics which requires a strong foundation of prior knowledge. And the loss of academic ground following time off from school extends into higher education too. We now know that having breaks between sequential closely related mathematics courses significantly lowers performance in the second course at the university level^[2]. How can we bridge the gap between courses and stem the loss of learning over school breaks for students in higher education who have busy lives and do not wish to spend their breaks from school studying and preparing for

*Corresponding Author:

Carla C. van de Sande,

Associate Professor, School of Mathematical and Statistical Sciences, Arizona State University, United States;

Email: carla.vandesande@asu.edu.

the upcoming semester? The Keeping in School Shape (KiSS) program was developed by the author as a mobile, engaging, innovative, and cost-effective way of meeting this need that is grounded in theories of learning and behavior. This paper describes the design, theoretical underpinnings, and implementation of the KiSS program as it was used to help university students transition between two sequential mathematics courses over winter break from university. In particular, patterns of participation and confidence ratings are examined to shed light on the potential of the KiSS program to address loss of learning over breaks in formal instruction by providing students with convenient opportunities to regularly rehearse previously learned material.

2. The Design of the KiSS Program

Figure 1 provides an overview of the design and delivery of the KiSS program. Each day over the break from school, a free bulk messaging script on Google Voice was used to send students a daily text message containing a link to an online quiz site (<https://www.flexiquiz.com/Home/Index>) where the problem of the day was found. Before seeing the problem, students chose one of five good causes that they wished to support if they answered the daily problem correctly. Next, students were shown the daily problem and asked to rate their confidence in being able to solve it correctly. They selected from five levels of confidence ranging from “not at all confident” to “very confident,” and each of the options was accompanied by a corresponding emoji. After rating their confidence, students solved the problem and responded by choosing one of five possible answers. Correct responses were rewarded with a positive, encouraging message, such as “Great job!” or “Extraordinary!” Both incorrect and correct responses were followed by a link to a video solution since viewing a solution is beneficial for learning regardless of accuracy [3]. The problems stayed open for 24 hours before being replaced by the next daily problem.

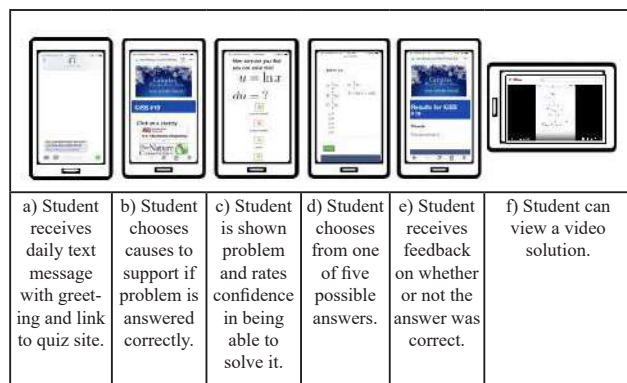


Figure 1. The KiSS program from daily text message to problem solution

The KiSS program was deliberately designed to fit into a student-centered education ecosystem [4] and as an activity that would appeal to university students. Design decisions regarding content, delivery, and visibility therefore reflect steps that were taken to limit time commitment and guard against infringement on other priorities in students’ lives. First, regarding the KiSS program content, the decision was made to construct the problems as multiple-choice items. This feature saves students both time and frustration by preventing students from having to laboriously type in involved mathematical expressions as their solutions and possibly make typographical errors (e.g., forgetting to pair up parentheses).

Another feature of the KiSS program is that it was delivered via text messaging. The intended audience for this implementation of the KiSS program consisted of young adults in their first or second year at university. Using text messaging facilitated broad general access since 92% of Millennials own a smartphone (85% for Gen Xers) [5], and smartphones are the primary means of online access for younger adults, non-whites, and lower-income Americans [6]. Furthermore, texting is aligned with the goal of being student-centered [7] since the KiSS program is then essentially at a student’s fingertips whenever they choose to engage with it.

The KiSS program was also designed to reduce feelings of math anxiety and exposure. One reason that students suffer from math anxiety is that they have a gap, or “dropped stitch,” in their prior mathematics learning [8]. Being confronted with a daily problem from material that a student has supposedly mastered and is expected to have retained for future learning might well trigger math anxiety in some students. Therefore, the KiSS program provided solutions to the problems to help refresh memory of relevant skills and concepts, and also allowed students in the program to cloak their visibility through participation using self-selected code names.

The student-centered nature of the KiSS program is further evident in the way that students were encouraged to participate. In addition to the intrinsic motivator of staying fresh on relevant skills and concepts, the KiSS program includes charitable giving as an incentive. This design decision reflects the characteristics, priorities, and ideals of the student audience, which is on the cusp of two generations, “millennials” (born roughly from 1980–2000) and the following generation known as “Generation Z” (born roughly from 1995–2010). Both of these generations have a reputation for being tech-savvy and generous. For instance, a survey of more than 35,000 millennials revealed that 52% were interested in monthly

giving, and 85% were motivated to give by a compelling mission or cause^[9]. Similarly, Generation Z members have been dubbed “philanthroteens” since 32% of UK and US Generation Z members surveyed reported having already donated money^[10]. Therefore, before answering the daily KiSS problem, students were asked to choose one of five good causes that would receive a point if they answered correctly. Four of the causes were non-profit organizations (spanning scientific research, humanitarian aid, nature conservation, and animal protection) and one was a university scholarship fund. At the end of the program, the cause with the largest number of points received that amount in dollars.¹

Each of these pragmatic design decisions was made so that students could have opportunities to regularly and conveniently practice previously learned skills and concepts over breaks from formal instruction. The inspiration for providing these opportunities in this way has been rooted in theories of learning and behavior.

3. Theoretical Framework

“If you don’t use it, you lose it” is the sad reality of what happens if skills are not used for lengthy periods of time. Therefore, it makes sense that a solution to losing ground over breaks from school lies in providing students with noticeable opportunities to regularly use what they have learned and need to retain when they are not in school. Daily problems delivered to students via text messages are one way of meeting this need since they serve as attention-grabbing prompts, or nudges, to retrieve previously learned materials. Theories explaining the benefits of retrieval practice are related to memory enhancement, and nudges are recognized as an effective way of bringing about behavioral change.

3.1 Retrieval Practice

The benefits of taking a memory test, or retrieval practice, have been repeatedly documented in both laboratory settings and in classrooms^[11,12]. Retrieval practice leads to flexible understanding, improves higher order thinking skills, and promotes knowledge transfer by making apparent to students what they have and have not mastered^[13]. A central idea of retrieval practice is that testing can be used as a study resource. Although testing is usually thought of as a neutral activity (one that allows learning outcomes to be measured), there is now substantial evidence supporting the fact that taking a test usually enhances later performance on the material relative to rereading it or to having no re-exposure at all^[14]. This phenomenon

has been dubbed the “testing effect”^[15]. In essence, testing provides students with retrieval practice opportunities that have been shown to be beneficial not only for retaining information, but also for knowledge transfer^[16-18].

Theoretical explanations for the testing effect focus on how retrieval practice affects memory. For instance, it has been posited that retrieval practice leads to the elaboration of existing memory traces or the creation of additional retrieval paths, thereby making future retrieval of information more likely^[19-21]. In a related vein of thought, the act of retrieval practice constitutes an effortful recall of information and increased reprocessing of memory traces to benefit long-term retention of the information^[22,23]. Thus, the general idea is that testing can be a valuable study technique because it solidifies memories which is precisely what is needed to help stem learning loss over breaks from formal instruction. A model of behavioral change speaks to why daily testing is the best way to get students to engage in memory testing.

3.2 Nudges

Just a brief amount of helpful information delivered in a visible and timely manner can promote a certain behavior. The power of such “nudges”^[24] has been well established in contexts that range from personal lifestyle issues^[25] to major life decisions^[26] advice, support, and reminders^[27,28], especially to at-risk populations^[29,30]. Although nudges can come from many sources (e.g., public announcements), nudges from an interested party can not only lead to changed behaviors but can also build key relationships. Most directly relevant for the purpose of designing the KiSS program, nudges from instructors have shown promise for increasing student engagement^[31] and preventing summer learning loss of literacy skills^[32]. Potential KiSS program participants were aware through recruitment materials that the KiSS program was designed and delivered by an instructor (the author) at their university. The underlying message was that a faculty member cared about their future success since formal and informal faculty-student interactions that reinforce and extend intellectual goals and purposes have been repeatedly linked to enhanced student learning^[33-37], particularly for freshman^[38]. Furthermore, conceptualizing the KiSS program as a “nudge campaign” makes sense because the delivery of nudges in the form of text messages has been shown to be effective for reaching college students^[28].

4. Methodology

This is an observational study in the sense that participants were volunteers who were not assigned to any treatment condition. For each participant, the dates and timing of participation, charitable giving selection, confidence

¹ The author supplied the funds for this study. However, as the KiSS program is scaled up to include more participants, one idea is to solicit sponsors who agree to donate funds for each correct answer to the causes chosen by their sponsored student(s).

ratings, and response to each problem were collected on the online quiz site for descriptive analysis. These measures provided insight into participation, accuracy, and confidence over the implementation of the KiSS program.

4.1 Participants

The KiSS program was implemented over winter break at a large university in the Southwest United States between two sequential mathematics courses, so participants had just completed the first course in the Introductory Engineering Calculus sequence during the fall semester and were planning on enrolling in the second course in the sequence in the upcoming spring semester following the break. The KiSS program ran for 25 consecutive days when the university was not in session for winter break, excluding two major holidays (Christmas Day and New Year’s Day) during that time period. Students were recruited by fliers (Figure 2) delivered to several classrooms (different sections of the first course in the sequence) during the last week of classes before winter break began. If they wished to enroll in the KiSS program, students texted a self-selected code name to the KiSS program number that was printed on the flier. In addition to protecting student identity, these unique code names allowed the author to track each student’s activity throughout the KiSS program. All students were at least 18 years of age and consented to participate before viewing their first daily problem. Students were also informed that they could end their participation in the program at any time without any penalty or negative consequences. In the interest of promoting the perception of the KiSS program as a review resource (rather than as a research study), no demographic information was collected.



Figure 2. KiSS program advertisement flier

4.2 Materials

Mathematics builds on prior knowledge, and many problems in mathematics require fluency with previously learned material. For instance, when students are learning multi-digit multiplication, they need to be able to readily recall their addition facts and how to add multi-digit

numbers, both skills which were taught in prior years. The same is true for the Introductory Engineering Calculus course sequence; many problems in the second course require fluency with material taught in the first course. Therefore, each of the 25 problems in the winter break KiSS program was included because it represented a skill that students need to retain in order to solve problems in the second course in the sequence. There were roughly three major topics covered in the winter break KiSS program, namely integration, differentiation, and limits. Within each of these topic areas, problems were selected based on the author’s extensive familiarity with the second course in the sequence and the skills from the first course that students often had trouble recognizing or recalling (e.g., the chain rule). Examples of KiSS problems are shown in Figure 3.

$\int (3 + 4 \sin \theta - 2 \cos \theta) d\theta$	$\frac{d}{dx} \cos(4x)$	$\lim_{t \rightarrow \infty} -e^{-t^2}$
A) $-4 \cos \theta - 2 \sin \theta + C$	A) $-4 \sin(4x)$	A) ∞
B) $4 \cos \theta + 2 \sin \theta + C$	B) $4 \sin(4x)$	B) $-\frac{1}{\infty}$
C) $3\theta - 4 \cos \theta - 2 \sin \theta + C$	C) $-\sin(4x)$	C) $-\infty$
D) $3\theta + 4 \cos \theta - 2 \sin \theta + C$	D) $\frac{1}{4} \sin(4x)$	D) 0
E) $3\theta + 4 \cos \theta + 2 \sin \theta + C$	E) $\sin(4x)$	E) $\frac{1}{\infty}$

Figure 3. Examples of KiSS problems for integration (left), differentiation (middle), and limits (right)

5. Findings

Although future work will portray the perspectives of various KiSS program participants and outcomes pertaining to subsequent course performance, the results reported here focus on the interaction of participants with the program. Measures of participation, accuracy, and confidence were analyzed to paint a picture of daily student activity during this implementation of the KiSS program. An analysis of charitable giving selections is not included in this paper.

5.1 Participation

Students were free to participate on any given day of the KiSS program. Therefore, looking at overall daily participation and individual amounts and patterns of participation can provide useful insight into how students responded to this implementation of the KiSS program.

5.1.1 Participation over Time

Because the number of students who received the invitation to participate in the KiSS program is unknown, it is not possible to calculate a precise participation rate. However, one measure of participation can be found by comparing the number of students who engaged in the

KiSS program with the number of students who demonstrated initial interest in participation; 59% of the students who selected a code name and texted it to the number on the flier after learning about the KiSS program went on to answer at least one of the daily problems.

Figure 4 shows how the percentage of enrolled students responding to the daily KiSS problem varied over the duration of the program. As shown in Figure 4, participation generally decreased over time with the largest drop in participation following the first 3 days of the KiSS program. Christmas Eve was the day with the fewest number of students participating. On Christmas Day (between KiSS problem #15 and #16) and New Year’s Day (between KiSS problem #21 and #22), no KiSS problem was posted. However, on Christmas Day, an update revealing the current amount of points for each of the charitable causes was sent to students, and this may explain the dramatic increase in participation for KiSS #16 on the following day. In contrast, there was no drop in participation on New Year’s Eve and only a small decrease in participation for KiSS #22 for the day following New Year’s Day on which no problem or update was sent out.

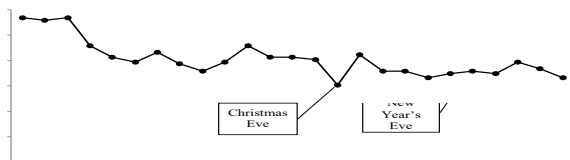


Figure 4. Percentage of students enrolled in the program who answered each KiSS problem. Hash marks represent holidays

5.1.2 Participation Amounts

Answering the question on any given day of the program was optional, so students could participate in the KiSS program as much or as little as they wished. However, only two students actively stopped participation by requesting removal of their phone numbers from the list. Figure 5 shows the number of total problems solved by students over the 25-day break. On average, students answered about 10 problems (approximately 41% of the total number of problems). As can be seen, however, the distribution of participation was roughly bimodal: students either participated very rarely (answering 5 or fewer problems) or quite often (answering more than 16 problems). Relatively few students demonstrated mid-level participation.

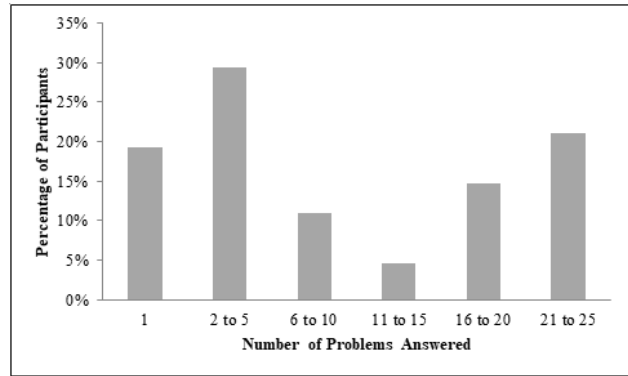


Figure 5. Number of problems answered by students.

5.1.3 Participation Amounts and Patterns

An examination of the amount and timing of participation revealed general shared patterns of activity. Figure 6 shows the date, day of the week, and problem number for the students who only answered a single KiSS problem; each row represents the participation pattern of a student, and shaded boxes indicate that the student answered the daily problem, whereas empty boxes indicate that the student did not participate. As can be seen, students who only answered one KiSS problem generally participated early in the program, i.e., on the first day or during the first week.

Date	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27	28	29	30	31	2	3	4	5
Day	M	T	W	TH	F	S	Su	M	T	W	T	F	S	Su	M	W	TH	F	S	Su	M	W	TH	F	S
KiSS Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Cruise																									
cminalop																									
Athenian																									
Woot																									
erikweidner																									
Katya																									
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Ihathamath																									
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MR97																									
azarf																									
OGMudbone																									
Madeline																									
mathsucks																									
Jdog																									
BryBry																									
Borchert																									
Captn																									
Aldo																									

Figure 6. Participation date, day of the week, and problem number for students who just participated once in the KiSS program

Figure 7 shows the participation activity for students who participated between two and five times. The students who only participated twice generally answered a problem and then, after a few days, a second problem toward the beginning of the KiSS program. Students who participated between 3 and 5 times participated in small clusters of sequential days, but also generally toward the start of the program. Some of these students, however, demonstrated what might be characterized as “bookend”

activity by answering a small number of problems at the beginning of the program and then returning toward the end of the program to answer a few more problems. Students who answered 6 to 15 of the problems had more simultaneous days of participation in each cluster, but showed a similar participation pattern to the students who answered between two and five problems with activity concentrated during the first week of the program and then falling off in the second week.

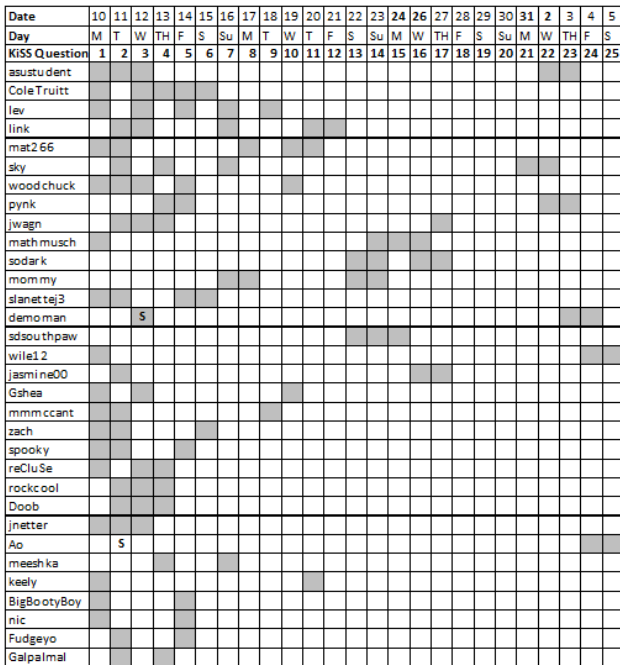


Figure 7. Participation date, day of the week, and problem number for students who participated between 2 and 5 times in the KiSS program²

Students who participated between 16 and 20 times showed large clustered days of participation with gaps in participation that spanned a few days (rather than being regularly interspersed throughout the program), as seen in Figure 8. These students appeared to take breaks (perhaps while on vacation) and then resume long stretches of participation. Finally, Figure 9 shows the activity patterns of students who answer 21 or more problems. These students generally only skipped a single day here and there over the course of the program.

Table 1 describes and characterizes the categories of participation that emerged from looking at participation patterns over the duration of the KiSS program. As participation increased in amount from answering only a single problem to answering 21 or more of the 25 problems, participation on sequential days increased and the length of gaps between these sequences of

²Some students (n=6) registered after the program had begun. An “s” in the chart indicates the day that they joined.

participation decreased.

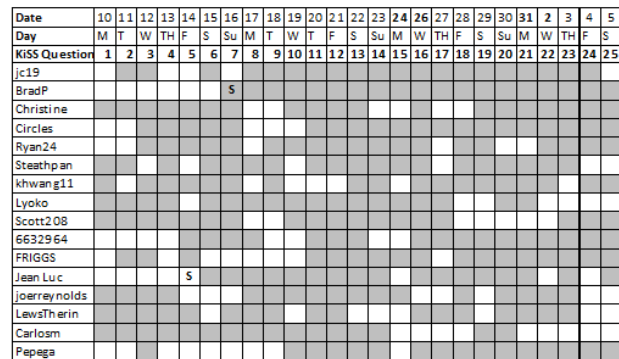


Figure 8. Participation date, day of the week, and problem number for students who participated between 16 and 20 times in the KiSS program

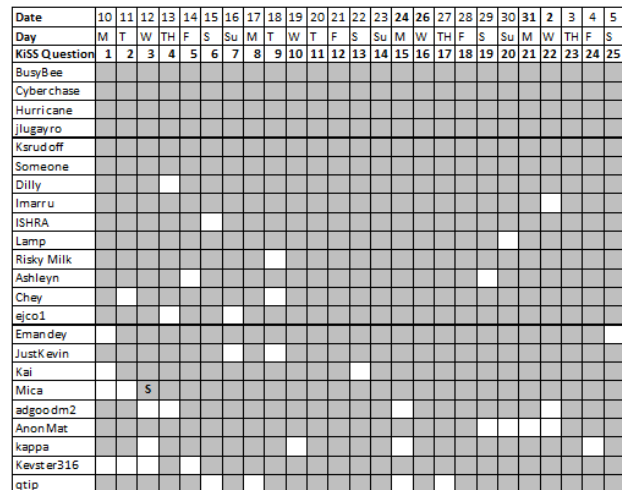


Figure 9. Participation date, day of the week, and problem number for students who participated more than 21 times in the KiSS program

Table 1. Description and characterization of KiSS program participation

Number of problems	Description of participation
1	Participated just once, generally during the first week of the program
2-5	Participated on short clusters of days, generally toward the beginning of the program
6-15	Participated on larger clusters of days, generally toward the beginning of the program
16-20	Participated on larger clusters of days, with short breaks before resuming participation
21-25	Participated regularly, with few, if any, isolated days of non-participation

5. 2 Accuracy

The main purpose of the KiSS program is to provide regular opportunities to rehearse previously learned material.

In this study, all of the problems were taken from the curriculum of the first course in the Introductory Engineering Calculus sequence that the students had just successfully completed. On average each student correctly answered 63% of the daily problems to which they responded. As Figure 10 shows, though, students who participated more in the program (e.g., answering 11 or more questions) answered a larger percentage of their problems correctly than did students who participated less.

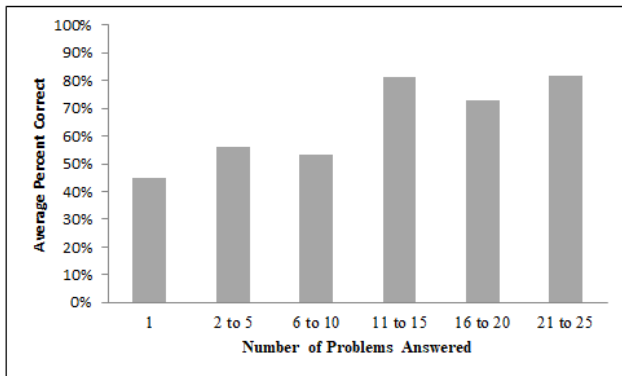


Figure 10. Average percent of problems correctly answered by number of problems answered.

Accuracy also varied across the different KiSS problems. Figure 11 shows the percentage of students who responded to each problem correctly. Across all problems, accuracy ranged from 4% (KiSS problem #16) to 57% (KiSS problem #14), indicating that students were less prepared to solve some problems in the KiSS program than others.

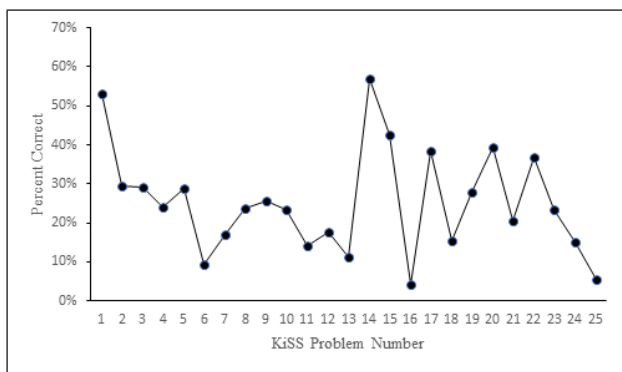


Figure 11. Percent of students who responded correctly to each KiSS problem

5.3 Confidence

Table 2 shows the distribution of confidence ratings made by students. After viewing the daily problem, students were quite confident that they would solve it; only 13% of the total ratings were either not very confident or not at all confident. And, as Figure 12, shows, students were generally accurate when they predicted they would be

able to correctly solve the daily problem; when students thought they would be able to solve the problem correctly, they were able to do so. On the other hand, there was also an indication that students underestimated their ability; almost half of the time students who were not at all confident that they would be able to correctly solve the problem were able to do so.

Table 2. Percent of ratings by confidence level

	not at all confident	not very confident	neutral	somewhat confident	very confident	Total
Percentage of ratings	5%	8%	23%	26%	38%	100%

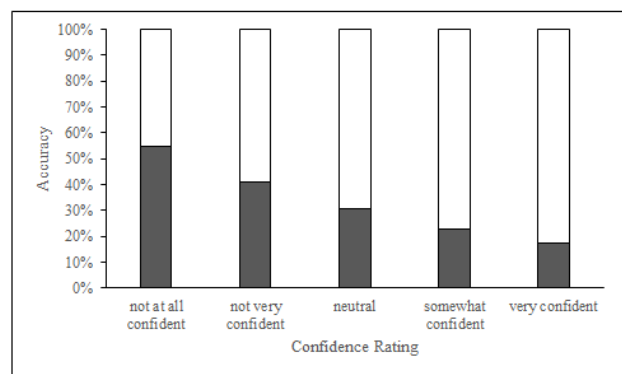


Figure 12. Percent accuracy for each confidence rating (Dark/light represents percent of inaccurate/accurate responses, respectively.)

As Figure 13 shows, confidence also varied with amount of participation. With the exception of students who only participated once, students who participated in less of the program were less confident that they would be able to correctly solve the daily problem. Students who participated only once displayed confidence ratings more similar to students who participated very regularly throughout the entire program, despite having lower accuracy on average (Figure 9).

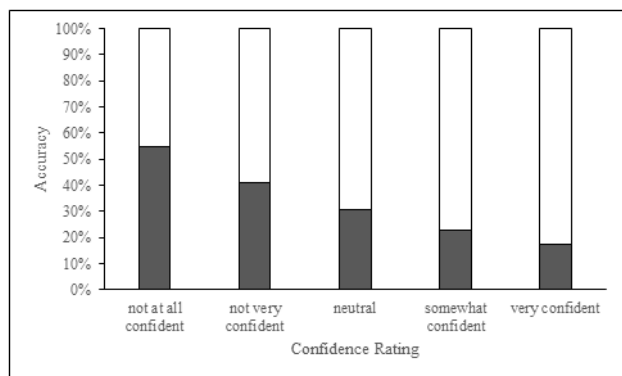


Figure 13. Percent of confidence ratings below neutral by number of problems answered

6. Discussion

This study explored participation, accuracy, and confidence in a KiSS program that was conducted during a winter break from university between two sequential introductory engineering mathematics courses. Students were texted a daily reminder containing a link to a multiple-choice problem from the first course that was considered a requisite skill or concept for the upcoming second course. After rating their confidence in being able to solve the daily problem, students indicated their response and then were provided with feedback and a solution. The KiSS program, in some ways, resembled a Massive Open Online Course (MOOC) in that it was advertised as a resource to help students maintain requisite skills during the break, and participation in the program was strictly voluntary and anonymous. Thus, students who enrolled in the KiSS program were able to participate as much, or as little, as they chose to without being penalized by an instructor. It is therefore not surprising that participation in this KiSS program was similar to that of MOOC participation with the largest amount of participation in the first few days of the program (about 50% of the those enrolled), followed by a sharp and then more gradual decline over subsequent weeks^[39]. The completion and attrition rates in the KiSS program might be accounted for to some extent by students' original intent^[40]. Some students who enrolled in the program may have done so with the intent of participating daily but then lost resolve after a short period of time, whereas other students may have enrolled with only the intent to see what the program was like but then become regular participants. Although this study did not collect data on intent, both of these potential outcomes point to the need to spark student interest immediately following program enrollment and to make the beginning of the program inviting and compelling.

One way to make the KiSS program more appealing to students might be to provide affective and cognitive support following incorrect responses. Despite the fact that the KiSS program consisted entirely of review material in multiple-choice format from a course that was just completed, many problems were answered incorrectly. Even though the program was deliberately designed to be non-threatening, getting such review problems incorrect may have a negative impact on students, especially those with lower self-efficacy^[41]. It is therefore worth considering the incorporation of messages to target persistence and growth mindset^[42], along with the inclusion of additional study and practice resources, into future KiSS program design.

In addition to lower accuracy, students who participated less in the program showed less confidence in their ability

to solve the daily problem. Therefore, another way to encourage persistence might be to incorporate a range of problem difficulty levels in the KiSS program. Ideally, the selection and difficulty of each daily problem would be tailored to individual student ability with the aim of boosting the self-confidence of students who are unable to recall a particular skill or concept, while at the same time allowing other students to challenge themselves and not become bored. In addition to potentially improving participation, adaptive problem selection based on dynamically generated problem difficulties has been shown to have a positive effect on student learning performance^[43].

Taken together, analyses of participation, accuracy, and confidence in this implementation of the KiSS program provide valuable insight into ways that the program can be improved and optimized for future implementation. The ultimate goal is to bridge the gap between sequential courses and stem the loss of learning by providing regular and convenient retrieval practice opportunities over school breaks. Future work will include outcome measures, such as perception of preparedness and course retention, and experimental studies to determine whether the KiSS program is living up to its name by keeping students in shape over breaks from formal instruction.

7. Conclusion

In the same way that a daily desk calendar can prompt people to work on a solution to a puzzle (e.g., a tangram) when they rip off the previous page and see the new puzzle for the first time, the KiSS program puts a daily math problem in front of students to entice them to solve it. Unlike paper desk calendars, though, the KiSS program delivers a nudge campaign through text messages so that it is accessible and visible to a broad student audience. Implementing the KiSS program to university students enrolled in a sequence of introductory calculus courses over winter break revealed that this strategy has promise for getting students to test themselves regularly. In doing so, they rehearsed previously learned material that is requisite for future learning and were made aware of gaps in their knowledge. The KiSS program therefore represents a viable resource that supports retrieval practice over breaks from formal instruction.

An additional benefit of the KiSS program is that the underlying concept can be implemented in a wide range of instructional contexts in which lengthy time gaps contribute to student inactivity. In particular, the KiSS program is easily adaptable for use in other subject areas and with other student populations as a resource to reach students when they are outside of the classroom for an extended period of time. Assembling a library of various

nudges (questions, problems, etc.) for this purpose could be a community endeavor in which instructors with shared experiences contribute material that they deem worthy of student rehearsal. In this way, the KiSS program not only connects individual instructors with students but can also serve as a collaborative frame for instructors to engage in action research.

New learning is constructed and built upon prior knowledge. Therefore, keeping requisite knowledge fresh and accessible is vital for student success. This paper describes a pioneering effort to use a novel combination of various technologies to reach students when they are away from the classroom and encourage them to rehearse essential skills and concepts. By heeding lessons learned from experience and also thinking ahead about design and implementation improvements and expansion, the hope is that the KiSS program concept will help many students stay in shape as they reach each new stage in their educational journey.

References

- [1] Cooper, H., Nye, B., Charlton, K., Lindsay, J., & Greathouse, S. (1996). The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. *Review of Educational Research*, 66(3), 227–268.
- [2] van de Sande, C. & Reiser, M. (2018). The effect of summer break on engineering student success in calculus. *International Journal of Research in Education and Science (IJRES)*, 4(2), 349–357.
- [3] Bangert-Drowns, R.L., Kulik, C.C., Kulik, J.A., & Morgan, M. (1991). The instructional effects of feedback in test-like events. *Review of Educational Research*, 61(2), 213–238.
- [4] U.S. Department of Education, Office of Educational Technology. (2017). *Reimagining the Role of Technology in Higher Education: A Supplement to the National Education Technology Plan*, Washington, D.C.
- [5] Jiang, J. “Millennials stand out for their technology use, but older generations also embrace digital life.” Pew Research Center, Washington, D.C. (May 2, 2018) <https://www.pewresearch.org/fact-tank/2018/05/02/millennials-stand-out-for-their-technology-use-but-older-generations-also-embrace-digital-life/>
- [6] Anderson, M. “Mobile Technology and Home Broadband 2019.” Pew Research Center, Washington, D.C. (June 13, 2019). <https://www.pewinternet.org/2019/06/13/mobile-technology-and-home-broadband-2019/>
- [7] Dabbagh, N., Bass, R., Bishop, M., Costelloe, S., Cummings, K., Freeman, B., Frye, M., Picciano, A. G., Porowski, A., Sparrow, J., & Wilson, S. J. (2019). *Using technology to support postsecondary student learning: A practice guide for college and university administrators, advisors, and faculty*. Washington, DC: Institute of Education Sciences, What Works Clearinghouse. (WWC 20090001) Washington DC: National Center for Education Evaluation and Regional Assistance (NCEE), Institute of Education Sciences, U.S. Department of Education. <https://whatworks.ed.gov>
- [8] Farrell, E. F. (2006). Taking anxiety out of the equation. *Chronicle of Higher Education*, 52(19), 41–42.
- [9] The Millennial Impact Report. (2015). *Top 100 Findings from the Millennial Impact Project*. Achieve and The Case Foundation. Retrieved from <http://www.themillennialimpact.com/index.php/past-research>
- [10] The Cassandra Report. (2017). *The Gen Z Effect*. New York: NY. Retrieved from <https://cassandra.co/reports/2017/06/29/the-gen-z-effect>
- [11] Butler, A. C., Marsh, E. J., Slavinsky, J. P., & Baraniuk, R. G. (2014). Integrating cognitive science and technology improves learning in a STEM classroom. *Educational Psychology Review*, 26, 331–340.
- [12] McDaniel, M. A., Anderson, J. L., Derbish, M. H., & Morrisette, N. (2007). Testing the testing effect in the classroom, *European Journal of Cognitive Psychology*, 19(4/5), 494–513.
- [13] Agarwal, P., Roediger, H. L., McDaniel, M. A. & McDermont, K. B. (2013). How to use retrieval practice to improve learning. Washington University in St. Louis: Institute of Education Sciences. Retrieved from <http://psychnet.wustl.edu/memory/wp-content/uploads/2018/04/RetrievalPracticeGuide.pdf>
- [14] Roediger, H. L., III & Butler, A. C. (2011). The critical role of retrieval practice in long-term retention. *Trends in Cognitive Science*, 15(1), 20–27.
- [15] Roediger, H.L., III, & Karpicke, J. D. (2006). The power of testing memory: basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181–210.
- [16] Butler, A.C. (2010). Repeated testing produces superior transfer of learning relative to repeated studying. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 36, 1118–1133.
- [17] Johnson, C.I., & Mayer, R.E. (2009). A testing effect with multimedia learning. *Journal of Educational Psychology*, 101, 621–629.

- [18] Rohrer, D., Taylor, K., & Sholar, B. (2010). Tests enhance the transfer of learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 36, 233–239.
- [19] Carpenter, S.K. (2009). Cue strength as a moderator of the testing effect: the benefits of elaborative retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 35, 1563–1569.
- [20] Bjork, R.A. (1975). Retrieval as a memory modifier: an interpretation of negative recency and related phenomena. In *Information Processing and Cognition* (Solso, R.L., ed.), pp. 123–144, Wiley.
- [21] McDaniel, M.A. & Masson, M.E.J. (1985). Altering memory representations through retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11, 371–385.
- [22] Pyc, M.A. & Rawson, K.A. (2009). Testing the retrieval effort hypothesis: does greater difficulty correctly recalling information lead to higher levels of memory? *Journal of Memory and Language*, 60, 437–447.
- [23] Gardiner, J.M. et al. (1973) Retrieval difficulty and subsequent recall. *Memory and Cognition*, 1, 213–216.
- [24] Thaler, R. H. & Sunstein, C. R. (2008). *Nudge: Improving Decisions About Health, Wealth, and Happiness*. 2nd ed., New Haven, CT: Yale University Press.
- [25] Woolford, S. J., Clark, S. J., Strecher, V. J. & Resnicow, K. (2010). Tailored mobile phone text messages as an adjunct to obesity treatment for adolescents. *Journal of Telemedicine and Telecare*, 16(8), 458–461.
- [26] Castleman, B. L. & Meyer, K. (April, 2016). Can text message nudges improve academic outcomes in college? Evidence from a West Virginia Initiative, EdPolicy Works Working Paper Series, No. 43.
- [27] Karlan, D., McConnell, M., Mullainathan, S., & Zinman, J. (2010). Getting to the top of mind: How reminders increase saving (No. w16205). National Bureau of Economic Research.
- [28] Obermayer, J. L., Riley, W. T., Asif, O., & Jean-Mary, J. (2004). College smoking cessation using cell phone text messaging, *Journal of American College Health*, 53(2), 71–78.
- [29] Castleman, B. L. & Page, L. C. (June, 2014). Freshman year financial aid nudges: An experiment to increase FAFSA renewal and college persistence. EdPolicy Works Working Paper Series, No. 29.
- [30] Castleman, B. L. & Page, L. C. (2015). Summer nudging: Can personalized text messages and peer mentor outreach increase college going among low-income high school graduates? *Journal of Economic Behavior & Organization*, 115, 144–160.
- [31] Kraft, M. A., & Dougherty, S. M. (2013). The effect of teacher–family communication on student engagement: Evidence from a randomized field experiment. *Journal of Research on Educational Effectiveness*, 6(3), 199–222.
- [32] Kraft, M.A., & Monti-Nussbaum, M. (2017). Can schools enable parents to prevent summer learning loss? A text messaging field experiment to promote literacy skills. *The ANNALS of the American Academy of Political and Social Science*, 674(1), 85–112.
- [33] Astin, A. (1993). *What Matters in College: Four Critical Years Revisited*, San Francisco: Jossey Bass.
- [34] Ewell, P., & Jones, D. (1996). Indicators of “good practice” in undergraduate education: A handbook for development and implementation, Boulder, CO: National Center for Higher Education Management Systems.
- [35] Pascarella, E. T., & Terenzini, P. (1991). *How College Affects Students: Findings and Insights from Twenty Years of Research*, San Francisco: Jossey-Bass.
- [36] Tinto, V. (1993). *Rethinking the Causes and Cures of Student Attrition* (2nd ed.). Chicago: University of Chicago Press.
- [37] Tinto, V. (2000). Linking learning and leaving: Exploring the role of the college classroom in student departure. In J. M. Braxton (ed.), *Reworking the Student Departure Puzzle* (pp. 81–94), Nashville: Vanderbilt University Press.
- [38] Pascarella, E.T.&Terenzini,P.T. (1977). Patterns of student-faculty informal interaction beyond the classroom and voluntary freshman attrition. *Journal of Higher Education*, 48(5), 540–552.
- [39] Ho, A.D, Reich, J, Nesterko, S, Seaton, D.T, Mullaney, T, Waldo, J, & Chuang, I. (2014). The first year of open online courses HarvardX and MITx (Working Paper No. 1).
- [40] Reich, J. (2014). MOOC Completion and Retention in the Context of Student Intent. *Educause Review*. Retrieved from: <https://er.educause.edu/articles/2014/12/mooc-completion-and-retention-in-the-context-of-student-intent>
- [41] Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist*, 28(2), 117–148.
- [42] Yeager, D. S., Hanselman, P., Walton, G. M., Murray, J. S., Crosnoe, R., Muller, C., Tipton, E., Schneider, B., Hulleman, C. S., Cintia P., Paunesku, D., Romero, C., Flint, K., Roberts, A., Trott, J., Iachan,

R., Buontempo, J., Yang, S. M., Carvalho, C. M., Hahn, P. R., Gopalan, M., Mhatre, P., Ferguson, R., Duckworth, A. L. & Dweck, C. S. (2019). A national experiment reveals where a growth mindset improves achievement. *Nature*. Retrieved from <https://doi.org/10.1038/s41586-019-1466-y>

[43] Mitrovic, A, Martin B. (2004). Evaluating adaptive problem selection. In De bra, P, Nejd, W (eds.) *Third International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems (Ah'2004)* (pp.

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