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Self-Regulated Learning in Kenyan Classrooms: A Test of ePEARL, a Process e-Portfolio[1]

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To align with Kenya 2030 Vision of education for self-reliance, there is a growing need for classroom instruction that develops students' capacity to be in control of their learning. This paper reports a two-year study that tested feasibility of implementing ePEARL, an e-portfolio, in the context of Kenyan public schools. By design, the digital portfolio supports the key learning processes though the phases of self-regulated learning -- forethought, performance, and self-reflection. In this study, students (N=137) from four secondary classrooms used the tool as part of classroom instruction to complete their project assignments. Repeated measures analyses revealed that, over-time, students who demonstrated fuller use of ePEARL made significantly higher gains and reported higher level of self-regulated strategies compared to their classmates who hardly used the tool. The results suggest that in order to yield important benefits, the tool should be meaningfully integrated into classroom instruction.

Keywords: electronic portfolio; Kenya; secondary education; self-regulated learning; student achievement

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INTRODUCTION

Countries of the developing world increasingly express the need for their education systems to develop active, autonomous individuals capable of advancing their national economies in the 21st century. Educational reforms have introduced competency-based curricula privileging student-centered pedagogies. For instance, the Kenya Vision 2030 strategy highlights the importance to develop "independent, confident, co-operative, and inspired learners" (Kenya Institute for Curriculum Development [KICD], 2017, p.10). Yet, in developing contexts, pedagogical interventions that foster skills to learn independently through the years of schooling remain sparse (e.g., Stephen et al., 2018). Based on the Zimmerman's model of self-regulation (2000), we designed an intervention that uses a digital portfolio tool (e.g., Meyer et al., 2010) to explicitly support students' self-regulatory practices. We studied the feasibility of this intervention in a handful of Kenyan low-secondary classrooms. A brief summary of this study foundations follows.

Self-regulated Learning

Independence in learning is associated with several concepts including learner autonomy, self-directedness, and self-regulation. Within cognitive psychology self-regulated learning (SRL) implies independence in learning where self-regulated learners understand their learning, are intrinsically motivated and actively engaged in and take responsibility for their learning. Drawing on the motivational theories of learning, metacognition, theories of self, the existing models of SRL are many but they agree on a general time-ordered view of learning sequence including planning, monitoring and control that student follow as they perform a task (Azevedo, 2009). In this study we rely on the cyclical model by Zimmerman who defines SRL as "self-generated thoughts, feelings and actions that are planned and cyclically adapted to the attainment of personal goals" (Zimmerman, 2000, p.14). It encompasses both meta-cognitive and motivational aspects of learning that unfold through the phases of forethought, performance, and self-reflection. In the three phases, students activate and sustain cognition, behaviours, and affects that systematically orient them toward the attainment of learning goals (Zimmerman & Schunk, 2011). In the forethought phase, goal setting and strategic planning is affected by learners' self-motivation beliefs in the form of self-efficacy, outcome expectations, intrinsic interest or value, and goal orientation. In the performance phase, learners participate in the processes of self-instruction, attention focusing, self-recording and self-experimentation and use task strategies, to yield vital information about how well they are progressing towards a goal. Finally, at the self-reflection phase, the processes of self-judgment and self-reaction are triggered as learners evaluate themselves relatively to others, attribute their successes and failures, experience self-satisfaction, and activate adaptive-defensive responses to the achieved outcome. Constant monitoring and subsequent correction of one's own performance based on feedback about recent efforts enable the cyclical nature of the self-regulation process. To reflect interactive learning contexts in which shared knowledge construction and collaboration emerge, individual cognitive-constructive theories of SRL like that by Zimmerman have been extended to also include social forms of regulation such as co-regulation and shared regulation (e.g., Hadwin et al., 2018).

There is a consensus in the research literature that SRL does not merely involve students' lonely effort. Classroom instruction plays the important role in enabling and supporting SRL explicitly. Specifically, systematic evidence of impacts that self-regulation has on academic performance, motivation to learn, and development of study skills and strategies clearly points to the benefits of self-regulation instruction for primary- and secondary-school students' learning. For instance, Dignath and Büttner's meta-analysis (2008) report the average effect sizes of SRL instructional programs on the primary and secondary students' achievement as + 0.61 and + 0.51, and + 0.75 and + 0.17 on their motivation outcomes respectively. The long-term effects of SRL instruction on student academic performance (+0.63) is reported in de Boer et al. (2018).

SRL and Digital Portfolio

Grown within the constructivist paradigm, a portfolio has been noted for its twofold value for student-centred instruction. It is a meaningful way to document one's learning path and progress, on the one hand, and to support processes that influence learning, on the other (e.g., Jonassen, 1991; Shelton, 2011). Portfolios have many uses and can be grouped in developmental or process, showcase and assessment portfolios (Abrami & Barrett, 2005). All types can serve to display selected work, enable learners to reflect on how they meet the assessment criteria and edit their work based on the feedback. Yet, it is only the process portfolio that offers embedded structures and strategies to support the processes of individual learning. By engaging students into planning, organization and development of their own learning, it supports students' metacognition, time-management, abilities to regulate their own physical and social environment and to control their effort and attention. According to Barret (2007), the process portfolio is a personal learning management tool meant to explicitly encourage individual growth and to yield a purposeful collection of work in one or more discipline areas that demonstrates a learner's efforts, progress and achievement.

Computer technologies added value to traditional paper-based portfolios. In digital portfolios students keep traces of learning through time and across subject areas, connect ideas, relate information and feed reflection processes, among other things. Further, the evolution of web technologies has been especially beneficial for the process portfolios allowing for anytime and anywhere learning. Not only a process e-portfolio engages a learner in knowledge construction by scaffolding SRL processes of goal-setting, self-monitoring, and reflection but also enables input from peers and more knowledgeable others and aggregates these inputs into overviews of personal progress.

Digital portfolios as knowledge tools have been used in instruction for over two decades and mostly in professional education and career development (e.g., teacher education, health sciences). Hence, the bulk of evidence on e-portfolios comes from the context of tertiary school and has been generated by western research. In the Global South, the study of the benefits of digital portfolios for university students has incurred some growth too (Modise & Mudau, 2021). The publications in this journal (e.g., Hendikawati et al., 2019; Karami et al., 2019; Lukitasari et al., 2020) are indicative of this interest. Meanwhile, the research on digital portfolio interventions in primary and secondary school remains sparse on a global scale. To date the systematic review by Blaustein and Lou's (2014)

synthesized 26 studies of e-portfolio implementation in K-12 settings. They revealed positive effects of the portfolio technology on a range of learning outcomes including self-regulation skills, motivation and academic achievement. Their findings also suggest that an effective digital portfolio is student-centred, designed to explicitly support the use of self-regulation strategies and fully integrated in the instructional routine.

Kenyan Context

Developing nations have expressed concerns over the capacity of their educational systems to promote quality learning. Despite the important investments made to extend access to education, these do not fully translate to the development of functional skills and knowledge needed for the workforce to advance their national economies (UNESCO, 2019). To address the challenge of realizing education's promise to the nation (Republic of Kenya, 2013) initially expressed in Kenya Vision 2030 and the Constitution of Kenya, the Kenyan Ministry of Education has undertaken a substantial reform of curriculum. Currently unfolding in primary and imminent in secondary school, the new competency-based curriculum (CBC) aims at developing citizens capable of succeeding in the 21st century. Student-centeredness is at the heart of the curriculum designed to foster "independent, confident, co-operative, and inspired learners" (KICD, 2017). These competencies and skills cut across the disciplines to enable students to be self-reliant, creative and innovative. In addition, the curriculum targets the development of the lifelong skills of learning to learn that will allow youth to learn for life in order to satisfy their needs and upgrade skills at the ongoing basis. The CBC also recognizes the potential that ICT offers in educating future workforce. Hence, solid commitments to educational technology have been made via the national Digital Literacy Programme (aka Digischool, Information and Communication Technology Authority, 2016). To this end, the initiative deploys devices in Kenyan schools; improves infrastructure; develops digital learning content and provides some training for teachers.

However, Kenyan research on the reform implementation pinpoints that the reform unfolds with little regard for available capacities and resources and, thus, gets restricted (Cheptu & Ramadas, 2019). For instance, Wafubwa (2021) argues that sketchiness of the curricular materials and lack of clarity in them does not provide sufficient guidance to enable teachers' move to student-centered practices. Akala (2021) adds that despite massive national trainings, teachers' capacity to teach and evaluate within the new framework remains a weak spot of the reform implementation and directly affects its intended outcomes. Specifically, teaching has not shifted to the new student-centred pedagogies imbued in the CBC. Therefore, the major aspiration to educate self-reliant citizens, actively engaged in life-long learning has been left largely unattended. A few existing survey studies on the use of self-regulation strategies by Kenyan secondary students confirm the important gap in students' capacity to regulate their own learning and the urgent need for the classroom instruction to address this gap (e.g., Ongowo & Hungi, 2014; Stephen et al., 2018; Githui, 2019).

To learn if a student-centered digital portfolio (ePEARL) designed to support the self-regulated learning could be implemented in Kenyan secondary classrooms, we conducted a feasibility study. Previous research conducted in Canadian classrooms suggested that in

a competency-based curricular context, teaching and learning with the tool would offer benefits for Kenyan students and their teachers (Abrami et al., 2013; Meyer et al., 2010). Particularly, after having used ePEARL in English Language Arts classes, the Canadian students improved their writing skills and use of self-regulation strategies such as setting goals, selecting strategies for task completion and using feedback and self-observations to improve on work. Being a student-centered tool, ePEARL also challenged their teachers into accepting classroom practices that go above and beyond teacher-centric forms of classroom instruction.

Together with exploring the practicality of implementing a process e-portfolio in the Kenyan secondary school context, this research studied whether and how the use of the ePEARL can help students' learning. Specifically, the following research questions were addressed:

(1) Does using ePEARL frequently have effects on the change of secondary students' perceptions of self-regulation and exam scores from pre- to post-test?

(2) Does use of ePEARL predict the variation in students' learning outcomes as measured by their exam scores? Do students' self-regulatory beliefs contribute to this variation?

METHOD

The following section summarizes how this research was completed. It contains a brief description of the study design, instruments and measures and analyses used in this study. A short overview of the intervention such as the description of ePEARL portfolio, training and implementation have also been included.

Study Design

We designed this study in partnership with I Choose Life Kenya and conducted it in the secondary schools involved in the Jielimishe Girls Education Challenge initiative led by the organization. The study unfolded over two years, 2018 and 2019, as a nonequivalent two-group pretest posttest where two groups under observation, e-portfolio-users versus non-users, emerged from the same classes. Measurements were taken before the ePEARL instruction and then after it. The student exam scores became available after the students completed their school exams in the end of terms 1 and 3 of each school year. Since in 2018 the implementation unfolded in term 2, these served as pre- and posttest measures of achievement. In 2019, the implementation started in terms 1 and 2, therefore only term 3 exam scores were used. The 2018 student data on self-regulation were collected before the intervention and then again after the software was used for terms 2 and 3 of the school year whereas the 2019 surveys were collected once, at the conclusion of the intervention.

Study Sample

The participation of secondary students and their teachers was secured after the partner staff approached the schools' headteachers and teachers for their willingness to be part of the project. Students were in secondary one in 2018 and secondary two in 2019. Their age varied between 14 and 19 with an average of 16.7 years old. Gender was split about

equally across the sample. There were important fluctuations in the number of participants throughout the study. By the end of 2018, of 140 student-participants from four classes the complete data were available for 79 students. In 2019, 172 students in four classes used ePEARL as part of their instruction whereas 124 students completed all the measures. Overall, 137 students completed some measures in both years and their data were used for analysis. Multiple reasons accounted for the fluctuations. In year one of the pilot, one school decided to reduce the class sizes. In both years, some students were sent home and not allowed to complete their term exams for failing to pay school fees or other school-related expenses. Important turnover of students during the school year also contributed to the reduction in the sample.

The teacher-participants had a university undergraduate degree and specialized in more than one subject area. The average teachers had 11 years of experience; this ranged from 1 to 19 years.

Instrumentation

To measure a possible shift in students' perceptions of their use of self-regulated learning strategies between the pre- and posttests, the adapted *Student Learning Strategies Questionnaire* was used (CSLP, 2014). The instrument psychometric properties were index of internal consistency, Cronbach's alpha of .86 for both total pretest and posttest scores and pre-posttest reliability coefficients for the six subscales ranging from .81 to .88. Rated on a four-point frequency scale, 37 items inquire of students about their ability to set learning goals, monitor and correct their performance, and reflect on the learning outcomes. Specifically, the items reflect six underlying self-regulation constructs, such as (1) Planning (task analysis and self-motivation beliefs), (2) Doing (self-control and self-observations), (3) Reflecting (self-judgement and self-reaction), (4) Predicting one's success (self-efficacy), (5) Reasons to succeed (self-determination) and (6) Feelings about the task (task value).

We used *ePEARL Implementation Assessment Protocol* (CSLP, 2009) to analyze student portfolios and code the extent of ePEARL use. The following codes were assigned: "1" for low use (e.g., student logged into ePEARL, left some traces (e.g., personalized the front page) but did not work on an artifact); "2" was assigned when one artifact was created with a task goal, and some reflection was added; and "3" was assigned to portfolios where multiple artifacts or versions of an artifact were created, including task goals, strategies and some form of reflection. These designations were made by considering number and/or versions of artifacts stored in the student portfolios, duration of use, and nature of ePEARL use (for storage only or use of SRL features).

Kenyan end-of-term examination results were used as a measure of learning growth in the subject area where ePEARL was part of instruction. In a school-made term exam (in each subject) a maximum score of 100 points can be achieved. Each subject exam is administered and graded by the subject teacher. After receiving the scores, we created a composite variable which was a merger of scores the students obtained in the subject where ePEARL was used as part of classroom instruction. For instance, in 2019 this variable included students' scores in English, Business Studies, Biology and Physics.

Data Analysis

All student scores were entered manually using SPSS for Mac OS X (version 24) and verified for accuracy. Students' data were analysed by year and the cases with missing data were excluded from the analyses. Six composite scores were created on the SLSQ data to reflect the underlying concepts of self-regulation. Data screening procedures suggested no marked departure from data normality. In addition to the descriptive statistics analysis, Repeated Measures (RM) MANOVA, posttest group difference and Hierarchical Multiple Linear Regression (MLR) analyses were run.

Specifically, to examine if the extent of the portfolio use has effects on the change of secondary students' perceptions of self-regulation and their exam scores from pre- to posttest in 2018, we ran a one-way RM MANOVA model. Testing time (pretest-posttest) was the within-subject variable whereas the extent of portfolio use (frequent use of ePEARL versus little or no-ePEARL use) was the between-subject factors. The dependent variables were the set of six SLSQ aggregated scores and the exam scores. The analysis of mean group differences was performed on the 2019 posttest data due to the important fluctuation of the sample between 2018 and 2019.

Further, to explore if the extent of ePEARL use predicts the variation in students' exam scores and whether students' self-regulatory beliefs contribute to this variation, the two-block MLR models were run on the 2018 and 2019 data.

ePEARL Intervention

ePEARL Portfolio

Electronic Portfolio (ePEARL) is a student-centered web-based process portfolio designed to foster and enhance student self-regulation along the three cyclical phases of forethought, performance and self-reflection. Three levels of ePEARL are geared to students in early elementary (Level 1), late elementary (Level 2) and high schools (Level 3). Level 1 is designed to introduce young students to the basic concepts of SRL. Levels 2 and 3 enable students to personalize their portfolio environment and develop their SRL skills further by addressing the following iterative phases:

(1) Planning: Setting general learning goals for a school term or year (see Figure 1) along with specific task goals, defining strategies that will be used to reach these goals, addressing motivation to complete a given task,

(2) Doing: Creating new or revising existing work. ePEARL offers a text editor and an audio recorder for the creation of work. Students may also attach videos, slideshows, podcasts, scanned images or photographs of paper-based work as representations of their learning. They can edit work, save multiple versions, and send work to a presentation folder to store it through their school years and export it when needed.

(3) Reflecting: Reflecting on the original goals and strategies and on the level of satisfaction of their work and sharing it to obtain feedback from teachers, peers, and parents.

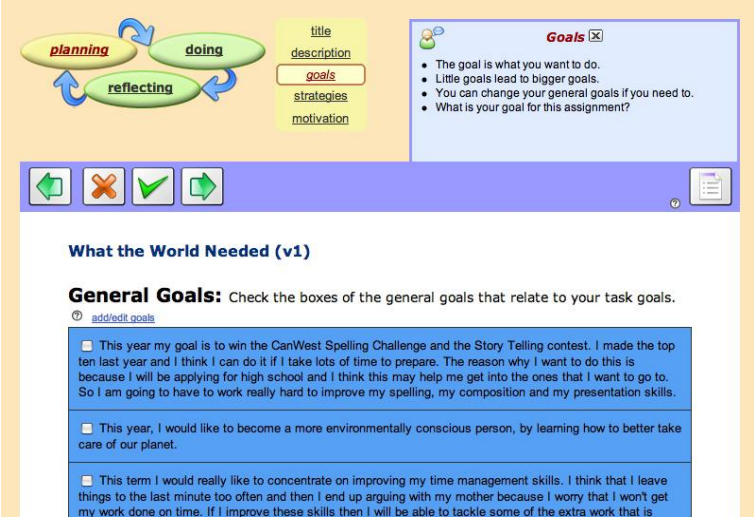


Figure 1
ePEARL general goals

The environment offers multimedia support materials for teachers and students to develop a better understanding of what, why and how of the self-regulation processes supported by the tool. A series of "jump start" lessons and a virtual tutorial were created to help support teachers' implementation of the SRL features within ePEARL. Additionally, just-in-time supports embedded within the software through help buttons accessible to students and teachers could. They provide definitions of SRL terminology, sample responses, and hyperlinks to the virtual tutorial. The teacher materials demonstrate and model student-centered skills and instruction, provide explanations of those skills, and elaborate the skills through additional support resources. The software is available at no cost to educators and may be explored at http://www.concordia.ca/research/learning-performance/tools/learning-toolkit/epearl.html

ePEARL Support and Implementation

A three-day ePEARL training of the participating teachers unfolded early in the school year. The session focussed on the components of self-regulated learning (SRL), the importance of SRL development with schoolchildren, and ePEARL use to support the development of SRL. Since these were the teachers of lower secondary, level 2 of ePEARL was the focus of training. One day of training was allotted to hands-on activities on how to integrate the software in classroom teaching where teachers worked in pairs to prepare a lesson plan they could implement in their classrooms. In addition, the teachers were given access to a range of pedagogical material, including lesson plans, activities, job aids, and virtual tutorials demonstrating and explaining the self-regulation features of ePEARL and helping integrate them into the instruction. Since authentic implementation by classroom teachers was in the focus of the project, the decision to use these support materials was left at the teachers' discretion. The ICL trainers were expected to support

their teachers by modeling instruction, team-teaching and holding thematic ePEARL-related workshops. Each teacher was provided an ePEARL account that allowed them to start their own portfolio in order to explore and understand the portfolio features. Yearly, in term 1, one half-day training workshop was held at a partner's premises. In term 2, school visits were rendered to the two implementing schools to support teachers and students in using the software.

The implementation of ePEARL varied from year to year and by class. Specifically, ePEARL was used to teach and learn English Language and Literature, Business Studies, Biology, and Physics. In year one the students used the e-portfolio around four weeks of term 3. In year two, two of the four classes did their ePEARL work for about 6 weeks in terms 1 and 2 and the other two classes worked on their portfolios only for three weeks in term 1. The problems with the school computer lab that was not functional during terms 2 and 3 of 2019 accounted for brief implementation. A handful of students from one class used the beginning level of ePEARL designed for early elementary.

FINDINGS

The analyses yielded some important results which we present below to answer each of the research questions that guided this two-year feasibility study.

Student Use of ePEARL, Exam Scores and Self-regulation

First, we addressed the first research question: *Does using ePEARL change secondary students' perceptions of self-regulation and exam scores from pre- to post-test when compared to students who barely used an e-portfolio for classroom learning?*

Table 1 offers a summary of the descriptive results including means and standard deviations on each of the six aggregated SLSQ subscales and the exam scores by the year of study and type of the ePEARL use. The results are consistent from year to year and are higher for the frequent users of the tool (N_{2018} =28; N_{2019} =73). Specifically, available as pre- posttest scores in 2018 and posttest scores in 2019, the results indicate that the students who used the tool more frequently report more frequent use of self-regulation strategies than their peers who used the software minimally or did not use it at all. For instance, this is especially noticeable for the strategies the 28 users in 2018 relied on when doing a task encompassing strategies of self-control and monitoring behaviors as well as on the total of self-regulation score. Similarly, the frequent users of ePEARL scored higher on their exams.

Table 1
SLSQ subscales and exam scores: means and standard deviations

Self-regulation & Exam scores	2018				2019 (post-test only)	
	Frequent use of ePEARL(N=28)		Little or no use of ePEARL (N=51)		Frequent use of ePEARL (N=73)	Little or no use of ePEARL (N=51)
	Pre	Post	Pre	Post		
SLSQ subscales:						
Planning a task	29.04 (1.86)	31.4 (3.73)	29.76 (2.95)	31.76 (2.31)	30.14 (3.69)	29.81 (3.32)
Doing a task	20.7 (1.97)	23.19 (2.16)	21.03 (2.19)	20.92 (2.12)	19.09 (3.69)	18.5 (3.17)
Reflecting	13.92 (1.56)	14.16 (1.76)	12.81 (2.27)	13.05 (2.36)	15.14 (2.27)	14.55 (2.30)
Predicting one's success in the task	15.76 (1.78)	15.75 (2.75)	15.52 (2.12)	15.82 (2.43)	16.45 (2.94)	15.41 (2.84)
Reasons to succeed	10.14 (1.28)	10.89 (1.22)	10.66 (1.54)	10.84 (1.21)	10.54 (1.41)	10.70 (1.87)
Feeling about the task	21.59 (2.6)	21.83 (3.01)	21 (2.58)	20.74 (3.21)	22.36 (2.19)	22.74 (2.57)
Total SRL score	112.58 (7.23)	116.98 (7.70)	110.78 (8.3)	113.27 (7.76)	113.73 (11.34)	111.72 (10.13)
Kenya exams	41.36 (14.84)	52.78 (19.29)	40.29 (16.3)	42.9 (17.76)	45.26 (18.59)	40.27 (21.65)

The two Repeated Measures analyses run on the 2018 data included testing times as the within-subject factor and ePEARL use as the between-subject factor. On a combined score of self-regulation perceptions overtime, the Pillai's trace criterion was $F(6, 78)=2.48$, $p= .03$ with the partial eta squared of 0.16 indicating statistically significant and important difference between the groups favoring the students who frequently used ePEARL. The analysis of the exam scores also revealed higher performance of frequent portfolio users (N=28) as compared to those whose portfolio use was scarce or non-existent (N=51). Namely, on the combined exam scores, the over-time difference between the students in the two conditions was $F(1, 77)=4.33$, $p= .041$; partial $\eta^2 = .05$ favoring gains of the frequent ePEARL users.

The analysis of the 2019 posttest results from 124 students echo the group differences captured in 2018. The average post-test scores of the 73 students who learnt with ePEARL are higher than those 51 who hardly used the tool albeit statistically non-significant. For the exam scores and the self-regulation total score, the group difference coefficients were $F(1, 123)=1.03$, $p=.29$ and $F(1, 123)=1.89$, $p=.17$ respectively.

Next, we addressed the second question: *Can the extent of ePEARL use predict the variation in students' learning outcomes as measured by their exam scores? Do students' self-regulatory beliefs contribute to this variation?*

To answer this question, we built a two-step regression model where the end-of-year exam scores were the criterion variable whereas predictors were the extent of ePEARL use and

the six aggregated self-regulation scores. The extent of use was the ordinal variable assessing students' use of ePEARL self-regulation features on a scale from 1 "low use" to 3 "high use". Specifically, in 2018 and 2019, the portfolios of 13 and 38 students were assigned the highest value of "3" respectively. As part of their class assignment, these students created several artifacts or multiple versions of an artifact. They identified task goals, selected task strategies and reflected on their work. The value of "2" was given to the work of 12 and 35 students who created one artifact with the task goal and added some reflection to it. The lowest value of "1" was assigned to 25 and 13 students' portfolios who logged into ePEARL, left some traces but did not attempt to complete any task using the tool. The number of high and low ePEARL users changed over time; in 2019 the number of high and moderate users nearly tripled in comparison to 2018 whereas the numbers of low-end users declined two-fold.

The results of the multiple regression analyses of 2018 and 2019 data are presented in Table 2. In both years the extent of the tool use was a significant predictor that alone accounted for the variation in the end-of-year exam scores explaining 15% and 9% of variance respectively.

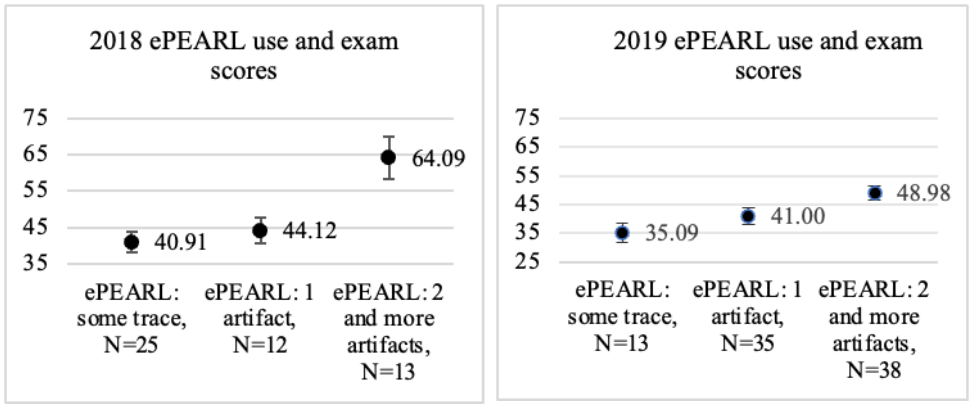
Table 2
Summaries of the hierarchical regression models and predictor standardized coefficients

2018 (N=50)				*2019 (N=86)*			
Model 1 (1, 48)	$R^2 = .15$	$R^2_{change} = .15$	$F_{change} = 8.51^{**}$	Model 1 (1, 84)	$R^2 = .09$	$R^2_{change} = .09$	$F_{change} = 8.34^{**}$
$ß_{ePEARL\ use} = .39^{**}$				$ß_{ePEARL\ use} = .30^{**}$			
Model 2 (6, 42)	$R^2 = .44$	$R^2_{change} = .29$	$F_{change} = 3.67^{**}$	Model 2 (6,78)	$R^2 = .15$	$R^2_{change} = .06$	$F_{change} = .87$
$ß_{ePEARL\ use} = .29^{*}$				$ß_{ePEARL\ use} = .36^{**}$			
$ß_{planning} = .08$				$ß_{planning} = .21$			
$ß_{doing} = .48^{**}$				$ß_{doing} = .05$			
$ß_{reflecting} = -.02$				$ß_{reflecting} = -.03$			
$ß_{predict\ success} = -.16$				$ß_{predict\ success} = -.17$			
$ß_{reasons\ to\ succeed} = .14$				$ß_{reasons\ to\ succeed} = .14$			
$ß_{feel\ about\ task} = -.13$				$ß_{feel\ about\ task} = -.002$			

* < 0.05; ** < 0.01

Graph 1 below illustrates how students' average exam scores in both years varied as a function of the extent to which the portfolio was used. A combination of the six self-regulation variables with that of the ePEARL use significantly accounted for the variation in exam scores but for 2018 data only.

Together with the ePEARL use, the students' perceptions of strategies they used to do a task were the strongest predictors of the student exam results. Specifically, one-standard-deviation increase in the use of the portfolio and performance-monitoring strategies lead to .29 and .48 standard deviation improvement in student end-of-year exam scores respectively.



Graph 1
Average exam scores by the extent of ePEARL use

ePEARL Artifacts

In 2018, 50 grade-one students completed some work in their e-portfolio; of those 33 students continued using ePEARL in the following year, whereas 53 grade-two students started their ePEARL portfolio in 2019. Among the students who used ePEARL in both years, the majority created two and more artifacts or versions of the same work. At a minimum, students formulated one task goal and identified a strategy they were to rely upon in order to compete the task. This section offers an overview of students' uses of the portfolio for Business Studies, English, Physics, and Biology and is organized along the three phases of self-regulation supported in ePEARL: forethought, performance and reflection.

Forethought

In both years, students' planning activity was limited to setting task goals. It is important to note that students predominantly used ePEARL to complete their class assignments that were driven by simple questions requiring students to reproduce their existing knowledge (i.e., provide definitions, put together a list of items). The verbs students used to set task goals in ePEARL reflect the nature of these assignments: "define the meaning of…", "identify the importance of…", "identify forms/types of…", "list advantages/disadvantages of ...". The portfolio analysis shows that some students also identified the strategies they intended to rely on to achieve the task goals. A few examples of task goals and selected strategies as well as task criteria from both years are shown in Figure 2 below.

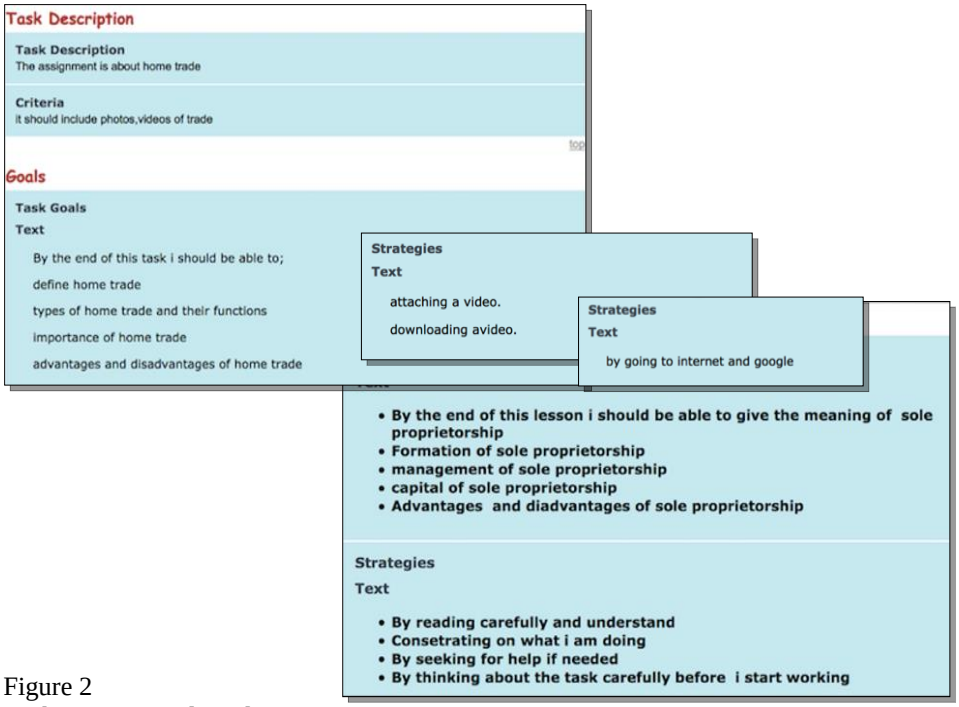


Figure 2
Task criteria, goals and strategies

It is important to note that the type of strategies preferred by students changed over the years. If downloading video and attaching photos was the dominant strategy for the task completion in the first year of the pilot, in the following year strategies became more diverse. It appeared that many if not all choices students made at the planning phase might have been prompted by the teacher. For instance, the wording used to set goals was similar in the portfolios of different students from the same class. The selection of strategies and how these were worded directly reflected the task criteria most probably set by the teacher.

Performance

In order to comply with the teacher-set requirements, most students incorporated images; some also attached audio and/or video files to their artifact(s). Every student artifact contained some text created with the tool's text-editor. In their writing, students relied on paraphrasing and summarizing the original content from a primary source without referencing it. Figure 3 offers examples of the students' creations using ePEARL levels 1 and 2.

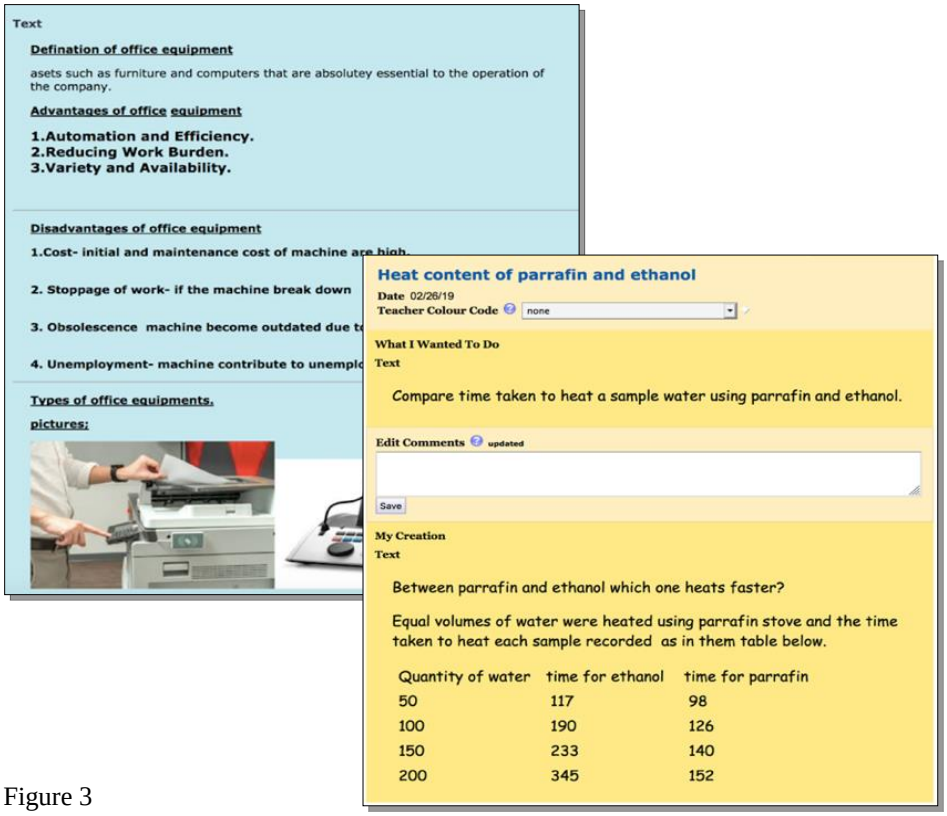


Figure 3
ePEARL creations

Reflection

The students used the reflection section of ePEARL to leave their comments. In both years the reflection statements echoed the task strategies the students identified at the planning phase. Therefore, the deliberations were quite generic offering thoughts about how to improve some aspects of their work and how to implement these improvements. A few examples of the students' comments can be seen in Figure 4 below.

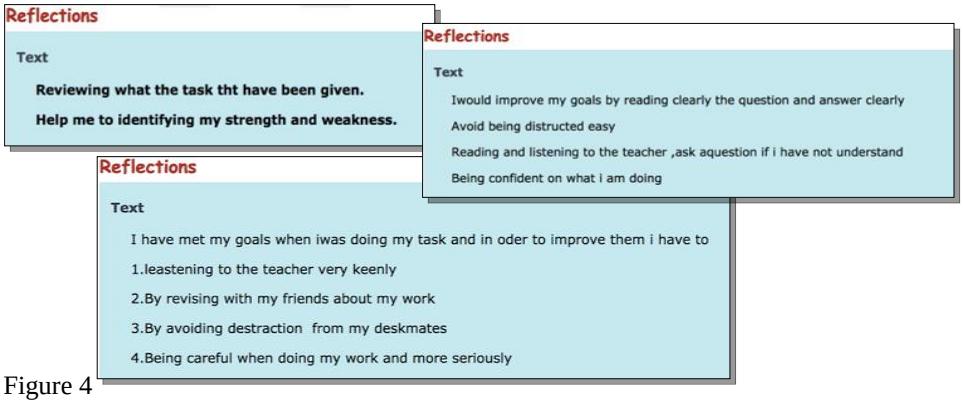


Figure 4
ePEARL reflection

Other ePEARL Features

All students shared their work either with the whole class or with some of their peers. A few students moved their work to the presentation folder offering [they had] "done it well" as a justification. Despite sharing, few students commented on each other's work and when they did, their feedback was rather basic. Teacher feedback was limited to students' goals in ePEARL.

DISCUSSION

Emphasizing the paradigm shift of pedagogical practices from teacher-centred to student-centred approaches, the curricular reform in Kenya aspires to educate independent, self-reliant citizens, actively engaged in life-long learning. This also entails classroom instruction that develops students' capacity to learn, to regulate the learning process and its outcomes (e.g., Stephen et al., 2018). To address the need, ePEARL, a digital process portfolio that purposefully supports learners to be in control of their learning, was introduced in a few secondary classrooms in Kenya. We explored the feasibility of implementing this tool for instruction and its potential effects on learning.

The results we obtained imply that as part of the regular classroom instruction, ePEARL can be beneficial for the students' learning outcomes. Frequent and comprehensive application of the portfolio features by the students to complete a class assignment translated into higher achievement in the respective subject area and self-reported positive changes in self-regulation skills. The underlying mechanisms responsible for this change in students' achievement and self-regulation skills are not definitively known. However, we can speculate that involving students in the purposeful acts of self-regulation through the three cyclical phases of forethought, performance and self-reflection (Zimmerman, 2000) might have contributed to these improvements. Another plausible explanation is that the authentic use of the tool's multimedia by the students to create artifacts may account for their learning gains (e.g., Abrami et al., 2013).

The findings of this study are especially assuring because they were obtained in the context of authentic classroom instruction where the implementation of ePEARL was driven and directed by the teachers themselves. While the meta-analytic evidence consistently suggests that greater effects are achieved when self-regulation programs are delivered by researchers rather than classroom teachers (e.g., Dignath & Büttner, 2008), these results imply that ePEARL can be effective in the hands of Kenyan teachers. They were able to use the tool to support their students' learning in the real-world context where classes are large, support is low, technology is unstable and access to it is limited, and many teachers and their students lack technology proficiency. Despite these challenges, the teachers persevered. The value-expectancy theory suggests that teachers might have valued the ePEARL pedagogy and anticipated it to be successful despite the perceived physical and psychological costs of implementation (Wozney et al., 2006).

However, it might be that some teachers opted for the symbolic use of the tool. They might believe that the tool helped their instruction become student-centred and, therefore, aligned with the current national educational discourse without significantly altering the ways they teach. For instance, the teachers often created tasks based on a simple question. To complete such a task, it was enough for students to reproduce existing knowledge. The students were also driven by the teacher-set goals and modalities rather than articulated their own understanding of the task and selected ways of how to complete it. Yet, process portfolios are promoted as knowledge tools and the complexity of the processes that they support require that such tools should be used for important learning where the value of effortful expenditure of time is apparent. In other words, ePEARL is not designed for learning which is viewed by the learner as easy to accomplish, already well-learned but is best used when the task is moderately difficult, has an element of novelty, and is perceived as valuable to achieve (Abrami, 2010). Both teachers and students should see the added value that the tool has on teaching and learning and that the investments they do in using ePEARL is equal to progress.

At the same time, we realize that change takes time and tiny shifts in teaching might indicate important advances on the way to lasting improvement in instructional practice. Given the impending curricular reform of secondary education in Kenya, many changes in teaching practice are looming. Since teachers are at the centre of any effort to improve student learning, further strengthening of the professional development aspect of ePEARL to address the teachers' needs in technical, pedagogical and content knowledge is critical for them to fully harness the potential of the tool (e.g., Mishra & Kohler, 2006). This means that teachers understand the core principles of self-regulated learning, and apply these principles to instruction by using ePEARL. We also see the support system as the way to continue strengthening contingencies between ePEARL implementation and student learning progress and reducing the perceived disincentives of teaching with technology.

This research adds to the modest pool of studies, mainly surveys, on self-regulation in Kenyan secondary schools (e.g., Ongowo & Hungi, 2014; Stephen et al., 2018; Githui, 2019) and also complement the positive evidence of ePEARL effects in Canadian elementary school context (e.g., Abrami, 2010; Abrami et al., 2013). The strength of this

research includes the purposeful integration of an e-portfolio as part of unscripted classroom practice designed and delivered by the regular classroom teachers, and the length of the project which unfolded over two years where we were able to replicate the year one results. The limitations of this research relate mostly to research design. Specifically, a planned quasi-experiment with control condition would allow us to avoid teachers priming their non-using students in their classes with self-regulation strategies and thus tempering the effects of ePEARL. Using a discipline-specific standardized tests of achievement instead of idiosyncratic school-made exams would result more reliable data by reducing the measurement error also inflated due to the teachers' involvement in administering and grading their students' exams. Contextual factors such as student attrition and failure of the school computer labs also affected this study results. Although less controllable, when possible, these factors could be moderated by make-up data collection and seeking stronger commitment from the partner and schools to maintain their computer devices operational.

CONCLUSION

The results of the feasibility study of ePEARL in Kenya secondary classrooms suggest that in teachers' hands technology for student-centred learning can positively impact learning outcomes. These findings also uncovered additional considerations that if implemented, could lead to enhancements in teaching and learning and align both with the goals set in the national curriculum. The study also exposed some questions that future ePEARL research should pursue. For instance, what are the requisite conditions for the digital portfolio to be fully embedded in classroom practice rather than being used as a mere add-on? We know that using technology for learning, especially when this technology is intended to support self-regulation, is not a straightforward teaching strategy to master, especially in the contexts where frontal instruction traditionally prevails. ePEARL provides the means to scaffold teachers and students in the portfolio process and better encourage self-regulation although it is not a sufficient condition for change. Teachers need to believe that the change to using a process portfolio is valued and necessary for authentic, more meaningful learning. In this regard, what is the right balance between the ''will" and the ''skill" components for the intervention to live and thrive? How can school and larger educational contexts factor in this process to help turn a tool's one-time test into stainable use? Finally, it is our hope that the answers we learn as we advance with the ePEARL project will extend opportunities for active and meaningful learning for many secondary students in Kenya.

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REFERENCES

Abrami, P.C. (2010). On the nature of support in computer supported collaborative learning using gstudy. *Computers in Human Behavior*, *26*(5), 835-839. http://dx.doi.org/10.1016/j.chb.2009.04.007

Abrami, P., & Barrett, H. (2005). Directions for research and development on electronic portfolios. *Canadian Journal of Learning and Technology 31*(3) Retrieved from https://www.learntechlib.org/p/43165/

Abrami, P. C., Venkatesh, V., Meyer, E., & Wade, A. (2013). Using electronic portfolios to foster literacy and self-regulated learning skills in elementary students. *Journal of Educational Psychology, 105*(4), 1188-1209. http://dx.doi.org/10.1037/a0032448

Akala, B. M. (2021). Revisiting education reform in Kenya: A case of Competency-Based Curriculum (CBC). *Social Sciences & Humanities Open*, *3*(1), https://doi.org/10.1016/j.ssaho.2021.100107

Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and Learning*, *4*(1), 87-95. https://doi.org/ 10.1007/s11409-009-9035-7

Barrett, H. C. (2006). Using electronic portfolios for formative/classroom-based assessment. *Classroom Connect Connected Newsletter, 13*(2), 4–6.

Blaustein, C., & Lou, Y. (2014, March). *Electronic portfolios: Motivation, self-regulation, and academic achievement in primary and secondary schools.* In 2014 Society for Information Technology & Teacher Education International Conference proceedings (pp. 1734–1742). Association for the Advancement of Computing in Education. https://www.learntechlib.org/p/131023/

Centre for the Study of Learning and Performance. (2009). *ePEARL implementation assessment protocol.* Unpublished instrument. https://www.concordia.ca/content/dam/artsci/research/cslp/docs/ePEARL_IAP_2009.pdf

Centre for the Study of Learning and Performance. (2014). *Student learning strategies questionnaire.* Unpublished instrument. https://www.concordia.ca/content/dam/artsci/research/cslp/docs/Instruments-UpdatedFiles-2019/Self-RegulatedLearning-Kenya/SLSQ_Form%20A3(pre-test)_ICL20180326.pdf

Cheptoo, R. & Ramadas, V. (2019). The 'Africanized' competency-based curriculum: The twenty-first century strides. *Shanlax International Journal of Education, 7* (4), 46-51. https://doi.org/10.34293/education.v7i4.640

de Boer, H., Donker, A. S., Kostons, D. D., & van der Werf, G. P. (2018). Long-term effects of metacognitive strategy instruction on student academic performance: A meta-analysis. *Educational Research Review*, *24*, 98–115. https://doi.org/10.1016/j.edurev.2018.03.002

Dignath, C., & Büttner, G. (2008). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition Learning*, *3*(3), 231–264. https://doi.org/10.1007/s11409-008-9029-x

Githui, P. (2019). Influence of learner related variables on academic performance: A case of public primary schools in Mathira, Nyeri County, Kenya. *African Journal of Education, Science and Technology, 5*(3), 209-219.

Hadwin, A., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation, and shared regulation in collaborative learning environments. In D. H. Schunk & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (pp. 83–106). Routledge.

Hendikawati, P., Zahid, M. Z., & Arifudin, R. (2019). Android-based computer assisted instruction development as a learning resource for supporting self-regulated learning. *International Journal of Instruction*, *12*(3), 389–404. https://doi.org/10.29333/iji.2019.12324a

Information and Communication Technology Authority, Republic of Kenya. (2016, October 20). *Government starts distribution of Digischool devices to over 22,000 public primary schools [Press release]*. http://icta.go.ke/2016/10/20/government-starts-distribution-of-1-2-digischool-devices-to-over-22-000-public-primary-schools/

Jonassen, D. (1991). Evaluating constructivist learning. *Educational Technology*, *31*, 28–33.

Karami, S., Sadighi, F., Bagheri, M. S. & Riasati, M. J. (2019). The impact of application of electronic portfolio on undergraduate English majors' writing proficiency and their self-regulated learning. *International Journal of Instruction*, *12*(1), 1319–1334. https://doi.org/10.29333/iji.2019.12184a

Kenya Institute for Curriculum Development (KICD). (2017). *Basic education curriculum framework.* https://kicd.ac.ke/wp-content/uploads/2017/10/CURRICULUMFRAMEWORK.pdf

Lukitasari, M., Rusdi H., & Sukri, A. (2020). The effect of e-portfolio on biological concepts understanding and responses of students with different academic achievement levels. *International Journal of Instruction*, *13*(1), 685–694. https://doi.org/10.29333/iji.2020.13144a.

Meyer, E., Abrami, P. C., Wade, A., Aslan, O., & Deault, L. (2010). Improving literacy and metacognition with electronic portfolios: teaching and learning with ePEARL. *Computers & Education, 55*(1), 84–91. http://dx.doi.org/10.1016/j.compedu.2009.12.005

Mishra, P., & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054. http://dx.doi.org/10.1111/j.1467-9620.2006.00684.x

Modise, M. E. P., & Mudau, P. K. (2021). Using e-portfolios for meaningful teaching and learning in distance education in developing countries: A systematic review. *UnisaRxiv*. http://dx.doi.org/10.25159/UnisaRxiv/000015.v1.

Ongowo, R. O., & Hungi, S. K. (2014). Motivational beliefs and self-regulation in Biology learning: Influence of ethnicity, gender and grade level in Kenya. *Creative Education*, 5, 218–227. http://dx.doi.org/10.4236/ce.2014.54031

Republic of Kenya (2012). Kenya vision 2030: A globally competitive and prosperous Kenya. http://vision2030.go.ke/social-pillar/

Shelton, M. (2011). How portfolios reflect constructivism. In M. Jones & M. Shelton (Eds.) *Developing your portfolio - enhancing your learning and showing your stuff* (pp. 26-35). Routledge.

Stephen, K., Mailu, S., & Koech, P. (2018). Relationship between learning strategies and student performance in Physics in public secondary schools in Nakuru East subcounty, Kenya. *European Journal of Social Sciences Studies*, *3*(3), 237–248. https://www.oapub.org/soc/index.php/EJSSS/article/view/456

UNESCO. Global Monitoring Report. (2019). *Meeting commitments: are countries on track to achieve SDG 4? https://en.unesco.org/gem-report/node/3094*

Wafubwa, R. (2021). Challenges of teaching and assessing the 21st-century competencies in Africa: A focus on the Kenyan New Curriculum of Basic Education. *East African Journal of Education Studies, 3*(1), 96 --105. https://doi.org/10.37284/eajes.3.1.332

Wozney, L., Venkatesh, V., & Abrami, P.C. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and Teacher Education, 14*(1), 173-207.

Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts & P. R. Pintrich (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.

Zimmerman, B.J. & Schunk, D. H. (2011). Self-regulated learning and performance: An introduction and overview. In B.J. Zimmerman & D.H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 1–12). Routledge