Exploring the Alignment of Instructor's Intent and Students' Perception of Using Self-Assessment in an Engineering Undergraduate Course

Mr. Viyon Dansu, Florida International University

Viyon had his Bachelors and Masters degrees in Systems Engineering. Thereafter he co-founded STEM-Ed Africa, a social enterprise involved in developing products and services geared at teachers' development and improving high school student's problem-solving abilities in STEM subject areas. He is currently a doctoral student of engineering and computing education at Florida International University, Miami.

Mr. Yashin Brijmohan, University of Nebraska Lincoln

Yashin Brijmohan is a registered professional engineer who is currently appointed as Chairman of Engineering Education Standing Technical Committee of the Federation of African Engineering Organizations, Executive committee member of the Commonwealth Engineers Council, Board Member of the UNESCO International Centre for Engineering Education, and Co-Chair of the Africa Asia Pacific Engineering Council.

He was the founding Executve Dean of Business, Engineering and Technology at Monash South Africa, former Vice President of the World Federation of Engineering Organizations, and led several committees in the engineering profession.

Yashin has both leadership and specialist experience within the engineering power industry and education sectors and is known for his thought leadership in capacity building and engineering education.

Dr. Nathaniel Hunsu, University of Georgia

Nathaniel Hunsu is an assistant professor of Engineering Education. He is affiliated with the Engineering Education Transformational Institute and the school of electrical and computer engineering at the university. His interest is at the nexus of the res

Exploring the Alignment of Instructor's Intent with Students' Perception of Using Self-Assessment in an Engineering Undergraduate Course

Abstract

Self-assessments are used in higher education to spur students to metacognitive learning engagements. In the process of self-assessing, students activate self-regulatory functions that enable students to take ownership of their own learning. Self-assessment activities include students reflecting on, evaluating, and monitoring their own learning performances. Students who self-assess are better able to identify areas they need to improve upon, and to determine the most appropriate courses of action to achieve academic success. However, little is known about the congruence in students' perception of self-assessment and instructor's intent in requiring self-assessments. Hence, the purpose of this study is to explore the perceptions of engineering students who participated in self-assessment in an engineering course and how their perspective of the experience compares with the intent of self-assessments by the course instructor. The study further investigates students' positive and negative experiences while engaging with the self-assessment process.

This investigation is an exploratory study that uses a multi-method qualitative design consisting of phenomenology and phenomenography. Participants are 121 undergraduate students who enrolled in an engineering class and the course instructor at a R1 public university in Southeastern USA. Data for the study was collected using a qualitative survey that included questions that required students to reflect on their experience and type their responses to prompts that probe their perception of the purpose, benefits, and difficulties of self-assessment activity they engaged in. In addition, the instructor's intent of using self-assessment was obtained through a semi-structured interview session.

The data were coded and analyzed using the NVivo data analysis software. A deductive thematic analysis was conducted on participants' responses using the self-regulation framework proposed by Zimmerman [15] and McMillan and Hearn [8]. The final codebook was based on the guiding framework and multiple iterations of coding and engaging in critical reviews of codes by peer debriefers.

The results showed students' perceived purpose, benefits, and difficulties of self-assessments. Further, findings revealed that self-assessment aided students' conceptual understanding, reflection on their learning and in identifying learning gaps. There was some alignment found between the overall students' perspectives of the purpose of self-assessment and the intent of self-assessment by the instructor. Students' positive and negative experiences with self-assessments are also illustrated in this study. The knowledge from this study could help instructors on ways to elicit informed feedback about their courses from students. This could in turn help in the redesign of instructional course materials to maximize students' learning gain.

Keywords: Self-assessment, Student learning, Engineering education, Self-regulation, Metacognition, Motivation, Autonomy

I. Introduction and Background

Assessments form an integral part of an education system. While assessments can be used to determine the performance level of a student, they can also be used to direct their learning [1]. In traditional assessment systems, the process is predominantly controlled and managed by the instructor [2]. Self-assessment is an alternative to traditional assessments and is commonly used in higher education to incentivize students to metacognitive learning engagements [3].

There are distinct differences between self-assessment and traditional assessments. Traditional assessments normally are in the form of standardized test measurements of a learner at a point in time such as quizzes and classroom tests [4]. These can use lower order thinking skills of a learner that has a predetermined way of evaluating progress, and in many cases rely on rote memorization [5]. Self-assessments can increase student engagement, motivation, and attitudes toward assessment [4]. However, there are some similarities between these two types of assessments. Like the traditional form of assessment, students use self-assessment formatively to evaluate the current state of their learning and it can also be used in a summative manner when the goal is to determine their grades in a course [6].

It is important to have a definition for self-assessment as concepts like self-evaluation, self-reflection, and self-appraisal have been used interchangeably with self-assessment in literature [7]. Self-assessment is a process by which "students monitor and evaluate the quality of their thinking and behavior when learning" [8]. Among other methods, self-assessment is enacted through the following: students grading their assignments and reflective practices [9]. The distinction of self-assessment from all other forms of assessment is that it is a student-centered approach and takes place "within the student" [7, p. 1248]. Structurally, self-assessment is divided into informal and formal self-assessments. In informal assessments, students take charge of the assessment process without relying on an external prompt from the instructor while the students are guided by instructor prompts and rubrics in formal assessments [7].

Self-assessment is found to be beneficial as students can leverage it to identify gaps in their learning and also set learning goals in a bid to improve their learning [8]. Also, by self-assessing their learning, students are brought into the learning process thereby making them active and not passive contributors to their own learning [6]. On the other hand, instructors also find self-assessments to be valuable as they take advantage of it to improve students' self-efficacy thereby making the students commit to learning outside of the classroom [6], [7], [10]. It was found in an engineering course that final grades were higher for students who took self-assessments compared to those that didn't [11]. As a result, Baisley [11] argued that self-assessment either improves the performance of students or that high-performing students are more likely to take self-assessments.

Despite the benefits of self-assessments to the students, researchers are of the opinion that students' subjective views about their abilities could negatively affect their learning [12]. In a study by Baisley [11], students' scores were found to be different to instructor scores fifty percent of the time in an engineering mechanics course. In addition, self-assessments can be restrictive when the ultimate goal of the instructor is to *teach to the test* [13].

Although Shuman and colleagues [12] studied the perceptions of undergraduate student's perception toward self-assessment, no study has considered the alignment of instructors and students' perceptions of self-assessment in the context of engineering education. It is good practice for instructors to design a course that has alignment between learning outcomes,

instruction, and assessments [14]. In this study, self-assessment was used as an instructional tool to promote learning. Hence it is important to have an alignment in the use of the tool in order to promote learning that achieves the course outcomes. Therefore, it is necessary for students to be aware of not only how the tool works, but how the tool can assist them to achieve learning outcomes. This clarity in the purpose and value of the tool can motivate students to use self-assessment as intended by the instructor [4].

This study explores this research gap from the perspective of both instructor and students. Hence, the purpose of this study was to explore the alignment between the perspectives of self-assessment by engineering undergraduate students who participated in an engineering course and the intent of self-assessments by the course instructor.

II. Theoretical Frameworks

Two guiding frameworks provided a basis for the conceptualization of the thematic areas of the study. McMillan and Hearn [8] highlighted in their work that when students self-assess they are engaging in three cyclical continuous processes namely, *self-monitoring*, *self-evaluation*, and *implementation of strategies* to address misconceptions and improve learning. Some of the activities students get engaged with during these three phases include students' involvement in reflective practices which require questioning their understanding level of the course material. In addition, students identify their current knowledge in comparison to what they ought to know in relation to the course learning outcomes. Figure 1 below is the student self-assessment cycle.

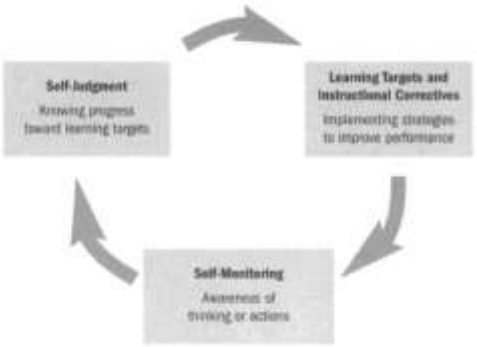

Figure 1: Student self-assessment cycle culled from McMillan and Hearn [8]

Similarly, the self-regulation model as conceptualized in Zimmerman [15] was used for conceptualizing the themes. The appropriateness of the theory for this study stems from its cyclical model providing a useful lens to study the different learning phases for the students during self-assessment. According to Zimmerman [15], the learning process is captured in three self-regulatory phases, namely, *forethought*, *performance*, and *self-reflection* phases. The *performance* phase covers the efforts students expend on their learning, while the *self-reflection* phase occurs after the learning efforts, and it helps in mediating students' reaction to their learning. The cyclical nature of the self-regulation theory is completed with the *forethought* phase, which facilitates students' subsequent learning cycles. Figure 2 below is the self-regulation model.

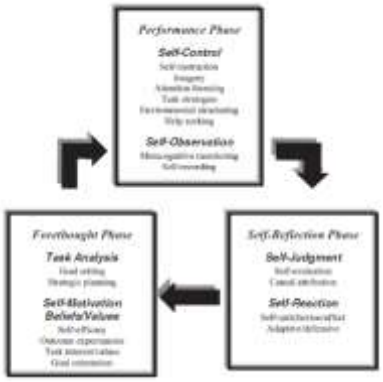

Figure 2: Self-regulation model culled from Zimmerman [15]

III. Methodology

A. Research Design and Project Overview

The setting for this case study design is the Probability and Statistics for Engineers course at a US Southeastern R1 university. The title of the course is *introduction to the field of probability and statistics* with an emphasis on topics and problems relevant to engineering. The students were requested to conduct self-assessment using a detailed rubric that was provided by the instructor for an assignment in the course. The study design is a *collective case* study. Case study design focuses on the in-depth exploration of a case (the perceptions of students and instructor on self-assessment being the *cases* for this study) and it uses multiple data sources to ensure an in-depth understanding of the *case* being explored [16]. The specific case study design used in this study, i.e., *collective case* study focuses on exploring more than a *case* either simultaneously or sequentially in a bid to have a more holistic understanding of the *case* [17].

This study sought to answer the following research questions:

RQ1: How do undergraduate students perceive the purpose of self-assessments on assignments undertaken in an engineering course?

RQ2: How do undergraduate students' perspectives compare with the intent for giving self-assessments by the instructor?

B. Participants

The participants for this study are 121 undergraduate students and an instructor from the Electrical and Computer Engineering program at a R1 public university in Southeastern USA.

C. Data Collection

The design for this study required two strands of data collection, i.e., from the student-participants and instructor-participant (hereafter referred to as the students and instructor respectively). The data from the student were collected using a qualitative survey that included questions that required them to reflect on their experience and provide responses to prompts that probed their perception of the purpose, benefits, and difficulties of self-assessment activity they engaged in. The items of the survey were based on a review of self-assessment literature and the motivated learning strategies questionnaire. In addition, the instructor's intent, benefits, and the challenges of using self-assessment was obtained through a virtual semi-structured interview session that lasted for about 60 minutes. The virtual semi structured interview items were

adapted from the student survey items and incorporated aspects from self-regulation theory by Zimmerman [15].

D. Data Analysis

Within the context of this study, the perceptions of the students and instructors were treated as distinct *cases* hence the use of a *collective case* study design. Crowe et al. [17] were of the opinion that each individual *case* should be analyzed separately before conducting a *cross-case* comparison to explore the similarities in their perceptions of self-assessment. Drawing on Crowe et al. [17], the multiple data sets were coded separately and analyzed using the NVivo data analysis software. An inductive thematic analysis was conducted on both data sets. The final codebook was conceptualized using both the self-regulation theory [15] and the student self-assessment cycle [3]. The authors completed multiple iterations of coding and engaged in critical reviews of codes by peer debriefers [16]. Thereafter, a *cross-case* comparison was conducted to explore the alignment of the student-participants and instructor-participant perceptions on self-assessment.

IV. Results and Discussion

In exploring the alignment of students' perceptions to the instructor's intent of giving self-assessment, the themes that emerged using an inductive analysis of the data are *learning engagement, learning analysis and self-evaluation*, *autonomy*, and *motivation*. Table 1 below shows these thematic areas and how they correspond with the elements of both the self-regulation and student self-assessment cycle.

Thematic Area	**Student Self-Assessment Cycle (SSAC)**	**Self-regulation model (SRM)**
Learning engagement	No similarity of thematic area with any element of SSAC	Performance phase (comprising attention focusing)
Learning analysis and self-evaluation	Self-monitoring, self-judgment	Self-reflection phase
Motivation	No similarity of thematic area with any element of SSAC	Forethought phase (comprising self-motivation/beliefs and values)
Autonomy	Self-judgment, learning targets	Forethought phase (comprising goal setting, strategic planning)

Table 1: Similarity of thematic areas with student self-assessment cycle by McMillan and Hearn [8], and self-regulation theory by Zimmerman [15]

The student self-assessment cycle and self-regulation theory were not used as a theoretical lens in analyzing the data, rather the thematic areas were conceptualized by drawing on the operationalization of the tenets of these two theories. As an example, illustrated in Table 1, the conceptualization of *learning engagement* drew on the performance phase of the self-regulation theory. Similarly, the conceptualizations of *learning analysis and self-evaluation*, *motivation* and *autonomy* drew on the *self-reflection* and the *forethought phases* of the self-regulation theory. In the same vein, some of the tenets of the student self-assessment cycle show some similarity with only two of the thematic areas as illustrated in Table 1.

The four thematic areas are discussed properly in the following sub-section.

Theme 1: Learning engagement

A theme that emerged is how self-assessments fostered engagement with the course content for the students. The student's suggested that self-assessment helped them to deepen understanding of the course by a continual engagement with the material. Consequently, a student described the layered levels of engagement and interaction that self-assessment affords them and how this was helpful in grounding their understanding of the course material.

> *One of the best ways to learn something is continually putting the information in front of you and actively engaging with it. The self-assessment exercise does this for most students. You have to actively engage with the material to understand where you made mistakes and having the self-assessment after receiving the homework back allows for another interaction with the content of the class.*

Connecting with the above student's perception, the instructor opined that the core of learning is *creation of meaning* and to this end the self-assessment was given.

> *Learning by itself is being able to create meaning from the content of material.*

Research findings show that student engagement goes beyond involvement in class activities. It requires *sense-making* as they engage in learning activities within the classroom [18]. Drawing on this finding, we argue that as the students *actively engage* with the course materials while self-assessing, it helps them to *make sense* of the material thereby *creating meaning* in their learning.

Theme 2: Learning autonomy

According to Chiu [19, p. 516], "autonomy is the need to feel in control of our own behaviors and goals." From the foregoing definition, the instructor illustrated how autonomy could be realized by the student through self-assessment.

> *…so self-assessment compared to every other type of assessment, takes the students out of the judgment, and puts the power of judgment in the hands of someone else, whereas to self-assess yourself, that's to assess yourself, we put the judgment in your hand. So, your destiny is, in essence, your hand.*

Congruously, the student's asserted that self-assessment helped to promote an *autodidactic* form of learning whereby they are able to teach themselves what they need to know.

> *The purpose was to benchmark my understanding of the coursework and teach myself what I do not fully grasp yet.*

In addition, the instructor spoke about self-assessment helping the students assess the differential in their current performance compared to the instructor's desired performance level in the course. This, the instructor reasoned, might help to bridge the gap they noticed in their learning thereby taking ownership of their learning.

> *Self-assessment helps them evaluate themselves relative to where their instructor expects them to be. What they do with this is up to them. Students who are reflective can leverage on what they gleaned having self-assessed. It is hoped that self-reflection would lead to self-regulation of learning.*

Both the students and instructor agreed that self-assessment helped students determine their learning needs and create the necessary goals to meet those needs, thereby empowering them to be able to teach themselves what they are required to know in the course.

Theme 3: Learning analysis and self-evaluation

Our analysis further showed that the students were of the opinion that self-assessment aided their *metacognitive* process. Metacognition is described as the "ability to think about thinking" and it is found to enable students to manage their cognition and emotion [20, p. 117]. The students suggested that having a second look at their work helped in evaluating the very thoughts they engaged in while working on the class assignment. One student described how self-assessment necessitated reflection of their thought process.

> *I understood the self-assessments in this course to be part of metacognition…who best to understand our thought process than ourselves.*

Along the lines of the student's perceptions, the instructor stated that one of the purposes of self-assessment is to "force" the students to think about the "why" underlying their answers in the assignment. This, he further reasoned, will help the students in analyzing their work, thereby making the necessary adjustment for subsequent assignments.

> *It forces them to think about what they are doing, why are they succeeding, why are they failing and what can they do about these? At least you know that the reason why I got all these points off is because I wasn't doing something right. And if I'm going to do my next assignment, how should I address the issue I had?*

Taken together, we argue that being able to "force" the students to think on why they are succeeding or failing is critical to ensuring they "understand their own thought process" (to use the words of the student).

Also, both the students and instructor emphasized the concept of *process over product*. In other words, it is important not just to focus on the expected outcomes for the learning (product), but to focus on the process of learning. Students were of the view that the purpose of self-reflection helped them to reflect more on the *process* rather than just the final answer (the product of their learning).

> *To reflect less on the answers that we got and more on how we arrived at those answers.*

The opinion of the instructor showed a similar thought pattern to the students'. The instructor stated that oftentimes students' attention is on the assignment's deadline and not on the *process*. He further emphasized that learning primarily entails a change in behavior and that self-assessment gives you the opportunity to assess and master the *process* leading to that change.

> *It's all about deadlines…but learning is not about deadlines, learning is about changing behavior and the opportunity to self-assess gives you the opportunity to stop, to take stock, to get real with yourself.*

Student self-assessment has been described as an "evaluation of student's products and processes in educational settings" [13, p. 1246]. *Products* and *process* are critical components of education according to O'Sullivan [21]. The author further explained that *product* refers to the knowledge or skill expected to be demonstrated by the learner while *process* focuses on the experiences that culminate in learning for the learner. The author also stated that when the instructional design emphasizes *process* the students are empowered to continue learning beyond their classroom settings.

By emphasizing *process,* the instructor further commented that self-assessment can help students pay more attention to the assignment's instruction which they do not often focus on.

> *Assessing themselves from the standpoint of the rubric, it's an opportunity to slow down and rethink their work…they are not just passing through the motion of, I have a deadline and I need to submit…And the other thing is that because the students are self-assessing, it actually forces them to reconsider what the instruction was, you know, because many times students do assignments without really focusing on the instruction. But if you self-assess yourself, it turns out that the reason why you are doing poorly is because you have not paid attention to the course instructions. Then you know that those were avoidable errors.*

Another corollary of emphasizing *process* and not just the *product* of learning is the identification of steps that are missing in students' communication of their work. To this end, the instructor argued that self-assessment could help in remediating short-comings with how students communicate their answers to assignment homework problems.

> *For example, they could have lost points even though they knew the concept but there wasn't enough clarity in their solutions because they skipped steps and that is bad communication. It's comparable to doing technical writing, we want them to be as explicit as possible…Also, to help them think through what was wrong with their approach to presenting themselves (their thoughts).*

In addition to the expected learning outcomes of a course, self-assessment can also assist in developing the student's written communication skill. According to Troy et al. [22] communication by engineers is "not merely the 'icing on the cake', but rather it constitutes part of the cake itself" (p. 3). In other words, an engineering solution is as good as the ability of the engineer to communicate their work. This underscores the importance of communication as a top skill required in engineering roles. When students skip steps while solving academic problems, it may be indicative of their misconception that *communicating* their solutions explicitly is not as important as showing the final result. To this end, the instructor was of the opinion that students need to be explicit while *communicating* their solutions and not just highlight the final result.

Theme 4: Motivation

Our analysis revealed that the self-assessment exercise helped the students to stay motivated in transitioning through the *liminality* stage of learning. In other words, self-assessment serves as a mediating *factor* between the stage when students are struggling to understand a concept to the stage, they gain understanding of that concept. In light of this, a student narrated:

It gave me another opportunity to learn in a position where I would normally give up.

Further, one of the students' opinions is indicative of a possible correlation between self-assessment and *self-efficacy*, an area of future research. According to Bandura [9], *self-efficacy* refers to the belief by an individual that they have the required behavior or ability to achieve specific results. Drawing on this, the student stated that one of the purposes of self-assessment was to develop their confidence.

> *Another purpose might be to be able to get [us] to have enough confidence in [our] work and answers.*

Also, the instructor was of the opinion that self-assessment results in student's empowerment which impacts positively on their motivation to learn.

> *…providing an opportunity to self-assess, brings the students into the assessment process, and empower the student, if the student takes advantage of it…I see self-assessment as impacting the motivation of most students to learn, because you've empowered them to be their own judge (Instructor)*

When students feel empowered, there is a greater tendency of retention within engineering education [23]. Similar to the instructor, a student posited that self-assessment helped in enabling their intrinsic motivation.

> *I believe the purpose was trying to motivate students to put in more work so that they are satisfied with their own results knowing that they achieved it themselves.*

Students that are intrinsically motivated often view learning as "rewarding in itself" [24, p.340] and research shows that intrinsic motivation is a critical factor in ensuring student learning in engineering education [25].

V. Implications, future studies, and limitations

According to Panadero et al. [1] "a student who only follows the teachers' prescription without understanding its purpose will not learn to monitor and self-adjust her work." Also, research shows that poor understanding of the purpose of self-assessment by the student can lead to shallow execution [26]. Drawing on these findings, we argue that as the students' perspectives align with the instructors' on the purpose of self-assessment, the students are in a better position to take advantage of self-assessment to regulate their learning.

The study expressed the purpose of self-assessment in four broad themes. These themes can be used to systematically express the purpose of self-assessment holistically and could be used to support the future development of a *self-assessment effectiveness model* in engineering education, an area of future study. A parallel model was developed in healthcare to help healthcare professionals determine what is lacking in their knowledge [27]. Hence, a *self-assessment effective model* could be leveraged by the instructor in re-orientating the students towards self-identification of gap in their learning. Another future study could explore which of the four thematic areas identified in this study an instructor would prioritize when designing self-assessments.

Although there is overall alignment between the students and the instructor's perspectives, there are some nuances in their expressions. An example under the theme of *learning engagement* is

that students appeared to express more interest in understanding how they made mistakes and how to correct them, while the instructor was more inclined to students making meaning of the content. Hence instructors could guide students on how to use the self-assessment process more for enhancing meaning than measuring learning performance.

Another key purpose that was expressed by the instructor is that students develop professional skills during the process of self-assessment. This is a unique finding, as self-assessment not only assists the students to achieve the course outcomes more effectively, but helps students practice and further develop their self-reflection, communication, and assessment skills. This study does not explore all the professional skills that were developed by the participants in this study. Owing to the calls for engineering instructors to ensure their instructions are designed to foster the development of the students' professional skills [28], future studies could assess the impact of self-assessment on the development of skills beyond the expected learning outcomes of a course. This is crucial, especially in the context and increasing complexity introduced by the technological revolution where individuals are rapidly required to acquire both technical (aligning to the new technologies) and professional competencies (such as interpersonal skills). Furthermore, self-assessment strategies can assist individuals with lifelong learning, especially during a period where technologies and ways of working are expected to change throughout their career.

The results of this study are limited given the exploration was conducted within an engineering course alone, additional research is needed to explore the perceptions of students and instructors in other engineering contexts. Furthermore, it is unknown if the students in this study were coached in the use of self-assessment, prior to implementation. Future studies could explore how prior knowledge and experience of self-assessments could improve the effectiveness of its use.

VI. Conclusion

The study explored the alignment of students' perceptions and the instructor's intent in giving self-assessments. The key findings show that the students' and instructors' perceptions of the purpose of self-assessment converged. The themes that emerged are *learning engagement*, *learning analysis*, and *self-evaluation*, *learning autonomy*, and *motivation*. The four thematic areas were conceptualized by drawing on the student self-assessment cycle and self-regulation theory. Understanding the alignment regarding the purpose of self-assessment could provide insight as to how to implement and structure self-assessments more effectively to achieve expected learning outcomes, as well as develop professional skills. The use of a *collective case* study showed congruence between the two *cases* (instructor's and students' perspectives), thus we are provided with a "broader appreciation" of the purpose of self-assessment in engineering education [17, p.2].

References

[1] E. Panadero, A. Jonsson, and J. Botella, “Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses,” *Educ. Res. Rev.*, vol. 22, pp. 74–98, 2017.

[2] R. Hernández, “Does continuous assessment in higher education support student learning?,” *High. Educ.*, vol. 64, pp. 489–502, 2012.

[3] M. M. C. Mok, C. L. Lung, D. P. W. Cheng, R. H. P. Cheung, and M. L. Ng, “Self-assessment in higher education: Experience in using a metacognitive approach in five case studies,” *Assess. Eval. High. Educ.*, vol. 31, no. 4, pp. 415–433, 2006.

[4] B. Lustgarten, “Impact Of Traditional Versus Alternative Assessment On Student Achievement,” 2022.

[5] S. Dikli, “Assessment at a distance: Traditional vs. alternative assessments.,” *Turk. Online J. Educ. Technol.-TOJET*, vol. 2, no. 3, pp. 13–19, 2003.

[6] M. A. Kurnaz and S. O. Çimer, “How do students know that they have learned? An investigation of students’ strategies,” *Procedia-Soc. Behav. Sci.*, vol. 2, no. 2, pp. 3666–3672, 2010.

[7] Z. Yan and G. T. Brown, “A cyclical self-assessment process: Towards a model of how students engage in self-assessment,” *Assess. Eval. High. Educ.*, vol. 42, no. 8, pp. 1247–1262, 2017.

[8] J. H. McMillan and J. Hearn, “Student self-assessment: The key to stronger student motivation and higher achievement,” *Educ. Horiz.*, vol. 87, no. 1, pp. 40–49, 2008.

[9] A. Bandura and S. Wessels, *Self-efficacy*, vol. 4. na, 1994.

[10] T. M. Walser, “An action research study of student self-assessment in higher education,” *Innov. High. Educ.*, vol. 34, pp. 299–306, 2009.

[11] A. Baisley, K. Hjelmstad, and E. Chatziefstratiou, “The accuracy of self-assessment in engineering mechanics,” in *2022 ASEE Annual Conference & Exposition*, 2022.

[12] K. Shagitha and A. K. Hadiyanto, “Undergraduate Students’ Perceptions toward Self-Assessments,” *SAGA J. Engl. Lang. Teach. Appl. Linguist.*, vol. 3, no. 2, pp. 103–124, 2022.

[13] J. H. Nieminen, “Beyond empowerment: student self-assessment as a form of resistance,” *Br. J. Sociol. Educ.*, vol. 42, no. 8, pp. 1246–1264, 2021.

[14] J. Biggs and C. Tang, *EBOOK: Teaching for Quality Learning at University*. McGraw-hill education (UK), 2011.

[15] B. J. Zimmerman, “From cognitive modeling to self-regulation: A social cognitive career path,” *Educ. Psychol.*, vol. 48, no. 3, pp. 135–147, 2013.

[16] J. W. Creswell and T. C. Guetterman, *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Pearson, 2019.

[17] S. Crowe, K. Cresswell, A. Robertson, G. Huby, A. Avery, and A. Sheikh, “The case study approach,” *BMC Med. Res. Methodol.*, vol. 11, no. 1, pp. 1–9, 2011.

[18] V. Trowler, “Student engagement literature review,” *High. Educ. Acad.*, vol. 11, no. 1, pp. 1–15, 2010.

[19] T. K. Chiu, “Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic,” *J. Res. Technol. Educ.*, vol. 54, no. sup1, pp. S14–S30, 2022.

[20] O. Lawanto, “Students’ metacognition during an engineering design project,” *Perform. Improv. Q.*, vol. 23, no. 2, pp. 117–136, 2010.

[21] Í. O’Sullivan, “Enhancing a process-oriented approach to literacy and language learning: The role of corpus consultation literacy,” *ReCALL*, vol. 19, no. 3, pp. 269–286, 2007.

[22] C. D. Troy, R. R. Essig, B. K. Jesiek, J. Boyd, and N. T. Buswell, “Writing to learn engineering: Identifying effective techniques for the integration of written communication into engineering classes and curricula (NSF RIGEE project),” in *2014 ASEE Annual Conference & Exposition*, 2014, p. 24.1406. 1-24.1406. 19.

[23] H. Steenkamp, A. L. Nel, and J. Carroll, “Retention of engineering students,” in *2017 ieee global engineering education conference (educon)*, IEEE, 2017, pp. 693–698.

[24] A. Fishbach and K. Woolley, “The structure of intrinsic motivation,” *Annu. Rev. Organ. Psychol. Organ. Behav.*, vol. 9, pp. 339–363, 2022.

[25] S. Y. Chyung, A. J. Moll, and S. A. Berg, “The role of intrinsic goal orientation, self-efficacy, and e-learning practice in engineering education.,” *J. Eff. Teach.*, vol. 10, no. 1, pp. 22–37, 2010.

[26] H. L. Andrade, “A critical review of research on student self-assessment,” in *Frontiers in Education*, Frontiers, 2019, p. 87.

[27] J. Asadoorian and H. P. Batty, “An evidence-based model of effective self-assessment for directing professional learning,” *J. Dent. Educ.*, vol. 69, no. 12, pp. 1315–1323, 2005.

[28] M. Mina, J. Cowan, and J. Heywood, “Case for reflection in engineering education-and an alternative,” in *2015 IEEE frontiers in education conference (FIE)*, IEEE, 2015, pp. 1–6.