International Journal of Evaluation and Research in Education (IJERE)
Vol. 13, No. 6, December 2024, pp. 4330~4337
ISSN: 2252-8822, DOI: 10.11591/ijere.v13i6.30324

Fortifying learners' self-regulation in biology through career-oriented teaching

Joelash R. Honra[1,2], Sheryl Lyn C. Monterola[2,3], Rosanelia T. Yangco[2]
[1]Department of Undergraduate Studies, Institute of Education, Far Eastern University, Manila, Philippines
[2]Science Education Area, College of Education, University of the Philippines, Quezon City, Philippines
[3]UP National Institute for Science and Mathematics Education Development, Quezon City, Philippines

Article Info

Article history:

Received Feb 18, 2024
Revised Jul 9, 2024
Accepted Aug 8, 2024

Keywords:

Biology education
Career-oriented teaching
Decision-making
Goal-orientation
Impulse control
K-12 program
Self-direction

ABSTRACT

Incorporating career-oriented teaching (COT) in technical-vocational education addresses challenges in graduates' job readiness by emphasizing practical skills aligned with career interests. This study investigates the impact of COT on students' self-regulation in biology, which is crucial for academic and career success. Quantitative analysis reveals that COT significantly enhances self-regulation skills, including decision-making, goal orientation, impulse control, and self-direction, compared to conventional science teaching (CST). Qualitative responses underscore the positive influence of COT on decision-making and goal orientation, with students setting positive goals and exhibiting improved impulse control. Moreover, COT fosters self-direction, promoting autonomy and responsibility for learning. These findings emphasize the importance of innovative teaching approaches like COT in developing students' self-regulation abilities and preparing them for the demands of the modern workforce. Integrating concrete, problem-based tasks in COT and teacher training can further enhance its effectiveness in developing specialized skills and self-regulation. This research contributes valuable insights into instructional practices' role in shaping students' self-regulation and highlights the need to explore further innovative teaching strategies to support students' holistic development.

Corresponding Author:

Joelash R. Honra
Department of Undergraduate Studies, Institute of Education, Far Eastern University
Manila, Philippines
Email: jrhonra@alum.up.edu.ph

1. INTRODUCTION

The K to 12 program in the Philippines aims to bolster the quality and global competitiveness of Filipino students by extending the basic education cycle to 12 years, encompassing kindergarten, primary, and secondary education [1], [2]. However, graduates, especially those in the technical-vocational-livelihood (TVL) track, encounter challenges in job readiness despite undergoing work immersion or on-the-job training [3], [4]. Studies from various countries, including the Netherlands and Western nations, have highlighted a predominant focus on academic achievement rather than career competencies in vocational education, resulting in graduates being ill-prepared for the demands of their respective fields [5]. In the Philippines, employability has been linked to critical skills such as critical thinking and problem-solving, exacerbating education-occupation mismatch and job mismatch [6], [7]. The gap between education and employment persists, particularly affecting TVL graduates who often lack proficiency in specialized subjects crucial for their chosen careers [8], [9]. This mismatch hampers graduates' employability and affects the overall economic landscape [10].

This study proposes integrating career-oriented teaching (COT) into core subjects like biology to enhance students' career readiness [11]. By promoting self-regulation among students-their ability to independently manage their emotions, thoughts, and behaviors to achieve academic and personal goals-the study seeks to foster independent learning and equip students with the necessary skills for success in both academic and professional realms [12]. Additionally, incorporating socioemotional skills such as grit and decision-making, along with career planning, aims to provide students with a holistic skill set essential for navigating the complexities of the modern workforce [13]. Collaboration among stakeholders is necessary in devising effective career plans and ensuring the seamless integration of COT into the educational framework [14]. Through authentic learning practices and a focus on specialized subjects, this study enhances students' content knowledge while promoting their employability through self-regulated learning practices [15].

In the landscape of educational innovation, COT emerges as a beacon of hope, offering a pragmatic solution to the persistent challenges encountered in technical-vocational education. Traditional educational paradigms often falter in adequately preparing students for the demands of the modern workforce, lacking in equipping them with the practical skills and career guidance essential for success. Contrastingly, COT integrates real-world relevance into classroom instruction, presenting students with a comprehensive learning approach that enhances their academic prowess and vocational readiness. Extensive research by several scholars [14], [15] underscores the transformative potential of COT, highlighting it is capacity to bridge the chasm between theoretical knowledge and practical application. However, amidst the accolades, a noticeable gap remains in our understanding of how COT influences students' self-regulation within technical-vocational fields, particularly in disciplines like biology.

In biology education, the cultivation of self-regulation skills is paramount, serving as the bedrock for academic excellence and career preparedness. Previous research [16], [17] expounded that self-regulation encompasses critical thinking and goal orientation, empowering students to navigate the intricacies of scientific inquiry and effectively apply their knowledge. Empirical studies suggest that adopting self-regulated learning strategies correlates positively with academic achievement and fosters a deeper appreciation for biology [18], [19]. Nonetheless, despite recognizing self-regulation's significance in shaping learning outcomes, there exists a gap in our understanding of its specific implications for students' performance in biology and the underlying mechanisms at play.

The current study aims to illuminate critical research lacunae by unraveling the nuanced interplay between COT and self-regulation within the technical-vocational education landscape, focusing on biology. While extant literature extols the virtues of COT in enhancing students' academic and vocational proficiencies, empirical evidence linking COT to heightened self-regulation in technical fields remains scarce [20], [21]. By investigating these intricate relationships, the study provides invaluable insights into how educational interventions can effectively cultivate students' career readiness and self-regulated learning. This ambitious undertaking addresses a critical gap in the scholarly discourse and holds profound implications for informing pedagogical practices and optimizing student outcomes in technical-vocational education.

The conceptual framework illustrated in Figure 1 delineates the impact of two teaching methodologies, COT and conventional science teaching (CST), as independent variables on students' self-regulation skills. Notably, self-regulation is a pivotal predictor of proficiency in life science-technical-vocational integrated skills [22], [23]. COT is a proactive approach to ensure that TVL students adeptly apply and hone life science-technical-vocational integrated skills, even within core subjects such as science. Drawing upon employability skill research by Shukla [11], these essential skills encompass metacognitive abilities, communication proficiency, collaboration aptitude, and problem-solving prowess.

Self-regulation, comprised of impulse control, goal orientation, self-direction, and decision-making, emerges as a multifaceted construct crucial for academic and vocational success. These facets, informed by the research instrument employed by Gavora *et al.* [22] underpin the investigation's focus on the correlation between exposure to COT and enhanced self-regulation. Furthermore, this study intended to answer the following research question: does exposure to COT improve students' self-regulation in biology?

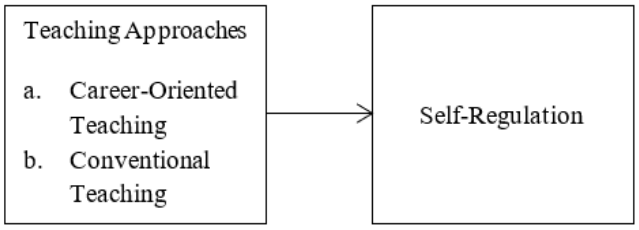

Figure 1. Conceptual framework of the study

2. METHOD

2.1. Research design

Employing a quasi-experimental research design, this study aimed to investigate the impact of integrating COT and CST on students' self-regulation within the technical-vocational education context [24]. Without a true control group and randomized sample selection, the design aimed to estimate the causal effect of the teaching intervention on the target sample, pre-grouped upon enrollment. The study involved two intact classes specializing in information and communications technology (ICT), with one class receiving the COT intervention and the other undergoing conventional teaching methods, measured through pretest-posttest assessments of self-regulation and life science-technical-vocational integrated skills. Additionally, qualitative data were collected and analyzed using thematic analysis to complement the quantitative findings. The research aimed to ascertain whether integrating COT into teaching biology could enhance students' self-regulation skills.

2.2. Participants

The study employed purposive sampling, targeting two intact sections of grade 11 students from a public senior high school in Makati City enrolled in the ICT strand, specializing in animation [25]. The respondents comprising 70 senior high school students aged 16-17. They were evenly distributed between the COT and CST groups within the TVL track.

2.3. Research instrument

The study employed two research instruments to measure the effects of COT and conventional science teaching (CST) on students' self-regulation skills. The self-regulation questionnaire (SRQ) was used to evaluate how students apply self-directive processes, cognitive behaviors, and emotions to achieve goals and cope with reactions [26]. The SRQ, comprising 27 items rated on a 4-point scale, assessed impulse control, goal orientation, self-direction, and decision-making, achieving a test-retest reliability of 0.88. After pilot testing with 100 grade 12 TVL-ICT students, the SRQ demonstrated good internal consistency with an overall Cronbach's alpha of 0.815, indicating reliability [22]. Table 1 provides sample items of SRQ in its components. The SRQ underwent validation by four experts specializing in Science and Educational Psychology from the University of the Philippines, resulting in revisions based on their feedback. The revised instrument retained it is original item count and underwent pilot testing before achieving a Cronbach's alpha of 0.81, indicating good internal consistency [22].

Table 1. Sample items of SRQ and it is components

Components of self-regulation	Sample items of SRQ
Impulse control	It is hard for me to see anything helpful about changing my ways.
Goal orientation	I can stick to a plan that is working well.
Self-direction	I usually only have to make a mistake one time to learn from it.
Decision making	I can usually find several different possibilities when I want to change something.

2.4. Teaching intervention

This study employed a non-randomized sampling technique, purposive sampling, to select two intact grade 11 classes specializing in animation within the ICT strand. These classes were randomly assigned to either the COT or CST group. To ensure fidelity to the lesson plan and minimize bias, a Master Teacher and a Department Head observed the teacher-researcher during the intervention, using a checklist known as the results-based performance management system classroom observation tool (RPMS-COT).

Both groups followed the 5Es learning cycle instructional model across seven weeks, covering topics such as introduction to life science and perpetuation of life. The 5Es learning cycle instructional model involves engaging students through exploration, explanation, elaboration, and evaluation, fostering a comprehensive and interactive approach to learning. The COT group has been involved in activities integrating technical-vocational skills with life science concepts. In contrast, the CST group followed the conventional teaching approach that was aligned with the DepEd curriculum guide. The integration of native language and English (code-switching) was used to facilitate learning, following previous research highlighting the importance of using students' first language in science education [27], [28].

Consent forms were obtained from parents before the intervention, and both groups underwent pretest and posttest assessments using the SRQ. Throughout the intervention, students in both groups worked collaboratively in small groups, assuming roles such as facilitator and reporter to enhance group productivity [29], [30]. The COT approach, integrated within the 5Es learning model, spanned seven learning cycles, allowing students to engage in various activities to improve self-regulation, with outputs generated after each cycle to reinforce learning.

2.5. Data collection and analysis

The implementation of the research study commenced after obtaining approval from the Schools Division Superintendent and securing informed consent from the parents of the grade 11 TVL-animation students. The self-regulation skills questionnaire was pilot-tested using Google survey forms answered by 100 grade 12 TVL-ICT students, demonstrating good internal consistency and reliability. A pretest of SRQ was administered to the participants before the intervention. During the intervention, which lasted for eight weeks, the COT group engaged in activities enriched with career-based and self-regulation components, while the CST group participated in traditional activities. Posttest assessments using the SRQ were administered to both groups after the implementation and accompanied by reflective journal writing to gather qualitative insights into students' self-regulation and integrated skills development.

The quantitative analysis involved comparing both groups' pretest and posttest scores using independent samples t-tests for initial comparability and computing Cronbach's alpha for instrument reliability. Thematic analysis was conducted on students' reflective journals to complement the quantitative findings, following a structured process from data familiarization to report production [31]. This mixed-method approach provided a comprehensive understanding of the effects of COT on students' self-regulation and integrated skills development.

3. RESULTS AND DISCUSSION

3.1. Initial comparability in self-regulation

An independent samples *t*-test analysis revealed no statistically significant difference in the pretest scores on self-regulation between the COT and CST groups, [$t(69)=2.032$, $p=0.092$], indicating initial comparability between the groups. The mean pretest ratings of both groups showed a perception of needing improvement in self-regulation toward learning biology. Similarly, Table 2 presents the descriptive values of the SRQ mean pretest ratings. The mean pretest ratings of the CFT group ($M=1.745$, $SD=0.257$) and the CST group ($M=1.660$, $SD=0.157$) generally responded 'disagree' in the 4-point scale instrument as shown by the mean ratings.

Table 2. Descriptive statistics of SRQ mean pretest ratings

Group	N	Mean	SD	SE
Career-focused teaching	35	1.745	0.257	0.013
Science conventional teaching	35	1.660	0.157	0.027

Note. SRQ maximum mean rating=4.0

3.2. Effects of teaching approaches on self-regulation

An independent samples t-test analysis revealed that after the intervention, students exposed to COT exhibited higher mean posttest ratings in self-regulation compared to those in the CST group, indicating an improvement in self-regulation in both groups after the intervention, $t(68)=-3.462$, $p=0.015$, as shown in Table 3. The study found that the COT group exhibited significantly higher levels of self-regulation in learning life science compared to the CST group [11]. Specifically, COT activities significantly enhanced decision-making, goal orientation, impulse control, and self-direction, fostering proactive learning in biology [26]. Conversely, the CST group struggled to demonstrate similar levels of self-regulation, likely due to its less interactive and career-oriented approach [27]. These results highlight the efficacy of integrating career-oriented elements into education to enhance self-regulation skills essential for academic and career success. The instructional design of COT, including inquiry-based learning activities and peer teaching, provided more opportunities for students to develop self-regulatory behaviors compared to traditional lecture-style instruction in CST [29], [30].

Table 3. Independent samples t-test of self-regulation skills posttest

Skill	t	p (one-tailed)
Self-regulation	3.462	0.015*

Note. *Indicates $p<.05$; $df=68$

Qualitative analysis further supported these findings, revealing significant enhancements in self-regulation among COT-exposed students compared to those in the CST group [32], [33]. Themes such as decision-making and goal orientation emerged prominently in students' reflections, emphasizing the role of COT in fostering essential skills for academic and vocational readiness [34], [35]. By encouraging students to

consider the consequences of their decisions and engage in practical activities, COT enhances employability and preparedness for future careers.

> COT Student 11: "*Nakatulong ang life science sa akin dahil bago ako magpasya. Sinisiguro ko muna kung ano ang maaaring maidulot nito sa akin at sa iba. Bilang isang TVL-Animation student, iniisip ko na maging film animator sa hinaharap.*"
> "Life science helped me before I make decisions. I always assess the consequences of a decision on me and others. As a TVL-Animation student, I'm thinking of becoming a film animator in the future." (Translation)

Research indicates that students with high levels of goal orientation tend to exhibit high mastery and academic performance [36]. These findings align with the observation that students, particularly those exposed to COT, diligently ensure that they meet set criteria and achieve desired outcomes [37]. Through systematic approaches taught during COT sessions, students improved their goal orientation, exerting effort to excel in science outputs and considering the broader impact of their actions on global issues. Additionally, some drew inspiration from teachers or relatives who were role models in career decision-making.

> COT Student 23: "*Pinapabuti ng Science ang aking goal orientation sa buhay dahil sa Agham, tinatalakay nito ang maraming mga proseso dahil hindi namin madaling makamit ang mga bagay. Tulad ng isang experiment, upang makamit ang layunin at upang sagutin ang problema ay nangangahulugang dapat kong gawin ang mga pamamaraan sa paggawa ng nasabing experiment. Pagkatapos kung pupunta ako sa tamang pamamaraan, nangangahulugan na nakamit ko na ang aking layunin.*"
> "Science improves my goal orientation in life because Science discusses many processes because we cannot easily achieve things. Like an experiment, to achieve the goal and to solve the problem means that I must practice the methods of doing such an experiment. Then if I go the right way, that means I have achieved my goal." (Translation)

Students exhibited improved impulse control due to COT integration. Many students reported engaging in reflective thinking rather than impulsive actions during the intervention, leading to well-executed outputs in the subject [38]. Moreover, the reduced disruptive behaviors observed by the teacher-researcher suggest enhanced impulse management among students, corroborating findings that effective strategies can mitigate disruptive behaviors and promote impulse control [39]. Qualitative responses from COT-exposed students mentioned that setting positive goals to avoid frustrations and incorporating reflective thinking to manage impulses effectively is vital. Tasks related to their specialization allowed them to apply their animation skills, facilitating rational decision-making even in challenging situations.

> COT Student 5: "*Sa paggawa ng isang gawain, karaniwang nagtatakda ako ng aking mga layunin. Ang pagtatakda ng isang positibong layunin sa pagtupad ng isang gawain ay nakatulong sa akin upang matapos ang gawain nang may mas kaunting pagkabigo.*"
> "In doing a task, I usually set my goals. Setting a positive goal in accomplishing a task has helped me to finish the task with less frustration." (Translation)

Moreover, qualitative responses demonstrate the impact of COT on students' self-direction. Students exhibited increased autonomy and responsibility for learning, relying less on external guidance [40]. Assignments and research projects allowed them to shape their work independently, fostering self-directed learning skills essential for future success [41]. Interviews revealed that the intentional design of the learning environment and technology-rich resources facilitated collaborative problem-solving and enhanced self-regulation among learners [42]. This suggests that COT promotes a shift towards self-directed learning, aligning with contemporary educational approaches prioritizing student autonomy and engagement in the learning process.

> COT Student 18: "*Pinahusay din nito ang aking direksyon sa sarili sapagkat sa Science, ang paksa na ito ay nagturo sa akin kung paano maging lohikal at analytic pagdating sa paglutas ng mga pang-agham na mga katanungan ng aking guro. Gamit ang wastong pamamaraang pang-agham, nagdadala ito ng direksyon sa akin upang makarating sa isang tamang konklusyon.*"
> "It also improved my self-direction because in science, this topic taught me how to be logical and analytic when it comes to solving my teacher's scientific questions. Using the proper scientific method, it brings me direction to reach a correct conclusion." (Translation)

Overall, the study unequivocally emphasizes the indispensable value of embracing innovative teaching methodologies, particularly the integration of COT, in fortifying students' self-regulation capacities and equipping them for the multifaceted challenges of today's workforce [43], [44]. By infusing career-oriented elements into the curriculum and providing authentic, real-world contexts for learning application, educators wield a powerful tool to cultivate self-regulation skills crucial for academic triumph and enduring scholarly pursuit [31], [45]. This research stands as a beacon, offering invaluable insights into the pivotal role of instructional practices in molding students' self-regulation prowess. Moreover, it serves as a clarion call to investigate innovative teaching strategies deeper, underscoring the imperative to explore avenues that foster students' holistic development in an ever-evolving educational arena.

4. CONCLUSION

The study's robust findings emphasize the transformative impact of integrating COT into biology education, illuminating significant enhancements in students' self-regulation skills, particularly evident through improvements in time management and problem-solving abilities among COT participants. These results highlight the pivotal role of learner-centered activities, such as simulations, debates, and laboratory work, in fostering student interest, engagement, and mastery of subject matter. While the study's focus on biology education yields valuable insights, it prompts critical reflection on the broader implications for education across diverse academic disciplines. Future research endeavors could extend the scope by investigating the longitudinal effects of COT implementation on students' career readiness and success trajectories. Moreover, investigating the efficacy of varied instructional strategies within the COT framework across various subject areas would enrich our understanding of its versatile applicability. Additionally, probing into the influence of teacher training programs in facilitating the effective implementation of COT and its subsequent impact on student outcomes holds significant promise. Through collaborative efforts between educators, researchers, and policymakers, we can cultivate an educational landscape that empowers learners to thrive in an increasingly dynamic and competitive global arena.

REFERENCES

[1] M. T. Montemayor, "2018 senior high school implementation exceeds DepEd outlook," Philippine News Agency. [Online]. Available: https://rb.gy/mptldq (Accessed: Mar. 28, 2023).

[2] D. Fisher and N. Frey, "Access to the core curriculum," *Remedial and Special Education*, vol. 22, no. 3, pp. 148–157, May 2001, doi: 10.1177/074193250102200303.

[3] A. Draaisma, F. Meijers, and M. Kuijpers, "The development of strong career learning environments: the project 'career orientation and guidance' in Dutch vocational education," *Journal of Vocational Education and Training*, vol. 70, no. 1, pp. 27–46, Jan. 2018, doi: 10.1080/13636820.2017.1392995.

[4] C. A. Maripaz and A. I. Ombra, "Graduates' competence on employability skills and job performance," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 5, no. 2, pp. 119–125, 2016, doi: 10.11591/ijere.v5i2.4530.

[5] M. D. A. Jasa, M. A. A. Jasa, and E. L. Corpuz, "Labor mismatch in the Philippines: analysis of the impact of education-occupation mismatch on wage and analysis of the Beveridge curve," M.S. thesis, University of Santo Tomas, Manila, Philippines, 2013.

[6] M. Mourshed *et al.*, "Policy debate | education and employment mismatch," *International Development Policy | Revue internationale de politique de développement*, no. 5.3, Aug. 2014, doi: 10.4000/poldev.1802.

[7] J. Kim, "Study: career-based teaching leads to more motivated students," 2013. [Online]. Available: https://archive.kpcc.org/blogs/education/2013/07/25/14347/study-career-based-teaching-leads-to-more-motivate/ (Accessed: Feb. 15, 2023).

[8] P. Acosta, T. Igarashi, R. Olfindo, and J. Rutkowski, *Developing socioemotional skills for the Philippines' labor market*. Washington, DC: World Bank Publications, 2017, doi: 10.1596/978-1-4648-1191-3.

[9] N. T. Pascual, "Factors affecting high school students' career preference: a basis for career planning program," *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, vol. 16, no. 1, pp. 1–14, 2014.

[10] S. Sahranavard, M. R. Miri, and H. Salehiniya, "The relationship between self-regulation and educational performance in students," *Journal of Education and Health Promotion*, vol. 7, no. 1, p. 154, 2018, doi: 10.4103/jehp.jehp_93_18.

[11] A. Shukla, "Review of efforts to integrate core skills for employability in vocational education and training systems," in *Integrating core work skills into TVET systems: Six country case studies*, L. Brewe and P. Comyn, Eds., New Delhi: ILO Publications, 2015, pp. 49–60.

[12] N. Attia, "Teachers' perception on the relationship between subject-specialized teaching and students' achievement in elementary classrooms," M.S. thesis, Ontario Institute for Studies in Education of the University of Toronto, Toronto, Canada, 2017.

[13] A. D. Rowe and K. E. Zegwaard, "Developing graduate employability skills and attributes: curriculum enhancement through work-integrated learning," *Asia-Pacific Journal of Cooperative Education*, vol. 18, no. 2, pp. 87–99, 2017.

[14] J. Amani, "Prevalence of, and factors associated with, unemployment among graduates: evidence from Tanzania," *Africa Education Review*, vol. 14, no. 3–4, pp. 230–244, Oct. 2017, doi: 10.1080/18146627.2017.1300064.

[15] R. Zhu, "The impact of major–job mismatch on college graduates' early career earnings: evidence from China," *Education Economics*, vol. 22, no. 5, pp. 511–528, Sep. 2014, doi: 10.1080/09645292.2012.659009.

[16] S. Arslan, "Social emotional learning and self-regulation: the mediating role of critical thinking," *International Journal of Learning and Change*, vol. 10, no. 2, pp. 101–112, 2018, doi: 10.1504/IJLC.2018.090935.

[17] J. Neroni, C. Meijs, R. Leontjevas, P. A. Kirschner, and R. H. M. de Groot, "Goal orientation and academic performance in adult distance education," *International Review of Research in Open and Distributed Learning*, vol. 19, no. 2, pp. 192–208, 2018, doi: 10.19173/irrodl.v19i2.3440.
[18] Ö. Sadi and M. Uyar, "The relationship between cognitive self-regulated learning strategies and biology achievement: a path model," *Procedia-Social and Behavioral Sciences*, vol. 93, pp. 847–852, Oct. 2013, doi: 10.1016/j.sbspro.2013.09.291.
[19] K. Kayacan and I. Sonmez-Ektem, "The effects of biology laboratory practices supported with self-regulated learning strategies on students' self-directed learning readiness and their attitudes towards science experiments," *European Journal of Educational Research*, vol. 8, no. 1, pp. 313–299, Jan. 2019, doi: 10.12973/eu-jer.8.1.313.
[20] M. Y. A. Hadi, R. Hassan, A. R. A. Razzaq, and M. Z. Mustafa, "Application of thinking skills in career: a survey on technical and vocational education training (TVET) qualification semi-professional job duties," *Procedia-Social and Behavioral Sciences*, vol. 211, pp. 1163–1170, Nov. 2015, doi: 10.1016/j.sbspro.2015.11.155.
[21] R. Palmer, "Skills development, employment and sustained growth in Ghana: sustainability challenges," *International Journal of Educational Development*, vol. 29, no. 2, pp. 133–139, Mar. 2009, doi: 10.1016/j.ijedudev.2008.09.007.
[22] P. Gavora, J. Jakešová, and J. Kalenda, "The Czech validation of the self-regulation questionnaire," *Procedia-Social and Behavioral Sciences*, vol. 171, pp. 222–230, Jan. 2015, doi: 10.1016/j.sbspro.2015.01.113.
[23] J. R. Honra, S. C. Monterola, and R. T. Yangco, "Career-focused teaching and its effects on students' biology-technical-vocational-fused skills," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 13, no. 5, pp. 3427–3434, 2024, doi: 10.11591/ijere.v13i5.29131.
[24] P. M. Steiner, Y. Kim, C. E. Hall, and D. Su, "Graphical models for quasi-experimental designs," *Sociological Methods and Research*, vol. 46, no. 2, pp. 155–188, 2017, doi: 10.1177/0049124115582272.
[25] M. D. C. Tongco, "Purposive sampling as a tool for informant selection," *Ethnobotany Research and Applications*, vol. 5, pp. 147–158, 2007.
[26] A. S. G. Erickson, K. Monroe, J. Soukup, and P. M. Noonan, "Self-regulation formative questionnaire," in *The skills that matter: teaching interpersonal and intrapersonal competencies in any classroom*, P. M. Noonan and A. S. G. Erickson, Eds., Thousand Oaks, CA, USA: Corwin Press, 2018, pp. 177–178.
[27] A. A. Alvarez, "Pilipino or English in science learning? the case of bilingual education in the Philippines," in *International Conference on Bilingualism and National Development*, 1991, pp. 3–18.
[28] D. Y. Yip, W. K. Tsang, and S. P. Cheung, "Evaluation of the effects of medium of instruction on the science learning of Hong Kong secondary students: performance on the science achievement test," *Bilingual Research Journal*, vol. 27, no. 2, pp. 295–331, Jul. 2003, doi: 10.1080/15235882.2003.10162808.
[29] S. A. Wheelan, "Group size, group development, and group productivity," *Small Group Research*, vol. 40, no. 2, pp. 247–262, 2009, doi: 10.1177/1046496408328703.
[30] A. A. Espinosa, S. L. C. Monterola, and A. E. Punzalan, "Career-oriented performance tasks in chemistry: effects on students' critical thinking skills," *Education Research International*, no. 1, p. 834584, 2013, doi: 10.1155/2013/834584.
[31] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, Jan. 2006, doi: 10.1191/1478088706qp063oa.
[32] J. Honra, "Building on success: revisiting the Tele-Aral program through the lens of appreciative inquiry," *PUPIL: International Journal of Teaching, Education and Learning*, vol. 7, no. 2, pp. 147–170, Sep. 2023, doi: 10.20319/pijtel.2023.72.147170.
[33] M. Matric, "Self-regulatory systems: self-regulation and learning," *Journal of Process Management. New Technologies*, vol. 6, no. 4, pp. 79–84, 2018, doi: 10.5937/jouproman6-19338.
[34] E. N. Abe and V. Chikoko, "Exploring the factors that influence the career decision of STEM students at a university in South Africa," *International Journal of STEM Education*, vol. 7, no. 60, pp. 1–14, Dec. 2020, doi: 10.1186/s40594-020-00256-x.
[35] D. Jacobson *et al.*, "Improved learning in U.S. history and decision competence with decision-focused curriculum," *PLoS ONE*, vol. 7, no. 9, p. e45775, Sep. 2012, doi: 10.1371/journal.pone.0045775.
[36] C. Was, "Academic achievement goal orientation: taking another look," *Electronic Journal of Research in Educational Psychology*, vol. 4, no. 10, pp. 529–550, 2006.
[37] M. N. Suprayogi, L. Ratriana, and A. P. J. Wulandari, "The interplay of academic efficacy and goal orientation toward academic achievement," *Journal of Physics: Conference Series*, vol. 1175, no. 1, p. 012132, Mar. 2019, doi: 10.1088/1742-6596/1175/1/012132.
[38] N. DeWall, "Self-control: teaching students about their greatest inner strength," *Psychology Teacher Network*, 2014.
[39] K. J. Garrett and K. Giddings, "Improving impulse control: using an evidence-based practice approach," *Journal of Evidence-Based Social Work*, vol. 11, no. 1–2, pp. 73–83, Jan. 2014, doi: 10.1080/15433714.2013.840197.
[40] J. D. Robinson and A. M. Persky, "Developing self-directed learners," *American Journal of Pharmaceutical Education*, vol. 84, no. 3, p. 847512, Mar. 2020, doi: 10.5688/ajpe847512.
[41] C. Silén and L. Uhlin, "Self-directed learning-a learning issue for students and faculty!" *Teaching in Higher Education*, vol. 13, no. 4, pp. 461–475, Aug. 2008, doi: 10.1080/13562510802169756.
[42] C. Fahnoe and P. Mishra, "Do 21st century learning environments support self-directed learning? Middle school students' response to an intentionally designed learning environment," in *Proceedings of Society for Information Technology & Teacher Education International Conference 2013*, 2013, pp. 3131–3139.
[43] A. Y. Atoum and H. H. Abu-Hilal, "The effectiveness of a training program based on goal orientations among Jordanian students," *SAGE Open*, vol. 7, no. 4, p. 2158244017735567, 2017, doi: 10.1177/2158244017735567.
[44] J. R. Honra, "Examining Teachers' Technological, Pedagogical, and Content Knowledge (TPACK) in Remote Teaching and Learning Modality," *International Journal of Multidisciplinary: Applied Business and Education Research*, vol. 3, no. 12, pp. 2537–2545, 2022. doi: 10.11594/ijmaber.03.12.07.
[45] J. R. Honra, "Development and Validation of Filipino Learners' Academic Resilience Scale," *American Journal of Education and Technology*, vol. 1, no. 2, pp. 107–113, 2022, doi: 10.54536/ajet.v1i2.664.

BIOGRAPHIES OF AUTHORS

Joelash R. Honra is an experienced educator at Far Eastern University, Manila. He earned his doctorate in Biology Education at the University of the Philippines, Diliman. His research interests include career-focused teaching, problem-based learning, design thinking, and biology education. His commitment to innovative teaching methodologies and research demonstrates his dedication to shaping the future of education. He can be contacted at email: jrhonra@alum.up.edu.ph.

Sheryl Lyn C. Monterola holds a Ph.D. in Physics Education from the University of the Philippines-Diliman and is a distinguished expert in 21st Century Skills, design thinking, metacognition, STEM Education, futures thinking, and AI in Education. Actively involved in projects like University-Industry Innovation and STEM Integration in TVET, she champions Learner-Centered STEM Approaches and organizes the Women in STEAM Summit. Currently, she is the Director of the UP NISMED (National Institute for Science and Mathematics Education Development). She can be contacted at email: scmonterola@up.edu.ph.

Rosanelia T. Yangco is a retired professor from the University of the Philippines College of Education, and is currently an adjunct faculty member at the University of the Philippines Open University. Specializing in biology and environmental education, she has authored high school science textbooks and has a wealth of publications in renowned local and international journals. She can be contacted at email: rtyangco@up.edu.ph.