

Student-centered Approach in Teaching and Learning: What Does It Really Mean?

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ABSTRACT: Student-centered approach has been the center of attention in teaching and learning as the emphasis to shift away from teacher-centered approach is growing. While the term has been widely used, it remains unclear how it can be effectively operationalized given the continuum nature of teacher-centered and student-centered approaches. This article examines 34 articles and included a thematic analysis of their contents to systematically present the methods to operationalize student-centered approach. A channel to practice student-centered approach is project-based learning where students work on projects, such as community and design projects, and are expected to manage the projects or at least propose actions or solutions. Problem-based learning is a variant of project-based learning and students often work on scenarios, cases, questions, or problems which are less extensive than projects. Problem-solving usually precedes lectures to promote self-directed learning and facilitate scaffolding. An argument-based curriculum incorporates arguments and debates that engage students in the self-discovery of different perspectives on a given topic. Student-centered approach is closely linked to the use of technology for research, interactions, gamification, simulations, and feedback. Student-centered feedback prompts active learning through deliberate feedback while adaptive teaching involves students in content-building. This review contributes to the enhancement of student-centered elements in teaching and learning.

KEYWORDS: Argument-based; education; student-centered; problem-based; project-based; technology

1. Introduction

Student-centered approach in teaching and learning or student-centered instruction has been a popular term used in the education sector nowadays to signalize an important shift in education from that which is teacher-centered. A conventional teacher-centered education usually centers on the imparting of knowledge and provision of information to satisfy the requirements of syllabi and the contents of teaching are often syllabi-directed [1]. The flow of information is commonly unidirectional with few attempts of engaging in meaning interactions with students.

In this context, students are likened to passive receivers of the information who are constantly told what they need to know and perform [2]. The knowledge is owned by teachers and students' participation in the acquisition of knowledge is minimal. Such approach often

undermines the ability of students to direct their own learning and engage in autonomous learning [3].

In order to better engage and empower students in learning, student-centered approach has been introduced and it is often upheld over teacher-centered approach. Student-centered approach is based upon the concept of constructivism that learners confer meanings to what they learn by relating new information to what they have already known [4]. In contrast to teacher-centered learning, student-centered learning shifts the locus of knowledge acquisition from teachers to students, hence placing the responsibility of acquiring information and making sense of the information on students, with teachers acting as facilitators [5]. In its most ideal sense, students take charge of their own learning, design their content of learning and define their learning paths in a student-centered approach [6]. However, in reality, teacher-centered and student-centered approaches are not mutually exclusive. They are two ends of a scale and there is a continuum of activities in between. Before student-centered learning can be fully realized, there is progressive facilitation that teachers have to render and efforts are needed to change students' conceptions of learning [7]. This is especially true in many regions of the world where reticence is still prevalent as a demonstration of respect for teachers [2]. There are also different forms of knowledge transmission in between the two extremes characterized by expanding beyond syllabi to presenting more coherent information to students prior to helping students to learn and finally apply and synthesize knowledge [8].

Taking contents for instance, they are defined by curricula in teacher-centered approach, but with the increasing shift towards student-centered approach, the contents gradually change from those defined by curricula to those with teachers having more say of what students should learn and ultimately to those constructed by students themselves [7]. Similarly, in terms of knowledge, it changes from being possessed by lecturers to being socially constructed [7]. Despite being touted as a better form of teaching and learning, student-centered approach is not without drawbacks. It requires teachers to understand their roles and responsibilities clearly in a student-centered classroom as placing learning mandate on students entirely could result in a lack of control in the classroom, especially when students are left to interact and look for information on their own [9]. Without intervention and monitoring to ensure that discussion and self-learning activities occur on the desired track, the classroom could become noisy and disorganized [10]. Besides, a student-centered classroom might work differently for students of different levels. For primary schools, the implementation of student-centered approach could be challenging as students often require clear instruction and guidance on learning activities and they may not have sufficient maturity to steer their own learning [10]. However, with greater maturity of students such as in secondary and tertiary educations, student-centered approach could be implemented with comparatively more ease. Teamwork and collaborative efforts are important features of student-centered learning and students often need to work in groups to exchange ideas, set out responsibilities and complete tasks [11]. Teamwork is, in fact, an important skill that is beneficial to students in integrating into society and workplaces [11]. Having said that, not all students are inclined to working collaboratively and some prefer to work independently.

There has been much interest in student-centered approach. The extant studies examine the perception of students and teachers towards student-centered learning in various settings [9, 12]. For instance, a study was conducted to gauge how students and teachers perceived or evaluated the employment of student-centered approach in translator training in Jordan. The

study found students and teachers to perceive student-centered approach positively but there were challenges in teamwork and time management and teachers felt the effectiveness of such approach depended on students' maturity [12]. Another study examined teachers' perception of student-centered approach in a middle school summer service-learning program in terms of the challenges encountered, their beliefs about teachers' and students' roles in such approach and the support needed [13]. Another attitudinal study among education experts and lecturers in Afghanistan revealed positive attitudes towards student-centered outcome-based learning, but its implementation was hampered by existing teaching and learning policies, and a lack of infrastructure and facilities [14]. There are studies investigating the effectiveness of different dimensions of student-centered approach. A study that compared two forms of student-centered learning, i.e., unregulated learning and co-regulated learning in supporting students' learning of undergraduate mathematics revealed that co-regulation provided the support structure and a better-organized environment for them to engage in self-directed learning [15]. Another study among Chinese nursing students demonstrated that self-directed learning positively influenced resilience among them [16].

Despite the popularity gained, there is a lack of framework guiding the implementation of student-centered approach, and in many instances, it still heavily relies on teachers to regulate the learning experience to make sure students are fixated on the desired learning outcomes. In some circumstances, student-centered approach is as ambiguous as its underlying principle of constructivism [7]. This paper presents the methods to operationalize student-centered learning through reviewing literature related to the implementation of student-centered approach in teaching and learning. In doing so, it hopes to enhance the effectiveness of student-centered approach.

2. Methods

This review examined the relevant literature on how student-centered approach in teaching and learning is operationalized. It involved literature search with scholarly databases comprising ScienceDirect, Scopus and Web of Science. The search was conducted with keywords comprising student-centered, learning, education, approach and pedagogy as well as a combination of the keywords such as student-centered learning and student-centered approach in refining the search. The search initially yielded 85 articles. These articles were screened for their relevance. The screening and selection of the articles were guided by screening criteria as follows: 1) The articles must be related to student-centered approach in teaching and learning and student-centered is not the same as person-centered in humanistic psychology; 2) The articles must be scholarly in nature and peer-reviewed; 3) The articles must be published in the past 5 years, namely between 2018 and 2023; and 4) The articles must contain information about the operationalization of student-centered approach. Articles focusing on perception towards student-centered learning without illustrating its implementation are excluded. After screening and selection, a total of 34 articles were included in the review.

3. Results and Discussion

3.1. *Small-group discussions.*

Student-centered approach has been implemented in courses taught at different educational levels across different regions, as a shift from teacher-centered approach to student-centered approach is increasingly emphasized. A summary of the implementation of student-centered approach in teaching and learning is presented in Table 1. An examination of the literature revealed common practices and patterns that emerge from the implementation of the approach. Small-group discussions are one of the predominant student-centered practices during which students or participants are divided into small groups to work on certain tasks [17]. The students are engaged in discussions which are often facilitated by teachers to ensure that they do not go off track [13, 17]. Such discussions could revolve around different themes from brainstorming of ideas, understanding of conceptions, identification of issues to examination of cases and exploring solutions [18]. Small-group discussions promote peer interactions and collaborative effort to explore ideas, concepts and solutions [18]. They enable students to search for information and initiate learning beyond what is defined in syllabi or textbooks. Students assume the autonomy to explore a larger pool of information but within the boundaries set by teachers.

3.2. *Project-based learning.*

In collaborative project-based learning, students are often given projects to work on. This constitutes another feature of student-centered approach, namely project-based learning [13, 19]. These projects can be community projects wherein students are required to identify community issues and analyze the issues through extensive research to propose and implement solutions [8]. Community projects allow students to take on the responsibilities to solve real-world problems, and through the process, they build rapport with the communities they serve. Community projects build students communication, leadership and interpersonal skills while granting them the autonomy to manage the projects towards the outcomes desired [20]. Having said that, teachers have pivotal roles in outlining the desired outcomes and guiding students through all stages of the projects [21]. The involvement of teachers depends on students' maturity. With more mature students, teachers can take a back seat and let students be in charge. With less mature students, the guiding and facilitating roles of teachers become instrumental to ensure the success of such projects [12]. An instance of such projects is to raise environmental awareness in a community through talks and activities that encourage waste reduction and recycling or those that reduce carbon emissions. Students have the freedom to choose the messages they wish to convey and the activities to conduct within the sphere of environmental awareness. They have the opportunity to engage in the entire project life cycle from initiation to closure, including monitoring the projects' effectiveness [20].

Another form of project-based learning is demonstrated in laboratory and experimental design. During the design, students are involved in 1) conceptualization of a design, 2) active experimentation to test the design, 3) concrete experience to implement the full design, 4) hands-on operations to observe how the design behaves and its efficiency, and 5) reflective observation in each design stage during which students reflect on the knowledge and experiences gained to validate and optimize the design [19]. Experimental design projects are

associated with experiential learning, prompting students to acquire higher-level learning outcomes such as investigation, critical thinking, problem-solving and engineering skills by actually performing a task, and in this instance, an experimental design [19]. If the task is based on a real-world practice, it confers the students an authentic experience which is useful in preparing them for work [22]. Student-centered approach is scaled up in open-ended laboratory which confers students the autonomy to develop experimental procedures to explore a subject of interest without being confined by the rigid guidelines of a lab manual [23]. The need for sequential instruction methodology with stage-wise feedback during the design process indicates that there is still significant reliance on teachers to ensure the success of experimental design projects.

Table 1. Implementation of student-centered approach in teaching and learning.

Education Type, Level and Location	Implementation of Student-centered Approach	Result and Implication	Reference
Elementary school mathematics, United States	Teaching routines consisted of small-group or individual activities to understand students' conception, selection of students' ideas for presentation to the entire class and prompting students to share ideas and respond to peer's ideas.	The new teaching routines aiming to understand students' mathematical thinking gave rise to student-centered instruction. Identifying students' ideas and incorporating them into lessons are crucial elements of such instruction.	[17]
Middle school summer learning program, United States	Students worked in team to select a community issue, conduct research on the issue, recommend solutions and act on it.	Student-centered approach in the form of project-based learning improved students' performance and motivation. It is crucial to support teachers in the transition from teacher-centered to student-centered as well as overcoming external domain challenges like assessments and curriculum requirements.	[13]
University mathematics, Finland	Students were given problems to solve prior to lectures, and lectures mainly comprised students' discussion and delving into the depth of the subject matter. Weekly new topic started with solving problems related to course content and study skills, with more challenging problems after the lecture.	Social supports in the forms of scaffolding and co-regulation of learning among others are beneficial to the self-directed learning of students.	[15]
'Basics of Control and Measurement Theory' at TU Berlin	Incorporation of student-centered approach in the redesign of learning activities for a course called 'Basics of Control and Measurement Theory'. This is characterized by intermittent lecturing to include questions or activities after each 15 to 20 minutes of lecturing. Students may be required to defend the solutions proposed. During tutorials, students would work on questions with the support from teaching assistants.	The redesign should ideally improve students' participation and make use of technology to further engage students. Its effectiveness has yet been tested.	[24]
Undergraduate chemical engineering laboratory, Canada	Implementation of a project-based laboratory with design consisting of abstract conceptualization to generate design ideas, active experimentation to conduct hands-on experiment, concrete experience to execute design and analyze experimental data, as well as reflective observation to validate and finalize design.	The approach improved students' learning experience while better equipping them to achieve high-level learning outcomes such as investigation, design, critical thinking, problem-solving, and engineering skills. The employment of sequential instruction methodology with staged feedback at crucial points of the design ensures its success.	[19]

Education Type, Level and Location	Implementation of Student-centered Approach	Result and Implication	Reference
Interprofessional awareness program on substance use disorders, United States	Participants were grouped based on their disciplines and each group was given a case scenario on the misuse of substances. Group discussion was guided by a worksheet. The discussion was followed by a debriefing.	The participants perceived the program to be informative and interactive. There were significant changes in determinants of attitudes towards substance use disorders among the participants.	[18]
Language arts, history, science and civic education in public secondary schools, Lisbon, Portugal	Implementation of ten sessions of student-centered argument-based curriculum, characterized by constructive peer-to-peer dialogue and argumentation.	The approach was effective in improving students' performance in a final argumentative essay. However, it required students to have self-regulation. Teachers perceived that student had gained cognitive, meta-cognitive, epistemological, communication and socio-emotional skills, as well as civic competences. Teachers needed to steer students' reasoning to align with the goals of the activities. The approach is a valuable pedagogical tool across different disciplines.	[25]
Teachers' conceptions of mobile technology-integrated instruction	Mobile technology-integrated instruction has been employed in student-centered learning. The student-centered attributes in such instruction perceived by teachers were 1) it promotes timely interactions between teachers and students; 2) it enables gamification of lessons which enhances students' learning motivation; 3) it permits students to learn at their own pace due to the adaptivity of mobile learning; 4) it facilitates students' collaborative learning; and 5) it involves students instructing or 'training' mobile technology in completing certain tasks.	Mobile learning can facilitate the implementation of student-centered approach. Training teachers in mobile technology-integrated instruction is beneficial.	[7]
Primary-level writing, Australia	Intervention in giving feedback to students' writing task was carried out to embed student-centered elements that promote students' self-regulation, hence engagement in feedback. The feedback would ideally prompt students to think actively and reflect upon their work. It contributes to a learning culture that welcomes feedback.	Students receiving student-centered feedback showed significant improvement in their writing tasks as compared to those who did not. The intervention increased teachers' ability to give effective feedback. Feedback strategies that improved the attainment of learning outcomes are those encouraging active learning.	[26]
Teachers' adoption of student-centered instructional practices in public lower secondary schools in the United States	The student-centered practices included adaptive instruction, ICT-supported learning, project-based learning and collaborative small-group learning.	Student-centered approach was more prevalent among teachers who received students' feedback on teaching, engaged in ICT training as well as professional development related to facilitating individualized learning, and continuously assessed students' learning.	[27]
The effect of blended case-centered learning on the academic performance of undergraduate nursing students in China, in comparison to offline case-centered learning	Case-based learning was implemented with increasing emphasis on student-centered learning. In blended case-centered learning, students were required to engage in 43 h of online learning and group case study in addition to 26 h of face-to-face lecture, 49 h of offline flipped classroom, 11 h of laboratory teaching and 15 h of clinical practices.	Blended case-centered learning resulted in better academic performance, improved critical thinking and self-confidence. While blended and offline case-centered learning modes are helpful to improve critical thinking of the nursing students, blended mode has a more pronounced effect on students' academic performance.	[28]

Education Type, Level and Location	Implementation of Student-centered Approach	Result and Implication	Reference
University-level atmospheric science course, China	A meaningful discourse with students was conducted at the start of a semester to garner their inputs on the assessment methods, contents and learning activities they deemed appropriate for the course after being briefed about the learning objectives of the course.	Students revealed their preferences for interactive learning, simulation-based learning, authentic assignments, experiential learning and problem-based learning. Students' participation in course development is helpful to adaptive teaching and learning in a student-centered setting.	[29]

3.3. Problem-based learning.

Problem-based learning is nuanced from project-based learning in the sense that a problem is not always a project requiring students to execute or at least to produce a proposal of its execution [21]. A problem could be a question or scenario that students are asked to solve and in a student-centered approach, this is usually given before lectures to encourage self-directed learning. During lectures, students could discuss the solutions while teachers could direct further discussions or delve into the in-depth of the subject matter [15, 24]. This is typical of constructivism with knowledge being scaffolded. It was found that providing social support in the form of co-regulation is beneficial when students are subjected to self-directed learning. Co-regulation is typified by the co-construction of knowledge with peer or someone who is more capable such as teaching assistants [24]. This implies that student-centered approach is not totally devoid of teacher-student interactions and teachers still assume crucial role in the approach to guide and scaffold students, and prepare them to self-learn.

Case-based learning could be perceived as a variant of problem-based learning and in this mode of learning, students are given cases or scenarios which might present certain problems to be solved or issues to be discussed [30]. It has been widely employed in the medical field for instance to raise awareness about and form attitudes towards substance use disorders and in nursing education [18, 28]. While working on the cases or scenarios, students frequently need to resort to and build upon the theoretical knowledge they have, as well as acquire new knowledge [28]. This process is not dictated by textbooks and it relies entirely on students to explore within the boundaries of the cases or scenarios.

3.4. Argument-based curriculum.

Student-centered approach drives students to look for answers and solutions on their own and in doing so, they need to be able to defend their answers and solutions, especially when they are required to present the answers and solutions to the class [30]. This gives rise to argument-based curriculum which utilizes arguments and debates as a major avenue to encourage peer-to-peer dialogue and self-study [25]. Its implementation requires teachers to undergo basic training for facilitation of such arguments and redesign the way information is presented to students, particularly through the use of controversies [31]. This would prompt students to take a stand and enable students to be subsequently grouped based on their respective stands for debates [31]. Such curriculum can be applied across multiple disciplines and it was reported to be effective in improving students' performance in argumentative essays [25]. However, it also rests heavily on teachers to regulate the arguments and steer them towards the desired learning outcomes. If properly implemented, it could improve students cognitive, meta-cognitive, epistemological, communication and socio-emotional skills [25].

3.5. Technology-aided learning.

Technology-aided learning is another important theme emerging from the literature related to student-centered approach in teaching and learning. It simply means the incorporation of technology in learning to engage students while guiding their access to electronic platforms promoting self-directed learning [7, 24]. The prevailing use of mobile phones for a myriad of purposes has made mobile technology an ideal tool for teaching and learning, particularly in the implementation of student-centered approach. Teachers perceived mobile technology to promote timely interactions between teachers and students, allowing students to get support and teachers to respond to students' needs effectively [7]. It also facilitates gamification of lessons in student-centered classrooms to promote students' learning motivation besides permitting students to learn at their own pace since they could access learning resources through mobile phones and go through them at flexible timing [2]. As mobile technology bridges students who are geographically apart, students could collaborate in learning wherever they are. With the advent of artificial intelligence, it is also possible to train mobile technology in completing certain tasks [7]. The collaborative, gaming, interactive, researching and adaptive qualities of mobile technology help propel student-centered learning. Other than mobile technology, the presence of a plethora of technologies such as online platforms facilitating conceptualization, design, interactions and gamification, is likely to help the transition to student-centered approach [28]. Other instances of technology-aided learning are flipped classroom, online learning and blended learning [32, 33]. While technologies are beneficial to learning, they need supervision and monitoring to ensure learning occurs in parallel to the intended goals.

3.6. Student-centered feedback.

There is also growing interest to make feedback student-centered. Conventionally, feedback informs students what they have done well and what they have not done well. This signals a one-directional flow of information from teachers to students without prompting students to engage in self-directed learning through feedback [34]. To equip teachers to provide student-centered feedback, intervention was given to primary school teachers in Australia through training. The teachers subsequently provided student-centered feedback to students' writing task with the hope of prompting students to think actively and reflect upon their work [26]. As a result, students receiving the feedback showed significant improvement in their writing tasks.

3.7. Adaptive teaching.

An important feature of student-centered approach is adaptive teaching. It implies an increasingly flexible syllabus that enables teachers to make adjustment to course contents based on what students are interested to learn, guided by the intended learning outcomes [7]. Students could be involved in brainstorming sessions in small groups to generate ideas and these ideas are open to peer comments before being incorporated into lessons [17]. Similarly, students could be guided through meaningful discourses to capture their desired contents, forms of assessment and activities for a course at the start of a course after being sufficiently briefed about the course objectives and learning outcomes [29]. Through these endeavors, teachers have the opportunities to make adjustment to the course contents, as well as the learning activities and assessments at more advanced stages of a course. Adaptive teaching helps

teachers to design and deliver lessons with students' interests in mind. Besides, it enables teachers to incorporate the latest information of a fast-evolving field such as climate change into the course contents based on students' feedback and participation, as courses progress [35].

4. Conclusions

The review sheds light into the operationalization of student-centered approach in teaching and learning through small-group discussions, project-based learning, problem-based learning, argument-based curriculum, technology-aided learning, student-centered feedback and adaptive teaching. In all forms of its operationalization, the student-centered practices fall between the extremes of teacher-centered and student-centered. While moving away from being teacher-centered to incorporate more rooms for self-directed learning, interactions and adaptive teaching, teachers are still playing important roles to ensure learning takes place in the desired directions and that it is set to achieve the intended learning outcomes. Teachers are often perceived as facilitators but their involvement varies depending on the levels and maturity of students, as well as the types of student-centered practices they implement. It has also been shown that their supervision, support and monitoring ensure the success of these practices. There is less rigidity with syllabi and contents as teachers plan and implement their teaching with students' interest in mind and to promote students' own initiatives in learning. However, it is still rare that learning is entirely student-centered with students assuming the full autonomy of directing their own learning and constructing their own contents. In addition, the proportions of contents constructed by students within the boundaries set by teachers also vary. In some instances, teacher-centered approach is still practiced particularly in imparting the fundamentals to prepare students for scaffolding. Therefore, the current educational practices frequently fall between the poles of teacher-centered and student-centered, and have different proportions of teacher-centered and student-centered approaches. This review offers the novelty of presenting and synthesizing the practical aspects of student-centered approach to confer a clear idea of its operationalization since student-centered approach is a broad concept often lacking clear frameworks. It is hoped that by knowing how to operationalize student-centered approach and increasing its proportion in teaching and learning, students' learning ability and performance could be optimized. In parallel to this, future study can look into ways to increase the proportion and effectiveness of student-centered approach in teaching and learning, in addition to exploring new means of operationalizing the approach.

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Competing Interest

No competing interest has been identified.

References

- [1] Degago, A.T.; Kaino, L.M. (2015). Towards student-centred conceptions of teaching: the case of four Ethiopian universities. *Teaching in Higher Education*, 20, 493–505. <https://doi.org/10.1080/13562517.2015.1020779>.

- [2] Tang, K.H.D. (2023). Gamification to Improve Participation in an Environmental Science Course: An Educator's Reflection. *Acta Pedagogia Asiana*, 2(2), 54–63.
- [3] Lojdová, K. (2019). Socialization of a student teacher on teaching practice into the discursive community of the classroom: Between a teacher-centered and a learner-centered approach. *Learning, Culture and Social Interaction*, 22, 100314. <https://doi.org/10.1016/j.lcsi.2019.05.001>.
- [4] Emaliana, I. (2017). Teacher-centered or student-centered learning approach to promote learning? *Jurnal Sosial Humaniora*, 10, 59–70.
- [5] Kang, J.; Keinonen, T. (2018). The Effect of Student-Centered Approaches on Students' Interest and Achievement in Science: Relevant Topic-Based, Open and Guided Inquiry-Based, and Discussion-Based Approaches. *Research in Science Education*, 48, 865–885. <https://doi.org/10.1007/s11165-016-9590-2>.
- [6] Murphy, L.; Eduljee, N.B.; Croteau, K. (2021). Teacher-centered versus student-centered teaching: Preferences and differences across academic majors. *Journal of Effective Teaching in Higher Education*, 4, 18–39.
- [7] Chen, C.-H.; Tsai, C.-C. (2021). In-service teachers' conceptions of mobile technology-integrated instruction: Tendency towards student-centered learning. *Computers & Education*, 170, 104224. <https://doi.org/10.1016/j.compedu.2021.104224>.
- [8] Tang, K. H. D. (2022). Reflection of an Online Climate Change Course and Its Pedagogies: Retrospection and Prospect. *Acta Pedagogia Asiana*, 2(1), 1–13. <https://doi.org/10.53623/apga.v2i1.104>.
- [9] Muganga, L.; Ssenkusu, P. (2019). Teacher-centered vs. student-centered: An examination of student teachers' perceptions about pedagogical practices at Uganda's Makerere University. *Cultural and Pedagogical Inquiry*, 11, 16–40.
- [10] Nuñez Enriquez, O.; Oliver, K.L. (2021). 'The collision of two worlds': when a teacher-centered facilitator meets a student-centered pedagogy. *Sport, Education and Society*, 26, 459–470. <https://doi.org/10.1080/13573322.2020.1738374>.
- [11] Tang, K.H.D. (2020). Personality traits, teamwork competencies and academic performance among first-year engineering students. *Higher Education, Skills and Work-Based Learning*, 11, 367-389. <https://doi.org/10.1108/HESWBL-11-2019-0153>.
- [12] Khoury, O. (2022). Perceptions of student-centered learning in online translator training: findings from Jordan. *Heliyon*, 8, e09644. <https://doi.org/10.1016/j.heliyon.2022.e09644>.
- [13] Dunbar, K.; Yadav, A. (2022). Shifting to student-centered learning: Influences of teaching a summer service learning program. *Teaching and Teacher Education*, 110, 103578. <https://doi.org/10.1016/j.tate.2021.103578>.
- [14] Katawazai, R. (2021). Implementing outcome-based education and student-centered learning in Afghan public universities: the current practices and challenges. *Heliyon*, 7, e07076. <https://doi.org/10.1016/j.heliyon.2021.e07076>.
- [15] Lahdenperä, J.; Rämö, J.; Postareff, L. (2022). Student-centred learning environments supporting undergraduate mathematics students to apply regulated learning: A mixed-methods approach. *The Journal of Mathematical Behavior*, 66, 100949. <https://doi.org/10.1016/j.jmathb.2022.100949>.
- [16] Zhou, H.; Wang, Y.; Cheng, L. (2022). The mediating effect of self-directed learning in the relationship between caring and resilience among Chinese nursing students: A multi-center cross-sectional study. *Nurse Education Today*, 119, 105598. <https://doi.org/10.1016/j.nedt.2022.105598>.
- [17] Thanheiser, E.; Melhuish, K. (2023). Teaching routines and student-centered mathematics instruction: The essential role of conferring to understand student thinking and reasoning. *The Journal of Mathematical Behavior*, 70, 101032. <https://doi.org/10.1016/j.jmathb.2023.101032>.
- [18] Mattila, A.M.; Astle, J.K.; Calhoun, B.C.; LaCroix, R.; Santacecilia, G.; D'Acunto, K.; Cavanaugh, J.E.; Morgan, A.A.; Lassila, H. (2022). A student centered interprofessional awareness program to increase knowledge and improve attitudes about substance use disorder.

- Journal of Interprofessional Education & Practice*, 28, 100530. <https://doi.org/10.1016/j.xjep.2022.100530>.
- [19] Zhang, M.J.; Croiset, E.; Ioannidis, M. (2022). Constructivist-based experiential learning: A case study of student-centered and design-centric unit operation distillation laboratory. *Education for Chemical Engineers*, 41, 22–31. <https://doi.org/10.1016/j.ece.2022.09.002>.
- [20] Tang, K.H.D. (2022). A model of behavioral climate change education for higher educational institutions. *Environmental Advances*, 9, 100305. <https://doi.org/10.1016/j.envadv.2022.100305>.
- [21] Guo, P.; Saab, N.; Post, L.S.; Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586. <https://doi.org/10.1016/j.ijer.2020.101586>.
- [22] Mandrikas, A.; Stavrou, D.; Skordoulis, C. (2017). Teaching Air Pollution in an Authentic Context. *Journal of Science Education and Technology*, 26, 238–251. <https://doi.org/10.1007/s10956-016-9675-8>.
- [23] Tang, D.K.H. (2021). A Case Study of Outcome-based Education: Reflecting on Specific Practices between a Malaysian Engineering Program and a Chinese Science Program. *Innovative Teaching and Learning*, 3, 86–104.
- [24] Knorn, S.; Topalovic, D.; Varagnolo, D. (2022). Redesigning a classic control course using constructive alignment, student centred teaching and continuous assessment. *IFAC-PapersOnLine*, 55, 180–185. <https://doi.org/10.1016/j.ifacol.2022.09.312>.
- [25] Rapanta, C. (2021). Can teachers implement a student-centered dialogical argumentation method across the curriculum? *Teaching and Teacher Education*, 105, 103404. <https://doi.org/10.1016/j.tate.2021.103404>.
- [26] Brooks, C.; Burton, R.; van der Kleij, F.; Ablaza, C.; Carroll, A.; Hattie, J.; Neill, S. (2021). Teachers activating learners: The effects of a student-centred feedback approach on writing achievement. *Teaching and Teacher Education*, 105, 103387. <https://doi.org/10.1016/j.tate.2021.103387>.
- [27] Zhang, L.; Basham, J.D.; Carter, R.A.; Zhang, J. (2021). Exploring Factors associated with the implementation of student-centered instructional practices in U.S. classrooms. *Teaching and Teacher Education*, 99, 103273. <https://doi.org/10.1016/j.tate.2020.103273>.
- [28] Yu, Z.; Hu, R.; Ling, S.; Zhuang, J.; Chen, Y.; Chen, M.; Lin, Y. (2021). Effects of blended versus offline case-centred learning on the academic performance and critical thinking ability of undergraduate nursing students: A cluster randomised controlled trial. *Nurse Education in Practice*, 53, 103080. <https://doi.org/10.1016/j.nepr.2021.103080>.
- [29] Tang, K.H.D. (2021). Engaging Students in the Development of an Atmospheric Science Course: A Discourse Analysis. *Asian Journal of Education and Social Studies*, 19, 1–9. <https://doi.org/10.9734/ajess/2021/v19i330463>.
- [30] Loyens, S.M.M.; Wijnia, L.; Rikers, R.M.J.P. (2023). Student-centered instruction: inquiry-, problem-, project-, and case-based learning. In *International Encyclopedia of Education*, 4th Ed.; Tierney, R.J., Rizvi, F., Ercikan, K., Eds.; Elsevier: Amsterdam, Netherland, pp. 701–711. <https://doi.org/10.1016/B978-0-12-818630-5.14080-1>.
- [31] Choi, A.; Seung, E.; Kim, D. (2021). Science Teachers' Views of Argument in Scientific Inquiry and Argument-Based Science Instruction. *Research in Science Education*, 51, 251–268. <https://doi.org/10.1007/s11165-019-9861-9>.
- [32] Tang, K.H.D. (2022). Impacts of COVID-19 on primary, secondary and tertiary education: a comprehensive review and recommendations for educational practices. *Educational Research for Policy and Practice*, 22, 23-61. <https://doi.org/10.1007/s10671-022-09319-y>.
- [33] Tang, K.H.D. (2021). Controversies of The Post-Lockdown New Normal - It May Not be Entirely Normal. *Current Research Journal of Social Sciences and Humanities*, 4. <http://doi.org/10.12944/CRJSSH.4.1.02>.

- [34] Vattøy, K.-D.; Smith, K. (2019). Students' perceptions of teachers' feedback practice in teaching English as a foreign language. *Teaching and Teacher Education*, 85, 260–268. <https://doi.org/10.1016/j.tate.2019.06.024>.
- [35] Tang, K.H.D. (2019). Are We Already in a Climate Crisis? *Global Journal of Civil and Environmental Engineering*, 1, 25–32.



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