Examining the Implementation and Impact of Reflective Practices in Engineering Courses: Insights from Faculty and Teaching Assistants

Dr. Logan Andrew Perry, University of Nebraska, Lincoln

Dr. Perry is an Assistant Professor of Engineering Education in the Department of Civil & Environmental Engineering at the University of Nebraska-Lincoln. His work contains a unique blend of engineering education and civil engineering projects. Dr. Perry's current work centers on understandin

Mrs. Ibukunoluwa Eunice Salami, University of Nebraska, Lincoln

Ibukunoluwa Eunice Salami is a PhD Student in Engineering Education Research at the University of Nebraska-Lincoln and graduate research assistant at the department of Civil and Environmental Engineering. She completed her undergraduate studies in Systems Engineering at the prestigious University of Lagos, Akoka and her masters in Industrial Engineering at the University of Benin, Ugbowo (both Universities are domicile in Nigeria). Her research interests include transfer of learning and transition from school (both undergraduate and postgraduate) to engineering industry. She is also interested in understanding how engineering students make design priorities using diverse technological tools.

Prof. Heidi A. Diefes-Dux, University of Nebraska, Lincoln

Heidi A. Diefes-Dux is a Professor in Biological Systems Engineering at the University of Nebraska - Lincoln. She received her B.S. and M.S. in Food Science from Cornell University and her Ph.D. in Food Process Engineering from the Department of Agricultural and Biological Engineering at Purdue University. She was an inaugural faculty member of the School of Engineering Education at Purdue University. She is currently a Professor in Biological Systems Engineering at the University of Nebraska - Lincoln. Her role in the College of Engineering at UNL is to lead the disciplinary-based education research initiative, establishing a cadre of engineering education research faculty in the engineering departments and creating a graduate program. Her research focuses on the development, implementation, and assessment of modeling and design activities with authentic engineering contexts; the design and implementation of learning objective-based grading for transparent and fair assessment; and the integration of reflection to develop self-directed learners.

Grace Panther, University of Nebraska, Lincoln

Dr. Grace Panther is an Assistant Professor in the Department of Civil and Environmental Engineering at the University of Nebraska – Lincoln where she conducts discipline-based education research. Her research interests include faculty change, 3D spatial visualization, gender inclusive teamwork, and studying authentic engineering practice. Dr. Panther was awarded an NSF CAREER award in 2024. Dr. Panther has experience conducting workshops at engineering education conferences both nationally and internationally, has been a guest editor for a special issue of European Journal of Engineering Education on inclusive learning environments, and serves on the Australasian Journal of Engineering Education advisory committee. Dr. Panther received both her Ph.D. and M.S. in Environmental Engineering from Oregon State University.

Mrs. Katie Mowat, University of Nebraska, Lincoln

Mrs. Katie Mowat is a PhD Candidate at the University of Nebraska. She is an engineer that loves to work with people, learn about new ideas and developments in her field, and spend quality time with friends and family. Her goal is to inspire people to be curious, excited, and passionate about engineering and life. She currently works as a civil engineer and her research focuses on engineering readiness in agriculture technology start-ups.

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Abstract

This paper explores the implementation and impact of reflective practices in engineering courses, as perceived by faculty members and teaching assistants (TAs) who integrated these strategies in their Spring 2023 course offerings. Reflection provides a valuable opportunity for students to enhance their learning process and become more self-aware of their strengths, weaknesses, and overall progress. This study aims to investigate the experiences and perceptions of instructors who employed reflective practices and gain insights into the effectiveness and challenges associated with their implementation.

The qualitative research design employed for this study involved conducting in-depth interviews with faculty members and TAs from two engineering disciplines, civil and environmental engineering, and biological systems engineering. These reflective practices encompassed six reflections over the semester, all aimed at promoting metacognition and fostering meaningful learning experiences. The interviews were structured to elicit detailed information regarding the perceived usefulness of reflective practices, the strategies employed, the perceived impact on student learning outcomes, and any observed challenges encountered during implementation. Preliminary results from interviews with three faculty members and three TAs highlighted the diverse ways in which reflective practices were integrated into engineering courses. Common themes emerged concerning the perceived benefits, including student and instructor growth, better self-regulation skills for the students, deeper learning, and enhanced critical thinking skills. Moreover, instructors found that these strategies could foster a more productive learning environment and improved student-teacher communication. However, challenges included time constraints, student resistance, and off-topic reflections. Faculty members and TAs stressed the importance of clear guidelines and scaffolding to optimize the effectiveness of reflective practices and mitigate these challenges.

The findings from this study will contribute to the scholarship of teaching and learning by providing empirical evidence on the successful implementation and positive outcomes of reflective practices in engineering education. This study also pinpoints valuable recommendations for instructors seeking to implement reflective strategies effectively. Additionally, the insights gained provide a foundation for further research and discussion regarding the integration of reflective practices into alternative STEM disciplines.

Keywords: reflection, metacognition

Introduction

Reflection is highly beneficial for both students and instructors in the engineering classroom [1]. For students, reflection promotes self-directed learning and enhances their self-awareness of their strengths, weaknesses, and overall progress in achieving the learning objectives. Research has shown that students who were trained to reflect on their work outperformed those who did not have a similar opportunity [2]. For instructors, reflection allows for valuable insight into

students' learning processes, the identification of students' needs, and the opportunity to make necessary adjustments to their teaching methods for improved student outcomes.

Based on Boud et al.[3], we define reflection as follows: "reflection is a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciation" (p. 19). This definition emphasizes that reflection helps individuals review, contemplate, and assess their experiences with the intention of refining their skills and gaining a more profound comprehension of those experiences [4].

Despite the importance of reflection, there is a paucity of research on the effectiveness of reflexive practices in engineering education courses and the challenges encountered in their application [5]. Moreover, prior literature has indicated that the formal incorporation of reflection in the engineering classroom remains rare [6]. As a result, *this study aims to investigate the experiences and perceptions of instructors who have employed reflective practices in engineering disciplines, seeking to illuminate the effectiveness of these methods and identify the challenges encountered in their application*. By doing so, this work will contribute to the existing literature on reflective practices and provide insights into how instructors can improve their teaching methods in engineering disciplines [2], [5].

Background

Reflection is a critical component of the learning process, enabling students to self-direct their own learning and practice habits of lifelong learning [5]. In the field of engineering education, the introduction of reflection is gaining attention [6]; however, there are few strategies available for its implementation [7], resulting in sporadic use across the field.

Scholars emphasize the importance of structured reflection practices in the engineering classroom. Schön [8] contends that reflective practice is crucial for professionals to develop the capacity to solve complex, real-world problems. Moon [9] suggests that reflective learning should be integrated into the curriculum to enable students to make connections between theoretical knowledge and practical applications. Dewey's [10] work on reflective thinking supports this approach, highlighting the need for active and persistent consideration of one's experiences for meaningful learning.

Reflection is operationalized within the engineering classroom using various activities. To implement reflection effectively, Boud, Keogh, and Walker (1985) recommend incorporating structured reflective activities such as journaling, group discussions, and portfolio assessments. These activities provide students with opportunities to critically evaluate their experiences, identify assumptions, and gain deeper insights into engineering principles. Additionally, Hativa and Goodyear (2002) propose that educators should create a supportive environment that encourages open dialogue and self-assessment, fostering a culture of continuous improvement in engineering education. Turns et al. [11] created a platform known as The Reflective Learner, an environment designed to facilitate reflection through essays. Though essays are the most common reflection activities, portfolios, surveys, reflective discussions, and other techniques have all been used to operationalize reflection in the engineering classroom [6].

Literature has investigated students' perceptions of reflection, specifically focusing on their understanding and appreciation for it as a lifelong learning skill. Csavina et al [5] found that students primarily view reflection as an opportunity to look back upon the past. A small portion of students saw it as an opportunity to inform future decisions, implying that most view reflection as simply an instructor-assigned activity as opposed to a useful life skill [5]. Senior students were far more likely to have positive associations with reflection than second-year students, meaning these perceptions can and will change over a curriculum. The data collected and analyzed in this paper is from a larger NSF-funded project on reflection centered on better understanding how reflection can develop students' ability to employ metacognitive strategies at a deep level over the course of an engineering degree.

Methods

This study aimed to answer the research question: *How do instructors and teaching assistants (TAs) describe the experience of implementing reflection in the engineering classroom?*

Setting and Participants

To answer this question, we employed a qualitative research design centered upon in-depth interviews with three faculty members and three teaching assistants (TAs) at a large, midwestern R1 university who taught or supported four courses within two engineering disciplines, civil and environmental engineering, and biological systems engineering, in Spring 2023. These disciplines were strategically chosen based on the principal investigators' home departments as proposed in the larger study from which this research is a part. 115 students participated in the reflection activities. The study was conducted in accordance with ethical guidelines and has received approval from the Institutional Review Board (IRB) of the University. The study protocol underwent rigorous review by the IRB to ensure the protection of participants' rights, safety, and confidentiality. Measures were implemented to uphold ethical standards throughout the research process, including obtaining informed consent from all participants and ensuring the secure handling of data. As part of a larger student-on-reflection integration into engineering courses, we asked each instructor to incorporate at least six reflections over the semester, all aimed at promoting metacognition and fostering meaningful learning experiences.

Data Collection and Analysis

Borrowing from the Cunningham et al. [12] framework, each reflection asked students to answer three questions:

1) What is one difficulty you are (or were) most concerned about? Be specific. Include a description of how you know (or knew) you are (or were) having this difficulty.
2) How have you tried to overcome this difficulty? Include a description of how your approaches have been successful or unsuccessful and what you learned.
3) What is your plan to further address this difficulty? Include an explanation of why you believe your plan will help. Or, if you were successful in addressing this difficulty, discuss how you might use these approaches to address future difficulties.

Students were asked to focus on a difficulty related to the course content in each of the six reflections.

At the end of the semester, instructors and TAs from each course were interviewed about their experience integrating reflection in their course. The interviews were semi-structured and were designed to elicit detailed information regarding the perceived usefulness of reflective practices, the strategies employed, the perceived impact on student learning outcomes, and any observed challenges encountered during implementation.

All interviews were transcribed and cleaned. Thematic analysis by Braun and Clarke [13] was then used to identify salient themes across all the interview data collected. Specifically, we began by familiarizing ourselves with the data through repeated readings, followed by generating initial codes that captured key concepts and ideas, and then organizing these codes into potential themes, which were refined and reviewed until the final themes emerged.

Findings

Four themes captured the insights from faculty and TAs on the impact of their reflection instructional practices in their courses during the spring 2023 semester. These include: (1) growth, (2) varied understanding of reflection, (3) importance of instruction, and (4) difficulty giving and using feedback.

Theme 1: Growth

We define growth as indicators that instructors are beginning to see that reflection has the potential to improve outcomes for both themselves and their students. This theme highlights the difference in the mindset of the participants before and after implementing reflection in their courses.

First, instructors highlighted their own personal growth in seeing how the students' reflections were instrumental in helping them review and revise their teaching practices. Specifically, they were able to focus on what the students noted as missing or unclear. One instructor explained:

If there is a certain homework problem that a lot of people made a comment about in the reflections, we could talk about that." (I2)

In other words, instructors used students' reflective responses to refine their teaching activities or make necessary changes to the curriculum based Students' reflections allowed the instructors to have a better understanding of the areas in which students may be struggling.

Second, participants acknowledged growth in students' metacognition and thinking about their learning. The instructors and teaching assistants believed that reflection in the engineering classroom helped students think more about their learning and how they were using their time. One instructor shared their experience:

"*being able to ask them, like, "do you feel confident in the problem?" so like the calculation part, and it's almost always yes. So I said. "then why are you spending time on that? Is that a good use of your study time?" and it's like a light bulb moment for them of like, no, it's not.* ***And so I think, through the reflection process. There was more conversation about how to learn in the class versus what to learn in the class.***" (I2)

Through reflection, students were able to decipher their own thinking to pinpoint what they are missing in the material, one instructor? even referring to it as a "light bulb moment."

Third, instructors and TAs perceived students to have improved their time management skills. Participants indicated that initially many students were reflecting on their struggles with time management and scheduling their activities appropriately. However, the impact of reflecting on their homework allowed students to discover their weaknesses and they become better at managing their time and their expectations. One instructor said:

"So ***I learned, at least from this class that time management is a big thing for students. So with their reflections most of the time they're able to recognize that they're having an issue managing their time****, causing them to start working on our homeworks late. And that's where they found, I guess, the most trouble. If they could figure out why they weren't doing well, it was generally they found that they just were putting things off to the last minute."* (I2)

Fourth, instructors also perceived growth in the students' abilities to control and be accountable for their own understanding of the course content:

"I think it was one of my better semesters, and I'm not sure if it was part of integrating reflection, and the ***student's having a lot of more like accountability for their own learning versus seeing me as the one that was in charge of their learning****."* (I2)

Fifth, results revealed that instructors and TAs were able to leverage the use of reflection in the classroom to improve themselves in terms of development of new research skills. This was particularly true for TAs who were involved in research in their graduate degree. They learned how to be intentional and specific in their use of libraries and in developing better writing skills.

One TA explained:

"*I think I have better research skills. You know, sometimes I don't know what I'm looking for in an activity or I'm just going with the flow…****but now I'm able to kind of think critically and draw out some patterns from what I'm seeing from what I'm observing****, you know."* (TA2)

As this comment illustrates, the teaching assistant became better at researching and synthesis because they were able to analyze the responses from the students to draw out patterns and observations.

In sum, students, instructors, and teaching assistants all experienced growth through the implementation of reflection activities, highlighting the multi-faceted nature of the benefits reflection can provide in the classroom.

Theme 2: Varied Understanding of Reflection

The second theme that emerged was centered around a varying understanding of reflection. This includes both the value or purpose of reflection, as well as cultural influences that may impact this perception of value. Both instructors and TAs expressed their concern about students not understanding the purpose of reflection:

"Reflection is I think the main thing and they don't see the end goal because ***it's not really attached to any engineering concept that they have****. As an engineer, you already have a very practical mindset, so you are like "why am I talking about my feelings?"* (I1)

Others emphasized that students felt the reflections were repetitive:

"I think it starts getting kind of not redundant per se. But ***students get a little bored because they're doing it over and over and over again, and they don't always see the value in it****."* (I3)

When asked to explain why they think students do not see the value in reflection, several participants mentioned the role of culture:

"Reflection is something people don't like to do because you need to sit there, quiet your mind, forget about everything that is going on or the twenty things that you have to do and then think and that is something that western society is not used to doing. We don't do meditation; we don't do any perspective type of thinking. So, it's not a cultural thing; it's not an instructional thing, so it's something that is going to be hard for them to achieve, so we have to be mindful of that."... (I2)

*"****I think that's probably a bigger cultural shift in how we educate people and it's probably a big shift for them, because they haven't really thought of this before.*** *But also the willingness to think about it isn't there. It's like they don't want to think about thinking they just want to do it and be done. It's almost like a larger cultural issue within the way we educate, like you said."* (I3)

These instructors note how our culture does not prioritize reflective practices, leading to students placing less value on the reflection activities. Many participants emphasized the importance of good instruction in surmounting this barrier.

Theme 3: Importance of Instruction

Throughout the conversations with the instructors and TAs, the importance of good instruction came up frequently. This theme primarily helps us understand best practices for incorporating reflective prompts into the curriculum and helping students understand its importance and implications for future applications. In fact, emphasizing the importance of reflection was

something most instructors planned to improve the next time they implement reflection in their courses:

"***I explained the importance of reflection…that it is something you take with you… they didn't really grasp it****…so I need to figure out a better way of connecting that to them where it's relevant.*" (I2)

Many of the instructors recognized that one of the challenges that affected the responses of the students was due to them not explaining the essence of the reflection prompts properly. They claimed that while they spoke about it, they felt they could have done better in terms of integrating the reflection prompt as a seamless part of the students' assignments. One instructor felt that if they had done this, it would have helped the students respond better to the reflection assignments. This is illustrated in their interview:

"***I think where I might have, where I failed, is to not only let them take the lead on it, but to really integrate it more, not only in the grading part, but in the assignment part and talk about it more than I did.*** *I did talk to them a few times, I did reinforce it a few times, but really make it seem like seamless part of their assignments...*" (I2)

One of the participants explained the purpose of using rubrics to clarify expectations in a formal manner. Rubrics can also provide more context for the reflective prompts, which may help the students as they answer the prompts. Several participants echoed this sentiment:

"*they need to be guided"* (TA2)

"the other thing that helped was the rubric...rubric provided that initial guidance." (TA2)
"*Have clear instructions when they are reflecting, reflect on what has happen in the course."* (TA2)

These quotes all reveal that getting quality responses from students heavily depends upon giving clear instruction and scaffolding the experience throughout the semester.

Notably, the importance of instruction was emphasized not only in the classroom, but also outside the classroom to properly prepare instructors and TAs for implementing reflection:

"***I think one thing I found useful was guidance, too, because I wasn't- I didn't have experience with it, so I had a senior colleague that kind of put me through, you know.*** *Gave me the pre-orientation and explained and actually gave me a task to do. "Okay...tell me what you think about this reflection." And I did that, she corrected me and from there with practice, I got better. Meet your other colleagues that are doing it and try to get more understanding about it.*" (TA3)

For this participant, the orientation they received from a senior colleague helped them improve their grading and understanding students' responses. This interaction with the senior colleague also helped them give better feedback to the students on how the students could improve their learning and future application for the course outcomes. Simply put, students, instructors, and TAs all need quality instruction to make reflection valuable in engineering courses.

Theme 4: Difficulty Giving and Using Feedback

Finally, the fourth theme that emerged centered on the difficulty of giving feedback, the reasons for which are multi-faceted. These reasons mainly included a lack of time, clarity, and context. A primary cause of the difficulty participants experienced while giving feedback on reflections stemmed from a lack of time. Instructors, in particular, expressed their desire to read through each reflection to understand what students were having difficulty with, but found that skimming was often their only option due to time constraints:

"I think I probably could have more time to look at them. ***I skim through them, but I don't always have the time."*** *(I3)*

Though many instructors shared that reflection has the potential to help them stay in touch with students' experiences in the classroom, thoroughly reading the reflections (especially for large courses) takes a significant amount of time, a resource that is already strained for many instructors.

Instructors and teaching assistants alike both expressed frustration with the lack of clarity in student reflections:

*"...****things are not really organized when they express themselves.*** *They want to rant. Lack of specificity. Too vague. (TA2)*

Beyond clarity, instructors also emphasized that the reflections were often off-topic. Though the reflection prompts asked students to reflect on a difficulty directly related to recent course content, many focused instead on more general study or professional skills:

"Something that we saw a lot was there were a lot of logistical things of like "

I need to manage my time better." Like, what are you struggling with? ...so ***it wasn't related to the course content, but more like the logistics of being a student in a class or being a student in general."*** (I1)

This made it difficult to provide helpful feedback, which is a critical part of effective reflection in the classroom. In fact, while many instructors planned on discussing common difficulties that came up in reflection in their lecture, many were unable to do so due to the off-topic nature of the reflections.

Another reason cited for difficulty giving feedback stemmed from a lack of context on the part of the TAs. Many instructors chose to have their TAs grade the reflections, which became difficult for those TAs who were unable to attend class themselves:

"I think one think that would have helped was to be involved in that maybe to just have a feel of what their class is like, because while I was giving feedback, ***I'm giving feedback as a, what will I call it, third party - I don't know anything about the course.*** *So, I'm only able to use my*

knowledge of engineering to kind of figure out what's going on...So probably being in one or two classes that they will reflect upon would have helped to guide them appropriately." (TA2)

TAs that were involved as graders only expressed difficulties connecting with the material that was not fresh in their minds. Though familiarity with the material is a common requirement of a TA, responding to reflections requires a deep understanding of the course material.

Discussion

The results of this study coalesced into four themes: (1) growth, (2) varied understanding of reflection, (3) importance of instruction, and (4) difficulty giving and using feedback. Our findings are consistent with literature that states incorporating reflection into teaching is beneficial to both the instructors and students. Reflection helps students become better self-regulated learners [14] is crucial for the identification of areas of improvement, the consolidation of new knowledge, and the application of insights gained to future situations, ultimately enhancing the overall learning experience. Our study also highlights the multi-faceted nature of the growth that occurs to reflection. Aside from student improvement, reflection can lead to improved communication between the instructor and students [15] and enhanced research skills.

Realizing these benefits depends upon clear instruction and scaffolding. Many students may come into the classroom with different beliefs about reflection, its importance, and its usefulness in engineering. Providing explicit instruction on the benefits of reflection for metacognition and lifelong learning [16] may help in ensuring students understand the importance and impact of quality reflective practices. Rubrics, along with appropriate scaffolding [17], can help ease students into reflection and provide clear guidelines for what is considered acceptable. The expectations for responses to the reflective prompts should also be reiterated to the students regularly so they are able to connect what they have learned to what the reflective prompt is meant to address.

Our results are also consistent with the challenges that many instructors face when implementing reflection in the engineering classroom. At the top of this list are the experiences of both the instructors and the TAs is the difficulty when giving feedback on student reflections. Feedback is key to achieving self-regulated learning, an objective which most instructors expressed as a key objective of incorporating the reflection into the classroom; hence, it is important that engineering instructors can set apart adequate time and resources to ensuring that students are given effective feedback, characterized by intentionality, ease of understanding, and relevant comments [18]. If done properly, students can grow from the feedback and continuously improve their reflective practices. Instructors must also collaborate effectively with their teaching assistants in giving feedback on reflection prompts. It is important that TAs are on board with the expectations of the instructors for the quality of students' responses. This encourages synergy between both parties and ensures that the gap experienced at times between the instructor's expectations and the students' responses is bridged [19].

Despite the challenges the participants highlighted, it was clear from the interviews that reflection can be beneficial in the engineering education context. It is evident that with the right training and implementation, students can grow and leverage the use of reflection to achieve

lifelong learning. For this reason, we recommend that "reflective practices can and should be taught – explicitly, directly, thoughtfully and patiently" [20].

Recommendations

The following summarizes our recommendations for incorporating reflection into the engineering classroom based on this study's findings, several of which align with recommendations provided by Aronson [21].

Emphasize the value of reflection in the classroom. Be clear to students and TAs why reflection is important, both in the course of interest, and in life more broadly. Employers need lifelong learners who understand how to direct their own learning – this should start in the classroom.

Ensure instructors and teaching assistants have proper training on reflection. Deriving the benefits of reflection in the classroom is dependent upon the instructional team having a good foundation in the value, importance, and implementation of metacognitive practices.

Use detailed rubrics. To be successful, students need to understand what constitutes quality reflection. Providing and using detailed rubrics encourages transparency and equips students with one tool that sets expectations for quality.

Allow ample time for providing feedback. To improve students' metacognitive abilities, detailed feedback on students' reflection responses requires time to read and interpret. Ensure adequate time and resources are allocated for proper assessment.

Limitations

The study presented in this paper has certain limitations inherent to qualitative studies that should be acknowledged. First, the study relied on a small number of instructors and teaching assistants from one university in the midwestern United States. Findings from this study are not generalizable to all contexts in which reflections may be implemented. Second, the use of interviews as the primary data collection method could introduce responder bias, as participants may feel compelled to provide socially desirable answers. Nonetheless, despite these limitations, the study provides valuable insights and a rich understanding of reflection implementation in engineering courses.

Conclusion

In conclusion, this study examined the implementation and impact of reflective practices in engineering courses through in-depth interviews with instructors and teaching assistants. The findings demonstrated participants' valuing of reflection in enhancing student learning and self-

awareness. The results highlighted instructor and TA identified common benefits such as personal and student growth. However, instructional challenges were also identified, including time constraints and student resistance. The study emphasizes the importance of clear guidelines and scaffolding to optimize the effectiveness of reflective practices. Future work will include more data collection along these lines as a part of the larger NSF grant geared towards incorporating reflective practices into engineering education. Overall, the findings contribute to the scholarship of teaching and learning and provide valuable recommendations for instructors. Furthermore, the study lays the groundwork for further research on the integration of reflective practices in other STEM disciplines.

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References

[1] S. L. Ash, P. H. Clayton, and M. P. Atkinson, "Integrating Reflection and Assessment to Capture and Improve Student Learning," *Mich. J. Community Serv. Learn.*, vol. 11, no. 2, pp. 49–60, 2005.

[2] H. Phan P., "Examination of student learning approaches, reflective thinking, and epistemological beliefs: A latent variables approach," *Electron. J. Res. Educ. Psychol.*, vol. 4, no. 3, pp. 577–610, 2006.

[3] D. Boud, R. Keogh, and D. Walker, *Reflection: Turning Experience into Learning*, vol. 1. London: Routledge, 1985. Accessed: Jan. 04, 2024. [Online]. Available: https://www.routledge.com/Reflection-Turning-Experience-into-Learning/Boud-Keogh-Walker/p/book/9781138984820

[4] Richards, "Beyond training: approaches to teacher education in language teaching," *Lang. Teach.*, vol. 14, pp. 3–8, 1990.

[5] K. Csavina R., C. Nethken Rochelle, and A. Carberry R., "Assessing Student Understanding of Reflection in Engineering Education," in *ASEE 123rd Annual Conference & Exposition*, New Orleans, LA, Jun. 2016, pp. 1–11.

[6] L. A. Sepp, M. Orand, J. A. Turns, L. D. Thomas, B. Sattler, and C. J. Atman, "On an Upward Trend: Reflection in Engineering Education," presented at the 2015 ASEE Annual Conference & Exposition, Jun. 2015, p. 26.1196.1-26.1196.13. Accessed: Feb. 06, 2024. [Online]. Available: https://peer.asee.org/on-an-upward-trend-reflection-in-engineering-education

[7] J. Walther, N. W. Sochacka, and N. N. Kellam, "Emotional Indicators as a Way to Initiate Student Reflection in Engineering Programs," presented at the 2011 ASEE Annual Conference & Exposition, Jun. 2011, p. 22.557.1-22.557.13. Accessed: Feb. 06, 2024. [Online]. Available: https://peer.asee.org/emotional-indicators-as-a-way-to-initiate-student-reflection-in-engineering-programs

[8] D. A. Schön, *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. in Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. San Francisco, CA, US: Jossey-Bass, 1987, pp. xvii, 355.

[9] J. A. Moon, *A Handbook of Reflective and Experiential Learning: Theory and Practice*. London: Routledge, 2004. doi: 10.4324/9780203416150.

[10] J. Dewey, *How we think*. in How we think. Oxford, England: Heath, 1933, pp. x, 301.

[11] J. Turns, W. Newstetter, J. Allen, and F. Mistree, "Learning essays and the reflective learner: supporting reflection in engineering design education," Jan. 1997.

[12] P. Cunningham, H. M. Matusovich, D. A. N. Hunter, and R. E. McCord, "Teaching metacognition: Helping engineering students take ownership of their own learning," in *2015 IEEE Frontiers in Education Conference (FIE)*, Camino Real El Paso, El Paso, TX, USA: IEEE, Oct. 2015, pp. 1–5. doi: 10.1109/FIE.2015.7344080.

[13] B. Virginia and C. Victoria, *Thematic Analysis*. SAGE Publications, 2021. Accessed: Apr. 25, 2024. [Online]. Available: https://us.sagepub.com/en-us/nam/thematic-analysis/book248481

[14] B. Zimmerman J., "Becoming a Self-Regulated Learner: An Overview," *Theory Pract.*, vol. 41, no. 2, pp. 64–70, 2002, doi: 10.1207/s15430421tip4102_2.

[15] I. Blau and T. Shamir-Inbal, “Re-designed flipped learning model in an academic course: The role of co-creation and co-regulation,” *Comput. Educ.*, vol. 115, pp. 69–81, Dec. 2017, doi: 10.1016/j.compedu.2017.07.014.
[16] M. Wijnen-Meijer, “Preparing students for lifelong learning by means of metacognition,” *GMS J. Med. Educ.*, vol. 37, no. 5, p. Doc54, Sep. 2020, doi: 10.3205/zma001347.
[17] H. Kang, J. Thompson, and M. Windschitl, “Creating Opportunities for Students to Show What They Know: The Role of Scaffolding in Assessment Tasks,” *Sci. Educ.*, vol. 98, no. 4, pp. 674–704, 2014, doi: 10.1002/sce.21123.
[18] G. Gay and K. Kirkland, “Developing Cultural Critical Consciousness and Self-Reflection in Preservice Teacher Education,” *Theory Pract.*, vol. 42, no. 3, pp. 181–187, Aug. 2003, doi: 10.1207/s15430421tip4203_3.
[19] A. M. Sharif and S. Z. Zainuddin, “Students’ perceptions of their reflective essay writing experience and teacher feedback comments,” *Indones. J. Appl. Linguist.*, vol. 6, no. 2, Art. no. 2, 2017.
[20] T. Russell, “Can reflective practice be taught? Reflective practice,” *Int. Multidiscip. Perspect.*, vol. 6, no. 2, pp. 199–204, 2005.
[21] L. Aronson, “Twelve tips for teaching reflection at all levels of medical education,” *Med. Teach.*, vol. 33, pp. 200–5, Mar. 2011, doi: 10.3109/0142159X.2010.507714.