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Review of the Literature on Question-Posing-based Self-Directed Learning

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Abstract: Self-directed learning presents a promising approach to enable students to achieve self-reliance and cultivate greater ownership over their learning pursuits. In the current teaching-learning scenarios, the implementation of classroom-oriented self-directed learning (SDL) strategies does not achieve their desired goal. The primary reason may be that the teachers are not trained to implement these strategies. According to the literature, learners face difficulties in following different SDL strategies. Question posing (QP) serves as a tool that can help learners understand the concept, clear misconceptions, and collaborate with peers to construct their knowledge. We have analyzed existing papers on question-posing-based classroom-oriented self-directed learning strategies to find how question-posing may help students overcome their difficulties and find ownership in their learning. We find that QP-based teaching-learning approaches require well-designed activities that can help students elicit questions and with which students can navigate in achieving ownership of their learning. The paper concludes with the identification of a QP-based strategy that conforms to the essential set of requirements of self-directed learning.

Keywords: Self-directed learning, question posing, learner difficulty.

1. Introduction

The 21st century is a technology-driven era. It has changed the conceptions of the way to learn and teach, the characteristics of classroom environments, students' thinking processes, the availability, and type of learning resources, and the teacher's role. In these rapidly changing and challenging environments, students want to learn topics according to their interests and follow strategies that will be under their control. Self-directed learning empowers students by giving them the agency to drive their learning. The self-driven learning environments should be based on the individual students' perspectives and allow students to interact with the educational design constructs as per their interests (Lorås et al., 2021). As pointed out by Kim & Zitzer (1999), in a self-directed learning process, students take charge of their own learning, and teachers are facilitators who understand the different needs of students in terms of students' knowledge and interests. Charoula (1998), emphasized this learning process satisfies individual students' needs at different rates.

Self-directed learning helps students adopt a thorough and deep method of studying (Bell et al., 2019) and enhances their educational experience (Pott et al., 2021). It is a powerful approach for increasing student engagement. It is an approach in which students construct and reconstruct knowledge dynamically and their growing engagement is supported by motivational, cognitive, and social aspects (Martinetti, 2020). Student-directed learning is based on constructivist theory, which defines knowledge as "temporary, developmental,

socially and culturally mediated and non-objective" (Brooks & Brooks, 1993). Within this paradigm, students are active knowledge constructors driven by their goals and curiosities. Students take control and ownership of their learning, (Vyas, 2018). In such classrooms, the students are at the center of their learning. As a descriptor for constructivist instructional approaches, within this paradigm, the teacher gives up the role of the transmitter of knowledge and interacts with the students as a facilitator with the perspective that learning involves the active construction of meaning (Biggs, 1989) by the students. In the SDL environments, students develop deep approaches to learning. The deep approaches are based on student interest in the subject matter. The strategy here is to maximize understanding so that curiosity is satisfied. It instills a sense of autonomy and mastery in the student, and a sense of purpose into the educational process.

Knowles (1975), defined self-directed learning as a five-phase process, in which students **(i)** recognize their learning needs, **(ii)** formulate learning goals, **(iii)** select learning resources, **(iv)** employ appropriate learning strategies, and **(v)** assess learning outcomes. (In this paper, we refer to them as SDL processes). Conceptions of learning vary from superficial to deep and the progression from surface to deep is aided by classroom processes that include student-driven learning and meta-learning (Biggs, 1989). To achieve self-directed learning, several strategies like project-based learning, problem-based learning, inquiry-based learning, etc. were studied by the researchers, which state, inbuilt complexities about these strategies to apply in a classroom setting. These complexities and challenges are faced both by the students and the educators (Hwang et al., 2020).

Though self-directed learning and student-directed learning are similar, there is a slight difference between them. While both self-directed learning and student-directed learning focus on individual autonomy and independence, student-directed learning involves more guidance and support from teachers or facilitators. In self-directed learning, learners have the freedom to make decisions and choices about their learning, however, in student-directed learning, the teacher or facilitator also plays a role in guiding and supporting the student's learning process. Self-directed learning skills continue to develop as individual learning progresses through early adolescence to adulthood (Brandt, 2020). Brandt (2020) proposed a self-directed learning continuum, where a student's self-directedness gradually grows from a dependent student to a self-determined student.

Due to the multifaceted definition of self-directed learning, often self-regulated learning is synonymously used with self-directed learning. Self-regulation is a more narrowly defined concept, representing one dimension of self-directed learning, according to Brandt (2020). Self-directed learning emphasizes learner autonomy in selecting learning goals and learning tasks, while self-regulated learning focuses on learner active management and regulating their learning process (Mulyawati, 2020).

In traditional teaching-learning environments, where teachers are not adequately trained on their roles and responsibilities as facilitators of student learning, shifting from teacher-driven learning to self-directed learning is challenging, and can lead to uncertainty in methods of implementation (Shpeizer, 2019). In their paper, Cintang et al. (2018), explained that most teachers, even experienced teachers, may face difficulties in implementing pedagogical strategies toward SDL goals. One of the primary sources of the difficulties as discussed by the authors is the fact that teachers are not trained to implement SDL strategies. Pablos et al. (2020), highlighted that due to lack of guidance, high school students did not know what they had to do during the project implementation. Literature reports that the students face difficulties in engaging with the traditional pedagogies toward SDL goals (Cintang et al., 2018). For example, Hussein et al. (2021), reported the lack of collaboration ability among tertiary students with their peers that leads to priority conflicts while implementing a project-based learning strategy.

Many of the existing pedagogies enable students with the autonomy to follow the phases of self-directed learning, however, most of them do not provide adequate support to the students to transition toward the specific goals of SDL (Emily et al., 2019). Wu (2020), found differences between high- and low-creativity tertiary students to execute the SDL strategies. Providing absolute autonomy can be devastating if students don't know what they should learn, where they should learn from, and how to learn. Ideally, a pedagogical strategy should

enable students to execute all the processes of SDL. This is a challenge for the pedagogy designers.

In Table 1, we have synthesized student difficulties in achieving SDL outcomes in different pedagogical strategies from the literature. The second column of Table 1 represents different pedagogical strategies that the researcher followed to achieve SDL. The third column represents student difficulties in following the corresponding SDL process. The Last column in the table emphasizes the hindered SDL process(es) in any given pedagogical strategy. The SDL processes are encoded as **(A)** recognizing learning needs, **(B)** formulating learning goals, **(C)** selecting learning resources, **(D)** employing appropriate learning strategies, and **(E)** assessing learning outcomes respectively. Most of the pedagogies worked on the process D.

Table 1**.** *Student difficulties in achieving SDL outcomes across different strategies*

Reference	Pedagogical strategies	Student difficulties	Obstructed SDL Process
Hussein, 2021	Project-based learning	Lack of collaboration ability with peers that leads to priority conflicts.	B, C, D
Pabloset al., 2020	Project-based learning	Lack of guidance during the project, at times when they did not know what they had to do.	B, D
Chin et al., 2010	Collaborative learning strategy	Identify peer misconceptions. Construct the student's own explanations.	A, B,D
Mamun et al., 2022	Inquiry-based learning	Difficulty in engaging with content, cognitive difficulty in processing the instruction or information.	C, D
Pott et al., 2021	Open-ended approach to learning	Difficult for students to be actively involved with the learning content in order to have a meaningful learning experience.	D
Rasheed et al., 2021	Blended Learning	Students' inability to properly self-regulate their peer learning activities in online mode. More specifically to prevent social loafing and refusal to participate in the online peer-learning discussion.	D
Kim et al., 2018	Problem-based learning	Students have difficulty in perception of both task difficulty and their own ability to tackle the task.	A, D

Generally, in classroom settings, students need clear guidance on what they should be doing in a set of learning activities (Kokotsaki et al., 2016). Merely providing broad instructions like "find the learning goal", "find the resources", etc. should not suffice, if students don't know "how to find the goals" or "What resources are needed". SDL Strategies must elicit the need for learning among the students and should enable them to identify what they need and want to learn.

2. SDL and Question Posing

Watkins (2017), proposed a set of meta questions that a student should ask to himself/herself to follow a student-directed learning process. These self-questions may ensure the successful achievement of SDLs before, during, and after a learning process. Question posing encourages learners to take ownership of their learning students by engaging them in metacognitive strategies (Mishra et al., 2015). When learners pose questions, they formulate their own questions, taking responsibility for their own knowledge acquisition and driving their own learning process. Question posing is a strategy that can help students think at a deep level, construct knowledge, and conduct high-order thinking (Rosenshine et al., 1996). Question posing involves new question generation based on life experience or learning situations, that can lead to new topics related to prior subject knowledge in a particular learning context.

Student questioning has been regarded as a tool to better address students' misconceptions and has been acknowledged as a type of high-level cognitive strategy that plays an important role in facilitating students' learning process (Hwang et al., 2020). Han et al. (2006), suggested that questioning has the potential to be used as an epistemic probe and heuristic tool initiating argumentation in inquiry-based science. Students' questions are the outcome of individual brainstorming and then expressing the questions, by which students become aware of both what they understood and what they did not comprehend in a topic. Therefore, students' own questions help them to identify what they need and want to learn, in the context of any given topic, and consequently can lead to a deeper understanding of the topic.

Student questions can help resolve conflicts during collaboration with peers. Students' questions serve as a cognitive tool for the students to foster critical conversation while resolving conflicts (Chin et al., 2010). Questions act as catalysts for argumentative and epistemic moves like concessions, challenges, and counter-challenges, which are expressed through explanations and justifications in the conceptions of the topic. Articulating their conflicts and beliefs with peer ideas, helps students to take meta-linguistic moves and formulate their concepts. Overall, student questions seem to be a promising pedagogical idea to help students realize various SDL processes, especially recognition of learning needs, formulation of learning goals, and self-monitoring and self-assessment of learning outcomes.

3. Research Questions

We are interested in understanding how student questions can help them in overcoming the SDL challenges and achieving SDL processes. We restrict our exploration to (online and offline) classroom learning contexts where a learner has a number of peers and a facilitator in the teaching-learning environment.

Broad Research Question
Can student-question-posing-based pedagogical strategy support SDL processes?
Specific Research Questions (RQ)

- **RQ1:** What are the ways in which student QP has been used to develop pedagogical strategies?
- **RQ2:** What are the challenges that are addressed using QP-based pedagogical strategies?
- **RQ3:** What are the outcomes achieved using QP-based pedagogical strategies?
- **RQ4:** Which of the QP-based pedagogical strategies adequately aligns with the SDL processes?

In the next section, we present the methodology used for literature synthesis. In the later sections, we discuss our findings from the literature review against each RQ.

4. Methodology

We have searched online databases with the keywords "question posing" AND "classroom" AND ("self-directed learning" OR "self-directed learning") with papers from 2015 to 2023 and received 150 papers. In the below Figure.1, we reported PRISMA techniques to select papers from the online publicly accessible databases. Prisma stands for preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Page et al., 2021). It helps to identify, select, appraise, and synthesize studies from a pool of papers collected from databases. Among these 67 papers are either a thesis or article or not published papers. Among them, 4 papers are not in the English language and 31 papers are not on questioning. After the screening process, we received 48 papers. Among them, 11 papers are not based on empirical study, 10 papers are not based on class or lab or online, and 5 papers are not based on students' focus. After fulfilling the selection criteria, we ended up with 26 papers. Among them, we included 21 papers in our analysis as 5 papers do not refer to any student difficulty. All papers are read and based on the criteria followed in Table 2, we analysed the papers. Here we have considered only papers that focus on classroom, lab, and online.

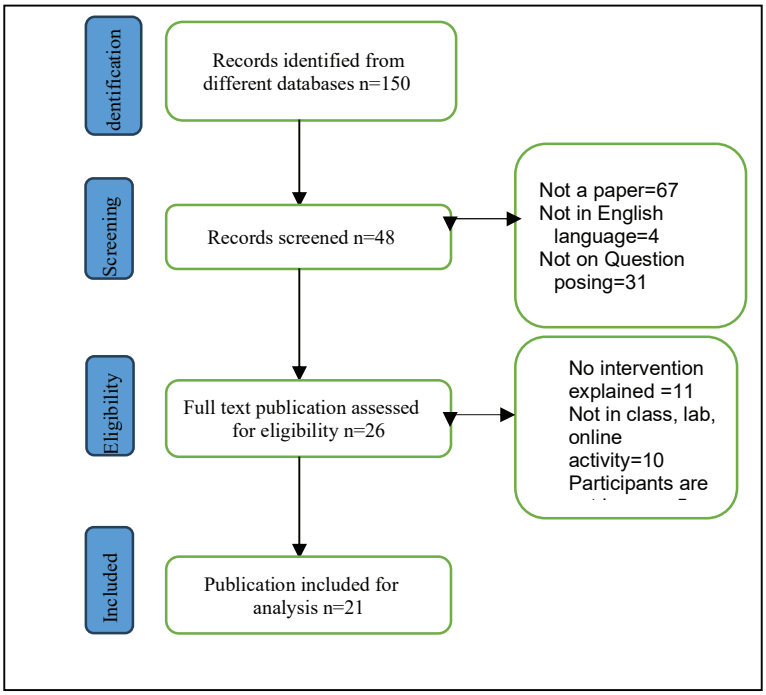

Figure1. Prisma flow diagram on selecting papers for analysis.

5. Result and Discussion

While analyzing the result, we found that most of the student difficulties in Table 1 are reported in Table 2 also. In below Table 2, we highlighted learner difficulties that are reported by the corresponding papers. In column 4, we represented how these papers used QP-based strategies. In column 3, students' difficulties addressed by these papers are represented. In column 5, SDL-related outcomes achieved by the corresponding paper are highlighted.

Table 2: *Different applications of question-posing (QP) based intervention to assist in-class student difficulties*

Reference	**Demography / Context /Mode**	**Challenges Addressed**	**How student-QP is incorporated into the strategy**	**SDL - Related Outcome achieved**
Lin et al., 2019	Graduate student. Nursing Course. Online in-class activity	The difficulty of students in in-depth understanding of the content.	ASQ (Annotation to extract key points, summarizing the whole concept and questioning in pre-class) based online flipped learning framework is used.	Achieved academic performance, self-efficacy, and critical thinking tendency as compared to the control group.
Pursitasari et al., 2020	Environmental pollution. In the class laboratory experiment.	In a guided inquiry method, students may face difficulty in getting involved in the experiment.	Students are allowed to ask questions as a part of a science context-based inquiry learning (SCOIL) model. Its open-ended problem and guided phases of observation, investigation, representation, conclusion, and communication help students to enhance critical thinking skills.	The critical thinking skills of students with the proposed model were greater than the guided inquiry learning model.
Sason et al., 2020	Ninth-grade student. Science text. In class intervention	Students face difficulty in connecting different pieces of information within the context, which may lead to inefficient and decentralized reading.	Self-generating questions are helpful in monitoring, regulating, and evaluating the learning process. This study shows that rather than self-generated questions connecting to prior knowledge (outside text), self-generating questions connecting between the text (within text) is helpful in having a long-term effect.	Achieved In-context coordination and connection, which leads to in-text comprehension achievement.
Chen et al., 2020	High school student. English Language learning course. E-learning method.	Difficulties of the student in engaging language learning.	students are encouraged to pose questions during the learning process. It enables students to	The learning performance of high-engagement participants was better than that of

			think and solve problems.	low-engagement participants.
George et al., 2022	University students. Mathematics Online, asynchronous.	Difficulty in self-motivation, monitoring, and regulation during Covid-19 online class.	Students are encouraged to ask questions that can clear their doubts, and misconceptions, and promote active learning.	Students' engagement, understanding, and self-regulation were achieved.
Looi et al., 2023	Grade 1 class student, Taiwan school.	The difficulty of disengaged and unmotivated students in the traditional examination-driven culture to learn by interest.	Proposed Learning-By-Questioning (LBQ) method. Teachers create an environment that fosters curiosity, deep exploration, and active participation. Students are encouraged to ask questions.	Showed deep interest and progression in reading. Developed reading and writing habits.
Mishra et al., 2015	Undergraduate CS course. In-class activity.	Difficulty in generating questions relevant to the given domain.	After listening to the lecture students are asked to pose questions and assign priority to own and peer questions.	Students posed questions and unfolded their own prior and future knowledge.

To answer RQ 1, different strategies designed using student question posing are listed in column #4 of Table 2. We found that most papers encouraged students to pose questions. For example, George et al., (2022), Sason et al., (2020), Pursitasari et al., (2020), and Chen et al., (2020) encouraged students to pose questions. Whereas Looi et al, (2023) created an environment using IDC theory, that fosters students' curiosity, and eventually students ask questions by themselves, and Mishra and Iyer (2015), allowed students to pose their questions and drive the subsequent lecture sessions based on student questions. The answers to RQ2 and RQ3 are listed in columns #3 and #5 of Table 2 respectively. We grouped student challenges from Table 2 and found that among all groups of challenges, engagement, and metacognition were mostly reported challenges. As far as RQ3 is concerned, we found that most papers applied QP as a tool to foster a better understanding of the content and improve engagement in the classroom.

In response to RQ4, we refer to Knowles' (1975) five SDL processes and analyze each of the QP-based pedagogies in this synthesized list (Table 2, Column 4) to determine which SDL processes are supported by each pedagogy. We find that Mishra and Iyer's (2015) question-posing-based strategy aligns directly with three out of five SDL processes, viz., (A) recognizing learning needs, (B) formulating learning goals, and (E) assessing (formative) learning outcomes. Other QP-based strategies synthesized in the table mostly address "(D) employing appropriate learning strategies." Mishra and Iyer (2015) name their strategy as Student Query Driven Learning (SQDL). They have employed student questions to recognize the learning needs and formulate the learning goals.

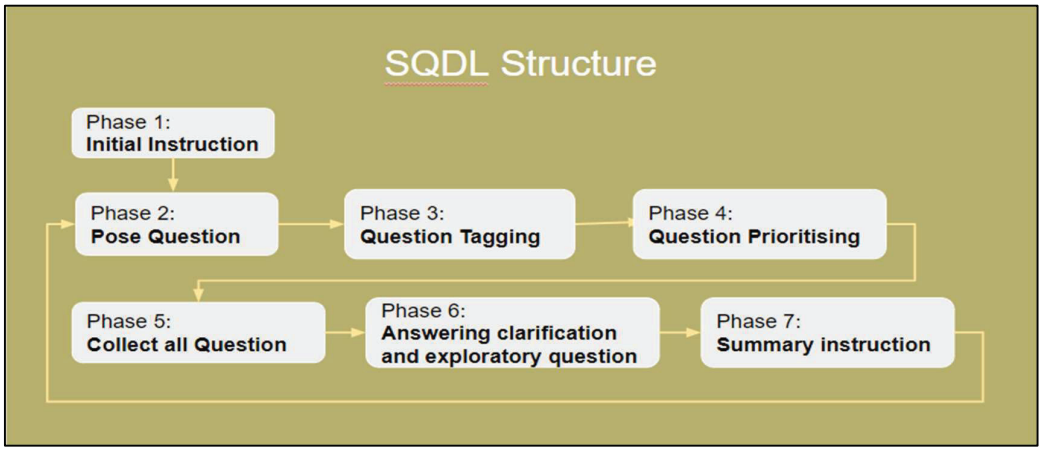

Figure2. SQDL structure

In Figure 2, the teacher will deliver the initial lecture in Phase 1. In phases 2, 3, and 4 students are allowed to pose questions and assign tagging and priority to their questions. The questions are treated as a representation of what students need to learn. Moreover, SQDL allows students to assign priority to their peer questions. This allows students to reflect on their learning priorities, considering diverse aspects of what they need and want to learn next. The teacher uses the priorities of the questions set by the students to determine the topic and order of the next lecture/ discussion in the classroom in phases 5, 6, and 7.

6. Future Work

The main motivation of self-directed learning is the learner's ability to become autonomous and the primary driver of SDL. Learners are surrounded by teacher-oriented learning in the contemporary teaching-learning situation. Additionally, teachers are not taught to apply SDL techniques. Implementing any SDL method in these situations is a challenging endeavour for both students and teachers. Here, we've examined how learners struggled to follow the SDL process facilitated by different pedagogies. The majority of the problems are engagement and metacognition-related. Each SDL process can benefit from the usage of the instrument of question posing. We discover how QP can be utilized to get over student challenges through the literature review. QP-based tactics largely succeeded in achieving engagement and content comprehension. We have also discovered that the majority of techniques concentrate on using various strategies to enhance comprehension of the information, engagement with the content, or peer interaction. Whereas Mishra and Iyer (2015), employed a QP-based technique to understand students' learning needs and future learning objectives. We will investigate the SQDL method more in the future.

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