

Exploring Students' Self-Regulated Learning through Educational Technology in Building Engineering Education: A Qualitative Case Study

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ABSTRACT

Self-regulation in Self-regulated learning is the process by which students plan, monitor, and evaluate their learning by coordinating cognitive, metacognitive, motivational, and behavioral strategies. In technology-assisted environments, access to digital resources can expand learning opportunities, but the benefits depend on how students select, use, and evaluate these resources. This article explores how students in the context of Building Engineering Education at Manado State University describe their use of educational technology to regulate their learning. The research uses a qualitative case study design and outlines a thematic analysis informed by the cyclical model of SRL. Narratives contained in the source documents indicate initial themes regarding task planning, digital resource selection, checking for understanding, attention management, help-seeking, feedback utilization, and barriers to technology access. However, there is insufficient information to verify the number of participants, the relevance of each quote to the original transcript, or evidence from observations and documents. Therefore, these themes should be treated as preliminary interpretations, not final findings representative of the student population. Before journal submission, authors are required to complete sample reporting, data collection procedures, analysis, ethics, and empirical evidence in accordance with standards. reporting study qualitative.

Keywords: education construction, educational technology, education technique buildings, education tall, regulation self in learning.

INTRODUCTION

Utilization technology education has change method student access information, participate in activity learning, communicating with lecturers and friends' peers, as well as finish task academic.

Digital platforms and various application can expand access to source learn and open opportunity for student for Study in a way independent. However, access to technology no automatic show that student capable organize the learning process in a way effective. Students still need determine what should studied, determined priorities, selecting appropriate strategies, monitoring understanding, managing time, and evaluate whether efforts made has reach objective study.

Regulation self in Study or self-regulated learning (SRL) refers to the process when participant educate in a way active direct cognition, motivation, behavior, and environment study for reach objectives. SRL views student as perpetrator active taking decision about method starting, running, and evaluating activity learning. Zimmerman's (2002) cyclic model distinguishes three phase main, namely planning forethought, implementation and monitoring (performance), and reflection self - reflection. Planning phase beginning covers determination objectives, analysis tasks, and strategic planning. Implementation phase covers strategy implementation, monitoring progress, as well as arrangement attention and effort. Reflection phase covers evaluation results and interpretation to the effectiveness of the strategy used. Third phase the can differentiated in a way analytical, but in experience study real can each other overlapping overlapping and repeating.

Technology-based learning adds another dimension to SRL. Digital resources can provide explanations, examples, feedback, communication channels, and tools for organizing learning activities. At the same time, the abundance of resources can be distracting, increase the demand for sorting information, or encourage shallow task completion if students do not exercise sound judgment. An umbrella review of 31 systematic reviews and meta-analyses emphasized the importance of supporting SRL throughout the learning cycle, not just through stand-alone technology features (Prasse et al., 2024). A review of SRL strategies in online learning also highlighted the role of time management, metacognitive monitoring, effort regulation, and critical thinking (Broadbent & Poon, 2015). Therefore, research needs to move beyond whether students use technology to examine how it fits into the process of organizing their learning. This approach requires attention to students' goals, actual practices, contextual constraints, and meanings of their learning experiences.

Engineering education building own distinctive orientation Because can blend knowledge technique with development competence teaching. Depending on the curriculum and activities real learning ongoing, students can face to face with technology construction, materials building, picture technique, concept structure, estimation cost, design assisted computers, digital modeling, learning media, and planning pedagogical activities the potential demand form regulations different learning. In the task picture engineering, for example, students possible need interpret specifications, choose function device soft, compare picture with condition technical, and repair errors. In preparing learning media, students possible need set objective learn, choose appropriate representation, and taking into account How participant educate understand draft technique. Example this nature illustrative and not statement that activity the has found in research data this. The final manuscript must mention real activity recorded in data.

Combination demands technical and pedagogical make context this relevant for reviewing SRL. Students can need coordinate understanding conceptual, accuracy procedural, usage digital devices, solutions projects and communication pedagogical. The technology used may also be different according to its function, for example for access information, produce artifacts technical, communicating, collaborating, or reflect on the learning process. With thus, the understanding of SRL is deep context this need notice connection between use technology and characteristics task. Same application can help the learning process in situations certain, but become source distraction or dependence on other situations. Its contribution no can understood in a way adequate without study objective students , demands tasks and conditions the learning that surrounds it.

Research on SRL in digital environments has encompassed online learning, blended learning, computer-assisted SRL, learning analytics, and technology-based interventions (Broadbent & Poon, 2015; Panadero, 2017; Prasse et al., 2024). Several reviews have shown that the pedagogical design and integration of technology are important because SRL encompasses multiple processes that occur throughout the learning cycle (Prasse et al., 2024). Relevant research has also been conducted in structural engineering education in Indonesia. Kembuan et al. (2023) examined educational technology, learning independence, and learning outcomes of structural engineering students using a survey-based approach. This study provides a reference in the context of a related discipline, but differs from the focus of this research, which sought to qualitatively understand students' learning regulation experiences and practices.

This study no assume that technology education or independence study not yet once investigated in education technique. The focus more specific: how student arrange learning through truly technology they use in context education technique building. There are three bases for develop this study. First, the SRL study is based on technology need explain decisions and practices student in activity study authentic, not treat use technology as uniform experience. Second, education technique building that combines demands technical and pedagogical potential shaping strategies, challenges, and perceptions student about study effective. Third, the study case qualitative can study connection between narrative students, observed practices, and artifacts learning, so that provide depth contextual that is not can concluded only from size survey. Third matter the is point proposed differentiator. Before delivery articles, authors need perform and document search literature that can replicated on Scopus, Web of science, and ERIC for evaluate how far the gap this supported by existing literature. Claims that gap the not yet once investigated globally not may made without adequate review.

The gap that can be maintained is need will explanation contextual about how student in an educational program technique coordinate SRL strategies with technology used and demands the task at hand. This statement no the same with claim that topic the not yet once investigated globally. Claim global novelty only may made after search structured that can replicated on Scopus, Web of Science, and ERIC, with a search strategy of, range time, and criteria reported selection. The digital environment expands access to material, demonstration, bait feedback, and communication, but also add demands arrangement study. Broadbent and Poon's (2015) review highlights role management time, metacognition, regulation effort, and thinking critical in online learning high education. Review more umbrellas new recommend SRL support that integrates support direct and indirect direct throughout cycle study , not just provide digital features in separately (Prasse et al., 2024). Therefore, the question main no only whether student use technology, but How technology selected, monitored, and evaluated for reach objective task. On assignment with criteria technical, bait come back can help student compare performance current with expected standards. Hattie and Timperley (2007) discuss function bait come back in answer goals, progress, and steps next. Nicol and Macfarlane-Dick (2006) place assessment formative as part from ability student arrange learning. In research this, concept the must become lens interpretation only: data needed show How student truly use bait back, not just that bait come back available.

This study aim understands How Building Engineering Education students at Manado State University organize learning through technology education. Questions proposed research is: 1). How student use technology education for planning, executing, monitoring, and reflecting learning them? 2). Technological, pedagogical, and contextual factors what is perceived student as supporters or inhibitor regulations self in learning? 3). How student integrate demands learning technical and pedagogical when arrange learning through technology education? The intended contribution is explanation sensitive empiricist to context about SRL in education technique building. Research

connect perspective cyclic SRL with technology and tasks really found student in context institutions certain. In particular conceptual, research examine how the SRL process is realized in discipline that combines learning technical and pedagogical. In terms of empirical, research utilize interviews, observations, and analysis document for inspect reported and observed practices in practical, research aim identifies implications for design activity learning and support technology in education technique building. Contribution end needs formulated return after theme empirical set. If the data is not showing interaction typical between demands technical and pedagogical, claims the need narrowed down.

CONCEPTUAL FRAMEWORK

SRL in the Environment Assisted Technology

SRL literature confirms that regulations Study No static characteristics, but rather an adaptive process that involves determination objectives, strategy selection, monitoring, management motivation, and evaluation. Zimmerman's model emphasizes cycle of forethought, performance, and self-reflection, whereas comparison of SRL models shows variation emphasis on metacognition, motivation, emotion, and regulation social (Panadero, 2017; Schunk & Greene, 2018; Zimmerman, 2002). Perspective This relevant for education technique Because student need decide How test understanding and assessing quality results work, not only access information.

Regulation in Learning as a Cyclic Process

This study uses Zimmerman's (2002) cyclical model as its primary theoretical starting point. The model helps organize questions about how students prepare for learning, organize their actions during tasks, and evaluate their experiences after learning (Panadero, 2017; Schunk & Greene, 2018). The model serves as a sensitizing framework, not as a coding scheme that forces all data into three categories. Student experiences do not always unfold sequentially. An unexpected technical issue, for example, may lead students to shift goals, seek help, revisit tutorials, and reevaluate previous strategies. A single SRL episode may involve multiple SRL processes simultaneously. Due to that, the framework analysis combines informed attention theory with openness to findings that are not estimated. The analysis also takes into account possibility that regulations Study influenced by lecturers, friends' peers, demands tasks and environment technology, not solely by individuals.

Educational Technology As Resources and Conditions Study

Technology education in study This defined based on function, not through a list of designated platforms since early. Technology entered to in analysis if the data shows that student use it for objective learning. Access information: search explanation, materials reference, demonstration, or guide technical. Production tasks: create, revise, or inspect artifacts learning. Communication and collaboration: discussing task, ask bait back, or coordinate work. Organization and monitoring: tracking deadlines, managing assignments, or review progress. Reflection and evaluation: comparing work with criteria, review bait back, or identify areas for improvement.

Category the is possibility analytical, not findings. Analysis end must show technology and function absolutely present in the data, including when technology seldom used, used in a way no consistent, or perceived no help. Technology no may treat as explanation independent on success learning. Its significance depends on the interaction between tools, student strategies, tasks, and context learning. Differentiation This in line with review that emphasizes the need study How

support technology covers various SRL processes and integrated to in environment learning (Prasse et al., 2024).

Framework Contextual Building Engineering Education

Proposed framework connect four element analytical: (1) demands discipline and pedagogy on assignments actual, (2) use technology based on the given function students, (3) the SRL process consists of planning, implementation-monitoring, and reflection, and (4) conditions contextual like access, design assignments, guidance lecturer, support friend peers, and bait back, along condition the supported by data.

METHOD

Research Design

In SRL analysis, Zimmerman's (2002) cyclical approach can be complemented by the view that learning regulation involves more complex and iterative processes, including goal formation, task condition monitoring, and strategy adaptation as students encounter new information (Boekaerts, 1999; Pintrich, 2000; Winne & Hadwin, 1998). Junaštíková's (2024) study places self-regulation in the context of modern technology, while Kembuan et al.'s (2023) study provides a contextual reference close to construction engineering education in Indonesia. These references help establish a theoretical context but should not be used to replace specific evidence from the UNIMA case.

The choice of case study needs to be justified through explicit case boundaries, context, and analytical objectives. Yin (2018) emphasizes the importance of defining the case and connecting evidence to analytical propositions, while Stake (1995) places a deep understanding of the context-bound case at the heart of the approach. Thomas (2021) and Creswell and Poth (2018) also emphasize the coherence between the research question, qualitative approach, case selection, and interpretation strategy. In this study, these methodological references can support design choices but do not replace the obligation to report the actual procedures performed.

Study use design studies case qualitative interpretive. Case study in accordance when objective study is understood something phenomenon in context life real and when connection between phenomena and context become part important from explanation. Case limited to the context of Building Engineering Education at Manado State University, participants whose experience relevant with question research, activities represented learning in the data, as well as period data collection. Study This no aim estimate prevalence SRL behavior across all student or test connection causal between use technology and results study. The goal is developing explanation contextual about How student arrange learning through technology education.

Location and Context Study

Study This located at Manado State University, Indonesia, in context education identified as Department of Building Engineering Education. Context This relevant Because orientation education program includes knowledge technique building / civil engineering and preparation as educators.

Participants and Techniques Election

Participants explained based on procedure recruitment and criteria true inclusion recorded. Research this use election purposive sampling with objective study is choose participants who are rich in information and have experience direct to the phenomenon being studied.

Characteristics relevant covers involvement in activity Study assisted technology, experience with eye studying technical and pedagogical, as well as variation method student do assignment. Perspective lecturer can enter If lecturer of course interviewed and his statement help give context to experience student.

Data Collection

Study This use three source proof qualitative, namely interviews, observations, and documents. All three offer type different insights. Interview catch interpretation and memory participants, observations provide proof practice in situation certain, whereas document or artifacts study can show demands tasks, results work, bait back, or other relevant recordings with regulations study.

Semi- structured interviews

Interview experience - driven student in arrange learning through truly technology they use. Questions asked request participants explaining concrete episodes, not only convey opinion general about technology. Topics used for report protocol interview includes: interpretation and planning assignments, elections technology and resources learning, monitoring understanding and progress, response to difficulty technical or conceptual, search help and use bait return, evaluation results as well as strategic changes, and integration demands technical with objective pedagogical If relevant with eye the lectures being researched.

Observation

Observation used for help identify How regulations study ongoing in practices, including interaction student with digital sources, organizing work, response to problems, and use bait back. Its analytical value depending on location, focus, and procedure true observation used.

Analysis documents and artifacts

Document used for give proof contextual and supporting. This depends on the actual material collected, documents relevant can covers syllabus, instructions assignments, rubrics assessment, teaching materials, feedback back, artifact artificial students, or notes activity learning assisted technology.

Data Analysis

Study This use analysis thematically to develop patterns of meaning across the entire dataset. Reporting explain approach Thematic analysis was chosen, as thematic analysis encompasses different approaches and should not be reported as a single, uniform procedure (Braun & Clarke, 2006, 2022; Byrne, 2022). Braun and Clarke's approach provides a systematic process that includes familiarization, coding, theme development, review, definition, and reporting (Braun & Clarke, 2006, 2022).

Analysis informed by SRL theory, but still open to findings inductive. Balance This important: three SRL phase can help centralize attention to relevant processes, but not data may force enter to in category planning, implementation, or reflection. Phase 1, familiarization with data. Researchers read transcript, notes observation and documents repeatedly to understand data coverage, recording relevant episodes, issues repeat, difference narrative, and possibilities contradiction. Phase 2, coding beginning. Relevant data segments given code based on its meaning in context. Code can concern determination objectives, strategy selection, monitoring, management time, search help, reflection, selection technology, demands assignments, or another issue that is really looks in data. Phase 3,

development candidate theme. Related code grouped become pattern meaning that explains aspect certain from regulations learning. The theme conveys outlook interpretive, not just naming topic wide like technology or motivation. Phase 4, review theme. Candidate theme checked to coded quotes and the entire dataset. Researchers evaluate internal coherence, adequacy data support, differences between theme, and its relevance to question study. Phase 5, defining and naming theme. Every theme given definition, focus analytical and explanatory about the relationship with narrative overall. Subtheme can used for show variation or contrasting experiences. Phase 6, drafting report. Analysis served as narrative supported interpretive quote selected, evidence observations, and relevant documents. Claims must comparable with strength evidence and acknowledge difference important.

Integration of Various Data Source

Interviews, observations, and documents in this study analyzed as source mutually supporting evidence related but different. The integration help explain which part of narrative participants in line with observed practice, which part gets context addition from documents, as well as which part shows difference.

Research Quality and Reflexivity

Study This show transparency about how interpretations are constructed and how the researcher's positionality may influence data collection and analysis. The standards for Reporting Qualitative Research (SRQR) comprises 21 reporting points to enhance the transparency of qualitative research (O'Brien et al., 2014). For interview reporting, the COREQ can serve as additional guidance (Tong et al., 2007). The trustworthiness framework in naturalistic research also emphasizes credibility, transferability, dependability, and confirmability as aspects that need to be explained contextually (Lincoln & Guba, 1985). Credibility: explain How interpretation supported by datasets and how conflicting cases checked. Depth contextual: describe background and participants in a way sufficient for the reader can evaluate relevance findings in other contexts. Transparency analytical: document How code and theme developed as well as revised. Reflexivity: explain connection researchers with location, participants, and topics as well as How position they can form interpretation. Traceability evidence: present quote anonymous and clear relationship between claim with proof interviews, observations, or document.

Consideration Ethics

Script in this study report protection truly ethical implemented. This covers agreement ethics or permission institutions If valid, agreement participant, participation voluntary, confidentiality, anonymization, secure data storage, and management appropriate digital artifacts. Due to research at the institution education can involving relation power between students and lecturers, respondents in study This participate in a way volunteer and position academic student protected.

RESULTS AND DISCUSSION

Planning Study As Foundation Self -Regulation

The results of interviews with respondents regarding the most challenging learning experiences during their studies at the Faculty of Engineering, Manado State University, especially in courses related to civil engineering or building engineering, respondents explained as follows:

I experienced difficulty when do task calculations and must understand stages settlement in a way sequentially. I need read material, see example workmanship, then try finish question yourself. When the results calculation different from for example, I must inspect return formula and steps used. (R-001)

Interview results the show that student describe the learning process as series planned activities. In the answer about challenging task, respondents explain that He read material, studying example solution, try do question in a way independent, and check return formula as well as step settlement when the result different. The strategy reinforced by the answer about planning tasks, namely read instructions, determine order work, share task to in a number of stages, and provide time addition for parts that have not been mastered.

This pattern can interpreted through the forethought phase in Zimmerman's (2002) self-regulated learning model. This phase related with determination goals, planning strategic, and readiness face task before the learning process taking place. In the context of education technique building, planning becomes important because work academic can need a number of mutually exclusive stages depends, like understand concept, determine formula, do calculation, composing image, and check results end. However, the results study This Not yet Enough For conclude that planning student always consistent or effective. Answer shows the existence of planning strategies reported by respondents, but not yet give proof observational about regularity its application, accuracy estimate time, or the impact to performance academic. With Thus, the findings that can be maintained is that planning perceived as an important strategy for manage complexity assignment, not that the strategy has proven increase results study.

Educational Technology As Source Complementary Learning

The results of interviews with respondents obtained information about what educational technology is actually used to help the learning process, and how you use it, as follows:

I use learning videos for understand step settlement questions, digital materials from lecturer as references and applications communication for discuss with friends. For task my picture use device available software in accordance need assignment. I choose different sources Because every source help part different learning. (R-002)

Respondents explain use of learning videos for understand step settlement questions, digital materials from lecturers as reference, application communication for discuss, and device soft for do task image. He also stated that selected digital sources based on different functions. This pattern show use technology that is complementary technology no treated as One tool single that replaces all over activity learn, but as gathering sources used for fulfil need certain. Lecturer material functioning as references learning, videos provide demonstration procedural, application communication facilitate interaction, whereas device soft support workmanship task technical.

From a self-regulated learning perspective, the selection source based on need is part from use of learning strategies and management source power. Panadero (2017) explains that regulatory models Study give attention to the cognitive, metacognitive, motivational, and behavioral strategies used participant educate for direct the learning process. In this research, utilization a number of type technology can read as indication beginning that student make an effort adapt source Study with characteristics task.

Although thus, the use of various technology no with by itself show effective digital integration. Data is not yet showing how much often every application used, how student evaluate

its quality, or whether displacement inter-source cause burden cognitive addition. Therefore, a more accurate interpretation appropriate is that respondents report election technology based on function study, while quality integration and effectiveness still need verification.

Monitoring Understanding Through Practice Independent and Examination Results

The results of interviews with respondents regarding how to set goals and plan learning activities before working on college assignments, obtained the following information:

Before do my job read instructions and determine the part that must be completed moreover first. I share work become a number of stages, such as understand concept, collecting reference, work on calculation or image, and check results. If the task Enough it's difficult , I provide time more Lots For parts that have not been I master. (R-003)

This information indicates that another important aspect is how respondents assess their understanding of the material. They stated that understanding was checked by attempting problems without looking at examples, explaining the rationale for using formulas, assessing the reasonableness of results, and checking the size and conformity of images to instructions. This pattern indicates a form of metacognitive monitoring. Students do not rely solely on information exposure or a feeling of understanding, but instead attempt to test their understanding through verifiable actions. In calculation tasks, these actions include independent work and assessing the reasonableness of results. In drawing tasks, these actions include checking the size and conformity of results to task requirements.

This findings in harmony in a way conceptual with performance phase in Zimmerman's (2002) model, which includes implementation of learning and monitoring strategies towards the work process. The interesting thing in context education technique building is that monitoring understanding no only ability - oriented remember information, but also on examination consistency procedures and quality product technical. However, the reasonableness perceived results student not yet of course the same with validity technical. Research advanced need dig whether student compare results with applicable standards, check units and assumptions, using rubric, or get validation from lecturer. With thus, the theme this more appropriate understood as inspection strategy indications self, not proof that all over results technical student has accurate.

Management Motivation and Attention As Part of the Learning Process

Interview results about use technology for understand material lectures and finish task academic, obtained information as following:

I usually read material from lecturer moreover first. If the explanation not yet enough obviously, i look for source additional and try do example question. For related materials with picture or modeling, I look for demonstration use device soft, then try apply steps in the task alone. (R-004).

Interview results about guard motivation and concentration when study use digital technology, as following:

I am more easy concentrate when have clear targets and complete them one part task before move to next part. However, the message login and social media sometimes bother attention. I try limit use applications that do not related with tasks and assign time special for study. (R-007)

Respondents state that clear targets and completion task in a way gradually help guard concentration. At the same time, the message login and social media called as disturbances that can divert attention. Respondents explain effort limit use applications that do not relevant and determining time special for Study.

Findings This expand understanding about regulations self because success study no only related with mastery material or skills use technology, but also with ability arrange attention and maintain involvement. Panadero (2017) places aspect motivational and emotional as part important in various SRL models. In the context of learning-based technology, easy access to source study can ongoing simultaneously with exposure to digital disruption. Therefore that, technology have potential double: help student get source learn and, at the same time, add demands management attention.

In a way pedagogical, answers the indicates that support against SRL no enough only with provide application or digital materials. Students also need develop strategies for determine priority, organize time, limit disturbances, and resolve task in a way gradually. However, because the data comes from report self, this research not yet can ensure how much consistency of the strategy implemented or how much big its influence to results academic.

Search Help and Verification Information As a Regulatory Strategy Study

The results of this study obtained information from respondents about how respondents know that you really understand the material studied through technology, as follows:

I try do question without see example moreover first. If I can explain reason use formula and obtain incoming results reason, I feel more certain to understanding i for task picture or modeling, I inspect return size, conditions tasks, and suitability results with instructions. (R-005)

Respondents report that he moreover formerly tries understand material in a way independent through notes and digital sources. If you have difficulty still appear after several times trying, he discusses with Friend or ask to lecturer. Respondents also stated that explanation received compared to return with material lectures for answers No accepted without understand the reason. When the learning video different from material college, he tries compare step solution and search clarification. This pattern shows two interconnected processes related, namely search help -seeking and evaluation information. Search help No always show dependency, in regulations learning, action they can become an adaptive strategy if student recognize the limits of his understanding, choose source relevant help, then use help the for-increase understanding. While that, comparison information show that student try consider credibility source and consistency explanation.

In education technique civil and building engineering, the verification process is very relevant because error in understand formula, unit, procedure, or representation picture can influence quality results work academic. However, the answers available not yet prove that student has use standard formal technical or reference scientifically validated in every inspection process. Therefore, the results This should formulated as indication beginning existence effort verification, not as proof mastery literacy information technical in a way comprehensive. Prasse et al. (2024), via review umbrella on study systematic and meta- analysis regarding SRL in environment learning assisted technology, emphasizing importance comprehensive support throughout cycle regulations study. In this research, support the can covers instruction about election sources, opportunities ask, bait clear feedback, and activities that encourage student explain the reason behind answer.

Reflections on Mistakes and Usage Feedback For Improving Strategy

Interviews with respondents revealed experiences when the technology they used didn't help resolve learning challenges. The following are some of the actions they took after experiencing these difficulties:

When the explanation in a different video from material college, me No direct using one of them. I compared step completion, checking return the material provided lecturer, and asked to Friend or lecturer If Still Not yet understand the difference. (R-006)

Respondents explain that when lecturer give correction, he tries understand wrong part, tracing reason error, fix assignments, and check return step workmanship. If the same error repeatedly, he realizes the need learn return draft base.

Interview results to respondents obtained information about choosing to resolve learning difficulties independently and asking for help from lecturers or friends, as follows:

I try understand material Alone moreover formerly through notes and digital sources. If after tried several times I still experience difficulties, I discuss with Friend or ask to lecturer. I compare explanation obtained with material study so as not to only accept answer without understand the reason. (R-008)

The results of interviews with respondents obtained information about the use of feedback from lecturers, assignment grades, or examination results to improve learning methods, as follows:

When the lecturer give correction, I try understand wrong part and reason error said. I then repair assignments and checks return step the workmanship. If the same error occurs appear over and over again, I need learn return draft basically. (R-009)

This response demonstrates a form of reflection that goes beyond receiving a grade. Students describe efforts to interpret errors and relate them to future learning needs. In Zimmerman's (2002) model, the self-reflection phase includes evaluating learning outcomes and processes, which can influence planning for the next cycle. The role of feedback in helping students assess gaps and determine next steps is also discussed in the literature on formative assessment and SRL (Hattie & Timperley, 2007; Nicol & Macfarlane-Dick, 2006). Thus, instructor correction has the potential to serve as input for changing learning strategies, rather than simply serving as a final assessment.

Things to do investigated more carry on is How reflection the realized in action. For example, whether student make notes error, repeat question similar, repair procedures, or apply lesson from one task to next task. Available data state reported intentions and strategies, but not yet show longitudinal evidence that a real change of strategy happens or endure. These findings own implications for design learning at the Faculty of Engineering, Unima. Feed come back will more useful if bo only show the wrong part, but also explains criteria success, reasons errors, and steps improvements that can be made done students. Lecturers can consider use explicit rubric, opportunity revise assignments and reflections short after settlement task technical. This recommendations is implications inherited pedagogical from analysis, not interventions that have been tested in the available data.

Access and compatibility constraints technology forming learning strategies

The results of interviews with respondents obtained information about device limitations, internet connections, access costs, or application incompatibility affecting learning activities, as follows:

When the internet connection is not stable, I try download material more formerly If possible. If the task needs device software that is not can run on the device I, I need look for alternative or use available facilities. These constraints can influence time settlement tasks and methods I arrange activity study. (R-011)

Respondents report that internet connection is not stable push him download material moreover formerly If allows . When the device required software no can run on the device owned, it consider use alternative or available facilities. Respondents also stated that constraint technology can influence time settlement tasks and methods arrange activity study.

Interview results to respondents obtained information about what changes had occurred in learning independence since using educational technology, and what support was still needed, as follows:

Technology help I access material and repeat explanation when required. However, the number of sources no always make I more easy study because I must determine proper sources and arrangements time alone. I need instruction clear tasks, sources quality learning, and feedback helpful feedback I know the part that must be repaired. (R-012)

These findings show that regulations self no ongoing in a completely space controlled by students. Ability plan, organize time, and maintain activity learning is also influenced by availability devices, connectivity, compatibility applications, as well as access to facility learning. Students can have a good learning strategy, but still face limitations when the necessary technology no available or no can used.

Therefore, the difficulty study no may direct interpret as weakness regulations self. Researcher need differentiate obstacles that come from individual strategies and constraints structural that is outside control students. This differentiation important so that the implications study no solely charge not quite enough answer to students, but also consider support institutions. Prasse et al. (2024) showed that SRL support in environment assisted technology need designed in a way comprehensive and customized with need participant educate throughout the learning process. Worthwhile implications considered covering provision material that can accessible offline if enable, clarity condition device software, support laboratory, and alternatives workmanship when student experience constraint technical. However, the needs and priorities current from support the need set through more data wide, not only one narrative interview.

Independence Study Viewed As Combination of Access, Selection Sources and Support Pedagogical

The results of interviews with respondents obtained information about different learning methods when working on engineering calculations, building drawings, digital modeling, or projects that require group work, as follows:

For calculation, I more Lots inspect formulas, units, and sequences settlement. For picture building, I more notice size, accuracy, and suitability with instructions. When working on project group, I must arrange distribution work and communication with other members. (R-008)

On the question about change independence study, respondents state that technology make it easier access material and repetition explanation. However, the number of sources no always make learning easier because student must determine proper sources and arrangements time in a way independent. Respondents also identified need will instructions clear tasks, sources study quality, and bait helpful feedback show necessary parts repaired.

Answer the indicates that independence study no identical with study without help lecturer. Student still need structure pedagogical assistance they understand goals, criteria, and direction workmanship assignment. Technology can expand access, but student still need evaluate relevance information, compiling priorities, and determine When help addition needed. In conceptual, pattern This in line with view that SRL involves coordination of cognitive, metacognitive, motivational, and behavioral strategies, not only access to source information (Panadero, 2017). Prasse et al.'s (2024) review also emphasized importance support that includes overall SRL cycle in learning assisted technology.

Thus, the primary interpretation of this theme is that technology is perceived as a tool that opens up opportunities for more independent learning, but that utilizing these opportunities remains dependent on students' ability to manage their learning process and the quality of learning support. Because the available evidence comes from a single set of responses, this interpretation is preliminary and cannot be generalized to all students in the Faculty of Engineering, UNIMA.

If eight theme the read in a way integrated, narrative interview shows something pattern conceptual: students describe the learning process that begins with understand demands task, continued with choose sources and strategies, checking understanding, seeking help when required, as well as repair work based on bait back. The process ongoing in conditions affected motivation, digital disruption, access devices, and quality directions learning. This pattern can be summarized as connection between regulations self-students, utilization technology, verification results learning, and conditions supporters learning.

In phase planning, respondents explain determination order activities and allocation time. In the phase implementation, he utilizes material lecturers, videos, digital resources, and devices soft in accordance need task. In the phase monitoring, he tries do question in a way independent and check fairness results. In the phase reflection, he uses correct for identify errors and determine necessary materials studied back. This pattern has suitability conceptual with the SRL cyclic model of Zimmerman (2002), but suitability the is results interpretation theoretical on narrative, not measurement empirical to the whole learning process student.

One aspect that stands out is that technology no automatic produce learning effective independence. Respondents precisely emphasize need for choose source, compare information, organize attention, and ask clarification when explanation different. In other words, the more lots available resources, the more important ability student determine relevance and reliability information. This is giving direction further research sharp compared to question general whether technology beneficial for learning: how student arrange use technology to remain in harmony with goals and demands academic?

Contribution Towards the Study of Self-Regulated Learning

Available narratives support reading that SRL can understood as series mutual actions related, not as one ability single. Planning, selection sources, monitoring understanding, searching assistance and reflection is part different potential each other influence. Students who are aware of errors, for example, need to be return identify undeveloped concept mastered, selecting improvement strategies, and checking the result. This describes characteristic cyclic regulations

study as explained Zimmerman (2002). Panadero (2017) compared six SRL models and show that regulations Study covers aspect cognitive, metacognitive, behavioral, motivational, and emotional.

In the context of this data, planning and inspection results represent dimensions cognitive as well as metacognitive, regulation time and distraction related with regulations behavior, whereas management concentration and motivation related with dimensions motivational. This multidimensional reading helps avoid SRL reduction to just ability student use application in a way independent. Although thus, the contribution empirical study not yet can state as a new model or connection causal. Available data Not yet show whether students who do planning more regularly also get results study more okay, is it type technology certain more effective than technology others, or How different SRL patterns according to study program and semester. Contributions that can be made developed after the data is complete available is explanation contextual about method student coordinating regulatory strategies self with demands learning technique.

Technology As Resources Required Regulation

Use of video, digital materials, applications communications, and devices soft describe technology as source selected power in accordance need tasks. However, respondents also reported existence different information inter-source, interference attention, and limitations device. This is show that technology no standing factors itself, its benefits depend on the method student select, use, check, and integrate source the to in the learning process. Overview umbrella Prasse et al. (2024), who analyzed 31 reviews systematic and meta-analysis, highlighting importance comprehensive approach for support SRL throughout cycle learning assisted technology.

In relation to this research, the provision of technology needs to be accompanied by a learning design that encourages goal setting, process monitoring, source evaluation, and reflection. However, this review provides a contextual literature review, not evidence that any particular support has been effective at UNIMA. For structural engineering education, the implication is that technology should be integrated with conceptual and technical inquiry activities. Students should not simply follow software demonstrations or copy problem-solving steps, they should explain the rationale behind method choices, check assumptions, assess the reasonableness of results, and connect digital representations to relevant engineering principles. These are pedagogical recommendations derived from the initial analysis and require further evaluation.

The Role of Lecturer Feedback and Support

Respondent narrative show that correct lecturer become input for identify errors and fixes tasks. Respondents also stated need to clear instructions, sources quality, and bait back that shows necessary parts repaired. With Thus, support lecturer no must view contradictory with independence learning. Targeted support precisely can help student develop ability for evaluate work yourself and determine step next.

These implications point to three practices worth testing at UNIMA's Faculty of Engineering. First, lecturers could provide rubrics outlining the quality criteria for outputs and the process. Second, assignments could include checkpoints that ask students to explain technical decisions or verify results. Third, students could be given opportunities to revise their work, along with brief reflections on errors and strategies for improvement. These practices cannot yet be considered research findings, but they can be formulated as implications for learning development and further research agendas.

Implications Study for Faculty of Engineering, Manado State University

Based on available narratives, implications beginning can grouped to in three field. At the level of students, SRL development can directed at ability set goals, composing stages work, choose relevant sources, managing disturbance, asking help in a way right, and evaluate results. At the level lecturer, support can be focused on instructions explicit tasks, organized digital materials, feedback return that can followed up, and activities that require student explain his thought process. At the level institutions, attention can give access device, stability connectivity, availability facilities and clarity need device soft for tasks technique.

These implications do not imply that all Unima students experience the same obstacles. The available data only provide a single set of responses without participant identification or sample characteristics. Therefore, policy priorities should be determined after researchers compare student experiences, including those with adequate access to technology and those facing limitations. Such comparisons can clarify whether the barriers are individual, pedagogical, technical, or structural. Study continuation can also be combining interview with observation workmanship assignments and documents learning, if source the available. As example, report student about inspection results can compared to with method He inspect calculation or picture when do Triangulation task like This will help distinguish the stated strategies in interview from practices that can observed, without consider one of them automatic more correct.

CONCLUSION

This Study concluded that self-regulated learning in learning Civil Engineering and Building Engineering Education students at the Faculty of Engineering, Manado State University are reflected through ability plan stages learn, choose technology education in accordance needs, monitoring understanding through exercise independent, manage attention, looking help when face difficulties, as well as evaluate and improve results study based on bait back. Technology education plays a role as source power that makes things easier access to materials, demonstrations procedure technical, communication, and resolution task, but the benefits depend on ability student choose credible sources, integrating information, and organize the learning process in a way independent. On the other hand, digital disruption, limitations devices and connectivity, as well as lack of clarity instructions can hinder the learning process. That therefore, development independence Study need supported by regulatory strategies self-student, design structured learning, feedback come back constructive lecturers, as well as access adequate technology. By conceptual, findings This in line with a cyclic self-regulated learning model that includes planning, implementation and monitoring, as well as reflection.

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