

Flexible Environment, Learning Culture, Intentional Content, and Professional Educator: Metacognitive Regulation and Reading Autonomy among Technical Students

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Abstract—This study examined changes in perceived reading autonomy among technical students and explored how Flexible Environment, Learning Culture, Intentional Content, and Professional Educator supported metacognitive regulation in flipped learning. An embedded mixed-methods, one-group pretest–posttest design was applied to technical students enrolled in a General English course. Quantitative questionnaire data were combined with qualitative evidence from interviews, classroom observations, reflective logs, and open-ended responses. The findings showed an increase in perceived reading autonomy after the learning activities. Flexible Environment and Intentional Content supported planning and independent strategy use, while Learning Culture promoted monitoring, problem-solving, and evaluation. Professional Educator scaffolding supported the gradual transfer of regulatory responsibility from the educator to the students. However, independent strategic transfer to unfamiliar and fully unassisted reading tasks was not directly assessed. These findings suggest that the four pedagogical conditions are associated with metacognitive regulation and increasingly independent reading among technical students.

Keywords—flexible environment, intentional content, learning culture, metacognitive regulation, professional educator, reading autonomy, technical students.

I. INTRODUCTION

Technical education requires students to develop occupational competence and the ability to adapt to changing technologies, professional practices, and information environments. Technical students therefore need transferable learning capacities, including accessing information, managing learning, monitoring understanding, and evaluating learning strategies. English reading is relevant because students may need English-language academic, digital, and professional resources during their studies and professional development (Simajuntak et al., 2025; Zhang & Osman, 2024). Understanding technical terminology is also important for connecting theoretical concepts with technical applications (Nandiyanto & Yulistiani, 2024).

Reading autonomy refers to students' increasing responsibility for setting goals, selecting strategies, monitoring comprehension, and evaluating learning outcomes. This capacity is important because technical students increasingly interact with digital information and learning resources. Technology can improve access to learning materials, but access alone does not ensure effective learning. Students must also be able to select and use resources purposefully (Makinde et al., 2023).

In English as a Foreign Language reading, students make decisions before, during, and after interacting with a text. Digital environments provide access to diverse materials and learning resources (Borrego Gómez et al., 2024; Fernández-Arias et al., 2026). Digitalized materials can also extend English learning beyond conventional classroom settings (Nurfazri et al., 2026). However, students still need to regulate comprehension, manage time, sustain effort, and select appropriate strategies. Reading autonomy therefore involves more than completing tasks without teacher supervision.

Metacognitive regulation provides a useful framework for understanding this process. It involves planning, monitoring comprehension, modifying strategies, and evaluating learning (Anderson, 2004; Flavell, 1979). Metacognition is also important in English-language education because it supports students in regulating their own learning (Damkam & Chano, 2024). In reading, these processes include Global Reading Strategies, Problem-Solving Strategies, and Support Reading Strategies (Ghaith & El-Sanyoura, 2019; Ghaith, 2020; Mokhtari & Reichard, 2002). However, using a strategy does not necessarily indicate autonomy. Students need to select, monitor, and adjust strategies according to their reading needs.

Flipped learning can provide conditions for developing these capacities through Flexible Environment, Learning Culture, Intentional Content, and Professional Educator. Flexible Environment gives students greater control over their learning activities, while Intentional Content provides purposeful preparation before classroom activities. Learning

Culture emphasizes active and collaborative learning, whereas the Professional Educator component provides guidance, feedback, and scaffolding. Together, these conditions can support increasingly independent learning.

These conditions, however, do not automatically produce autonomy. Flexible learning may support self-management but can also lead to procrastination. Digital resources may facilitate independent problem-solving but can create dependence. Similarly, educator scaffolding supports autonomy only when responsibility is gradually transferred to students. Feedback should therefore support learning without maintaining unnecessary dependence on external assistance (Katel, 2026).

Previous studies have indicated that flipped learning and technology-supported learning can foster engagement, strategic awareness, critical reading, and learner autonomy (Dewi et al., 2025; Du et al., 2024; Jiang & Peng, 2023; Pang, 2022; Tsai, 2025). However, there is still little evidence among technical students, especially regarding the relationship between Flexible Environment, Learning Culture, Intentional Content, and Professional Educator, and metacognitive regulation and reading autonomy.

The objective of this study was to explore perceptions of reading autonomy among technical students and the relationship between the four pedagogical conditions and metacognitive regulation of reading. The relationships are conceptualized as explanatory pathways rather than causal mechanisms, as the study did not include a comparison group or test statistical mediation.

II. LITERATURE REVIEW

A. Technical Students' Autonomy in Reading

Reading autonomy refers to the ability of students to assume responsibility for their learning through goal setting, activity management, strategy selection, progress monitoring, and outcome evaluation (Dewi et al., 2025). Autonomy can also develop through learning experiences that require individuals to make independent decisions, manage their activities, and take responsibility for their own outcomes. In English reading, autonomous students establish reading purposes, select appropriate resources, monitor comprehension, adjust strategies, and evaluate their effectiveness. Autonomy should therefore be distinguished from successful task completion because students may answer comprehension questions correctly while remaining dependent on educators, peers, or digital tools. For technical students whose main specialization is outside English, this distinction is important. English may be a supporting subject, but English literacy and autonomous learning can facilitate access to academic and professional information (Simajuntak et al., 2025; Zhang & Osman, 2024). Reading autonomy can therefore support students in regulating comprehension, evaluating resources, and continuing to learn with decreasing external assistance.

B. Metacognitive Regulation in Reading

Metacognitive regulation involves planning, monitoring, strategic adjustment, and evaluation (Flavell, 1979). Planning includes setting goals and selecting appropriate strategies. Monitoring enables students to identify comprehension problems, while strategic adjustment involves changing approaches when comprehension fails. Evaluation allows students to assess both their understanding and the effectiveness of the strategies used.

In English reading, these processes can be expressed through Global Reading Strategies, Problem-Solving Strategies, and Support Reading Strategies (Deliany & Cahyono, 2020; Mokhtari et al., 2018; Mokhtari & Reichard, 2002). Global Reading Strategies support planning and purpose setting. Problem-Solving Strategies involve activities such as re-reading, inferencing, and adjusting reading speed. Support Reading Strategies include purposeful use of dictionaries, annotation, note-taking, and summarization.

Metacognitive strategies become autonomy-supportive when students select and adapt them according to task demands rather than simply following educator instructions. Metacognitive learning activities can strengthen students' awareness and regulation of their own learning processes (Damkam & Chano, 2024). Metacognitive strategies can also support higher-order learning by encouraging students to plan, monitor, and evaluate their learning processes more deliberately (Boonpratham et al., 2027). Thus, metacognitive regulation is treated in this study as a process that helps explain changes in perceived reading autonomy rather than as a statistical mediator.

C. Flexible Environment, Learning Culture, Intentional Content, and Professional Educator

The pedagogical structure can be defined by Flexible Environment, Learning Culture, Intentional Content, and Professional Educator. The Flexible Environment allows students to control the time, place, and pace of their studies. Intentional Content: Purposeful materials and activities carried out before class. Learning Culture focuses on active involvement, discussion with peers, comparison of interpretations, and collaborative problem solving. Professional Educator models, asks questions, gives feedback, scaffolds, and gradually removes direct support. Flexible Environment and Intentional Content allowed students in the current General English course to plan reading and use resources prior to classroom help. Learning Culture allowed for comparison of interpretations, identification of problems in comprehension, and revision of strategies. Professional Educator gave specific guidance and gradually reduced the amount of help offered to students. This structure was designed to gradually transfer the responsibility for regulation from the educator to the students. Prior studies have suggested that flipped reading can foster comprehension, critical thinking, engagement, and strategic participation (Du et al., 2024; Pang, 2022; Samiei & Ebadi, 2021). However, these outcomes do not explain how different pedagogical conditions relate to specific forms of metacognitive regulation. This study therefore treats Flexible Environment, Learning Culture,

Intentional Content, and Professional Educator as related but separate pedagogical conditions.

D. Conceptual Framework

The conceptual framework relates the four pedagogical conditions to several aspects of metacognitive regulation and reading autonomy. Flexible Environment and Intentional Content are primarily related to planning, resource selection, and independent preparation. Learning Culture provides a way to monitor, problem-solve, make strategic adjustments, and evaluate. The Professional Educator supports these processes through scaffolding and the gradual transfer of regulatory responsibility. These relationships are developmental, not deterministic. Independent self-regulation is evident when students intentionally control preparation and resources. Strategic decision-making occurs

when students select, evaluate, retain, or modify reading approaches according to their comprehension needs. Strategic transfer requires students to apply these strategies to new tasks with reduced or no external assistance.

The relationships among Flexible Environment, Learning Culture, Intentional Content, Professional Educator, metacognitive regulation, and reading autonomy are summarized in Figure 1. The framework shows how these pedagogical conditions provide different opportunities for planning, monitoring, strategic adjustment, evaluation, and increasingly independent reading. The four pedagogical conditions are not treated as direct causes of reading autonomy. Instead, they provide learning conditions in which metacognitive regulation may develop and regulatory responsibility may gradually shift from the educator to the students.

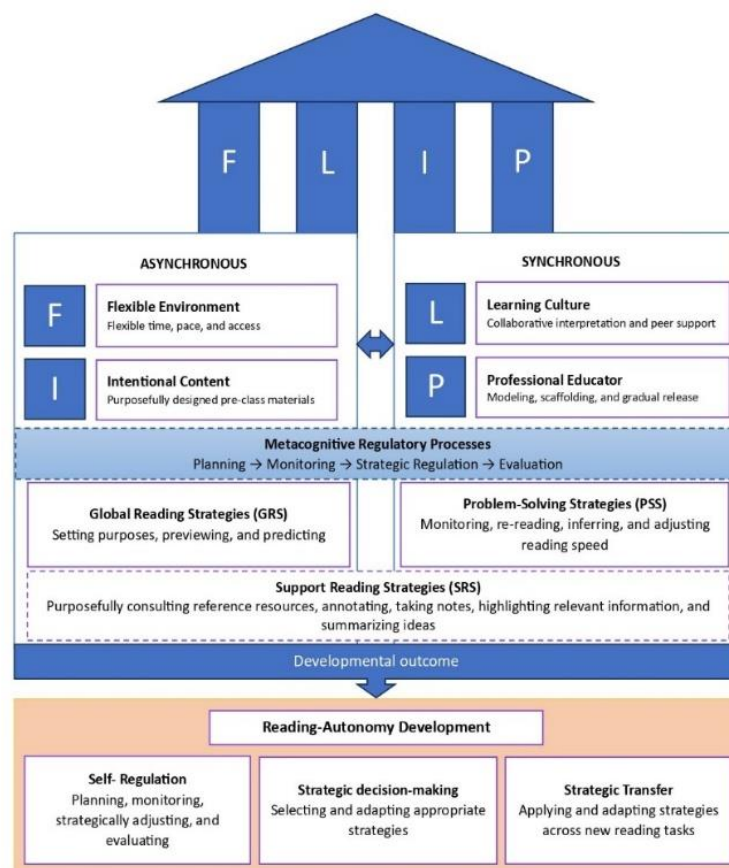


Fig . 1. Conceptual Framework Linking Flexible Environment, Learning Culture, Intentional Content, Professional Educator, Metacognitive Regulation, and Reading Autonomy.

III. METHOD

This study employed an embedded mixed-methods, one-group pretest–posttest design. The quantitative strand examined changes in perceived reading autonomy before and after the learning activities, while the qualitative strand explored how students experienced Flexible Environment, Learning Culture, Intentional Content, and Professional Educator, and how these conditions were associated with metacognitive regulation. Because the study did not include a comparison group or random assignment, the quantitative

analysis was used to examine change during course participation rather than establish a causal intervention effect. Quantitative data were obtained from the perceived reading-autonomy questionnaire administered before and after the learning activities. Qualitative evidence was collected through semi-structured interviews, classroom observations, reflective logs, and open-ended questionnaire responses. The two strands were integrated during interpretation by comparing quantitative changes with qualitative evidence of planning, monitoring, strategic adjustment, evaluation, reduced assistance, and continued

dependence. The overall research procedure is summarized in Table I.

A. Participants and Context

The program is positioned within applied higher education, where students develop professional and practice-oriented competencies alongside transferable academic skills during the 2025–2026 academic year. The participants were second-semester students aged 18–21 years, comprising 31 female and 9 male students. At the time of the study, they were enrolled in a General English course that supported general language comprehension, strategic reading, and transferable self-regulatory learning rather than nursing-specific English.

Most students had no previous experience with a formally structured flipped-learning course, while a small number reported occasional exposure to pre-class digital materials followed by classroom discussion. No standardized English-proficiency test was administered specifically for this study. Course records and lecturer observations indicated heterogeneous basic-to-lower-intermediate English ability.

The inclusion criteria were enrollment in the intact General English class, voluntary consent, completion of both questionnaire administrations, and participation in the

learning activities. All participating students met these criteria and were included in the paired analysis. The intact-class setting preserved the natural instructional context but limited causal inference and generalizability.

B. Learning Activities

The learning activities combined asynchronous preparation with synchronous collaborative reading. During asynchronous learning, students accessed intentionally designed General English texts and prompts, established reading purposes, previewed texts, anticipated difficulties, selected supporting resources, and recorded their strategy use in reflective logs. During synchronous learning, students compared interpretations, identified comprehension problems, re-read difficult passages, revised interpretations, and justified responses using textual evidence. The educator provided modeling, diagnostic questions, hints, and feedback while progressively reducing direct explanation.

The activities were organized according to Flexible Environment, Learning Culture, Intentional Content, and Professional Educator. Their operationalization and relationships with metacognitive regulation and reading autonomy are presented in Table II.

TABLE I
MIXED-METHODS RESEARCH PROCEDURE.

Stage	Activity	Analytic Purpose
Pre-intervention	Students completed the perceived reading-autonomy questionnaire, and contextual information on previous reading and flipped-learning experience was recorded.	Establish baseline perceived reading autonomy.
Learning activities	Asynchronous preparation emphasized purpose setting, previewing, resource use, and reflective logging. Synchronous activities emphasized comparison of interpretations, comprehension monitoring, strategic revision, and scaffolded problem solving.	Provide conditions for metacognitive regulation.
Post-intervention	Students completed the same questionnaire. Interviews and open-ended responses explored perceived changes, difficulties, continued dependence, and experiences of scaffolding.	Examine change and obtain explanatory qualitative evidence.
Analysis and integration	Quantitative changes were compared with qualitative patterns from interviews, observations, reflective logs, and open-ended responses.	Identify convergence, complementarity, and qualification across the two strands.

TABLE II
OPERATIONALIZATION OF FLEXIBLE ENVIRONMENT, LEARNING CULTURE, INTENTIONAL CONTENT, AND PROFESSIONAL EDUCATOR.

Pedagogical Condition	Learning Space	Core Activities	Primary Metacognitive Process	Intended Autonomy Capacity
Flexible Environment	Asynchronous	Self-paced access; management of time, pace, and place; preparation before class	Planning and self-management	Independent self-regulation
Intentional Content	Asynchronous	Purposeful General English texts; previewing prompts; anticipation of difficulties; resource selection	Planning, Global Reading Strategies, and purposeful Support Reading Strategies	Independent self-regulation
Learning Culture	Synchronous	Comparison of interpretations; peer discussion; evidence-based justification; re-reading and revision	Monitoring, Problem-Solving Strategies, adjustment, and evaluation	Strategic decision-making
Professional Educator	Asynchronous and synchronous	Modeling, diagnostic questions, hints, feedback, and progressively reduced direct explanation	Metacognitive prompting and transfer of regulatory responsibility	Emerging regulatory independence

The learning activities lasted four consecutive weeks. Each cycle included approximately 45–60 minutes of asynchronous preparation through the institutional learning-management system and one 100-minute synchronous class meeting. Students worked with four General English texts of approximately 600–800 words, broadly aligned with A2–B1 reading demands and covering non-specialist topics such as

study habits, digital communication, healthy lifestyles, and environmental awareness.

Scaffolding was progressively reduced across the learning activities. Initially, the educator modeled a think-aloud reading process and provided an explicit planning–monitoring–evaluation checklist. Subsequently, modeling was reduced, and students responded to targeted metacognitive prompts and hints. Students then increasingly

selected and justified strategies through peer discussion with limited educator intervention. In the final activities, students completed initial reading and strategy selection with minimal generic prompting before discussing and evaluating their choices. This progression was intended to transfer regulatory responsibility gradually from educator guidance to student decision-making.

C. Instruments

Perceived reading autonomy was measured using a five-point questionnaire consisting of 30 items across six dimensions: Initiative and Goal Setting, Flexible Learning Management, Global Reading Strategies and Planning, Monitoring and Problem-Solving Strategies, Support Strategies and Resource Use, and Evaluation, Strategic Decision-Making, and Transfer. The instrument was reviewed by five experts, with item-level content validity indices ranging from 0.80 to 1.00 and a scale-level average of 0.93. A pilot study with 20 non-participants yielded a Cronbach's alpha of 0.88, while internal consistency was 0.86 at pretest and 0.90 at posttest. Qualitative data were collected through semi-structured interviews, classroom observations, reflective logs, and open-ended questionnaire responses. Twelve technical students representing different levels of score change were selected for interviews. The qualitative instruments focused on students' experiences of Flexible Environment, Learning Culture, Intentional Content, Professional Educator, and associated metacognitive processes.

D. Data Analysis

Pretest and posttest scores were analyzed using descriptive statistics, a paired-samples t-test, a 95% confidence interval, and Cohen's *dz*. Qualitative data were analyzed thematically to identify planning, monitoring, strategic adjustment, evaluation, resource use, reduced assistance, and continued dependence. In the interpretation, quantitative and qualitative results were integrated to explain changes in perceived reading autonomy.

IV. RESULTS AND DISCUSSION

A. Change in Perceived Reading Autonomy

All of the technical students completed both administrations of the questionnaire. Reading autonomy perceptions were greater on the posttest than on the pretest. The paired-samples t-test indicated a statistically significant

mean increase of 20.25 points, $t(39) = 8.10$, $p < 0.001$, with a large within-participant effect size (Cohen's $dz = 1.28$). The details of the results are shown in Table III. The result shows a significant increase in perceived reading autonomy during the course. However, this change should not be interpreted as evidence that the learning activities alone caused the improvement, as the study was conducted using a one-group design.

B. Metacognitive Processes in Relation to Change

The qualitative data showed three major pathways linking pedagogical conditions, metacognitive regulation, and reading autonomy. The pathways are listed in Table IV. With Flexible Environment and Intentional Content, technical students could guide their preparation, set reading goals, preview texts, and choose resources. These conditions allowed self-regulation in the case of purposeful use of resources. However, some students were still dependent on dictionaries and translation applications, suggesting that flexible access did not automatically lead to autonomy. Discussion with peers facilitated monitoring and strategic revision through Learning Culture. Technical students compared interpretations, identified comprehension problems, re-read passages, and revised answers with textual evidence. This process was conducive to making strategic choices, although some students still depended on more adept peers. Thus, collaboration seemed to strengthen regulatory agency without diminishing social support. The professional educator modeled, questioned, hinted, provided feedback, and gradually reduced direct explanation to foster metacognitive regulation. With less external aid, the students had to make more of their own strategic choices. However, transfer to unfamiliar, fully unassisted reading tasks was not examined. The findings therefore point to developing regulatory independence instead of proven independent strategic transfer.

C. Mixed-Methods Integration

The quantitative and qualitative results showed a convergence and qualification. The quantitative analysis showed a significant increase in perceived reading autonomy, while qualitative evidence showed greater planning, monitoring, strategic adjustment, evaluation, and decision-making during learning activities. The integrated findings are summarized in Table V.

TABLE III
PAIRED-SAMPLES T-TEST RESULTS FOR READING AUTONOMY.

Contrast	Mean Difference	SD Difference	SE	95% CI	t	df	p
Posttest – Pretest	20.25	15.83	2.50	[15.19, 25.31]	8.10	39	< 0.001

TABLE IV
PEDAGOGICAL CONDITIONS, METACOGNITIVE PROCESSES, AND READING AUTONOMY.

Pedagogical Condition	Metacognitive Process	Autonomy-Related Outcome	Limitation
Flexible Environment and Intentional Content	Planning, Global Reading Strategies, purposeful resource use	Independent self-regulation	Dependence on dictionaries and digital tools remained
Learning Culture	Monitoring, problem solving, adjustment, evaluation	Strategic decision-making	Regulation remained partly peer-supported

Professional Educator	Metacognitive prompting and reduced support	Emerging regulatory independence	Independent transfer was not directly assessed
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TABLE V
INTEGRATION OF QUANTITATIVE AND QUALITATIVE FINDINGS.

Quantitative Finding	Qualitative Evidence	Interpretation
Perceived reading autonomy increased significantly.	Students demonstrated more deliberate planning, monitoring, revision, and resource use.	Perceived autonomy increased alongside stronger metacognitive regulation.
Large self-reported improvement	Some students still relied on peers, educators, dictionaries, and digital tools.	Increased perceived autonomy did not indicate complete independence
Perceived transfer was included in the questionnaire	Fully unassisted transfer to unfamiliar texts was not directly tested	Behavioral strategic transfer remains unconfirmed

Flexible Environment, Learning Culture, Intentional Content, and Professional Educator set up different but complementary conditions of metacognitive regulation. These results coincide with research that flipped and learner-centered environments can promote autonomy and self-directed engagement (Colque-Quispe et al., 2025; Dewi et al., 2025; Tsai, 2025).

Flexible Environment and Intentional Content were closely associated with planning and purposeful use of resources. Their contribution depended on technical students’ intentional use of flexibility rather than simply accessing materials independently. This is a significant difference, as digital learning can promote autonomy as well as dependence on easily accessible resources.

Learning Culture helped with monitoring, problem-solving, and strategic revision. Peer discussion helped students identify weaknesses in their first interpretations and reconsider reading strategies. This is consistent with research highlighting the significance of metacognitive scaffolding and collaborative participation in English language learning (Du et al., 2024; Ghaith & El-Sanyoura, 2019). But the continuing presence of more expert peers shows that strategic regulation was also partly socially underpinned.

The Professional Educator contributed via guided questioning, feedback, and gradually reducing direct support. The pattern suggests the value of scaffolding that allows technical students to make their own decisions rather than simply getting answers. Structured mentoring and educator support can contribute to learner development in higher education (Glushchenko, 2026). In the present study, such support became increasingly autonomy-oriented as direct assistance was gradually reduced.

The findings have implications for technical education in the real world. Supporting General English courses can impact the broader learning capacities when reading activities require the technical students to plan, monitor understanding, evaluate resources, and revise strategies. Digital resources can broaden learning opportunities, but the value of digital resources is dependent on purposeful use and students’ ability to self-regulate their learning (Katel, 2026; Toshmuradovna, 2026).

However, the findings should be interpreted with caution. The results were mostly based on self-reported reading autonomy. The study was conducted with one intact class, and no comparison group was employed. Thus, the observed increase may also reflect greater awareness of strategic reading or other course-related influences. Future

studies should use stronger comparative designs and directly assess whether students can transfer reading strategies to unfamiliar tasks without educator or peer support.

D. Implications for Technical Education

The findings indicate that General English can support broader learning capacities among technical students beyond language performance. Flexible Environment and Intentional Content can provide opportunities for independent preparation and purposeful resource use, while Learning Culture can encourage students to monitor and revise their understanding through interaction. Professional Educator can further support autonomy by gradually reducing direct assistance.

These capacities are relevant to technical education because students need to access information, evaluate resources, and adapt their learning as knowledge and technologies change. Competency-oriented education also emphasizes the development of professional capacities through active learning and competency development (Hasanovna, 2023). However, the present findings concern General English reading and should not be interpreted as evidence of improved nursing-specific or occupational competence.

E. Limitations and Future Research

Several limitations should be considered. The study involved one intact class without a comparison group, limiting causal interpretation and generalizability. Reading autonomy was primarily measured through self-report, and the questionnaire has not undergone independent factor-analytic validation. In addition, behavioral transfer to unfamiliar and fully unassisted reading tasks was not directly assessed. Future research should involve larger samples and comparison groups, validate the questionnaire structure, and examine reading autonomy using direct behavioral measures. Longer studies should also investigate whether metacognitive regulation and independent strategy use are sustained and transferred to new reading contexts.

CONCLUSION

This study showed an increase in perceived reading autonomy among technical students. Flexible Environment and Intentional Content were associated with planning and purposeful resource use, Learning Culture was associated with monitoring and strategic decision-making, and the Professional Educator component was associated with the

gradual transfer of regulatory responsibility. However, complete independent transfer was not demonstrated. These findings suggest that flipped-learning conditions may provide supportive conditions for metacognitive regulation and increasingly independent reading among technical students.

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