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Application of the SQ3R method and wattpad science fiction to enhance concept mastery in the excretory system

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ABSTRACT

Concept mastery is a crucial component of science learning; however, many students struggle to achieve deep understanding because they use ineffective reading strategies. This study aims to examine the effectiveness of the Survey, Question, Read, Recite, Review (SQ3R) method integrated with Wattpad-based science fiction to improving students' conceptual mastery of the excretory system. The research employed a pre-experimental design with a one-group pretest–posttest design. The research instrument consisted of multiple-choice test items developed to measure students' conceptual understanding across various cognitive levels. The participants were Grade XI science students at SMA Pasundan 3 Bandung, with class XI MIPA III selected through purposive sampling. The results revealed a significant improvement in students' conceptual understanding, indicated by a normalized gain (N-gain) of 0.6781. Improvements were observed across all cognitive levels: C1 (86.11) through schema activation in the Survey stage (assimilation), C2 (81.79) through information encoding and integration in the Question and Read stages (assimilation-accommodation), C3 (83.80) through concept transfer in the Recite stage (equilibration), and C4 (90.28) through schema reorganization and argument construction in the Review stage. These findings suggest that the SQ3R method applied to Wattpad science fiction effectively enhances students' concept mastery of excretory system material, in alignment with cognitive learning theory.

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Keywords
Concept mastery, Excretory system, Science fiction, SQ3R method, Wattpad.

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INTRODUCTION

Biology is considered one of the most challenging subjects to learn and teach, due to the breadth of its content, the abstract nature of many concepts, and the presence of complex scientific terminology (Arshad & Ishak, 2023; Hallaby *et al.*, 2024). One of the main factors contributing to these difficulties is students' low engagement in reading activities, particularly in scientific literacy, which directly hinders their conceptual understanding (Ardiyanti *et al.*, 2019). The ability to comprehend biological content deeply depends not only on exposure to information but also on effective reading strategies. Previous studies have suggested that effective reading habits can help students develop a better conceptual framework and interpret scientific ideas meaningfully (Montfort *et al.*, 2013).

Despite global efforts to improve reading literacy, Indonesian students continue to perform poorly in international assessments. For instance, according to the Programme for International Student Assessment (PISA), Indonesia's reading literacy score dropped from 371 in 2018 to 359 in 2022, reflecting a significant challenge in students' reading competence (Alfaruqi & Nurwahidah, 2025). Although the country's percentile rank improved slightly (Herlina & Abidin, 2024), the decline in the score indicates that students still struggle with critical reading skills, which, in turn, affects their conceptual mastery in subjects such as biology. This reading problem is closely linked with students' lack of motivation, interest, and reading strategies.

Several researchers have emphasized that concept mastery in science requires not only the ability to recall definitions but also the ability to analyze and apply scientific knowledge. Students who possess strong reading comprehension skills are more likely to demonstrate high-level thinking abilities, such as reasoning and problem-solving (Herlina & Abidin, 2024; Juhji & Mansur, 2020). However, studies have also highlighted that students often face misconceptions and difficulty in understanding abstract concepts in biology, particularly in excretory system topics, which are typically perceived as boring and complex (Azizah & Alberida, 2021; Simorangkir & Napitupulu, 2020). These challenges are exacerbated by teacher-centered approaches, such as lectures, which offer limited opportunities for students to engage in active reading or exploration (Amini *et al*., 2018).

To address these issues, recent studies have explored the use of innovative reading strategies, such as the SQ3R method, as an effective pedagogical intervention. The SQ3R strategy—Survey, Question, Read, Recite, and Review—promotes structured and strategic reading to enhance comprehension and retention (Aisah & Setyawan, 2021). This method encourages active student engagement and supports deeper understanding of the learning material (Halimah, 2015; Tendrita *et al*., 2016). However, despite its benefits, SQ3R is rarely integrated with digital storytelling platforms that can increase students' motivation.

On the other hand, digital platforms such as Wattpad have gained popularity among students and can be effectively used to deliver science content through engaging narratives. Wattpad allows users to read and write stories, including science fiction that creatively embeds scientific processes such as those in the excretory system (Yuliadi Saputra & Andriani, 2022). The integration of science fiction into reading materials has the potential to foster curiosity and build scientific thinking while maintaining student interest (Syafi'i & Zahro, 2022; Suryaman, 2017). However, research that combines the SQ3R strategy and science fiction-based digital platforms like Wattpad remains limited.

Previous studies have either focused on improving reading literacy using strategy-based models or enhancing conceptual understanding through digital media. A few researchers focused on reading strategies for general comprehension, and some explored media use in science learning. There have been few studies concerned with combining structured reading methods with engaging digital storytelling in science education, particularly for complex topics such as the human excretory system. Therefore, this research aim to investigate the impact of applying the SQ3R method with science fiction reading on Wattpad to improve students' conceptual mastery.

METHOD

The method used in this study is a quantitative pre-experimental design with a one-group approach (Creswell & Creswell, 2018). The research was conducted by giving a pretest to one selected group, followed by treatment using the SQ3R method integrated with Wattpad-based science fiction content, and concluded with a posttest and questionnaire to assess students' concept mastery. Concept mastery was measured through a series of tests (pre-test and post-test) developed based on the revised Bloom's Taxonomy by Anderson et al. (2001), covering four cognitive levels: remembering (C1), understanding (C2), applying (C3), and analyzing (C4). The instruments used in this study included a multiple-choice concept test and statistical analysis software (SPSS 25) for data processing. The design of a one-group pre-test and post-est is illustrated in Figure 1.

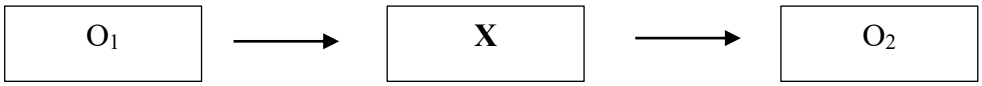

Figure 1. One group pretest and posttest design research model
Source: (Creswell & Creswell, 2018)

In this research design, O1 represents the pre-test administered to participants before any treatment is given, serving to measure their initial condition or baseline level. X denotes the intervention or treatment applied to the participants during the study. Meanwhile, O2 refers to the post-test conducted after the intervention, which is intended to measure the participants' condition following the treatment and to determine whether any changes have occurred as a result of the intervention.

To measure the increase in concept mastery, the normalized gain (N-Gain) was calculated based on pre-test and post-test scores. The formula for normalized gain is:

$$\text{N-Gain (g)} = \frac{\text{Posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}} \qquad (1)$$

Source: (Sugiyono, 2024)

The post-test score refers to the value obtained by students after the learning process has been completed, reflecting their level of understanding or achievement following instruction. The pre-test score represents the value obtained by students before the learning process begins, serving as a measure of their initial knowledge or baseline competence. Meanwhile, the maximum score denotes the highest possible value that can be achieved on the test, which functions as the upper limit for assessing students' performance.

Table 1 Instrument test results

Validity			Reliability		Difficulty Index	
Average Index	Status	Criteria	Index	Status	Average Index	Status
0,463	Valid	moderate	0,736	High	0,607	Moderate

Object of this study focused on the application of the SQ3R method, students' mastery of the excretory system concept through science fiction narratives on Wattpad. The data were collected using instruments developed specifically for this context. The concept mastery test consisted of 30 multiple-choice items given to 34 students, validated through expert judgment, and aimed to measure knowledge before and after treatment. Before being given to students, these 30 multiple-choice items underwent validity, reliability, and difficulty, yielding the following results.

RESULTS AND DISCUSSION

Consistent with the pre-experimental research approach employing a one-group pretest-posttest design, students were asked to complete a pretest prior to the learning session and a posttest upon its conclusion (Sugiyono, 2024). The data below presents a comparison of the pretest and posttest scores obtained by 36 students from class XI-MIPA 3.

Table 2 Results of pretest and posttest analysis

	Pre-test Score	Post-test Score
Mean Score	56,76	86,39
Standard Deviation	17,28	6,16
Maximum Score	80,00	96,67
Minimum Score	13,33	73,33
Number of Students	36	36
Ideal Score = 100		

Table 2 shows a notable increase in post-test scores after the intervention, indicating improved concept mastery. This increase demonstrates that the SQ3R method, combined with science fiction, effectively improved students' performance. The cognitive focus of SQ3R fosters comprehension and reasoning, leading to stronger concept mastery. According to Aini et al., (2024), SQ3R enhances students' ability to identify main ideas, infer meaning, and summarize content, while Rohim & Rahmawati (2020) and Juhji & Mansur (2020) emphasize that reading habits are key to mastering scientific concepts and supporting higher-order thinking. This visualization also supports the calculated average Gain of 29.63 points and an N-Gain of 0.6781, which fall into the moderate category according to Sundayana's (2020) classification. Therefore, the SQ3R method demonstrates a fairly effective way to improve concept mastery.

Table 3 N-gain test results

Description	Pre-test	Post-test	Gain	N-Gain	Category
Total Score	2043.33	3110.00	1066.67	24.41	Moderate
Mean Score	56.76	86.39	29.63	0.6781	Moderate

This Research also measured the improvement in students' concept mastery across four cognitive levels based on Anderson's (2001) revision of Bloom's Taxonomy, namely remembering (C1), understanding (C2), applying (C3), and analyzing (C4), both before learning (pretest) and after learning (posttest). The results of the concept mastery calculation based on cognitive levels before and after learning are presented in the Table 4.

Table 4 Calculation results of concept mastery based on cognitive levels before and after learning

No	Cognitive Level	Before Learning		After Learning	
		Mean Score	Category	Mean Score	Category
1	Remembering – C1	22.01	Very Low	86.11	Very High
2	Understanding – C2	16.85	Very Low	81.79	High
3	Application – C3	54.63	Low	83.80	Very High
4	Analyzing – C4	9.07	Very Low	90.28	Very High

Based on Table 4, students' concept mastery at the C1 (Remembering) cognitive level increased, with the average score rising from 22.01 (very low category) to 86.11 (very high category). This finding indicates that students were increasingly able to recognize the rules governing the use of concepts and

to develop intuitions aligned with the core propositions of the concepts they learned, reflecting meaningful concept mastery (Rabin, 2020; Talyzina, 2023). This improvement at the C1 level was achieved through the *Survey* stage of the SQ3R method, which was implemented using science fiction reading materials on the Wattpad platform. This approach places greater emphasis on the capacity to evaluate and analyze ideas, procedures, processes, and principles rather than on rote memorization (Zhou et al., 2017). During this stage, students reviewed chapter titles and recorded keywords from six chapters designed based on cognitive indicators of the excretory system. The titles of these six chapters are presented in Figure 2. In line with this, Azizah & Alberida (2021) reported that students' mastery of biological concepts remains low due to difficulties in understanding materials that involve complex terminology and abstract concepts. Several studies have shown that the application of various variables, such as teaching models, significantly influences conceptual understanding (Dewi et al., 2015). Meanwhile, Putri (2015) emphasized the importance of instructional strategies and methods, along with other variables, in shaping students' conceptual understanding. Accordingly, the application of the SQ3R method is considered necessary, as it can help students focus more on the main ideas of the material they study and achieve a deeper understanding (Tendrita et al., 2016).

The use of Wattpad in biology instruction can be implemented by integrating science fiction narratives that depict biological processes related to the excretory system (Telotte, 2019; Moraes et al., 2021). In the study by Zhu and Peng (2021), the definition of the science fiction genre was also shown to have broader impacts, such as encouraging public expenditure on scientific research during the COVID-19 outbreak, based on a constructivist interpretation of the science fiction work *The Epic of Gilgamesh*. What distinguishes science fiction from other genres is its adherence to scientific logic; these narratives do not attempt to contradict scientific principles but rather extend possibilities grounded in existing scientific and technological foundations (Menadue & Jacups, 2018; Menadue et al., 2020). This is evidenced by Table 2, which shows an increase in the mean score from 56.76 on the pretest to 86.39 on the posttest. This finding is consistent with Aini et al. (2024), who reported that SQ3R is effective in improving concept mastery because its procedural steps support students in understanding concepts, including identifying main ideas, interpreting explicit and implicit meanings, summarizing, and restating the content in their own words.

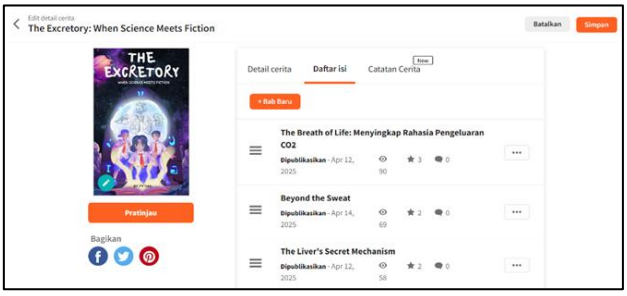

Figure 2. Chapter titles from the novella "The excretory: When science meets fiction"

Referring to Table 4, further details are provided on the aspects that support improvements across cognitive levels C1 - C4. They were also asked to connect the identified keywords with their prior knowledge by searching for additional information. This activity helped rebuild their foundational understanding before fully engaging with the reading material, in line with constructivist

theory (Siregar, Ilham, & M., 2020; Khoiroh iet al., 2021). Furthermore, keyword identification strategies have been shown to effectively enhance both short- and long-term memory retention (Hanif *et al* 2023), making this method particularly suitable for improving concept mastery at the initial stage of learning.

When viewed through the lens of cognitive theory, the Survey stage in the SQ3R method activates students' schemata by having them read chapter titles, note key terms, and connect them to prior knowledge. This process promotes the assimilation of new information into existing cognitive structures, strengthens memory retention, and builds anticipation for the content being studied. As a result, the average score at the C1 level significantly increased to the very high category, reflecting the method's effectiveness in reinforcing basic concept recognition. According to Piaget (Dewi & Sari., 2022) and (Schunk, 2012), learning occurs when new information is processed and linked to pre-existing schemas in long-term memory, which serve as frameworks for understanding and storing knowledge. According to Sommer et al. (2022), schemata function as knowledge frameworks that facilitate the comprehension, organization, and storage of new information, thereby making learning more efficient and meaningful. In line with this, pre-reading activities that emphasize prediction and schema activation have been shown to help learners better recall and integrate new knowledge (Ding & Zhu, 2019; Siha, *et al* 2025). Furthermore, Wade et al. (1999), as cited in Kuzmičová and Bálint (2019), stated that reading materials that are relevant to readers' interests or needs have been shown to enhance focus, facilitate better recall of the content, and increase motivation to spend time reading voluntarily.

Based on Table 4, students' concept mastery at the C2 (Understanding) cognitive level showed a improved significantly from a very low to a high category following the implementation of the SQ3R method, particularly during the *Question* and *Read* stages. In the *Question* stage, students formulated questions derived from previously identified keywords, encouraging critical thinking and facilitating connections with prior knowledge, in line with the self-questioning strategy (Daniel & Williams, 2021; Yeari, 2017). Subsequently, in the *Read* stage, students read six science fiction novella chapters on the Wattpad platform, each designed according to indicators related to the excretory system, to seek answers to their questions. This process not only enhanced students' comprehension of the text and identification of main ideas but also enabled the integration of new information into existing knowledge schemas (Sari et al., 2022; Khoiroh et al., 2021; Elleman & Oslund, 2019).

The improvement of concept mastery at the C2 (Understanding) cognitive level can be explained through the lens of cognitivist theory. In the SQ3R method, the *Question* stage facilitates active encoding and metacognitive reflection through student-generated questions, while the *Read* stage supports the assimilation and accommodation of new information into existing knowledge schemas. This is reflected in the significant increase in the average C2 score to 81.79 (high category) after the intervention. This strategy aligns with Schunk (2012) and Bormanaki & Khoshhal (2017), who argue that self-questioning promotes critical thinking and deeper comprehension. It also supports Piaget's concept of equilibration, where learning occurs through the active restructuring of cognitive schemas. Moreover, active reading fosters schema expansion and adjustment, particularly when unfamiliar information requires accommodation to form new or modified mental structures (Brown et al., 2021). In line with this, Montfort et al. (2013) stated that effective reading can help

students develop a deep understanding of the material, enabling them to explain or interpret concepts accurately even when expressed in different forms. In addition, Tang et al. (2017) also emphasized that the more students read, the better their comprehension becomes.

Based on Table 4, students' concept mastery at the C3 (Application) cognitive level increased from an average score of 54.63 (low category) to 83.80 (very high category) after implementing the *Recite* stage of the SQ3R method. In this stage, students engaged in group discussions to answer questions they had formulated based on science fiction texts from Wattpad, then completed additional items on the student worksheet. This process trained their skills in sequencing and connecting information, reflecting their ability to apply concepts logically. Oral and written recitations of the reading material facilitated the transfer of knowledge from comprehension to application in real-world contexts. This strategy aligns with the Reading-Questioning-Answering (RQA) and Think-Talk-Write (TTW) approaches (Sagala *et al.*, 2019), as well as Koretsky *et al.*, (2016), who argue that reasoning-based questions strengthen conceptual understanding and its relevance to everyday life.

From the perspective of cognitive learning theory, the improvement in concept mastery at the C3 (Applying) cognitive level was achieved through the *Recite* stage of the SQ3R method, which encouraged students to process textual information through group discussions and written responses actively. This stage reinforced students' cognitive schema and facilitated knowledge transfer from science fiction texts to real-world contexts through logical and applied reasoning—such as sequencing the stages of filtration from simple to complex and linking kidney structures to their functions. The application of deductive and inductive strategies strengthened the integration of new information into existing cognitive structures. The increase in the average score to 83.80 (very high category) demonstrates the method's effectiveness in promoting higher-order thinking. Consistent with cognitive theory (Hatija *et al.*, 2023; Wu, 2020), collaborative text-based discussions and reflective activities foster deeper elaboration, exploration, and meaningful application of concepts. In addition, Liu et al. (2022) and Liu et al. (2025) noted that learner-paced discussions promote deeper cognitive engagement, in which learners more frequently operate at the stages of exploration, integration, and resolution, which aligns with the objectives of C3 in the cognitive taxonomy.

Based on Table 4, students' concept mastery at the C4 (Analyzing) cognitive level increased significantly from an average score of 9.07 (very low) to 90.28 (very high) following implementation in the Recite and Review stages of the SQ3R method. In the *Recite* stage, students engaged in group discussions to answer questions targeting C4 indicators, such as analyzing disorders of the excretory system and diagnosing appropriate medical treatments, based on the science fiction texts "The Healer from the Future" and "The Trauma Code of Dialysis." This process was further strengthened in the *Review* stage, where students compiled summaries and presented their group discussions, while other groups provided analytical feedback. These activities encouraged students to evaluate information, connect data across different sections of the text, and construct logical arguments. This strategy aligns with the findings of Niyazi & Wu (2024) and Castells *et al.*, (2022), who emphasize that analytical questioning enhances higher-order thinking skills, as well as Sari et al. (2022), who argue that the *Recite* and *Review* stages reinforce understanding and retention through active and collaborative reflection.

In the cognitive learning perspective, improvement in concept mastery at the C4 (Analyzing) level was achieved through the *Recite* and *Review* stages of the SQ3R method, which encouraged students to reconstruct information from science fiction texts, analyze disorders of the excretory system, and connect them to appropriate medical diagnoses. The *Review* stage further reinforced understanding through presentations, Q&A sessions, and reflection, promoting metacognitive skills. This process reflects the principles of verbal elaboration and representational change, supported by scaffolding from peers and teachers that facilitates deep information processing (Schwering et al., 2021). The average C4 score increased significantly to 90.28 (very high category), the highest among all cognitive levels, indicating the effectiveness of the SQ3R method in fostering meaningful and structured understanding, in line with Ausubel's meaningful learning theory (Anugrah, 2024; Enke *et al.*,2022.; Patrick *et al.*, 2015; van Nooijen *et al.*, 2024).

CONCLUSION

The use of the SQ3R method based on science fiction from Wattpad significantly enhanced students' concept mastery, as reflected in both the average pretest-posttest scores and across all measured cognitive levels. At the C1 (Remembering) level, improvement occurred during the Survey stage, which activated prior schemata by identifying keywords and building anticipation for the text, aligning with the principle of assimilation in cognitive theory. At the C2 (Understanding) level, the *Question* and *Read* stages facilitated active encoding and the integration of new information into existing cognitive structures, allowing students to construct meaning through reflection and inter-conceptual connections, in line with the principles of assimilation and accommodation. At the C3 (Applying) level, the *Recite* stage promoted equilibration and the transfer of concepts to real-life contexts through discussion and verbal recall of reading content, indicating the transformation of knowledge into meaningful application, in accordance with the principle of equilibration. At the C4 (Analyzing) level, the *Recite* and *Review* stages required students to reorganize their schemata by analyzing relationships between information and constructing logical arguments, supported by verbal interaction through group presentations and Q&A sessions with the audience, which triggered deep representational restructuring. This process aligns with Ausubel's (1963) theory of meaningful learning in cognitive theory.

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