Water Inquiry in Geography Education: A Comparative Analysis of Analytical Thinking Enhancement in Hydrosphere Dynamics among Indonesian High School Students

Ummah Afiyatun Nissa, Nabila Nurul Hawa
1Universitas Negeri Malang, Malang, Indonesia
2Universiti Kebangsaan Malaysia, Selangor, Malaysia

ABSTRACT
Analytical thinking skills, characterised by complex reasoning and the creation of meaningful learning processes, are crucial for students to master in the evolving educational landscape. Despite the widespread application of inquiry-based learning methods, there needs to be more research exploring the specific effectiveness of the Water Inquiry Learning Model within the context of geography education, particularly in the domain of hydrosphere dynamics. This study aimed to ascertain the influence of the Water Inquiry Learning Model on the analytical thinking abilities of 10th-grade students at SMA Negeri 2 Batu, Malang, Indonesia. Utilising a proper experimental design with a pretest-posttest control group setup, two classes were observed: X-7 (experimental) and X-8 (control). Findings revealed a superior gain score of 72% for class X-7 compared to 45% for class X-8, signifying a significant enhancement in the experimental group’s analytical thinking capabilities. These results underscore the powerful impact of the Water Inquiry Learning Model on students’ analytical thinking skills. Nonetheless, a deeper understanding and adaptation of the model by students are imperative. Future implementations should provide detailed instructions regarding using biomonitoring cards, a component that may further amplify learning outcomes.

KEYWORDS
Water Inquiry; Geography Education; Analytical Thinking

INTRODUCTION
The 21st century, often termed the era of Industrial Revolution 4.0, has ushered in profound transformations across multiple sectors, including economics, technology, industry, transportation, and education. This era, characterised by an unprecedented surge in knowledge and technological advances, epitomises the ‘Era of Openness’. In such a rapidly evolving in the landscape, students are expected to harness skills like critical thinking,
creativity and innovation, communication, and collaboration, collectively known as the "4C" skills (Rosnaeni, 2021). However, modern pedagogy goes beyond mere skill acquisition; it emphasises an integrative approach that blends literacy, attitudes, technological proficiency, and skills.

As technology continues to reshape the world, educators are tasked with preparing learners to be at the forefront of this digital revolution. This involves fostering logical, analytical, creative, and contextually relevant thinking in students to navigate the intricate phenomena of the real world. With the shift towards student-centred learning, there is an increased focus on analytical thinking that bridges the gap between academic content and real-world challenges while simultaneously promoting active societal engagement (Syahputra, 2018).

Geography education, especially within the framework of the innovative 'Sekolah Penggerak' curriculum, is no longer confined to mere content comprehension. It demands students to analyse and ideate solutions to local environmental challenges. Geography education is anchored on three pillars: 1) Geography content/theme/essential, addressing the 'what' of learning; 2) Geography skills, encompassing the formulation of geographic questions, acquisition, organisation, analysis, solution design, and communication of geographic information; and 3) Geography perspectives (Nofrion, 2018). However, a concerning observation has emerged. Students, in their learning trajectory, seem to excel predominantly in the realm of geographic content, with limited proficiency in skills and attitudes. This indicates a pattern where students might memorise geographical concepts effectively but often fall short in genuine comprehension and practical application to real-world issues (Puspita et al., 2018).

Despite the emphasis on a holistic approach to geography education, there appears to be a disconnection between content knowledge and practical application. This study seeks to address this gap by investigating the potential of the Water Inquiry Learning Model in enhancing analytical thinking capabilities, facilitating deeper understanding, and promoting effective application in real-world contexts.

In the 21st-century learning era, geographic education demands innovative approaches that enable students to understand and address environmental issues holistically. While numerous learning models have been employed to realise this objective, there is an imperative to evaluate the efficacy of these models within specific contexts (Handoyo & Said, 2020). One model that has garnered significant attention is the 'Water Inquiry Learning Model'. Research findings by Handoyo and Said (2020) underscore the effectiveness of the Water Inquiry Learning Model, especially when integrated with the bioassessment method, in augmenting students' comprehension of water quality and fostering environmental consciousness. However, despite the pronounced potential of this model, a research gap persists regarding its influence on students' analytical thinking capabilities in the realm of geography, particularly concerning hydrospheric dynamics.

The Water Inquiry Learning Model is a synthesis of multiple pedagogical approaches, encompassing constructivist, contextual learning, cooperative learning, active learning, and the scientific approach. A distinguishing feature of this model is its utilisation of rivers, specifically the Brantas River, as the primary learning medium. Through this model, students are not only encouraged to grasp theoretical content within the classroom but also to actively collect and analyse data in field settings (A. Tanjung et al., 2021). Moreover, this model is meticulously
designed to hone both the hard and soft skills of students. Said and Handoyo (2010) crafted a comprehensive Water Inquiry syntax encompassing five pivotal stages intended to bolster students' understanding, skills, and environmental cognisance, especially regarding water quality.

In the context of geographic education, the pertinence of the Water Inquiry Learning Model is increasingly salient, especially for institutions implementing the 'Pioneer School Curriculum'. This model offers an integrated approach, melding classroom learning with hands-on field experiences, thereby enriching students' understanding of geography and environmental challenges. While the Water Inquiry Learning Model demonstrates promising potential, there remains a shortage in the literature regarding its optimal application within the Indonesian geographic education context, as well as its specific impact on students' analytical thinking prowess. This study endeavours to bridge this gap by evaluating the model's effectiveness in enhancing the analytical thinking abilities of students at SMA Negeri 2 Batu, Malang, Indonesia.

METHOD

This study employed a robust true experimental design using the pretest-posttest control group design framework. Subjects were selected via a simple random sampling technique to ensure unbiased, representative samples. Specifically, two sample groups were used: X-7 (experimental) and X-8 (control). The design was meticulously chosen to control extraneous variables that could potentially confound the experimental outcomes (Sugiyono, 2019).

Prior to the treatment, both groups were given a pretest, aiming to gauge the baseline analytical thinking skills of the students. The treatment varied between groups: X-8 was subjected to conventional learning, while X-7 experienced the Water Inquiry Learning Model. At the conclusion of the treatment phase, a posttest was administered to both groups to assess any changes in their analytical thinking abilities. The study involved Grade 10 students from SMAN 2 Batu during the second semester of the 2022/2023 academic year. The sample, determined through random sampling, comprised 72 students (X-7 F:22, M:14 and X-8 F:21, M:15).

The research instruments included a Learning Objective Flowchart (ATP), student activity sheets, modules, a water quality monitoring guidebook employing the bioassessment method, and a complex multiple-choice test consisting of five items. These items, centred on river water quality issues and watershed conservation, incorporated indicators of analytical thinking. The test instrument's validity and reliability were rigorously assessed using Cronbach's alpha method. The instrument's validity was confirmed through the product-moment correlation technique, yielding a table value of 0.344. Each item's validity surpassed this threshold, deeming all items valid. Subsequent reliability testing using Cronbach's Alpha method resulted in a reliability coefficient of 0.607, confirming the instrument's reliability.

The research utilised quantitative data derived from pretest and posttest scores on analytical thinking abilities. The pretest scores provided an initial insight into students' capabilities before the treatment, while the posttest scores reflected the outcomes post-treatment. The difference (gain score) between these two datasets served as the basis for hypothesis testing. For hypothesis testing, an independent sample t-test was employed to analyse the gain score differences between the two sample groups. Normality tests, based on the
Kolmogorov-Smirnov decision with a 95% confidence level and 5% significance, were undertaken (Setyawan, 2020). Furthermore, a homogeneity test was performed using Levene’s test for equality of variances at a 5% significance level.

RESULT

The research findings on the Water Inquiry Learning Model, employing the bioassessment method, have demonstrated a significant influence on students' analytical thinking abilities. The differential gain scores observed between the two classes further substantiate the impact of this model on students' analytical reasoning capabilities. Subsequent analyses were conducted to ascertain the significance level of the enhancement in analytical thinking for both classes. Table 1 presents the disparities between the pretest and posttest scores for the two classes.

Table 1. Pretest and posttest results for experimental class and control class

<table>
<thead>
<tr>
<th>Class</th>
<th>Pretest Average</th>
<th>Posttest Average</th>
<th>Gain Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-7</td>
<td>54.08</td>
<td>86.68</td>
<td>71%</td>
</tr>
<tr>
<td>X-8</td>
<td>61.61</td>
<td>80.97</td>
<td>49%</td>
</tr>
</tbody>
</table>

Table 1 presents the data wherein the mean pretest and posttest scores for the experimental group stand at 54.08 and 86.68, respectively, reflecting an enhancement of 71%. In contrast, the control group manifests a growth of merely 49%, with mean pretest and posttest scores registering at 61.61 and 80.97, respectively. According to the criteria set forth by Richard R. Hake (1999), a gain score of 71% is classified as highly effective, while a gain score of 49% is deemed ineffective. Prior to the intervention, the analytical thinking competency of group X-8 surpassed that of group X-7, as evidenced by the pretest outcomes. Nonetheless, subsequent to the intervention, the analytical thinking scores of the students in group X-7 witnessed a notable surge, signifying that their analytical capabilities outperformed those of group X-8.

Table 2. Data normality test results for analytical thinking abilities

<table>
<thead>
<tr>
<th>Class</th>
<th>Kolmogorov Smirnov Statistics</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>.104</td>
<td>36</td>
<td>.200</td>
</tr>
<tr>
<td>Control</td>
<td>.113</td>
<td>36</td>
<td>.200</td>
</tr>
</tbody>
</table>

Table 2 presents the results of the normality test for both classes using the gain score values, yielding a consistent result of 0.200. Based on the Kolmogorov-Smirnov decision-making guidelines and a 5% significance level, it can be inferred that both classes exhibit a significance value >0.05, indicating that the analytical thinking ability scores are normally distributed.

Table 3. Data homogeneity test results for analytical thinking abilities

<table>
<thead>
<tr>
<th>Levene Statistics</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.255</td>
<td>1</td>
<td>70</td>
<td>0.76</td>
</tr>
</tbody>
</table>

Based on the homogeneity test using Levene’s Test for Equality of Variances at a 5% significance level, the obtained Levene’s statistical significance value is greater than 0.05. This indicates that the variance of the analytical thinking ability variable is homogenous. Subsequently, the prerequisite test results displayed in Tables 6 and 7 serve as the reference for hypothesis testing. The hypothesis test is conducted using the independent sample t-test under the assumption of equal variances.
Table 4. Independent Sample t-Test results

<table>
<thead>
<tr>
<th>Kelompok</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>36</td>
<td>22.861</td>
<td>3.206</td>
<td>70</td>
<td>.000</td>
</tr>
<tr>
<td>Control</td>
<td>36</td>
<td>22.861</td>
<td>3.206</td>
<td>63.542</td>
<td>.000</td>
</tr>
</tbody>
</table>

Based on the hypothesis testing utilizing the gain score values, as presented in Table 8, a Sig. (2-tailed) value of 0.000 was obtained. Consequently, the null hypothesis (H0) is rejected, and the alternative hypothesis (H1) is accepted, indicating that the Water Inquiry Learning Model significantly influences students' analytical thinking abilities.

DISCUSSION

This research underscores the significant influence of the Water Inquiry Learning Model on students' analytical thinking capabilities. In the context of the newly introduced 'Merdeka Curriculum' for pioneering schools, the model's alignment is evident. Notably, the Water Inquiry Learning Model transcends traditional literacy-based classroom teachings, advocating for a numeracy approach emphasizing hands-on field data collection. This mirrors the curriculum's objectives, which emphasize boosting competencies and fortifying Pancasila-oriented student character through both literacy and numeracy learning experiences (Kemendikbud, 2021).

Contrary to the conventional teaching models that predominantly adopt a teacher-centric approach, which can occasionally stifle the diversity of learning processes and diminish student feedback (Kresma, 2014), the Water Inquiry Learning Model stimulates an engaging, creative, and meaningful learning environment. It propels students beyond mere knowledge acquisition, facilitating deep conceptual understanding and its implications for real-world environmental issues (Handoyo & Said, 2020). The model emboldens students to constructively, actively, and scientifically explore their surrounding environment. It seamlessly aligns with the principles of constructivist learning, where students actively construct new ideas or concepts based on their existing knowledge (Handoyo & Said, 2020). This experiential form of education, where theory and practice intertwine, necessitates proficiency in analytical thinking—a vital skill for analyzing phenomena and problem-solving in daily life, leading to tangible solutions (Fitriani et al., 2021).

Analytical thinking is delineated by several indicators: problem identification, causative factor analysis of a phenomenon, forecasting potential issues, proposing solutions, and articulating scientific analytical narratives (Setiawati Rokhis, 2018). Each phase of the Water Inquiry Learning Model distinctly nurtures these indicators. This is evident in the experimental class, which emphasizes contextual learning, steering students towards analytical, scientific investigations of phenomena, particularly those around the Brantas River. Such an approach fosters a deeper connection between students' existing knowledge and real-world phenomena, yielding a richer, more meaningful learning experience than purely theoretical instruction (Afriani, 2018).

The model's implementation commences with 'grouping,' wherein students are heterogeneously assembled into six cooperative teams. Preliminary briefings on objectives, necessary equipment for fieldwork, and a video introduction to water issues, especially those pertinent to Indonesian rivers and the Brantas River, equip students with a foundational context. This phase, by stimulating students
with visual cues and relevant information, prepares them for hands-on fieldwork. It encourages them to formulate geography-related questions, enhancing their analytical acumen to assess local environmental issues (Kidman, 2018). While the Water Inquiry Learning Model has been previously acknowledged for its benefits in fostering environmental awareness and analytical thinking skills (Handoyo & Said, 2020), this study uniquely evaluates its effectiveness in the context of the Merdeka Curriculum in pioneering schools. Moreover, its application in enhancing analytical thinking, as detailed by specific indicators, provides a refined understanding of its pedagogical value.

During the observation phase, students are directly immersed in the Brantas River environment, conducting constructive, active scientific exploration and research on water quality and surrounding ecological conditions. In this hands-on activity, students utilize biomonitoring cards and activity sheets as guides for data collection. This experiential learning approach, which integrates students into the learning process, encourages them to employ higher-order thinking skills in identifying and understanding environmental phenomena, which is consistent with the findings of Utami et al. (2021).

After field observation, students analyze data, referencing their biomonitoring cards and activity sheets. This phase is instrumental in honing students' analytical thinking as they discern causative factors of identified issues, moving from a general to a specific perspective. Integrating classroom knowledge with field observations facilitates problem-solving, leading to relevant, accurate conclusions and recommendations. This phase particularly amplifies students' analytical thinking abilities, allowing them to strategize problem-solving techniques, drawing parallels with Polya's problem-solving framework (Polya, 1957) cited in Rahmawati et al. (2021). The culmination of this stage is the collaborative creation of infographics, further fostering students' analytical skills, as underscored by Eggen Kauchak (1996) in Annisa et al. (2016). Student groups present their infographics, each allotted a ten-minute segment. Communication, as defined by Siti Zubaidah (2018), encompasses the conveyance of information, ideas, emotions, and skills in verbal or visual forms. The subsequent Q&A sessions stimulate student interactions, fostering their analytical communication skills.

The concluding phase involves thoroughly assessing the learning process, identifying potential challenges, and evaluating the extent of achieved outcomes. According to Miller Maellaro (2016), the essence of evaluation or reflection is to delve deeper into information, facilitating informed decision-making in problem-solving. Within the syntax of the Water Inquiry Learning Model, this manifests as the evaluation and reflection phase. Post-model implementation, students reflect on their learning experiences, impressions, future strategies concerning water issues, and their implications for life. The evaluation segment grants students the opportunity to appraise the entire learning journey. This research offers a meticulous exploration of the Water Inquiry Learning Model's stages, bridging the knowledge gap regarding its systematic implementation and impacts. The delineation of each phase underscores the model's potential in cultivating students' analytical competencies, providing educators with a structured framework to foster holistic environmental education.

CONCLUSION

The present research has substantiated the significant influence of the Water Inquiry Learning Model on students' analytical thinking capabilities. The
observed significance value (t-test) of 0.000 affirms the rejection of the null hypothesis (H0) and acceptance of the alternative hypothesis (H1), solidifying the model's impact on enhancing students' analytical thinking. The effectiveness of this learning model is further corroborated by the average gain score of the experimental class at 71% compared to the control class at 49%. Notably, the Water Inquiry Learning Model transcends traditional literacy-based classroom teachings, emphasising a numeracy approach that promotes hands-on field data collection, particularly through active observations and explorations in the Brantas River. This model stimulates students to address identified problems constructively, actively, and scientifically, bridging classroom insights with real-world applications. The holistic approach of the Water Inquiry Learning Model offers students opportunities for data collection, analysis, informed decision-making, and infographic communication.

Despite its merits, the study acknowledges certain limitations. A primary constraint is the potential unfamiliarity of students with the intricacies of the Water Inquiry Learning Model. This necessitates a more comprehensive orientation and detailed instruction, particularly concerning using biomonitoring cards. Future research should delve deeper into optimising the Water Inquiry Learning Model's instructional methods, ensuring students fully grasp its procedures and tools. Additionally, expanding the sample size and diversifying the student demographics could provide broader insights. Further, integrating technology-driven methods within the Water Inquiry Learning Model could enhance its effectiveness and make it more adaptable for contemporary educational settings.

REFERENCES


**AUTHORS**

**Ummah Afayatan Nissa**, is a student of the Geography Education undergraduate program, Department of Geography, Faculty of Social Sciences, State University of Malang, Malang, Indonesia (Email ummah.afiyatan.1807216@students.um.ac.id).

**Nabila Nurul Hawa**, is a student at Universiti Kebangsaan Malaysia, Selangor, Malaysia (Email p107389@siswa.ukm.edu.my).