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P14 - Empowering Rural Students through Research-Based Astronomy Education: Development of the ASTRO-KHURU Project-Based Learning Model in a Thai Secondary School

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Access to authentic astronomy research experiences remains limited for many students in rural schools, particularly in contexts where scientific equipment, specialist support, and opportunities for advanced inquiry are not readily available. This study presents the development and implementation of the ASTRO-KHURU Model, a project-based astronomy learning model designed to promote astronomical research competencies among secondary school students in a rural Thai school context. The study aimed to: 1) develop a project-based astronomy learning model integrated with the ASTRO-KHURU framework, 2) construct and validate the quality of the developed instructional model, and 3) examine the effects of the model by comparing students' post-learning abilities in planning and conducting astronomical research with the 80% criterion, alongside a qualitative analysis of students' learning behaviors and research skill development.

The target group consisted of 35 upper secondary school students from Khuruprachasan School, Chainat, Thailand, who voluntarily participated in the project "Astro Research Kick-off: Igniting Dreams, Cultivating Young Astronomy Researchers." The participants were selected through purposive sampling. The research instruments included: 1) the ASTRO-KHURU instructional model, developed through the integration of Project-Based Learning, systems thinking, and the PDCA cycle; 2) an astronomical research skills assessment; and 3) field note and learning reflection forms. Data were analyzed using descriptive statistics, including mean and standard deviation, a one-sample t-test, and content analysis.

The findings revealed that the ASTRO-KHURU Model was operationalized through nine structured learning stages: A: Activate Curiosity, S: System Thinking and Science Literacy, T: Teamwork and Topic Selection, R: Research Design, O: Observation and Operation, K: Knowledge Construction, H: Highlight and Presentation, U: Use of Feedback, and R: Reflection and Future Path. These stages enabled students to engage in astronomy research through curiosity-driven inquiry, collaborative topic development, systematic research design, hands-on observation, knowledge construction, academic presentation, feedback-based improvement, and reflective planning for future learning.

The quality evaluation showed that the appropriateness of the model, as assessed by experts, was at the highest level (Mean = 4.43, S.D. = 0.38). The instructional efficiency of the model was 82.12/88.45, exceeding the established 80/80 criterion. After implementation, students' astronomical research skills reached 89.66%, which was significantly higher than the 80% criterion at the .01 level. Students' overall satisfaction with the learning model was high (Mean = 4.52, S.D. = 0.41), with the highest-rated aspect being "inspiration for future learning and careers in science" (Mean = 4.68). Content analysis of students' reflections further indicated that 100% of the students were able to clearly describe their cognitive development, acquired research skills, and inspiration for further study in space science.

These findings indicate that the ASTRO-KHURU Model is an effective instructional approach for promoting active learning and developing astronomical research competencies among secondary school students in rural educational contexts. The study demonstrates that, when rural students are provided with a structured learning process, meaningful mentorship, and opportunities to engage in authentic scientific inquiry, they can develop research skills, confidence, and motivation to pursue astronomy and space science. The model therefore offers a practical and scalable framework for expanding research-based astronomy education, reducing opportunity gaps, and cultivating young astronomy researchers in rural and underserved schools.

Keywords: ASTRO-KHURU Model, project-based learning, astronomy education, rural school, astronomical research competencies, young astronomy researchers, active learning, research-based learning

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