

the students revisit what they had already learned and enhance their ability to explore and think about scientific knowledge. In particular, this program promoted the students' curiosity and interest in science and facilitated their thinking from different angles. When it came to the level of difficulties of the mission provided, the students responded differently but the majority of them answered that the mission was not that difficult to solve. Those who answered that the mission was not easy had had difficulties in inferring the answers to the mission or collecting evidence necessary to solve the mission. Yet, this made them feel a sense of challenge.

The SMART Science program enabled the students to learn scientific knowledge through associated activities, learn in integration with other subjects, and carry out creative activities. Mission-type inquiry activities helped the students set their goals and the competition element among the groups promoted their interest in learning. The use of tablet PCs and SNS for scientific inquiry activities facilitated the students' learning in fun ways, collaborating with other students, and sharing what they have learned with each other. Having them share the results of each group's inquiry activities and post comments on other groups' mission performance results on SNS had a positive influence on the students' deep understanding of the subject they were learning and character education. This study presents the results of the implementation of the SMART Science program. For further development of the SMART Science program using mobile technology for creative discovery learning, many follow-up studies should be conducted to consolidate the effectiveness of the method and create diverse ways of its application to real world situations in schools.

#### Acknowledgements

Hankuk University of Foreign Studies partly sponsored this study for publication.

#### References

- Benford, S., Duncan, R., Hull, R., Morrison, J., Facer, K., & Clayton, B. (2004). "Savannah": designing a location-based game simulating lion behaviour. MobileBristol, Bristol.
- Bruner, J. (1966). *Toward a Theory of Instruction*. Cambridge, MA: Harvard University Press
- Kangas, M.(2010). Creative and playful learning: Learning through game co-creation and games in a playful learning environment, *Thinking Skills and Creativity*, 5, 1–15.

- Kipnis, N. (2007). Discovery in science and in science education, *Science & Education*, 16, 883–920.
- Kirschner, P.A., Sweller, J., & Clark, R.E. (2006). Why Minimal Guidance During Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching, *Educational Psychologies*, 41(2), 75–86.
- Hammer, D. (1997). Discovery learning and discovery teaching. *Cognition and Instruction*, 15(4), 485–529.
- Lave, J and Wenger, E (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge, England: Cambridge University Press.
- Matthews, M.R. (2002). Constructivism and science education: A further appraisal, *Journal of Science and Technology*, 11(2), 121–134.
- Mayer, R.E. (2004). Should There Be a Three-Strikes Rule Against Pure Discovery Learning?, *American Psychologist*, 59(1), 14–19.
- Ministry of Education and Science of Korea (2011). National Plans for Smart Education.
- Naismith, L., Lonsdale, P., & Vavoula, G., & Sharples, M. (2006). *Literature Review in Mobile Technologies and Learning*, Futurelab Series Report 11.
- Pachler, N (ed) (2007) *Mobile learning: towards a research agenda*, London: WLE Centre, Institute of Education.
- Piaget, J. (1929). *The Child's Conception of the World*. New York: Harcourt, Brace Jovanovich.
- Rudd, T.(2008). *Reimagining outdoor learning spaces Primary capital, co-design and educational transformation*, A Futurelab Handbook, Available online at [www.futurelab.org.uk/resources](http://www.futurelab.org.uk/resources).
- Vygotsky, L.S. (1978). *Mind in Society: the Development of Higher Psychological Processes*. Edited Cambridge Mass, London: Harvard University Press