UNDERSTANDING INTEGERS: USING BALLOONS AND WEIGHTS SOFTWARE

Lisa Clement Lamb
San Diego State University
Lisa.Lamb@sdsu.edu

Eva Thanheiser
Rutgers University
evat@sunstroke.sdsu.edu

The purpose of this paper is to describe software we developed (*Balloons and Weights*) that supports students' integer understanding and to share results of its use in a fifth grade classroom. Integers are an integral part of the middle school curriculum (NCTM Standards, 2000) and mark a transition from arithmetic to algebra because of the abstract thinking required when working with them (Linchevski & Williams, 1999). Given the abstract nature of integers, it is not surprising that students have tremendous difficulty operating on them. Despite the importance of understanding integers and the difficulties students have understanding and operating on them, relatively little research has been conducted in this area. The development and use of software described in this study represents one attempt to address this void.

A paper-pencil version of the *Balloons and Weights* software was initially reported by Janvier (1983). In our interactive version, balloons and weights can be attached to a basket. Helium balloons represent positive integers, whereas weights represent negative integers. One balloon raises the basket one unit. One weight lowers the basket one unit. Thus, one balloon and one weight cancel each other to create a zero pair. Adding on balloons or weights represents addition of integers, whereas removing balloons or weights represents subtraction. The result of adding on or removing balloons and weights is represented on a vertical number line. Also, the model is set in a context of traveling up and down in a basket with balloons and weights attached that is experientially real to students. Because the weights in this model indicate a direction (pulling down) and result in a position, the rules associated with their actions are not as arbitrary as those for a typical horizontal number line. The software affords animation that can serve to support students' imagery when they make and test conjectures about what will happen when, for example, one begins with 4 weights and adds on 7 weights (-4 + -7) or compares beginning with 10 weights and removing 3 weights (-10 - -3) with beginning with 10 weights and adding on 3 balloons (-10 + 3).

This software was used in a 5th grade classroom to introduce addition and subtraction of integers. The students engaged in a variety of experiences in which they added and removed balloons and weights and were asked to describe the outcome of each action and relate that to the symbolic notation. By the end of the lessons most students in the class were able to solve symbolic integer problems without the explicit use of the software by drawing on the imagery supported by the software.

References

Janvier, C. (1983). The understanding of directed number. In J.C. Bergeron & N. Herscovics (Eds.), Proceedings of the Fifth Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (Vol. 2, pp. 295 – 301). Montreal: Universite de Montreal, Faculte de Sciences de l'Education.

Linchevski, L., & Williams, J. (1999). Using intuition from everyday life in 'filling' the gap in children's extension of their number concept to include the negative numbers. *Educational*

Alatorre, S., Cortina, J.L., Sáiz, M., and Méndez, A.(Eds) (2006). Proceedings of the 28th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Mérida, México: Universidad Pedagógica Nacional.

Studies in Mathematics, 39, 131 – 147.
National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics.* Reston, VA.: NCTM.