Evaluation Report for Integer Multiplication Learning Object

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Introduction

Common Core Math Standards shifted how K-12 mathematics were taught in three key ways: focus, coherence, and rigor (CCSSI, 2022a). The new standards were designed to give students more in-depth instruction in fewer topics in a specific grade level while helping students to connect new content knowledge to previously learned concepts from earlier mathematics classes (CCSSI, 2022a). Additionally, the rigor of the standards was increased through the incorporation of three components: conceptual understanding; procedural skills and fluency; and application (CCSSI, 2022a; Gaddy et al., 2014). Students not only needed to be fluent with the processes of solving mathematical problems, but they also needed to understand the underlying concepts to be able to apply them to real-world contexts.

The shift from a focus on mathematical facts (procedural fluency) to including conceptual understanding and application has not always been a smooth transition. In particular, concepts such as fractions and integers have presented challenges to both students and teachers. This was the impetus for the design of the Integer Multiplication learning object. In middle and high school math classes, students often have a gap in their conceptual understanding of integer multiplication, which is the multiplication of positive and negative non-decimal and non-fractional whole numbers, such as $-6 \times 3 = -18$. While 6th grade students are introduced to the concept of negative numbers, in 6th grade math standards, negative numbers are used only in contextual applications (such as negative temperatures) and the ordering of numbers (on number lines and coordinate planes), not in operations (CCSSI, 2022b). In 7th grade, students begin to perform operations, including multiplication, with negative and positive numbers (CCSSI, 2022b). If students do not have a solid conceptual understanding of integer multiplication when leaving 7th grade, they often struggle with future math classes because concepts such as solving

equations, which are key concepts in later math courses such as Algebra I and Geometry, build upon this foundational concept and skill.

The Integer Multiplication learning object was created using Articulate Storyline. The target audience is math students in grades 7 through 12 who have already been introduced to the concept of integer multiplication. The learning object was designed to be used independently and asynchronously with the option to download a report or view a student's mastery at the end of the learning object to determine if further supports or practice are required. Due to its importance in students' mathematics education, the Integer Multiplication learning object was designed to support learners who either need additional support with conceptual understanding (understanding the concept of integer multiplication) or procedural fluency (need additional practice). In the learning object, the learner helps their friend, Tim, calculate how much money he has at the end of the month after a variety of different transactions. Procedural fluency is developed through the interactive scenarios as well as the embedded practice questions at the end of the learning object. Conceptual understanding is reinforced in the learning object through the application of integer multiplication to a real-world problem.

Instructional Design Models

The Integer Multiplication learning object was designed using Keller's ARCS Model of Motivation. Motivation and engagement are built throughout the learning object through the ARCS categories of attention, relevance, confidence, and satisfaction (Keller, 2010). The structure of the object, in which the learner is helping Tim calculate how much money he has spent and received, makes the learner an active participant in a real-world context, which builds perceptual and inquiry arousal. Perceptual and inquiry arousal impact the learner's attention to the instruction (Keller, 2010). The real-world context and familiarity of situations described in

the learning object are key to making the learning relevant, another component of Keller's model (Keller, 2010). In the learning object, the objectives are explained to the learner as they begin the learning object and then are summarized before the learner begins the practice component. Additionally, through the learner's interactions with the learning object, where they are given various pictorial, numerical, or verbal expressions, feedback is given to either confirm the learner's choice or provide additional guidance about a misconception. Through the use of learning requirements, success opportunities, and personal control, the learning object builds the learner's confidence with the content (Keller, 2010). Satisfaction, the final component of the ARCS Model, was built through the use of natural consequences (embedded praise or constructive feedback and real-world applicability) as well as equity in learning through explicitly stated learning objectives.

The evaluation process of this learning object was directed by the ADDIE Instructional Design model. The ADDIE Model is comprised of five stages: analysis, design, development, implementation, and evaluation (Mayfield, 2011). The model is iterative and collaborative, where each phase of the model facilitates feedback and revisions (Mayfield, 2011). For the Integer Multiplication learning object, the need for and purpose of the learning object and the identification of the learning objectives, methods, and materials through the use of storyboards and models took place during the analysis and design phases. During the development phase, the learning content was created, and subject matter experts, including a middle and high school math teacher as well as a special education teacher, were consulted. The subject matter experts found that the content of the learning object was appropriate for the target audience and the examples, activities, and embedded practice aligned with the learning objectives although some of the phrasing needed to be changed to ensure that the content met the level of the standard.

The implementation and evaluation phases of the ADDIE model are the focus of this evaluation report. During the implementation phase, the learning object is given to learners, and combined with the evaluation phase, data is collected to identify discrepancies and determine areas for improvement (Mayfield, 2011). In this evaluation of the Integer Multiplication learning object, the learning object was given to a small sample of learners. Learners were given a pre-test to determine their prior understanding of the learning objectives, completed the learning object (including the embedded practice), and then asked to assess the user experience with the learning object. Follow-up interviews were conducted to further understand the user experience. The evaluation of the learning object was designed to answer the following questions:

1. To what extent is the learning object effective at reinforcing students' conceptual understanding of integer multiplication?
2. To what extent is the learning object effective at building students' procedural fluency with integer multiplication?
3. To what extent is the learning object easy to use?
4. To what extent is the learning object engaging for learners?

Data Analysis and Results

Sample

Data was collected during a 45-minute class period at Diamond Oaks Career Campus, where I am a mathematics instructor. Twenty-five twelfth-grade students enrolled in Financial Algebra participated in the evaluation, although two participants did not complete the learning object, so their responses have been removed from the sample, leaving a total of 23 respondents. The evaluation process was verbally explained, and I was present to answer participants' questions throughout the evaluation. Students were able to complete the evaluation at their own

pace. Two weeks after the survey was administered, follow-up one-on-one interviews were conducted with eight students to better understand what users liked and disliked about the learning object.

A week prior to the evaluation, the evaluation process was explained to students and a paper was sent home to parents. A passive consent process was used, since there was a minimal risk of adverse outcomes during the administration of either the learning object or the questionnaire. No students or parents refused participation in the evaluation process, and students were reminded (both verbally and in the questionnaire itself) that they were able to opt-out of the process at any time. All students present at the time of the evaluation chose to participate in the evaluation, although the two students who completed the survey but did not complete the learning object were removed from the sample.

The evaluation was comprised of three components: a questionnaire, the learning object, and follow-up interviews. The questionnaire, administered via Google Forms, contained a total of 30 items, which included two demographic questions, the eight-item pre-test and the 20-item user experience evaluation. The Integer Multiplication learning object was uploaded as a SCORM to Schoology, the school's learning management system. Participants accessed the link to the Google Forms questionnaire and the Integer Multiplication learning object through their Schoology Financial Algebra class. Interviews were conducted one-on-one and included open-ended and probing questions to better understand the feedback received. Demographic information about the sample was collected in the pre-test portion of the questionnaire and is shown in Table 1.

Table 1

Evaluation Sample Demographics

	Questionnaire Respondents $n = 23$	Interview Respondents $n = 8$
	Gender	
Male	9	4
Female	13	4
Non-binary	1	0
Prefer not to say	0	0
	Age	
12 or younger	0	0
13 – 14	0	0
15 – 16	1	0
17 – 18	20	7
19 or older	2	1

Data Analysis

During the Google Forms administration, student emails were collected in order to match student's learning object results with their questionnaire. Once the data downloaded from Schoology was matched with the respondent's Google Forms data, students' emails were removed from the dataset.

Pre- and Post-Tests

To facilitate statistical analysis about the effectiveness of the learning object on learners' conceptual understanding and procedural fluency, a matched pre- and post-test model was used. MacFarland (2014) suggests that a t-test for matched pairs should be used "to examine differences to a single measured variable between pairs" (p. 47). Since two of the questions of interest focused on whether the learning object had an effect on learners' abilities to perform integer multiplication, this was an appropriate model. The embedded eight-question practice at the end of the learning object was replicated in the Google Forms questionnaire administered before students began the learning object. After working through the scenarios in the learning object, participants then completed the same items in the learning object. The results from the

Google Forms questionnaire were downloaded as an Excel spreadsheet, and data was collected from Schoology about students' responses. In Excel, students' emails were used to match their Schoology results with their pre-test responses.

For statistical analysis, correct responses were coded 1 while incorrect responses were coded 0. Student accuracy (percent correct of the eight items) was calculated for both the pre- and post-tests, then the data was loaded into R for analysis. The sample statistics are shown in Table 2.

Table 2

Pre- and Post-Test Sample Statistics

		Mean	N	Std. Deviation	St. Error Mean
Pair	Pre-Test	0.942	23	0.154	0.0321
	Post-Test	0.915	23	0.12	0.0250

User Experience Questionnaire

Items on the User Experience Questionnaire (see Appendix A) were derived from two different questionnaires. Items 1 through 8 were pulled from Schrepp and Thomaschewski's (2019) UEQ+, which is a modular extension of Schrepp, Hinderks, and Thomaschewski's (2017) User Experience Questionnaire (UEQ). The UEQ+ questionnaire was chosen because of the ability to use the four-item constructs independent of the whole questionnaire (Schrepp & Thomaschewski, 2019). Items on the User Experience portion of the Google Forms questionnaire pertained to two scales: perspicuity and stimulation. Perspicuity measures how easily the learner was able to understand and use the structure of the learning object, which is important because if what the learner is expected to do is too difficult for the learner to easily understand, they will struggle to engage with the content being taught. Stimulation assesses how exciting and

motivating the learning object is to use. The items used a 7-point Likert scale "from -3 (fully agree with negative term) to +3 (fully agree with positive term)" (Schrepp et al., 2017, p. 40). Data analysis of the UEQ+ items was performed using the UEQ+ Data Analysis spreadsheet provided with the item.

The second portion of the User Experience questionnaire measures the visual aesthetics of the learning object. Items 9 through 20 were derived from Moshagen and Thielsch's (2010) Visual Aesthetics of Websites Inventory (VisAWI). Visual aesthetics have been linked with perceptions of increased usability, performance, affect and satisfaction (Moshagen & Thielsch, 2010). While VisAWI was designed to evaluate websites, Moshagen and Thielsch (2010) encourage its use in other digital contexts. The items included from the VisAWI measure three subscales (simplicity, craftsmanship, and diversity) and use a 7-point Likert scale "ranging from 1 'do not agree at all' to 7 'do fully agree'" (Moshagen & Thielsch, 2015, p. 8). Data for items 9 through 20 were recorded in the questionnaire as text responses to the Likert scale from "Strongly Disagree" to "Strongly Agree." To analyze the data, the responses were coded 1 (strongly disagree) to 7 (strongly agree). Items 9, 14, 16, 19, and 20, which were negatively-keyed were re-coded (Moshagen & Thielsch, 2015). Per the analysis instructions, overall item means, subscale means, and questionnaire means were calculated in Excel.

One-on-One Interviews

After initial data analysis was completed, it was determined that more information was needed from learners to pinpoint specific areas for improvement to the learning object. To gain insight into the questionnaire results, eight one-on-one interviews (see Appendix B) were conducted with participants from the initial evaluation. The interviews were conducted approximately two weeks after the initial evaluation process. Interviews lasted approximately

five minutes each, although there was no time limit. Learner responses were recorded in a Word document without identifying information and then analyzed for common themes.

Results

Pre-and Post-Tests

A matched-pairs t-test was conducted to compare the effect of the Integer Multiplication learning object on students' pre- and post-learning object conceptual and procedural fluency of integer multiplication. The results are shown in Table 3. Based on the t-test, there was not a significant difference in the scores for the pre-test and post-test conditions; t(22)= 1.311, p = 0.2034.

Table 3

Paired Samples T-Test Results

	Paired Differences							
				95% Confidence Interval of the Difference				
n = 23	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pre-Post	0.0274	0.0337	0.0070	-0.0159	0.0707	1.311	22	0.2034

User Experience Questionnaire

Questions 1 through 8 used a 7-point Likert scale from -3 to 3, with 0 indicating a neutral response. The results are shown in Table 4. The mean for the items on the perspicuity scale was 0.27 with a variance of 6.89 and standard deviation of 2.61. This indicates that overall, respondents were neutral about the perspicuity (ease of understanding and using) of the learning object, although further analysis found that the means for item 1 ($\bar{x}$=2.48, s=0.77) and item 3 ($\bar{x}$=2.48, s=0.93) were mostly positive, while items 2 and 4 were mostly negative. Item 2 had the greatest variability of the items on the perspicuity scale (s=1.95, s^2=3.97) which indicates a wide

range of responses to the question about whether the learning object was difficult or easy to learn. Item 4 had the lowest item mean ($\bar{x}$=-2.14) which indicates that many respondents found the learning object confusing. Since the questionnaire was comprised of only closed-items, there is not enough information from these items to identify what users found confusing about the learning object, so one-on-one interviews were added to the evaluation process.

Table 4

Perspicuity and Stimulation Scales from UEQ+

In my opinion, handing and using the learning object is…	Sample Size n	Mean $\bar{x}$	Standard Deviation s	Variance s^2
Perspicuity Scale	23	0.27	2.61	6.89
Q1. not understandable (-3) … understandable (+3)	23	2.48	0.77	0.62
Q2. difficult to learn (-3) … easy to learn (+3)	23	-1.83	1.95	3.97
Q3. complicated (-3) … easy (+3)	23	2.48	0.93	0.90
Q4. confusing (-3) … clear (+3)	23	-2.14	1.46	2.22
Stimulation Scale	23	1.33	1.61	2.62
Q5. not interesting (-3) … interesting (+3)	23	1.65	1.34	1.87
Q6. boring (-3) … exciting (+3)	23	0.43	1.88	3.71
Q7. inferior (-3) … valuable (+3)	23	1.73	1.32	1.83
Q8. demotivating (-3) … motivating (+3)	23	1.52	1.47	2.26

The mean for the stimulation scale was 1.33 with a standard deviation of 1.61 and variance of 2.62 which indicates that respondents were somewhat positive about the stimulation of using the learning object. The standard deviation and variance indicate that there was some variability in responses, although responses were more cohesive than the perspicuity scale. All items in the stimulation scale had positive means, which indicates that overall, participants were

positive. Question 6 ($\bar{x}$=0.43, s=1.88) received the most neutral answers. The results of the stimulation scale suggest that users found the learning object to be interesting, valuable and motivating.

The twelve items on the questionnaire about the aesthetics of the learning object were from VisAWI. The results are shown in Table 5. Questions 9 through 20 used a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree), with 4 indicating a neutral response (neither agree nor disagree). The mean for the aesthetics scale was 4.99, with a standard deviation of 0.52 and variance of 0.27, which indicates that respondents were somewhat positive about the aesthetics and uniform in their responses.

Table 5

Aesthetics Scale for VisAWI

	Sample Size n	Mean $\bar{x}$	Standard Deviation s	Variance s^2
Simplicity Subscale	23	5.80	1.04	1.07
Q9. The layout appears too dense.*	23	5.04	1.69	2.86
Q10. The layout is easy to grasp.	23	6.09	1.31	1.72
Q11. The layout appears well structured.	23	6.09	1.08	1.17
Q12. Everything goes together in the learning object.	23	6.00	1.24	1.55
Craftsmanship Subscale	23	4.69	0.33	0.11
Q13. The layout appears professionally designed.	23	6.09	1.12	1.26
Q14. The layout is not up-to-date.*	23	5.78	1.38	1.91
Q15. The learning object is designed with care.	23	6.04	1.07	1.13
Q16. The design of the learning object lacks a concept.*	23	5.74	1.36	1.84

	Sample Size n	Mean $\bar{x}$	Standard Deviation s	Variance s^2
Diversity Subscale	23	4.48	0.36	0.13
Q17. The layout is pleasantly varied.	23	5.61	1.12	1.25
Q18. The layout is inventive.	23	5.26	1.29	1.66
Q19. The design appears uninspired.*	23	5.83	1.07	1.15
Q20. The design is uninteresting.*	23	5.74	1.29	1.66
Aesthetics Scale	23	4.99	0.52	0.27

Note. * indicates items that were reverse scored; polarity has been reversed in analysis.

VisAWI subdivides the aesthetics scale; the simplicity, craftmanship, and diversity subscales were included in the questionnaire because they best measured the constructs of interest. The simplicity subscale assessed the layout and structure of the learning object, which was measured in Questions 9 through 12; the mean was 5.80 with a standard deviation of 1.04 and variance of 1.07. This mean indicates that respondents were favorable about both the layout and structure of the learning object. The craftsmanship subscale measured how cohesive the layout and design were. The mean for the craftsmanship subscale was 4.69 with a standard deviation of 0.33 and variance of 0.11, which means that respondents were slightly positive, and responses were consistent about the cohesiveness of the layout and design. The diversity subscale was the final component of the aesthetics scale. The mean was 4.48, with a standard deviation of 0.36 and variance of 0.13. The diversity subscale assessed whether the learner found the layout and design interesting. Based on the results, it can be concluded that respondents were slightly positive about the interest of the layout and design and that their responses were consistent.

One-on-one Interviews

Responses from the one-on-one interviews were analyzed for common themes. The results are shown in Table 6. Overall, the feedback from the one-on-one interviews was positive. In particular, learners noted that the multiple representations used in the learning object met the needs of multiple different learning styles, and they also mentioned that the explanations given after each problem were helpful because they reinforced what they were doing right or gave them feedback on what to correct for the next problem. Learners thought that the learning object's layout was professional and effective and stated that that they thought how integer multiplication was taught in terms of money to be effective. One area of particular interest was clarification about the items on perspicuity from the UEQ+ (items 2 and 4) where respondents indicated that they found the learning object to be difficult to learn and confusing. Data collected from the one-on-one interviews suggests that learners found the learning object easy to use, but the math complicated, suggesting that users were evaluating the content not the learning object itself when answering items 2 and 4 on the questionnaire.

Table 6

Thematic Analysis of One-on-one Interviews

Theme	Incidence $n = 8$	Related Quotes
1) The use of multiple representations (audio, picture, text, numerical expressions) were helpful	6	"Audio, pictures, and text were a good combination – not overwhelming." "Pictures were helpful as a visual learner." "Audio was helpful – the combination of audio and visual was great."
2) The learning object looked cohesive and professional	6	"I liked the layout." "It looked professional." "I have ADHD, so I though the layout was colorful but not distracting."
3) The approach to integer multiplication was effective	5	"The content was presented in a way that was easy to understand, especially for someone with an IEP like me."

Theme	Incidence $n = 8$	Related Quotes
3) The approach to integer multiplication was effective	5	"I liked that the process was explained step-by-step." "The matching and summary at the end were helpful." "Money was a good way to talk about this."
4) Explanations after each question were helpful	5	"I liked the feedback and explanation, especially with a different representation." "The skill was challenging but the explanations helped." "Hearing and seeing the explanation helped me understand.
5) The learning object was easy to use	4	"I could do the learning object without help, but I think it would be better after a lesson because the math was hard." "It was easy to follow." "It was easy to do."
6) The math facts were challenging	4	"The math facts were a bit too easy during the lesson part but were harder during the practice. I got the skill, but struggled with the math facts." "I knew how to do the negative-positive part, but I had a hard time doing the math without a calculator." "I thought the multiplication facts were hard." "It was too long because the math was complicated. I'm not used to not using a calculator."
7) The learning object needs to be tested on multiple browsers/platforms.	2	"I did the learning object on my Mac, and the answer boxes to the fill-in-the-blank questions already had a 0 in them, so when I typed my answer, I got it wrong because there was an extra 0." "The big black box around it was kind of clunky, but I think that was probably a Schoology thing."
8) The mechanics of the learning object could be frustrating.	2	"I could use process of elimination for some questions during the learning object instead of learning the skill." "The feedback on the matching problems didn't give me enough information about what I needed to fix, which was frustrating."

Note. Theme 5: While half of the students identified the math facts as being too challenging, three students stated that the math facts were appropriate for the learning object.

While there was less uniformity in feedback about areas for improvement, three specific areas of improvement were identified from the interviews. One identifiable theme from learners' responses was about the math facts used in the learning object. Half of students identified the math facts used in the practice as being too hard for them to do easily without a calculator, although three students disagreed and stated that the math facts were appropriate for the learning object. A few students identified technical issues that require further exploration, including how the learning object worked within Schoology, as well as how the learning object behaved in different operating systems and/or browsers. Finally, a couple of students identified limitations of the Articulate Storyline software, such as not being able to receive detailed feedback about wrong responses to multi-part matching questions.

Recommendations

Conceptual Understanding and Procedural Fluency

There was no significant difference between pre- and post-test scores, although scores overall were above 90%. An item analysis suggests that it might be necessary to adjust some of the items in the practice, specifically item 7, which was an open-response item. When the individual responses were analyzed for item 7, of the seven incorrect responses, only three of the incorrect responses were due to an integer multiplication problem (answered 32 instead of -32). The remaining four incorrect responses were due to incorrect math facts (responses of -38, -30, -8, and 27). This indicates that for some students, their incorrect response was not due to their understanding of the integer multiplication rule (which three out of the four got right) but instead due to their knowledge of multiplication facts, which the learning object is not designed to address. This same pattern is evident in item 5, where participants were asked to match the

product with the correct multiplication problem, and some students selected the wrong multiplication fact, not the wrong integer operation. This pattern is supported by feedback received in the one-on-one interviews in which participants noted that the math facts were sometimes too challenging. To ensure that the embedded practice in the learning object assesses the learning objective (integer multiplication), the math facts in the learning object should be changed to easier math facts (such as the two- or five-times tables) which will ensure that the assessment is assessing the desired skill, not students' procedural fluency with the multiplication algorithm.

Testing the Learning Object

The one-on-one interviews identified some technical issues with different browsers and platforms which need to be addressed. Before the evaluation process, the learning object was only tested on a PC and a Chromebook; no major issues were identified. As improvements are made to the learning object, efforts must be made to test the learning object on multiple operating systems, different devices, and different browsers to identify potential issues before use. While not all technical issues can be prevented, testing the operating systems, devices, and browsers in advance will allow for better support of users.

Articulate Storyline

Some of users' frustrations with the learning object were due to limitations of the Articulate Storyline software. As the learning object is improved, solutions to the identified issues such as the lack of detailed feedback for some questions, should be addressed as much as possible. While it may not be possible to address all of users' concerns, since detailed feedback was an important aspect of what participants enjoyed about the learning object, this is an area that is worth further investigation.

Reflections

This learning object was created during my first semester of the Instructional Design and Technology Masters program. At that point in the program, I was comfortable with the subject matter (integer multiplication), but I had not yet learned about different learning theories or assessment methods. This is evident in the math facts I used in the learning object's lesson compared to the learning object's practice portion. Now that I am finishing the Masters program, I have a better understanding of how to align assessment with instruction and how to design assessments that assess what is actually being taught (integer multiplication) instead of peripheral skills (math facts). This will be important as I work to improve the Integer Multiplication learning object.

During this evaluation process, one of my struggles has been the need to collect actionable feedback with complete responses. Before beginning this Masters program, I worked on a graduate certificate in Assessment and Evaluation, and one of the major conversations in my classes was the challenge of getting complete responses and methods to prevent break-offs. This concern impacted the design of my evaluation as I decided to limit my evaluation questionnaire to only closed-ended items, since there is a smaller likelihood of break-offs since they do not require as much cognitive lift from the respondent. While analyzing closed-items is easy to do statistically, the data is limited in what it can tell you. Before conducting my one-on-one interviews, I was only able to make conjectures based on the data I had collected. In retrospect, including open-ended items on the evaluation questionnaire that gave participants the chance to give more detailed feedback would have made this evaluation process more meaningful and impactful from the beginning of the evaluation.

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Appendix A: User Experience Questionnaire

The purpose of this evaluation is to determine the effectiveness of the learning object at supporting students with integer multiplication, as well as how easy the learning object is to use and whether students find the learning object engaging. The purpose of the learning object is to help students better understand how the multiplication of negative and positive numbers works. The information collected from the survey will be used to improve the Integer Multiplication Learning Object.

Welcome to the evaluation of the Integer Multiplication Learning Object! Thank you for your time and participation.

What is the evaluation process?

- First, you will answer a few basic questions about yourself. Then, you will complete 8 integer multiplication practice questions.
- Next, you will go to Schoology and complete the Integer Multiplication Learning Object, which consists of some scenarios and embedded practice problems.
- After you complete the learning object, you will return to this Google Form, and answer questions about your experience completing the Integer Multiplication Learning Object.

Remember, you are not being tested - the Integer Multiplication Learning Object is! Thank you for your input!

Click "Next" to get started!

Section 1: Demographic Questions

1. What is your age?
    a. 12 or younger
    b. 13 – 14
    c. 15 – 16
    d. 17 – 18
    e. 19 or older

2. What gender do you identify as?
    a. Male
    b. Female
    c. Non-binary
    d. Prefer not to say

Please click "Next" to continue.

Section 2: Integer Multiplication Questions

Do NOT use a calculator for these questions.

1. Match the problem with the correct rule.

	Positive x positive = positive	Negative x positive = negative	Positive x negative = negative	Negative x negative = positive
6 x 5 = 30				
-3 x 10 = -30				
15 x -2 = -30				
-1 x -30 = 30				

2. Find the product: -6 x 4 = ?
   a. -2
   b. -24
   c. 24
   d. 2

3. Find the product: 3 x -9 = ?
   a. -6
   b. 27
   c. 6
   d. -27

4. Find the product: -8 x -4 = ?
   a. -12
   b. 32
   c. 12
   d. -32

5. Check the box next to the correct product. Answers can be used multiple times.

	30	-30	20	-20
6 x -5				
4 x 5				
-4 x 5				
4 x -5				
-4 x -5				
6 x 5				
6 x -5				
-6 x 5				

6. Multiply to find the product: 6 x 10 = ? Type your answer in the box.

7. Multiply to find the product: 16 x -2 = ? Type your answer in the box.

8. Multiply to find the product: -3 x -10 = ? Type your answer in the box.

Click “Next” to continue.

Section 3: Integer Multiplication Learning Object

Go to Schoology and find the Financial Algebra course. The first item in the Schoology course is the Integer Multiplication learning object. Click the play button to get started. YOU WILL NEED HEADPHONES.

Remember, you are not being tested - the Integer Multiplication Learning Object is! Thank you for your input!

When you have reached the "Results" screen, you will come back to this survey and click "Next" below to continue.

Section 4: User Experience Questions
Please complete the following questions to assess the learning object. The following items contain opposing pairs of product properties. The grades between the opposites are indicated by circles. Click one of the circles to indicate your level of agreement with the individual terms.

Try to make a spontaneous decision! It is important not to think too long about the terms to reach a direct assessment. Please always check one answer, even if you are insecure about your assessment of one pair of terms or if you think that it does not fit the product.

There are no "right" or "wrong" answers. Your personal opinion is all that counts!

1. In my opinion, handling and using the learning object is... not understandable / understandable

2. In my opinion, handling and using the learning object is... easy to learn / difficult to learn

3. In my opinion, handling and using the learning object is... complicated / easy

4. In my opinion, handling and using the learning object is... clear / confusing

5. In my opinion, handling and using the learning object is... not interesting / interesting

6. In my opinion, handling and using the learning object is... boring / exciting

7. In my opinion, handling and using the learning object is... inferior / valuable

8. In my opinion, handling and using the learning object is... demotivating / motivating

Click "Next" below to continue to the next screen.

Please evaluate the learning object according to the following statements on a scale ranging from 1 (strongly disagree) to 7 (strongly agree).

	Strongly Disagree	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
9. The layout appears too dense.	1	2	3	4	5	6	7
10. The layout is easy to grasp.	1	2	3	4	5	6	7
11. The layout appears well structured.	1	2	3	4	5	6	7
12. Everything goes together in the learning object.	1	2	3	4	5	6	7
13. The layout appears professionally designed.	1	2	3	4	5	6	7
14. The layout is not up-to-date.	1	2	3	4	5	6	7

Please evaluate the learning object according to the following statements on a scale ranging from 1 (strongly disagree) to 7 (strongly agree).

	Strongly Disagree	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
15. The learning object is designed with care.	1	2	3	4	5	6	7
16. The design of the learning object lacks a concept.	1	2	3	4	5	6	7
17. The layout is pleasantly varied.	1	2	3	4	5	6	7
18. The layout is inventive.	1	2	3	4	5	6	7
19. The design appears uninspired.	1	2	3	4	5	6	7
20. The design is uninteresting.	1	2	3	4	5	6	7

Press "Submit" below to finish the evaluation. Thank you!

Appendix B: Interview Questions

Note. This is the general structure of the interview, although additional probing questions were added as needed to understand participants' responses.

1. What did you like about the Integer Multiplication learning object?
2. What did you dislike about the Integer Multiplication learning object?
3. If you could change anything about the learning object, what would you change?
    a. Why?
4. What did you think about the math facts used in the learning object?
5. Did you have any problems using the learning object?
    a. If yes: What problems?
6. Do you have any other feedback to improve the learning object?