Ceci n’est pas une Mouse-Trap Car

Physical Versus Virtual Materials in the Classroom

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Abstract

The increasing availability of computers as instructional media in elementary school classrooms makes possible an exciting range of new tools and techniques to support learning. For example, by using computer simulations students are able to manipulate virtual objects and materials in ways that would be totally impractical, unsafe, or prohibitively expensive in the physical world. Virtual experimentation is also time efficient. Per unit time, students are able to run many more experimental trials in a virtual lab setting than in an actual school laboratory.

But we instinctively place a high value on real-world experience. One does not master the violin by reading about musical technique. So it is counter-intuitive that the unique learning advantages that 'must' be offered by physical manipulation have been difficult to identify experimentally. With rapidly increasing use of technology in the classroom, it becomes important to understand how to deploy those tools to students' best advantage.

The learning differences, if any, between virtual and physical object manipulation is a central issue and the focus of this project. In our study, 4^{th} and 5^{th} grade children were divided into two groups. One group used virtual (i.e. computer generated) materials and the other used physical materials to learn about designing simple unconfounded experiments. In agreement with previous research, we found that the two types of instruction were equal in both domain general and domain specific learning objectives.

Introduction

There are many theories concerning the value and best use of physical and virtual materials in learning environments. Physical manipulatives are thought to help children by providing an additional channel for conveying information, activating real-world knowledge, and improving memory through physical action. (McNeil & Jarvin, 2007) Virtual manipulatives, however, address some of the shortcomings of physical materials in that they provide links to representations, provide custom feedback, and provide a trace of past actions. Most evidence indicates that it is the process of manipulation, rather than the medium employed, that promotes learning. (Triona & Klahr, 2003)

Empirical Studies

As computer simulations have gained popularity in classrooms, there has been an increase in the number of empirical studies aimed at identifying the benefits and drawbacks. Many researchers argue that physicality is the basis for conscious memory and learning. (Klatzky & Lederman 2002) In science education, it is argued that physicality is important for acquisition of psychomotor skills, awareness of safety procedures, and learning how to use human senses for observations. (Zacharias, 2010) Other studies have argued that measurement errors (and subsequently learning to deal with them) that are intrinsically present when using physical materials are also an important part of learning that is lost in the over-idealized virtual world. (Toth, Klahr, & Chen, 2000)

However, virtual materials potentially offer unique educational benefits since they can be created to specifically address inherent deficiencies in physical materials. Virtual materials are claimed to: accommodate individual cognitive levels, make phenomena more visible to learners, display information via multiple representations, allow students to change variables that would be impossible to change in the natural world, provide immediate feedback regarding errors, provide low cost opportunities to repeat the same experiment immediately, focus attention on targeted areas, visualize objects beyond perception, experience more examples, and address safety concerns. (Zacharias, 2008) These attributes make virtual instructional materials very appealing as teaching tools but have also sparked research that has yielded mixed messages and results.

A number of prior studies have identified trade-offs between physical and virtual materials. In one study where children were given paper squares, deines blocks, no materials, or virtual squares for a learning task, both virtual squares and deines blocks outperformed no materials and paper squares. Because methods were not held constant it was difficult to generalize between virtual and deines block conditions. However, it was clear that the different interfaces influenced the children's actions differently. The important consideration brought up in this study was the fact that virtual materials constrained children's actions whereas the deines blocks forced children to self-constrain. The results suggest that, if a task involves recognizing an incremental change, it may be beneficial to constrain manipulation to one object at a time via virtual materials. On the other hand, physical materials may be better for exploring changes applied to groups of objects. (Manches et al., 2010)

Another study, using an older participant pool, found similar trade offs. Results showed that students who worked with computer simulations of pulleys obtained better conceptual understandings of the processes being taught whereas students who worked with actual pulleys obtained better understanding of effort force. (Gire et al., 2010) It seems apparent from these and other studies in this area that in order to provide the best learning experience possible a thoughtful pairing of object manipulation interfaces to the nature of the concepts being taught is necessary.

Recognizing which areas of knowledge are activated by particular interfaces is a central component in recent research examining the effects of using a combination of physical and virtual study materials. Several studies have sought to determine the optimal sequential order for presenting physical and virtual instruction materials. Overall, these studies have found that the most effective sequential order depends upon the type of information being taught and the experience level of the student. Specifically, when students have little experience in an area and need grounding then physical materials are useful to use before virtual ones. (Winn et al., 2006) This idea is supported through research on concreteness fading where learning benefits have been shown to be maximized when one starts with concrete very realistic perceptual information and fades it into abstract/idealized information. (Goldstone & Son, 2005) This ordering of physical then virtual materials offers a strong perceptual grounding at the outset which appears to aid in mastering more advanced abstract concepts on a computer interface. Conversely, a different study found that virtual materials should precede physical materials when experimenting with complex phenomena. (Zacharia & Anderson, 2003)

One very recent study has examined a framework for “blending” virtual and physical instruction materials. Blending refers using the two types of materials concurrently. A six-step method for blending physical and virtual materials is proposed: 1) identify the over-arching general learning objective, 2) review relevant literature and identify unique affordances in physical/virtual materials, 3) match the results from the first two steps, 4) determine whether required affordances are available through accessible materials, 5) design a training intervention (explaining how to use the physical/virtual materials), 6) revisit experiments and create a blend of the virtual and physical materials. This multistep planning process does seem to yield worthwhile results. Results showed that the blended condition outperformed well-matched physical-only and virtual-only conditions. This challenges the notion that physical and virtual materials in a laboratory setting are at odds and suggests more research is needed to further understand whether blended methods are superior particularly to sequential methods. (Zacharias, 2011)

This Study

This study is an extension of two influential studies that examined aspects of the relative efficacy of physical vs. virtual domain instruction. The primary motivation for both of those studies was to empirically test the widespread belief that “physicality” is an important aspect of learning in early science instruction. Both studies used a similar paradigm of impoverished (uninteresting) virtual interfaces for one condition and physical materials for the other. The goal was to give the physical materials the best chance they could to outperform the virtual materials while holding everything else constant.

In the first study, 3rd and 4th graders were taught via direct instruction about Control of Variables Strategy. The Control of Variables Strategy (CVS) refers to the approach of comparing conditions or situations, which are different only in the variable of interest; the remaining variables are controlled. Students designed effective experiments using physical or virtual weights to find out about properties of springs. Both groups then transferred their CVS knowledge to physical ramps. (Triona & Klahr, 2003)

In the second study, 7th and 8th graders used a discovery learning technique to learn domain specific knowledge via physical or virtual materials. (Klahr et al. 2007) Discovery Learning refers to the acquisition of knowledge without explicit guidance. In this study, children were tasked with discovering CVS independently and then accurately interpreting their results. The virtual interface for this study was also very simple in order to give the physical materials the advantage. However, in this study the participants were discovering domain specific knowledge about mousetrap cars, not being taught how to design good experiments. It was hypothesized that the advantages of physical mousetrap cars would show up in measures of domain specific knowledge about a physics topic more readily than domain general knowledge. Additionally, motivation was hypothesized to be higher when using the physical materials. Surprisingly, an equal amount of learning was measured for both conditions in each of these two studies, thus providing no evidence that physicality provided an advantage.

This study aims to replicate the findings in Triona & Klahr (2003). However, this study uses mousetrap cars instead of springs; a domain in which one might expect physical materials to be particularly engaging and physically salient. Additionally, while CVS learning will be of primary interest, children will also be learning domain specific knowledge about mousetrap cars that is not explicitly taught. Both types of learning will be measured as well as a metric of students' confidence in their answers to test questions.

Experimental Methods

Participants

Participants were 32 fourth- and fifth- graders (17 girls and 14 boys) from a private elementary school in an urban area of Western Pennsylvania. Participants were recruited with consent forms handed out to students in class for parents to sign and return. Children were randomly assigned to virtual or physical instruction materials. All students had taken part in a related study prior to the present study. [1]

Design

We used a 2 (condition: physical vs. virtual materials) x 2 (phase: pretest and training, posttest) factorial design with phase as a within-participant factor. During the pretest and post-test children designed four comparisons: two for each of two variables. The post-test had one variable in common with the pretest and one new variable. Identical CVS knowledge questionnaires were given during pre-test and post-test. The post-test also included an assessment of domain specific knowledge.

[1] Matlen & Klahr (2012) had previously taught students about CVS which may have contributed to overall high pre-test scores. Additionally, students had recently finished participating in a "science fair" for which their teachers had taught them CVS.

The two test conditions differed only in the type of instruction materials used. In the physical condition, children assembled and tested using wooden mousetrap cars. In the virtual materials condition, children assembled virtual cars by using a computer track pad input device and "clicking" to select car parts. They then tested the virtual cars they assembled by clicking "Test Car" and viewing a dynamic computer simulation of their cars moving across the screen with the finishing distance (in feet) displayed at the top.

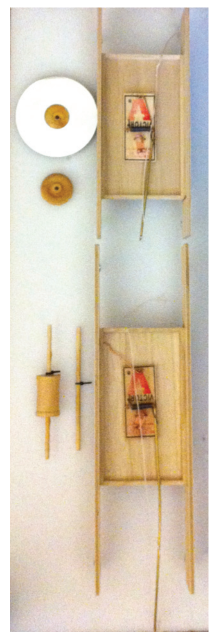
Materials

Physical Mousetrap Cars

Figure 1 shows a fully assembled (short body) wooden mousetrap car and **Figure 2** depicts its disassembled parts. Each mousetrap car has a flat square surface where the mousetrap is attached with a perpendicular rectangular wooden strip running its length on opposite sides. The wooden strips are 18 inches for the long body car and 12 inches for the short body car.

Figure 1

Figure 2



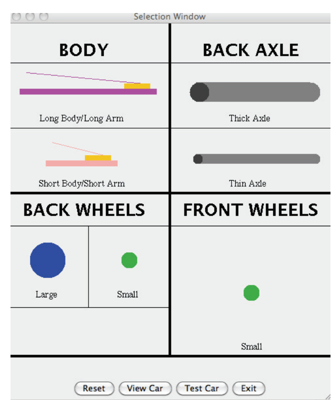
Attached to the 4 downward facing corners of the strips are 4mm metal hook eyes. Two wooden dowels (diameter= 1cm) serving as axle are secured to the car by inserting each through 2 hook eyes. The mousetrap "snapper" consists of only of 1 long metal pole (the "lever arm") attached to the mousetrap spring.

The lever arm is 6 inches for the short body and 12 inches for the long body cars. A string is secured on the end of the lever arm and runs the length of the car so that it may only be wrapped around the axle when the mousetrap is "set" or folded back. The string has a loop at the end and can be secured to the axle by a hook in the center of the axle. The mousetrap moves when the spring-loaded lever arm is released and pulls the string that is wrapped around the axle (generally similar to how a toy "top" is set spinning by pulling on a string which has been wrapped around it).

Virtual Mousetrap Cars

Virtual mousetrap cars were constructed and run using an updated computer program from Triona et al. (2007) to assemble and test mousetrap cars. The program consisted of 3 open windows: one to select the car parts, one to view the car, and one to watch a simulation of the car selected. The car selection window is shown in **Figure 3**. It consists of 4 panels, three of which, corresponding to body length, wheel size, and axel width. Each of these windows contained two options for building the car. The fourth panel was intended to clearly convey the fact that the front wheels of the virtual car were "small" wheels, something that would be readily apparent to students in the physical condition. The virtual car parts available for

Figure 3



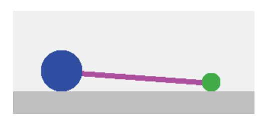
selection corresponded closely with the physical car parts available to students in the physical condition.

Simulator Functionality

Students "assembled" their virtual cars by using the track pad and clicking on the car parts they wished to use. When selected, the background behind the selected part turned bright yellow. Students could change their selections by clicking the alternative option, which would highlight the new selection in yellow and cause the previous selection to return to a blank background. Students could alter their selections an unlimited number of times.

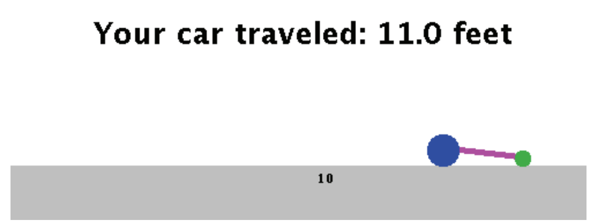
Once students were sure about their choices in the pre-test they clicked either "View Car" (pre-test) or "Test Car" (assessment) on-screen buttons. The View Car button displayed a line-figure of the car using the selected parts, as shown in **Figure 4**. The Test Car button

Figure 4.



opened a simulation window with "Start Simulation" and "Close Window" buttons. The student could then click "Start Simulation" to view the line drawing seen in the View Car window move across the screen at a constant rate then stop. The total distance that the car traveled would then appear over the car in 18-point font as shown in **Figure 5**. The distances displayed ranged from 4.5 to 39 feet depending upon the car that was assembled. All of the virtual cars were calibrated to the actual performance of their physical counterparts. Students in both

Figure 5.



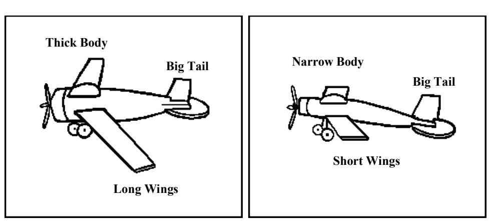
conditions therefore received similar feedback from their designs.

Questionnaires

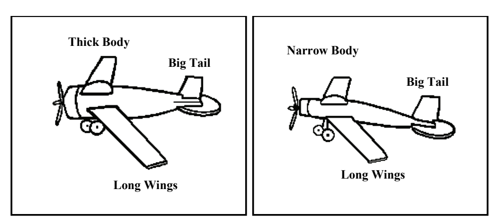
Before and after students assembled their cars they were probed orally about their beliefs and given a knowledge assessment questionnaire. The oral probes assessed their initial beliefs concerning which factors were most important in determining how far a car would travel. The experimenter recorded the answers.

The written pre-test questionnaire assessed Control Variable Strategy (CVS) knowledge. The questionnaire consisted of 5 experiments each set up 3 different ways for a total of 15 experiments. (**Figure 6**) Students were asked to choose whether or not each comparison was set up a good way or bad way. The final two problems involved students choosing from 4 to 5 different experiments for the correct one. Students were given identical questionnaires post-test. Additionally, in the post-test students were asked again to identify which design features would most influence a car's travel distance. They were also asked to rate their confidence on a 5 point scale for each answer given.

Figure 6



Good Test or Bad Test?



Good Test or Bad Test?

Datasheet

In both conditions, children were asked to fill out a data sheet on which they recorded the cars they built and the distances they traveled. The part under test was listed at the top of the datasheet as a reminder. The data sheet was split into two sets of comparisons with two cars documented under each. Children circled the parts they chose for each car then recorded the distances traveled in feet/inches.

See **Appendix A.**

Experimental Procedure

Students were tested in a large quiet room in their school. The experimenter first introduced herself, and then established rapport with the child by asking a few questions about the child's weekend plans. All children were shown a fully assembled mousetrap car and were informed about each part of the car and how the parts could vary (e.g. large vs. small back wheels). The mousetrap car was then "set off" while the experimenter held it so that the children could see how the string rotated the axle. The children were told that they were going to test how far a car travels when different parts are altered and that they'd be doing this by comparing two cars to each other. The experimenter then explained how to keep track of the cars tested and distances traveled on the datasheet. Students were then asked if they needed any further clarification.

The experimenter then asked three oral questions (one question for each of the varying parts: body length, wheels, axel width) to determine the Student's initial beliefs concerning which factors would most influence the distance travelled by a car. The experimenter recorded children's answers on a separate gridded sheet by participant number.

Children were then given the first pre-test questionnaire packet and told to move as quickly and accurately as they could and not to worry if they didn't know an answer. When children reported they had finished the first packet they were told they had two more questions to do before moving on. The experimenter then read the directions on the sheet aloud for the next two problems and gave clarifications when needed.

For the exploration section of the pretest, children were told that they were going to make comparisons to figure out what makes a car move farthest and that for each comparison they'd make two cars. At this point children were told whether they would be using the physical or virtual materials. All children were told to select the parts that they would use to build two cars designed to test to what extent the wheel size makes a difference in how far the car goes. The experimenter then recorded the children's selections on the data sheet.

Children were asked why they chose the car parts they did. The experimenter then set up a hypothetical: "Say I told you this car went further than that car; could you tell for sure from this comparison whether the wheel size made a difference?" Children were then asked to select parts for another pair of cars that they would design to test whether wheel size makes a difference and the same protocol was followed.

The experimental process was repeated to examine whether body length made a difference. It is important to note that during this phase of the experiment children only selected parts and no cars were built or tested. For further clarification see the chart below which provides an outline of the study procedure from Pre-Test to Post-Test. Additionally, it highlights the differences between the two conditions (physical/virtual) at each experimental step.

Pre-Test				
	Initial Beliefs	**Good/Bad Test Packet**	**Choose Correct Experiment**	**Assemble**
Physical	Domain Specific Knowledge (Oral) scored 0-3	5 experiments set up 3 different ways each = scored 0-15	2 experiments set up 1 way each = scored 0-2	Physically Pick the parts for 2 comparisons (8 cars total) for each of 2 variables (Wheel/Body Length) *Do not build or test cars.*
Virtual				Virtually Pick. *Do not build or test cars.*
Direct Instruction				
Physical	Children are given direct instruction about how to design un-confounded experiments using the mouse trap car parts. 3-4 Scenarios are given: Axel Width(ultimately confounded, unconfounded), Body Length(slightly confounded, if answered incorrectly: unconfounded)			
Virtual	Children are given direct instruction about how to design un-confounded experiments using the mouse trap car parts. 3-4 Scenarios are given: Axel Width(ultimately confounded, unconfounded), Body Length(slightly confounded, if answered incorrectly: unconfounded)			
Post-Test				
	Assessment	**Domain Specific Questionnaire**	**Good/Bad Test Packet**	**Choose Correct Experiment**
Physical	Pick the parts for 2 comparisons for each of 2 variables (Wheel/Axel Width) leading to 4 comparisons and 8 total cars. *Build and test cars.*	Domain Specific Assessment: Choose the parts that lead to the car traveling furthest and state confidence.	5 experiments set up 3 different ways each = scored 0-15	2 experiments set up 1 way each = scored 0-2
Virtual	Pick the parts . *Build and test cars.*			

Direct Instruction

Students were informed that they would now learn how to determine which factors makes the most difference in how far a car goes. They were also alerted to the fact that many different parts might matter. The experimenter then selected parts for two cars to test whether axel width made a difference. The first comparison was confounded in 3 ways.

Children were asked the same questions as in the pretest about what they could tell from this comparison. The experimenter then explained control variable strategy:

> "In fact, you could not tell for sure from this comparison whether it was the axel width that made a difference in how far these cars go. And the reason why you can't tell for sure is that these two cars are different in other ways, not just axel width. These two cars also have different lengths of body and different wheel sizes, right? So it may be that one of them goes farther because it has a longer body or because it has smaller wheels. As you can see, if you compare these two cars, you can't tell whether it is the axel width or the length of the body or the wheel size that makes one go farther than the other."

The experimenter then set up a non-confounded experiment and asked the children to explain why it is a good way to find out if axel width makes a difference. The experimented re-iterated why it was a good experiment using similar dialogue as above. The experimenter then set up an experiment to test length of body with one confounds. Children were asked if it was a good choice to find out about long/short body and whether they could tell for sure from the comparison it was the length of the body that made one car go farther. If children answered correctly that it was not a good way to tell and could explain why in terms of control variable strategy then they moved on to the next phase if not the experimenter repeated the above protocol. The experimenter then moved on to the next phase regardless of how the child answered the prompts.

Assessment

Children were then told they were going to make some more comparisons to find out about how wheel size makes a difference and that they would actually be testing the cars after selecting and recording their chosen parts. Children were then given the data sheet and shown where to fill in each cars distance traveled. Children set up two comparisons and recorded how far each car went. They were then asked what they learned about wheel size. The same process was repeated for axel width.

Post-test

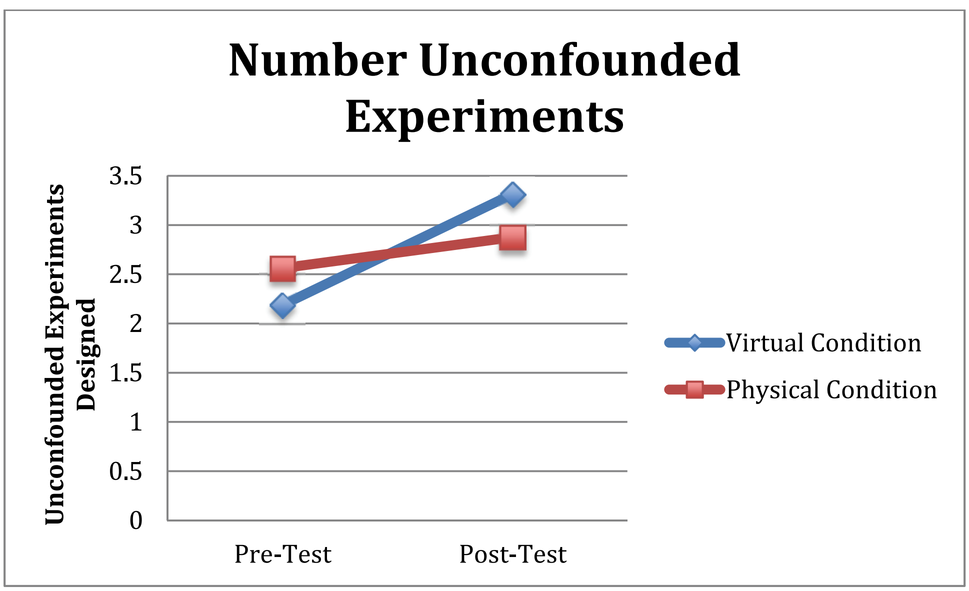
Children were told they would fill out another questionnaire similar to the one they completed at the beginning of the study. In addition to the pre-test questionnaires, they were given a questionnaire about their knowledge of what contributes to how far a car goes with a confidence scale under each question. The experimenter then showed the children the confidence scale and explained how to correctly use it. Off the record, at the end of the study children were allowed to construct their "distance car" using the parts they selected on the questionnaire. However, this was not recorded and they were not able to change their answers after seeing the result.

Results

Our analyses address three possible effects of physical versus virtual instructional materials: (a) learning of CVS, as reflected in questionnaires and experimental design (b) changes in knowledge specific to causal factors for mousetrap cars(c) confidence in conclusions about domain specific knowledge.

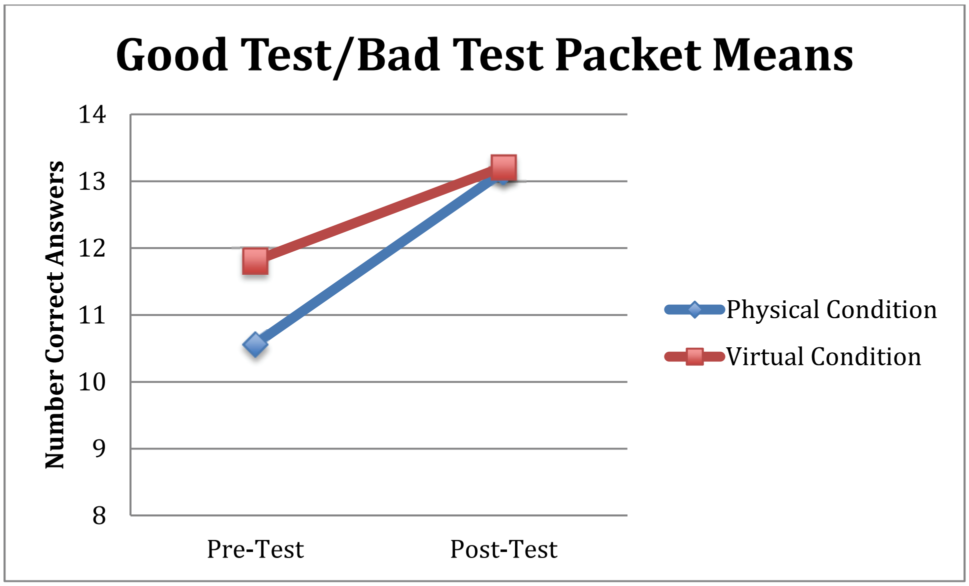
Learning and Transfer of CVS.

Our primary question was whether there was a difference in learning of control variable strategy based on instructional medium when all other variables were held constant. Our first analysis focused on the number of unconfounded experiments students constructed. A 2(training condition) x 2 (phase) ANOVA with phase as a within-participant factor, showed a main effect for phase, F(5.688), p=.024, with no main effect or interaction of condition. The two types of training were equally effective in teaching children how to design unconfounded experiments.



Our second analysis focused on packets assessing CVS knowledge. Each packet had 5 experiments set up 3 different ways for a total of 15 questions. Each question had 2 options (good test or bad test), which were scored in binary, and then a total score was computed.

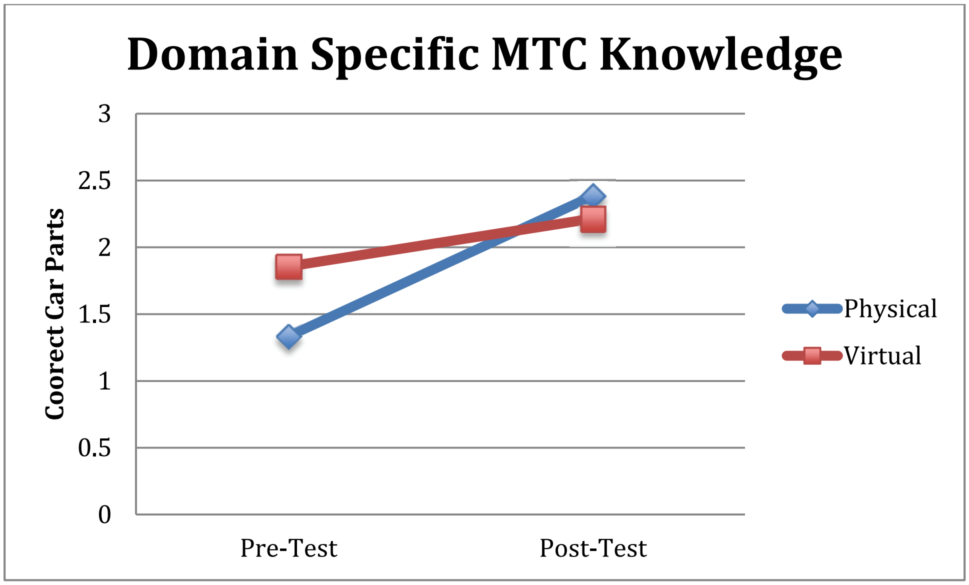
A 2(training condition) x 2 (phase) ANOVA with phase as a within-participant factor, showed a main effect for phase, F(17.9), $p<.001$, with no main effect or interaction of condition. It is worth noting that several students were excluded from this analysis due to not having time to complete the end assessment.



Knowledge about Factors Contributing to Distance Traveled

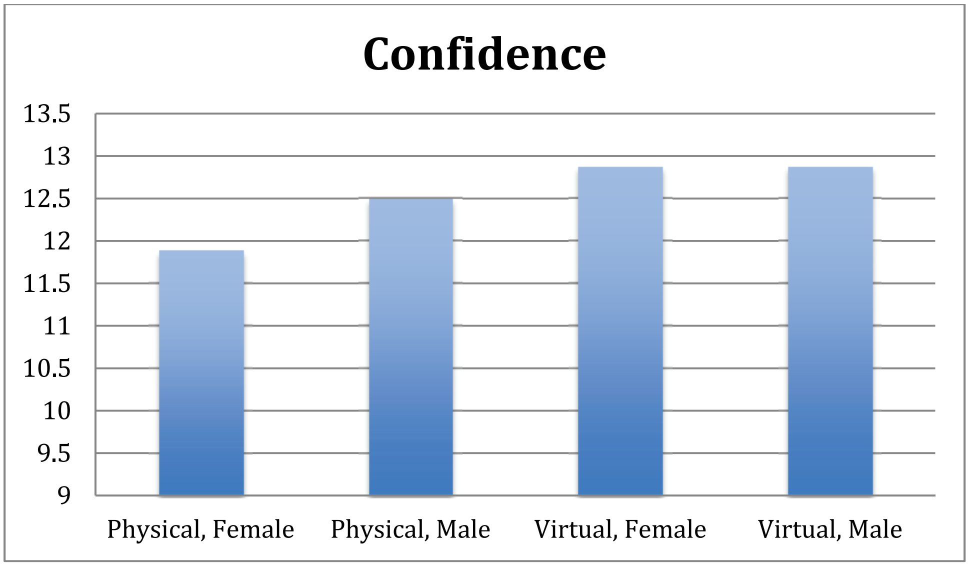
Each child's choice of the "best" value for the causal variables was scored (1) correct if the choice would contribute to the car moving farther than the other variable available and (0) if not. A "doesn't matter" option was presented but no students chose it so for the sake of our analyses it is excluded. The three responses were summed into a "total knowledge" score.

Children's initial knowledge was already very high for both groups. Despite this a 2(phase: pre- or posttest) x 2 (material: physical or virtual) ANOVA on children's test scores showed a main effect for phase, F(10.51), $P<.005$ with no other main effects or interactions. As additional precaution we plotted individual scores and no differences between conditions were readily apparent.



Confidence.

Recall that children were asked to rate their confidence for each question on the domain specific questionnaire about parts that contribute to the car going farthest. No significant differences between condition (physical vs. virtual), between gender, or between gender and condition were found.



In summary these analyses failed to reveal any difference of type of training on children's ability to either correctly execute control variable strategy procedures or identify the correct the car parts associated with a car moving farther.

Discussion

The results of this study suggest that fourth and fifth graders learned to design unconfounded experiments equally well when taught using either virtual or physical materials. Children in both conditions made learning gains in their experimental design performance as well as their domain specific knowledge regarding the factors that most influence car travel distance. Additionally, children in both groups were equally confident in their conclusions, even across gender.

While intuitively one would think physical and virtual interfaces would lead to learning differences these results show that simply replacing physical manipulation with virtual manipulation does not alter the amount of learning when other relevant factors are held constant. This result suggests that computer simulations and virtual labs of this kind should be considered “real” hands-on activities, despite the current prevailing recommendation to the contrary. Additionally, this study provides support for two very influential previous studies.

This study extends the results of two previous studies in this area. First, Klahr et al. (2006), investigated the effect of material in the context of discovery learning—contrasting cells D and H (**Table 1**). Like Triona and Klahr (2003) we investigated the effect of material in the context of direct instruction—contrasting cells A and E (**Table 1**). Second, Triona and Klahr (2003), focused on control variable strategy—a domain general procedure—whereas Klahr et al. (2006) focused on the domain specific acquisition of knowledge about causal factors in mousetrap cars. This study taught both domain general and domain specific knowledge. Third, Triona and Klahr(2003) used 3rd and 4th graders whereas Klahr et al. (2006) used 7th and 8th graders. We used 4th and 5th graders thus closing the gap in the age range which physical and virtual materials have proven equally effective.

Table 1
Space of some potential contrasts in studies of science activities

	Instructional Goal			
	Domain-General Knowledge		Domain-Specific Knowledge	
	Direct Instruction	Discovery Learning	Direct Instruction	Discovery Learning
Hands-on materials				
Physical	A	B	C	D
Virtual	E	F	G	H
Hands-off	I	(J)	K	(L)

Figure depicting the large sample space in this body of literature. (Klahr et al., 2007)

Triona and Klahr (2003), used springs and weights which required relatively little intricate manipulation and were quick to set up. Like our study, Klahr et al. (2007) used mousetrap cars but their older participants likely manipulated materials with more ease than our younger participants. Like these previous two studies we found no virtual—physical effect. This is especially surprising since we used a set of materials that require more manipulation in a younger age group where concrete instantiation may be more important. Additionally, the period in which manipulation was occurring was longer in the physical condition than virtual. The fact that no differences were found supports the conclusions of previous research that virtual manipulation can replace physical manipulation while achieving learning goals.

Interestingly, we found no differences in confidence between males and females whereas Klahr et al., (2006) found significant differences when using mousetrap cars with 7th and 8th graders. It's plausible that this could be due to the different age groups used. Klahr et al., (2006) hypothesized that either gender specificity or ambiguous feedback were responsible for confidence discrepancies since it is well established that girls are less confident than boys about their performance in domains that are stereotypically perceived as male-dominated tasks and in situations having ambiguous feedback. The lack of significant differences in our study using the same "male-type materials" suggests that the latter is the more likely explanation. It is plausible that the direct instruction about CVS used in this study made the task seem less ambiguous than the Klahr et al. (2006) discovery-learning paradigm. Thus it is possible that either age group differences or differences in perceived ambiguity caused the discrepancy between these two studies.

Additionally, the less fine grain methods used in this study may not have been sensitive enough to detect small differences in gender.

Previous studies in this area that have found differences between virtual and physical interfaces have often been using a wider battery of knowledge assessments than used in this study. It is possible that students in the virtual or physical condition learned different pieces of mousetrap car knowledge that was measured by our assessments. For instance the floor that the physical mousetrap cars were tested on was very smooth and occasionally the wheels would "spin out" under the car and the car would not move at all. Students may have picked up domain specific knowledge from such events (for instance about friction) that was not measured on our assessments. A follow-up study using more tangential or harder questions may yield differences between physical and virtual conditions.

This study and its precursors represent only a small part of the experimental space of hands-on-science materials and much work is currently being conducted in new domains within this sample space. Nevertheless this study adds to the solid platform for future work in the physical/virtual domain.

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Appendix A (Page 1 of Data-Sheet Packet)

Data Sheet Participant # _____________

Exploration Part 1 (Wheel Size)

Car 1

Body Length:	**Back Wheels:**	**Axel Width:**	**Distance Traveled:**
Long Body Short Body	Large Wheels Small Wheels	Thin Axle Thick Axle	(Feet, Inches)

Car 2

Body Length:	**Back Wheels:**	**Axel Width:**	**Distance Traveled:**
Long Body Short Body	Large Wheels Small Wheels	Thin Axle Thick Axle	(Feet, Inches)

Car 1

Body Length:	**Back Wheels:**	**Axel Width:**	**Distance Traveled:**
Long Body Short Body	Large Wheels Small Wheels	Thin Axle Thick Axle	(Feet, Inches)

Car 2

Body Length:	**Back Wheels:**	**Axel Width:**	**Distance Traveled:**
Long Body Short Body	Large Wheels Small Wheels	Thin Axle Thick Axle	(Feet, Inches)