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CAN WE IMPROVE PROBLEM SOLVING BY NURTURING CREATIVITY?

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YOUNG REVIEWERS:

B. D. BILLING-HURST MIDDLE SCHOOL

AGES: 13–15

NICOLAS

AGE: 10

Did you ever face a problem you needed to solve? Most of us face such problems daily—for example, finding the shortest route to school, locating the source of a bad smell, fixing a broken home appliance, or settling a disagreement. Problem solving is an essential life skill. Problem solving is also a creative process, and creativity is considered an important life skill, too. In this study, we tested whether we could improve problem solving among teenagers by increasing their creativity using a simple method. We found that we could improve participants' creativity, and that this led to improved problem-solving ability.

PROBLEM SOLVING

Finding correct solutions to challenges, tasks of puzzles.

THE IMPORTANCE OF PROBLEM SOLVING

Problem solving is an important part of our lives. We all solve problems every day. You probably face many problems in school. Some of these problems relate to the stuff you learn, for example, how to complete the assignment the teacher gave you, how to recognize parts of speech in a sentence or properties of a matter, or how to

memorize historical facts. However, you probably face many other types of problems, too—such as how to play with as many of your friends as possible during recess, how to cope with upsetting situations with other students, or how to get home by the shortest route.

In addition, children, teens, and adults face many problems that are *not* related to school—for example, how to fix a broken appliance, how to trace the source of a bad smell, how to settle a disagreement, or how to plan a fun family trip. Overall, problem solving is considered a key life skill that everybody needs to master.

WHAT IS CREATIVITY?

CREATIVITY

A mental skill that helps produce something that is both new and useful.

Creativity is somewhat difficult to define. First, it is important to know that creativity is a skill that can be learned, practiced, and improved. It is not something that you are either born with or not. Scientists know this for sure after decades of studying creativity among various populations. Second, it should be clearly noted that creativity applies to *all* aspects of life and not just to the arts. Many people are creative in what they do, even if they are teachers, mathematicians, mechanics, pediatricians, or programmers. Furthermore, creativity can be shown in everyday activities, like playing (especially when pretending), cooking, or debating a topic with others.

With that in mind, creativity is traditionally defined as producing something that is both *new* and *useful* [1]. Imagine trying to bake a creative cake for a school contest. If your recipe is original (new) but the result is inedible (not useful), then your cake is not creative. On the other hand, if the cake looks or tastes amazing (useful) but the recipe is someone else's (not new), your cake is also not creative. For your cake to be considered creative, it should be both based on an original (new) recipe and it should be edible (useful).

HOW CAN YOU MEASURE CREATIVITY?

Most people can appreciate that something is creative when they see or hear it, but how can we measure just *how creative* something is? This is a critical issue when we want to study creativity and test whether it has changed. One of the common ways to measure creativity is by giving a creativity test, and then calculating a few values to get the results. In the test that we used, called Torrance's Test for Creative Thinking [2], the test page consists of 12 identical empty circles. The person taking the test is asked to draw as many drawings as possible using the circles as part of them, in just a few minutes. So, one circle can be turned into a pizza pie, another circle can be turned into an emoji, and another into a basketball. Furthermore, two circles could be combined to form wheels of a bicycle, and multiple circles could

be connected and turned into a caterpillar. The options are endless (Figure 1).

Figure 1

A filled-up page from Torrance's Test for Creative Thinking, which we used in our study. Participants were given with a sheet of paper that has 12 empty circles, and were asked to draw as many drawings as possible while making use of the circles as an integral part of these drawing. Note that, in more than one case, two circles were used to form a single drawing (glasses and a Google logo). Note also that this participant felt that it was ok to draw outside the original circles (which is indeed ok).

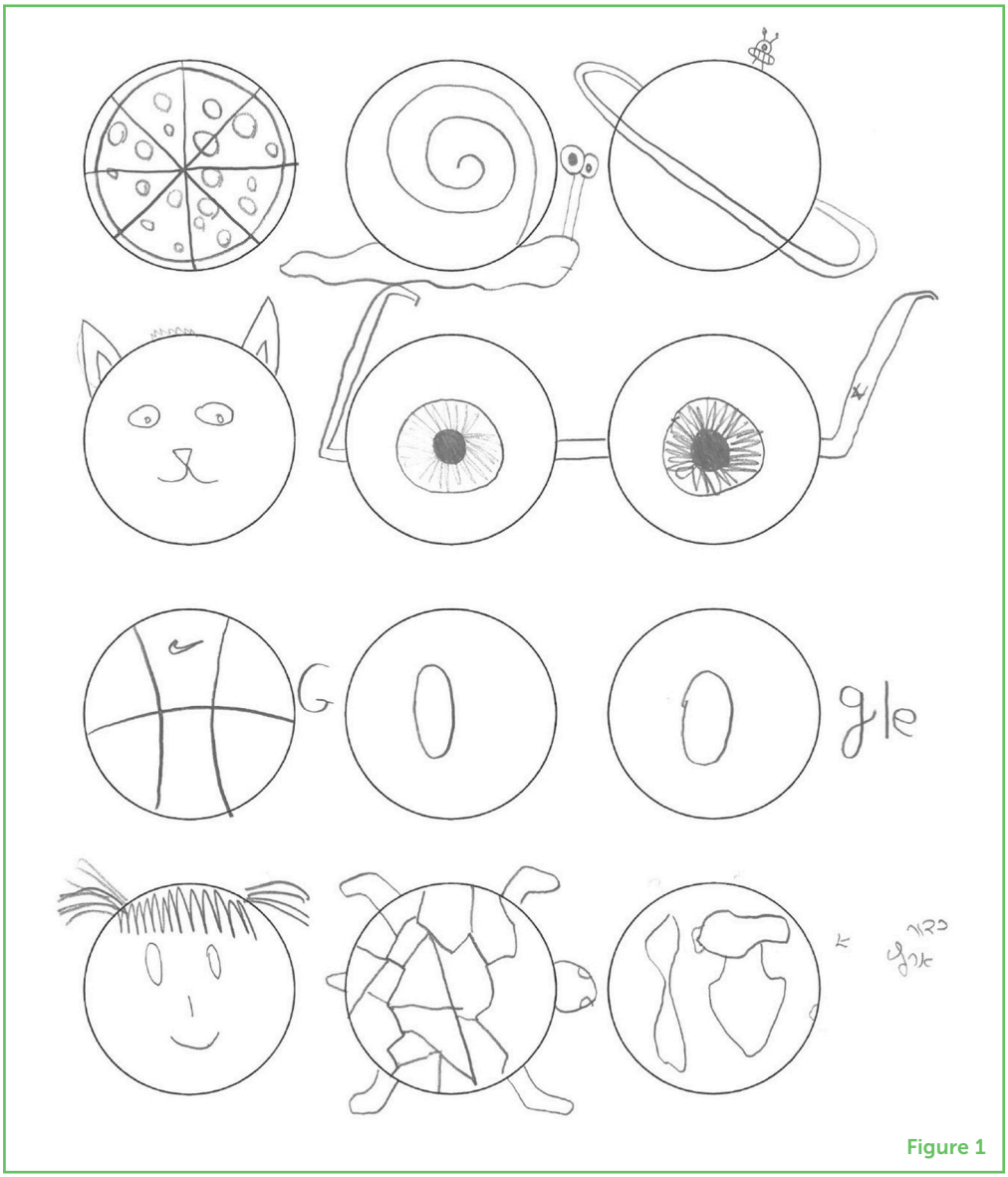

Figure 1

Once the test is finished and the papers are collected, we can calculate various dimensions of creativity. One such dimension is how many drawings the person completed. Another dimension has to do with how many different types of drawings the test-taker drew; for example, a basketball, soccer ball, and tennis ball are different drawings but are of the same type. A third dimension involves how original the drawings are compared to other participants. The final dimension involves how many details were included in the drawings. These dimensions can be easily computed, and they can help researchers assign a numerical value to each test.

HOW DOES CREATIVITY RELATE TO PROBLEM SOLVING?

Creativity has a lot to do with problem solving. In many cases, people demonstrate creativity when they try to solve problems. Recall the example of the cake contest from above—in that case, we could say that the problem was how to win the contest. So, it is probably not surprising that creativity has been suggested as a way to improve problem solving in several areas, for example when learning mathematics, science, foreign language, literature, or history [3].

Also, remember that creativity can be learned, practiced, and improved. This means we can ask whether we can improve creativity in a way that also improves problem solving—and this is exactly the question that we posed in our study.

INSIGHTS FROM OUR STUDY

In our study, we tested teens' creative thinking and problem-solving skills before and after an activity that was aimed at promoting their creativity. This way, we could check whether the creativity training improved their creative thinking and problem-solving skills.

The problem-solving activity was done in an online learning environment. The participants were asked to lead a virtual astronaut through several tasks to get her to her destination. In each task, participants were presented with a path the astronaut should follow and with a pool of blocks that each represent a certain action, like "move forward" or "turn right." The blocks could be dragged and connected like Lego bricks to construct a sequence of actions. For example, if a participant wanted the astronaut to go one step forward and then turn right, they used a "move forward" block connected to a "turn right" block (Figure 2). We tested how well participants solved these problems by measuring the time it took them and the number of tries they needed to complete the tasks. The creative thinking test we gave them was just like the one we described above, with 12 empty circles.

Then, we gave some participants a special activity, called an **intervention**, for nurturing their creativity. This involved one 15-min meeting per week for 10 weeks. In each meeting, we presented the participants with pictures of everyday objects—like a paper cup, ruler, car wheel, basketball, etc.—and for each object, we asked participants to write down as many uses as they could think of (Figure 3). They worked independently, so no one could see or hear what the others wrote, and we recorded their responses anonymously. Once in a few intervention sessions, we shared with them interesting uses that were mentioned by the group. This way, we helped them to practice thinking creatively. We also had a **control group** made up of a group of

INTERVENTION

An action researchers take to test the impact on research participants.

CONTROL GROUP

A control group holds part of a research population who do not get an intervention. Comparing the control group to the other participants helps scientists deduce that the intervention worked.

Figure 2

A task from the online learning environment that we used in our study, and its solution. Participants had to put together steps to guide the astronaut through the path to her destination. We measured how many attempts it took participants until solving this task, how much time did it take then, and how original were their solutions.

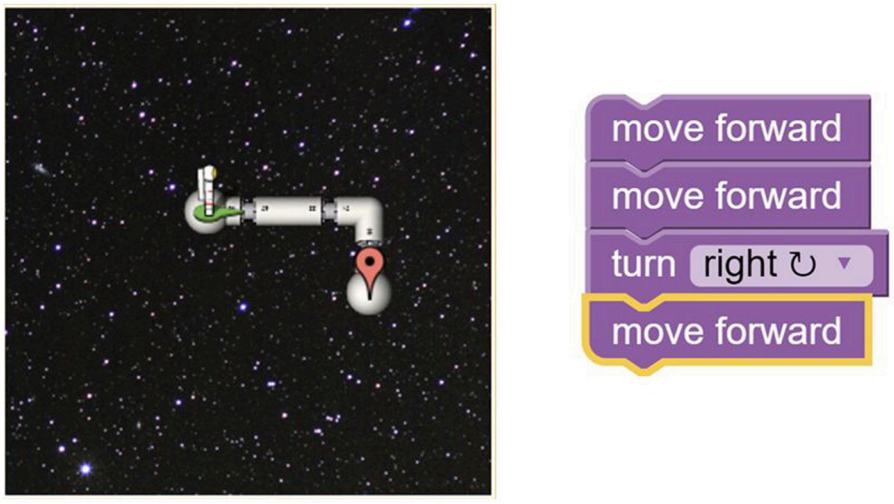

Figure 2

participants that did not take part in this intervention. Using a control group allows to test whether the results of the experiment replicate with no intervention.

Figure 3

During our intervention, we presented the participants with daily objects—one at a time—just like the ones shown here. For each object, participants were asked to write down as many uses as possible. This intervention was shown to improve their creative thinking and problem-solving abilities.

Figure 3

PRE/POST-TESTS

Similar or identical tests that are given to research participants before ("pre") and after ("post") an intervention, to determine the impact of the intervention.

After this intervention, all the participants were given another problem-solving test, this time with different, more difficult tasks, and another creativity drawing test, this time with squares instead of circles.

When we analyzed the data by comparing their performance on the **pre/post-tests**, we observed two fascinating patterns. First, all participants improved in measures of creativity, but those who did

the intervention improved more than those in the control group. Second, everybody improved their problem-solving skills, but those who participated in the intervention improved these skills more than those in the control group.

So, in our study, we were able to improve creativity and, by doing so, we also improved problem solving!

YOU TOO CAN BE MORE CREATIVE AND A BETTER PROBLEM SOLVER!

These findings are promising, especially because our intervention was simple and it could be given by anyone, anywhere, without special equipment or special knowledge. This means that you too can use this intervention to improve your own creativity, or you can help your friends or classmates improve their creativity. Simply think of a daily object you are familiar with, and think of as many possible uses to it. By doing so, you will probably become a better problem solver, which can help you in school and throughout life.

ORIGINAL SOURCE ARTICLE

Israel Fishelson, R., and Hershkovitz, A. 2022. Cultivating creativity improves middle school students' computational thinking skills. *Inter. Learn. Environ*. doi: 10.1080/10494820.2022.2088562

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWERS

B. D. BILLINGHURST MIDDLE SCHOOL, AGES: 13–15

We read this paper online. It was cool to read about how we can practice to be creative. We get together to play video games, this was kind of different but we liked studying science.

NICOLAS, AGE: 10

My name is Nicolas and I am 10 years old. I like technology, programming, science, and listening to music while doing other things.

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Dr. Arnon Hershkovitz is a faculty member at Tel Aviv University's School of Education, in Israel. His research is focused on understanding behaviors of learners while using online learning environments. He does so while analyzing data that is stored automatically and continuously in such environments, and logs every student action. He is passionate about learning, technology, and creativity. Before he became an Education research, he studied Mathematics and Computer Science and worked as a programmer and an algorithm engineer. *arnonhe@tauex.tau.ac.il

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Dr. Rotem Israel-Fishelson is currently a postdoctoral researcher at the College of Education at the University of Maryland. She studies how to teach students Data Science, where data comes from, and how it impacts our lives. Before that, she got her doctorate from Tel- Aviv University in Israel, where she studied the connection between computational thinking and creativity using computer games for kids. She has always been passionate about education, technology, and creativity, which she believes can help students develop better problem-solving skills and think outside the box.