# GEOTRACE: IMPROVING 5-YEAR-OLD CHILDREN'S DRAWING COMPETENCY THRU GEOMETRIC TRACING

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**ABSTRACT**

This action research investigated the effect of GeoTrace, a 3D printed educational tool, as an intervention in improving motor skills and drawing competence in Kindergarten students. The study aimed to assess GeoTrace's effectiveness in enhancing targeted competency on ECCD Competency “Draws a house using Geometric forms”. Participants were five kindergarten learners struggling with the "Draws a house using Geometric forms" competency. The intervention involved sequential stages, beginning with geometric shape tracing using GeoTrace. Subsequently, students transitioned to freehand drawing, practicing on paper. Findings revealed varied success among learners, reflecting the developmental nature of fine motor skills in young children. Grip postures also differed, highlighting the need for explicit instruction in this area. Post-intervention assessments demonstrated significant improvements in drawing competencies. Some students have improved their drawing skills and ability to replicate geometric figures. However, grip posture remained unchanged.

Keywords: *2023, Action Research, Geometry, Kindergarten, Motor Skills*

## I. CONTEXT AND RATIONALE

The development of fine motor skills is an important aspect of child growth and development. In the K-to 12 Program, fine motor skills are emphasized in the domain of *"Kalusugang Pisikal at Pagpapaunlad sa Kakayahang Motor* "(DepEd Curriculum Guide, 2016) and are interconnected with other domains for the holistic development of the child.

As teachers, we concern ourselves with helping kindergarten children develop and mature into more prepared learners for higher levels in the curriculum. Thus, it is important to investigate the developmental gaps and address them as they happen in school. For this project, I reflected on the experiences of preschool pupils at Dalagdag Elementary School as a basis for action and intervention. I examined reports on the least learned experiences of 5-year-old pupils over the years, and I noticed that during the first quarter of the school year, pupils mostly still have difficulties with fine motor skills. Of particular interest to me is the competency on:

"Draws a house using geometric forms."

This competency is assessed using ECCD Checklist Record 2 (for ages 3-5 years old). Children are given a pencil and paper and are tasked to "Draw a house" and are given credit if "the child has drawn at least the roof, main frame, and a door or window" (ECCD). This competency, which is under the "Fine Motor Domain," requires the child to use his concept of a house and illustrate it on paper using his or her grip of a pencil. As teachers, our interest in motor development would be about how well the child uses his hands and fingers to write or draw. However, success in this competency also requires the concept of a house that has a roof, frame, and door or window. In a sense,

a house drawing requires cognition of geometric forms, such as shapes related to or like those of a house, and their use of fine motor skills. Von Sommer's (1984) describes children's drawings as "multi-storied edifices" involving mechanical, motor, and cognitive layers. Thus, it is important to see that competency, while in the fine motor domain, also has a cognitive component.

In reflection, the competency gap observed is a problem in children's zone of proximal development (Vygotsky, 1978). Quite simply, a child cannot develop a competence that has not yet matured in him or her. From a social constructivist perspective, teachers must provide graduated opportunities for students to develop that competence. Hence, a series of scaffolding activities that would address the motor and cognitive aspects of competence would be necessary. But how should this scaffolding be done?

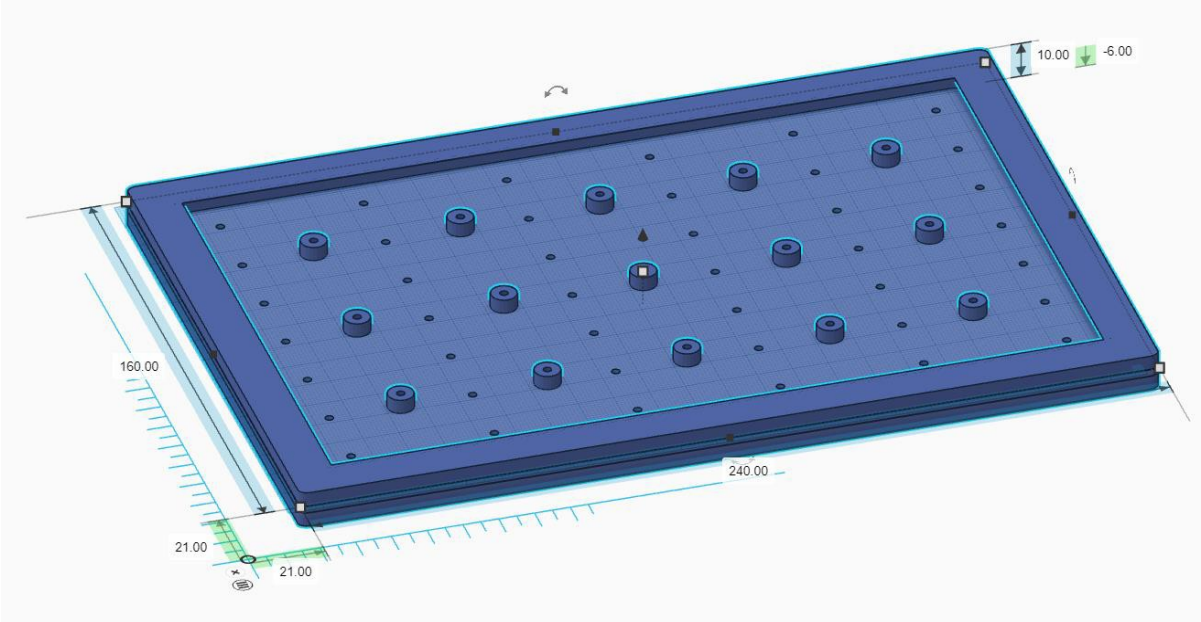
I think this is possible if children are first allowed to "physically touch", trace and copy geometric forms, and connect these real-life structures until they can reproduce them independently. In this manner, students are allowed to use external cues (a real house or a geometric object to the touch) as a means of developing their fine motor skills and then internalizing them (Cohen et al., 2021). At present, our students do most of the tracing (lines, letters, etc.) in worksheets and exercises in self-learning modules (SLMs). These are essential exercises for them to practice while learning at home. However, I also noticed that these activities do not provide a graduated set of experiences that will allow them to internalize an observed external structure, such as a house, into a more abstract and symbolic geometrical form. More so, rather than integrative exercises, the SLMs only provide a singular paper-based copying exercise. There is no "physical touch" associated with the tracing

activity. Maybe there is a need to innovate on existing materials for this purpose. Perhaps a modified Geoboard can be used for physical tracing.

An action research in this context would be helpful to identify ways to improve and help students develop their fine motor skills and early literacy, which could be beneficial for future STEM education. I also think that SLMs should be complemented by physical activities essential to children's motor and cognitive development. This proposed action research will be helpful for teachers when engaging kindergarten students, who for the first time are in school, trying to learn and develop their skills.

## II. INNOVATION, INTERVENTION AND STRATEGY

GeoTrace is a 3D-printed material that combines elements of the traditional geoboard with pencil holes that allow pupils to trace shapes when instructed by the teacher. It is an innovative tool that has the potential to improve the way geometry is taught in schools. Figure 1 below shows the 3D design of GeoTrace.



The intervention using GeoTrace involves students visualizing shapes by using rubber bands or pins and tracing them using the pencil holes. For example, a student might learn about the different types of triangles by tracing different shapes on the GeoTrace.

The material also allows for more personalized learning. Teachers can use GeoTrace to create custom activities that are tailored to the needs of their students. For example, a teacher could create a GeoTrace activity to help students who are struggling with the concept of a triangle or a rectangle.

## III. ACTION RESEARCH QUESTIONS

This study aimed to answer the following research questions:

a. How would Geometric Tracing (GeoTrace) help improve the motor skills and drawing competence of 5-year-old kindergarten students?

b. Did the learners' motor skills and drawing competence improved after using the innovative tools?

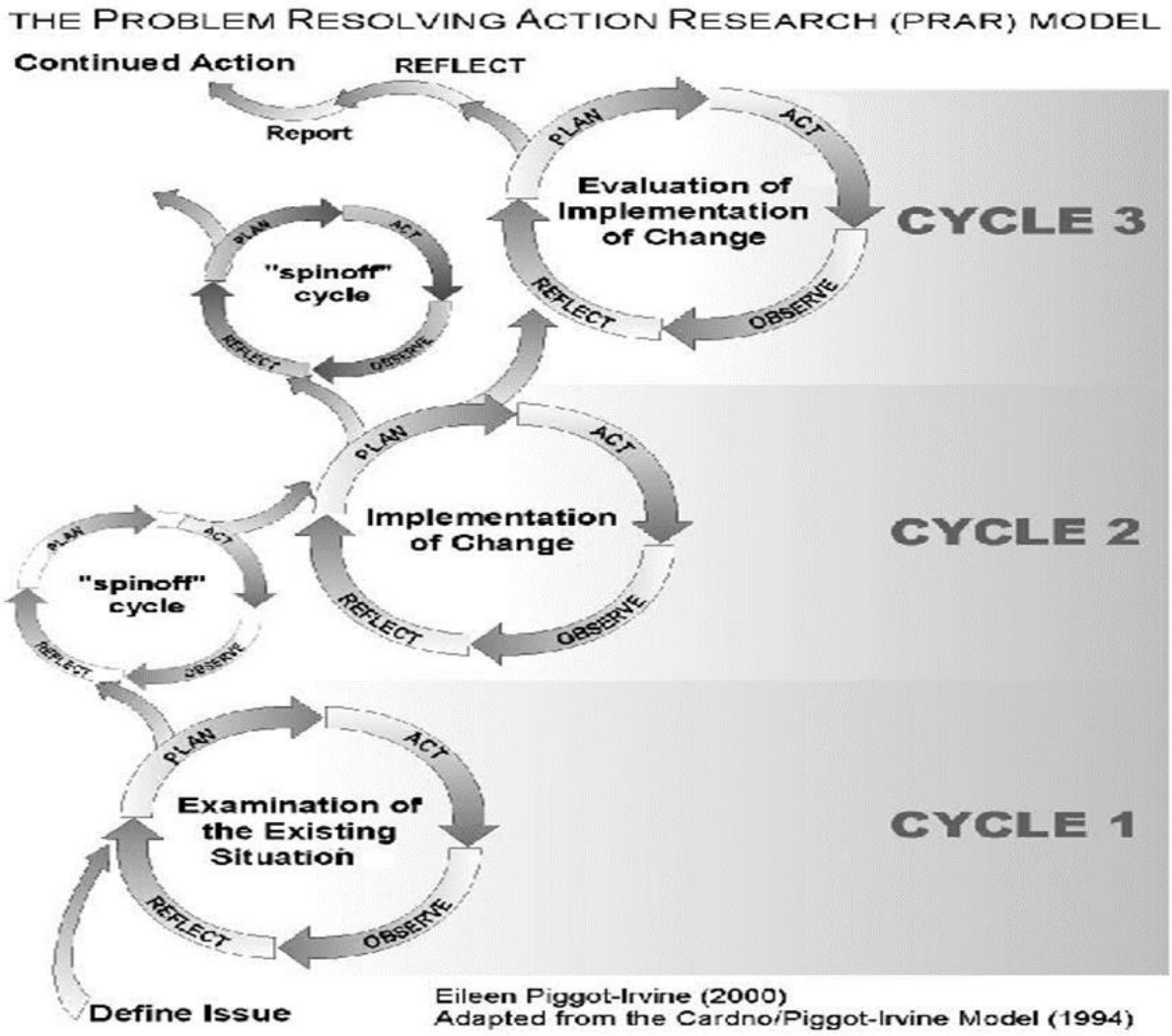
## IV. ACTION RESEARCH METHODS

### Research Design

The study is action research aimed at improving the competence of children in drawing geometric figures as part of their fine motor development. As a practitioner-researcher, I aim to determine whether geometric tracing or as I name it "GeoTrace", helped develop the competence of children identified and improved teachers' practice.

The action research design for this study is the Problem Resolving Action Research (PRAR) model. This model is a spiraling process of planning, acting, observing, and reflecting.

Figure 3. The PRAR Model




**Participants**

The participants in this study were five five-year-old pupils who have been identified to have difficulties with the ECCD Competency "Draws a house using Geometric forms". These participants were enrolled in their Kindergarten and were assessed to have not mastered the competency during the first quarter.

**Research Instrument**

In order to assess the development of their fine motor skills, I used the ECCD Checklist Record Book 2 for five-year-old children. But I also included my version of a Geo-Trace Assessment Tool that will cover tracing and drawing competence.

**Data Gathering Methods**

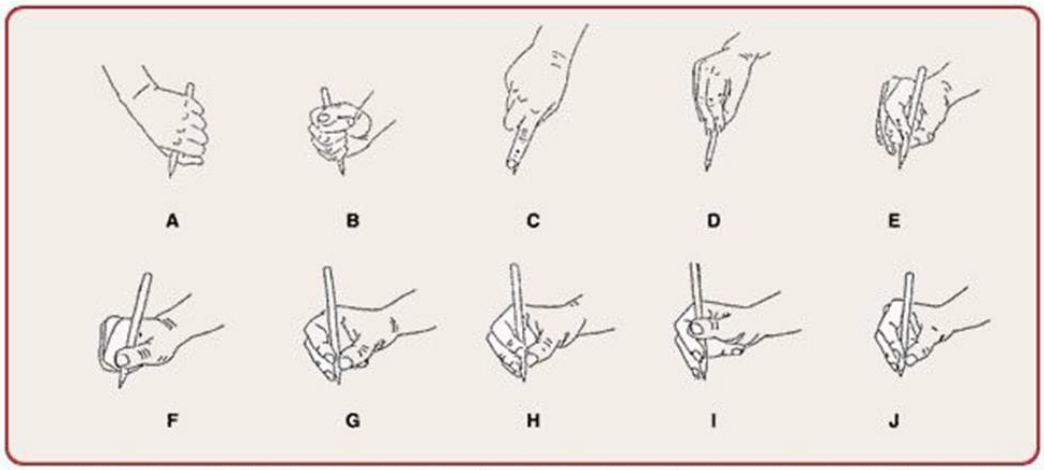
*a. Consent of Participants*

Before doing the study, I sought permission from my school head and district heads and the consent of the parents for conducting the investigation. The data from each of the target students was recorded and analyzed.

*b. The Baseline Assessment*

The baseline assessment included the use of ECCD Checklist Record 2 and my own Geo-Trace Assessment. The results from these assessments served as the baseline data for ascertaining improvement in the drawing competence and fine motor skills of the student. This assessment also included observing pencil-grip posture to determine whether they have mature posture or not. Kavak & Bumin (2009) have identified the grip postures as shown in Figure 1 below. Postures E to J are considered mature postures.

Figure 1. Pencil Grip Postures (Kavak & Bumin, 2009)




A = radial cross palmar grasp; B = palmar supinate grasp; C = digital pronate grasp, only index finger extended; D = brush grasp, E = grasp with extended fingers; F = cross thumb grasp; G = static tripod grasp; H = four fingers grasp; I = lateral tripod grasp; J = dynamic tripod grasp.

*c. The Intervention*

The intervention was done in a graduated sequence. First, the learners were tasked with tracing figures using the GeoTrace board. The learners were asked to recall the following and to use a rubber band to illustrate a triangle and a square or rectangle..

Students were then asked to reverse the board and trace the figures they have just illustrated. Students were given 10 minutes to practice the given shapes, after which they had some free time to play with the equipment.

Students practiced using the geo-trace board for three days. In the practice, they were tasked with making a house in any shape they liked. The learners were asked to trace an arrangement of dots and edges of pictures of real-life objects on paper.

In the third part of the intervention, students were asked to draw objects they had observed in school or at home on paper. At this stage, the observations focused on the use of shapes learned by the student. The intervention procedures were repeated, as needed, for students who hadn't yet mastered the competency.

**a. Data Analysis Plan**

The analysis was made based on improvements made to the baseline data. The analysis also included how quickly each participant had mastered the competency. The notable differences in the pencil grip were noted and considered.

## V. DISCUSSION OF RESULTS AND REFLECTION

### The Baseline Assessment

Table 1 shows the baseline assessment results of the 5 participants with the ECCD competency "Draws a house using geometric forms".

Table 1. Pre-intervention assessment results of the drawing task

| Learner Code | Successful drawing? | Geometric shapes drawn | Observed Pencil Grip Posture |
|---|---|---|---|
| 1 | No | Lines (Straight) | Grasps with extended fingers |
| 2 | No | Lines (Crooked) | Brush Grasp |
| 3 | Yes, but shapes are not discernible | Hardly discernible outline of a house | Grasps with extended fingers |
| 4 | Did not finish task (Cried) | N.A. | Brush Grasp |
| 5 | No | Lines (Crooked) | Grasps with extended fingers |

The results show that the learners had varying degrees of success in drawing geometric shapes. Some learners were able to successfully draw shapes, while others were not. Proficiency with drawings is only possible if the various motor processes involved in drawing have reached a functional level (Laszlo & Broderick, 1985). This explains the learners' varying degrees of success in drawing geometric shapes, as they are still developing their fine motor skills. It also indicates that the learners needed more instruction and practice on how to draw geometric shapes.

The observed grip posture of the learners is also noteworthy, as learners

demonstrate developing and mature postures. Learners 1, 3, and 5 used a grasp with extended fingers. This type of grasp is appropriate for drawing, as it allows for greater control over the pencil. Learners 2 and 3 used a brush grasp, which is not as appropriate for drawing as it can make it difficult to control the pencil.

**After Intervention Assessment**

Table 2 shows the after-intervention assessment results of the 5 participants with the ECCD competency "Draws a house using geometric forms".

Table 2. Pre-intervention assessment results of the drawing task

| Learner Code | Successful drawing? | Geometric shapes drawn | Observed Pencil Grip Posture |
|---|---|---|---|
| 1 | Yes | House with Triangle and Rectangle (dots being connected) | Grasps with extended fingers |
| 2 | Yes | House (Pentagon) | Brush Grasp |
| 3 | Yes | House with Triangle and Rectangle | Grasps with extended fingers |
| 4 | Yes | House with Triangle and Rectangle (crooked) | Brush Grasp |
| 5 | Yes | House with Triangle and Rectangle | Grasps with extended fingers |

The post-intervention assessment results show that the learners have successfully completed drawings of a house with geometric figures. This is a marked improvement from the baseline assessment. However, drawing skills still vary. Learner 1 has gotten used to connecting dots, an effect presumably derived from experience with tracing from GeoTrace. Learner 2 was unable to

use other geometric figures and provided only an outline of the drawing..

There is no notable change in the pencil grip postures. This is probably because the intervention did not explicitly focus on developing this skill. In reflection, addressing pencil grip posture could have been a crucial aspect of the study, as research suggests that more mature grips are associated with stability and efficiency in writing and drawing (Schneck & Henderson, 1990; Selin, 2003). Inefficient grips, on the other hand, can also lead to stress and variations in both writing and drawing outcomes (Burt & Benbow, 2007).

**Reflection**

In reflection, GeoTrace has provided opportunities for learners to improve their drawing skills and recognition of simple geometric shapes, but its effectiveness also depends on the activity that it is designed for. The study has shown that it can be used effectively to improve drawing skills, but it has also shown that it does not have any effect on grip posture. This I attribute to the intervention activities implemented.

## VI. ACTION PLAN

Based on the results, the following action plan is recommended:

a. Teachers can continue to provide explicit instruction on how to draw different types of shapes and objects. They can also encourage learners to practice drawing different types of shapes and objects. Teachers can provide learners with feedback on their drawings and help them identify areas where they can improve.
b. Teachers can use a variety of teaching activities to help learners practice drawing different shapes and objects. Teachers can use

GeoTrace as a tool to help learners learn about geometric shapes and improve their drawing skills.

c. There is also a need to observe the learners' pencil grip postures and identify any learners who are using a grasp that is not appropriate for drawing. Learners may also benefit from explicit instruction and practice on how to use a grasp with extended fingers.

d. There is also a need to work with parents or caregivers to develop activities that are attuned to the use of GeoTrace in teaching early geometric ideas and concepts.

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