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Individual Learning Gains and Practical Effect of Cooking Class-Based Learning on Fine Motor Development in Early Childhood

Nur Indah Sari[1*], Rahmawati Jamil Hasibuan[2]
[1]Department of Early Childhood Teacher Education, Universitas Negeri Medan, Indonesia
[2]Department of Law, Universitas Terbuka, Indonesia
[*]Corresponding author, email: nurindahsari944@gmail.com

Abstract— Fine motor development in early childhood requires meaningful, hands-on, and developmentally appropriate learning experiences. Cooking activities provide children with opportunities to perform coordinated hand and finger movements while engaging in contextual learning. However, group average scores alone may not fully describe how individual children respond to a learning intervention. This study aimed to analyze individual learning gains and the practical effect of cooking class-based learning on fine motor development among children aged 5–6 years. A quantitative quasi-experimental approach with a pretest-posttest control group was employed involving 40 children at RA Baitul Ibadah, Binjai Barat, consisting of 20 children in an experimental group and 20 children in a control group. Data were collected using an observation instrument assessing children's fine motor performance and analyzed using absolute learning gain, normalized gain, standardized effect size, and probability of superiority. The experimental group increased from a mean pretest score of 23.80 to a posttest score of 37.55, producing a mean gain of 13.75 points. The control group increased from 19.30 to 26.75, producing a mean gain of 7.45 points. The difference in mean gain between groups was 6.30 points. The standardized effect size was approximately 1.68 based on Hedges' g, indicating a large practical effect. Furthermore, 90% of children in the experimental group achieved at least a moderate normalized gain, compared with 45% in the control group. These findings indicate that structured cooking class activities provide a substantial practical advantage for fine motor development. Cooking activities can therefore be integrated into early childhood learning as an experiential strategy for stimulating children's fine motor abilities while maintaining appropriate safety supervision.

Keywords: cooking class, fine motor skills, early childhood, learning gains, effect size

1. Introduction

Early childhood is an important period for the development of various abilities, including physical, cognitive, language, social, emotional, and motor development. Fine motor skills are particularly important because they involve controlled movements of the hands and fingers that children use in writing, drawing, coloring, arranging objects, manipulating materials, and performing daily activities. Adequate fine motor development can support children's independence and readiness to participate in subsequent educational activities.

Fine motor stimulation in early childhood education should provide children with opportunities to perform meaningful and varied movements. Learning activities that involve direct manipulation of objects can

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provide richer learning experiences because children are actively engaged in performing actions and understanding the purpose of those actions. The importance of learning through meaningful activity is consistent with the broader concept of learning with understanding, in which learning is not merely the acquisition of isolated skills but involves connecting activities with meaningful knowledge and experiences [1], [2], [3].

In learning activities, children may demonstrate different levels of understanding and performance even when they receive the same learning experience. Therefore, learning should provide opportunities for children to actively engage with objects, actions, and representations. The use of concrete activities and opportunities to explain or demonstrate actions can support the development of understanding and active participation [4], [5]. In early childhood settings, such principles can be adapted into developmentally appropriate hands-on activities that simultaneously provide opportunities for motor practice.

Cooking class is one activity that can provide these opportunities. Cooking class allows children to participate directly in preparing simple food products through a sequence of activities. Depending on the type of food being prepared, children can peel, cut, arrange, roll, pour, mix, insert, and decorate ingredients. These activities require coordination, precision, and controlled hand movements.

Previous research by Sari and Hasibuan demonstrated that cooking class activities can improve fine motor development in early childhood and emphasized the importance of implementing such activities within a safe educational environment [6]. Similarly, an analysis based on normalized gain scores found that cooking class learning produced measurable improvement in children's fine motor development [7]. Sari also developed a cooking class learning model designed to stimulate fine motor skills through structured learning activities [8]. Research involving children aged 5–6 years at RA Baitul Ibadah further demonstrated differences in fine motor development following cooking class-based learning [9].

Another advantage of cooking class is that fine motor stimulation takes place within a meaningful learning context. Children do not perform movements merely as isolated exercises but use their movements to accomplish a concrete task and produce a recognizable result. This characteristic can encourage active participation and provide children with opportunities to connect actions, objects, and learning objectives. The importance of connecting different forms of information and representations has also been emphasized in research on teaching practices [10]. In addition, the way teachers name, explain, and guide learning activities can influence how learners engage with the learning process [11].

The effectiveness of a learning activity is therefore not determined solely by the activity itself but also by how the teacher organizes and guides the learning process. Research on professional development and teaching practices emphasizes the importance of teachers' productive handling of learning tasks and instructional situations [12]. Similarly, the design of learning activities and their specific components can influence the effectiveness of the learning experience [13]. Although these studies were conducted in mathematics education contexts, their broader instructional implication is relevant to the present study: learning activities need to be deliberately structured, guided, and connected to meaningful learner engagement.

The cooking class activities implemented in this study consisted of four different food preparation activities. The children participated in making jasuke, making rolled bread, making banana kolak, and making fruit satay. Although the activities involved different ingredients and procedures, all activities required children to perform various forms of hand and finger manipulation.

The fine motor development of children was assessed using five indicators. These indicators included the ability to use writing tools, move writing tools, move the hand according to the direction of writing, copy letters, and connect dots. Each indicator was assessed using observable performance criteria with a four-point scoring scale. The relationship between learning experiences and children's development can also be understood from the perspective of teacher-guided learning. Previous research has shown that professional learning and teacher practices can influence students' learning outcomes, particularly when teachers provide appropriate instructional support [14]. In the present study, the teacher's role was therefore not limited to supervising children but also included providing explanations, demonstrations, guidance, and opportunities for children to perform activities independently.

The learning process was designed around concrete experiences rather than isolated repetition of motor movements. This approach is consistent with the broader principle that meaningful learning develops when learners can connect actions and experiences with concepts and purposes [15]. Although Hiebert and Carpenter's framework was developed in mathematics education, the principle of learning with understanding provides a useful conceptual basis for viewing hands-on learning as more than repetitive skill practice.

Previous analysis of the same research data demonstrated that the experimental group obtained a substantially higher normalized gain than the control group. However, mean normalized gain alone does not fully describe the distribution of individual responses. Two groups may have similar average gains while showing substantially different patterns among individual children. Therefore, examining individual learning gains can provide additional information about the consistency and magnitude of children's improvement.

In addition, statistical significance alone does not necessarily indicate the practical importance of an educational intervention. An intervention may produce a statistically significant difference while having only a small practical effect. Conversely, a relatively large practical difference may be educationally important even when the sample size limits statistical power. Therefore, effect-size analysis is useful for interpreting the magnitude of differences between groups.

The present study therefore provides a complementary analytical perspective by focusing on individual learning gains and practical effect size. The analysis examines absolute score changes, normalized gain categories, standardized effect size, and probability of superiority. This approach provides a broader interpretation of the effectiveness of cooking class-based learning beyond comparison of group mean scores alone.

The objective of this study was to analyze individual learning gains and determine the practical effect of structured cooking class-based learning on fine motor development among children aged 5–6 years at RA Baitul Ibadah, Binjai Barat.

2. Method

This study used a quantitative quasi-experimental approach with a pretest-posttest control group design. The study involved 40 children aged 5–6 years at RA Baitul Ibadah, Binjai Barat. The participants were divided into an experimental group consisting of 20 children and a control group consisting of 20 children.

The experimental group received cooking class-based learning, while the control group participated in regular learning activities. Fine motor development was measured before and after the learning process using the same observation instrument. The intervention was structured as a sequence of teacher-guided activities, with explanations, demonstrations, practical activities, and reflection. Such structured instructional design is consistent with evidence emphasizing the importance of deliberate teaching practices and appropriate task organization in supporting learning [12], [13].

The fine motor observation instrument consisted of five main indicators covering children's ability to use writing tools, move writing tools, move their hands according to the direction of writing, copy letters, and connect dots. Each indicator contained observable descriptors. The scoring scale consisted of four levels.

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Score 1 represented a child who was not yet able to perform the activity, score 2 represented a child who could perform the activity with teacher assistance, score 3 represented a child who could perform the activity correctly, and score 4 represented a child who could perform the activity correctly and neatly.

The selection and implementation of observable performance indicators were intended to capture children's actual performance during learning activities rather than relying solely on verbal responses. This approach is compatible with the broader perspective that learning performance can involve connections between actions, representations, and understanding [3], [4]. In the context of the present study, these principles were adapted to the observation of children's fine motor performance.

The cooking class intervention consisted of four activities. The first activity was making jasuke, involving corn, milk, and cheese. The children participated in preparing and manipulating the ingredients. The second activity was making rolled bread using bread, banana, chocolate, cheese, and other toppings. Children participated in peeling, cutting, arranging, rolling, and decorating.

The third activity was making banana kolak. The children participated in preparing the banana and other ingredients, while the cooking process involving heat was conducted with teacher supervision. The fourth activity was making fruit satay using several types of fruit. Children participated in washing, peeling, cutting, arranging, inserting, and decorating the fruit.

These activities were selected because they provided repeated opportunities for children to manipulate objects through different forms of hand and finger movement. Previous studies specifically examining cooking class learning have reported improvements in fine motor development and have demonstrated the potential of cooking activities as a learning strategy for young children [6]–[9]. The present study extends this line of research by examining individual learning gains and practical effect magnitude.

Each cooking activity was incorporated into the daily learning process. The activities included an introduction, explanation of the topic, discussion of the ingredients, explanation of safety rules, practical activities, recalling, and reflection. The learning process was designed so that children could participate actively while receiving appropriate guidance from the teacher.

The teacher provided instructions and demonstrations before children performed the activities. During the practical stage, the teacher provided assistance when necessary while allowing children to perform the tasks independently whenever possible. This structure was intended to maintain children's active participation while providing appropriate instructional support. Research on teaching practices has emphasized the role of teacher guidance, explanation, and instructional organization in supporting meaningful learner engagement [10]–[14].

The analysis focused on individual improvement between pretest and posttest. Absolute learning gain was calculated by subtracting the pretest score from the posttest score. The calculation is presented in Equation (1).

$$Gi = X_{post,i} - X_{pre,i} \tag{1}$$

where Gi represents the absolute gain of participant i, $X_{post,i}$ represents the posttest score, and $X_{pre,i}$ represents the pretest score.

Normalized gain was then calculated to determine the proportion of possible improvement achieved by each participant. The calculation is presented in Equation (2).

$$gi = \frac{X_{post,i} - X_{pre,i}}{X_{max,i} - X_{pre,i}} \tag{2}$$

where gi represents the normalized gain, X_{max} represents the maximum possible score, and $X_{pre,i}$ and $X_{post,i}$ represent the participant's pretest and posttest scores.

The normalized gain was interpreted according to the percentage categories used in the research data. Values below 30% were categorized as low, values from 30% to 70% were categorized as moderate, and values above 70% were categorized as high.

The practical magnitude of the difference between groups was evaluated using standardized effect size. Cohen's d was calculated using Equation (3).

$$d = \frac{\bar{G}_E - \bar{G}_C}{S_P} \tag{3}$$

where $\overline{G}_E$ represents the mean gain of the experimental group, $\overline{G}_C$ represents the mean gain of the control group, and S_P represents the pooled standard deviation.

Because the study involved a relatively small number of participants, the small-sample-adjusted Hedges' g was also considered when interpreting the magnitude of the effect. Probability of superiority was used as an additional practical interpretation of the difference between groups.

3. Results and Discussion

The comparison of pretest and posttest scores provides an initial overview of changes in children's fine motor development. The descriptive results of both groups are presented in Table 1.

Table 1. Comparison of Fine Motor Scores Before and After Learning

Group	n	Pretest Mean	Posttest Mean	Mean Gain
Experimental	20	23.8	37.55	13.75
Control	20	19.3	26.75	7.45

As shown in Table 1, the experimental group increased from a mean pretest score of 23.80 to a mean posttest score of 37.55. The resulting mean gain was 13.75 points. The control group increased from 19.30 to 26.75, resulting in a mean gain of 7.45 points.

The difference between the mean gains was 6.30 points. Thus, the increase observed in the experimental group was substantially greater than the increase observed in the control group.

The difference in improvement is consistent with the characteristics of the cooking class activities. Children in the experimental group were directly involved in manipulating ingredients and simple cooking materials. The activities required different combinations of hand and finger movements, including grasping, peeling, cutting, arranging, rolling, pouring, inserting, and decorating.

The individual absolute gains were subsequently examined to determine whether the improvement occurred consistently among participants. The distribution of individual gains is presented in Table 2.

Table 2. Distribution of Individual Absolute Learning Gains

Indicator	Experimental	Control
Participants	20	20
Participants with increased scores	20 (100%)	20 (100%)
Minimum gain	2	3
Maximum gain	20	14

Indicator	Experimental	Control
Mean gain	13.75	7.45

Table 2 shows that all children in both groups experienced an increase between pretest and posttest. Nevertheless, the maximum gain in the experimental group was considerably higher. The experimental group recorded a maximum gain of 20 points, whereas the maximum gain in the control group was 14 points.

The experimental data also demonstrate substantial individual variation. The smallest gain was 2 points, while the largest gain was 20 points. This indicates that the cooking class intervention did not produce identical changes among all children.

Such individual variation is expected in early childhood learning because children enter the learning process with different levels of initial ability and different experiences in performing fine motor activities. Nevertheless, the fact that all children in the experimental group showed improvement indicates that the learning activity provided opportunities for positive motor development across participants.

The normalized gain analysis provides a relative measure of improvement by considering the initial score of each child. The distribution of normalized gain categories is presented in Table 3.

Table 3. Distribution of Children According to Normalized Gain Category

N-Gain Category	Experimental	Control
Low	2 (10%)	11 (55%)
Moderate	13 (65%)	9 (45%)
High	5 (25%)	0 (0%)
Total	20 (100%)	20 (100%)

As presented in Table 3, the experimental group showed a more favorable distribution of normalized gain. Thirteen children, representing 65% of the experimental group, achieved moderate gain, while five children, representing 25%, achieved high gain. Only two children, or 10%, were categorized as having low gain.

In contrast, 55% of children in the control group were categorized as having low gain, and 45% achieved moderate gain. None of the children in the control group reached the high-gain category.

Consequently, 90% of the children in the experimental group achieved at least moderate normalized improvement, compared with 45% in the control group. The difference of 45 percentage points indicates that cooking class-based learning was associated with a more favorable distribution of individual improvement.

The research data also showed an average normalized gain of 66.35% for the experimental group and 29.16% for the control group. The individual distribution in Table 3 helps explain this difference. The higher average in the experimental group was accompanied by a greater proportion of children achieving moderate and high levels of improvement.

The practical magnitude of the difference between groups was further examined through standardized effect size. The results are presented in Table 4.

Table 4. Practical Effect of Cooking Class-Based Learning

Measure	Result
Mean gain, experimental	13.75

Measure	Result
Mean gain, control	7.45
Difference in mean gain	6.3
Cohen's (d)	1.72
Hedges' (g)	1.68
Probability of superiority	0.895

As shown in Table 4, the difference in mean gain between the two groups was 6.30 points. The standardized effect size produced a Cohen's d of approximately 1.72 and a Hedges' g of approximately 1.68. The magnitude indicates a large practical difference between the two learning conditions.

The Hedges' g value remains large after adjustment for the relatively small sample size. This indicates that the difference in improvement between the experimental and control groups was substantial relative to the variability of the gain scores.

The probability of superiority was approximately 0.895. This result provides an intuitive interpretation of the effect: a randomly selected child from the experimental group had approximately an 89.5% probability of showing a greater learning gain than a randomly selected child from the control group.

The large practical effect can be related to the direct and repetitive nature of the cooking activities. Fine motor development requires opportunities for children to practice controlled movements. Cooking activities naturally provide repeated opportunities for children to manipulate objects while completing meaningful tasks.

For example, making fruit satay requires children to handle different fruits, position them, and insert them onto skewers. Making rolled bread requires children to manipulate bread and filling materials and perform a rolling movement. Making jasuke requires children to handle ingredients and arrange toppings. These different activities provide varied opportunities for hand-eye coordination and controlled finger movements.

The activities also provide immediate and concrete outcomes. Children can see the food product they have helped prepare. This may increase their motivation to participate and encourage them to complete the sequence of activities.

The results also have practical implications for early childhood teachers. Cooking class does not need to be treated exclusively as a food-related activity. When appropriately designed, it can function as an integrated learning activity that combines motor stimulation with language, social interaction, health, hygiene, creativity, and simple problem-solving.

However, the implementation of cooking activities should be adapted to children's age and abilities. Activities involving knives, hot surfaces, boiling liquids, or cooking equipment must be conducted under direct adult supervision. Children should be given safe tasks that allow them to manipulate materials without exposing them to unnecessary hazards.

Another important implication is the need to consider individual children's progress. Although the experimental group demonstrated a strong overall improvement, the individual gain scores varied considerably. Teachers can use individual observations to identify children who require additional assistance, repeated practice, or modified tasks.

The results therefore suggest that evaluation of early childhood learning interventions can benefit from combining group-level and individual-level analyses. Mean scores describe the overall direction of change, normalized gain describes relative improvement, and effect size describes the practical magnitude of the difference. Together, these measures provide a more complete interpretation of the learning outcomes.

4. Conclusion

This study examined individual learning gains and the practical effect of cooking class-based learning on fine motor development among children aged 5–6 years at RA Baitul Ibadah, Binjai Barat.

The experimental group demonstrated greater improvement than the control group. The mean score of the experimental group increased from 23.80 to 37.55, resulting in a mean gain of 13.75 points. The control group increased from 19.30 to 26.75, resulting in a mean gain of 7.45 points. The difference in mean gain between the two groups was therefore 6.30 points.

The individual analysis showed that all children in both groups experienced improvement. However, the experimental group demonstrated a higher maximum gain and a more favorable distribution of normalized gain. Ninety percent of children in the experimental group achieved at least moderate normalized gain, compared with 45% in the control group.

The standardized analysis produced a Hedges' g of approximately 1.68, indicating a large practical effect. The probability of superiority of approximately 0.895 further indicates a strong practical advantage for children who participated in cooking class-based learning.

The findings demonstrate that structured cooking activities can provide meaningful opportunities for fine motor stimulation in early childhood. The main contribution of this study is the demonstration of the intervention's practical magnitude not only through group averages but also through individual learning gains and the distribution of children's responses.

Cooking class can therefore be considered a useful experiential learning strategy for early childhood education, particularly when activities are structured according to children's developmental abilities and implemented with appropriate safety supervision.

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