

# فعالية نظام التواصل بتبادل الصور على التواصل الاجتماعي بين الأطفال ذوي الإعاقات النمائية: دراسة تحليل بعدي

Efficacy of Picture Exchange Communication System on Social Communication Among Children with Developmental Disabilities: A meta-analysis Research

إعداد

**د. حسين رشيدان الرويلي**

أستاذ التربية الخاصة المساعد – كلية التربية والآداب – جامعة الحدود الشمالية

**DR. Husain Rushadan Alruwaili**

Assistant professor in Special Education, College of Education and Arts, Northern Border University

## **Efficacy of The Picture Exchange Communication System on Social Communication Among Children with Developmental Disabilities: A meta-analysis Research**

**DR. Husain Rushadan Alruwaili**

Assistant professor in Special Education, College of Education and Arts ,  
Northern Border University

**Abstract:** Picture Exchange Communication System (PECS) is an intervention with a growing evidence base focused on developing social communication among developmental disabilities. The current meta-analysis study aimed to explore the effectiveness of the PECS on developing social communication among children with developmental disabilities in Arab countries. In addition, it explored the moderating roles of overall practice time, number of training sessions per week, participant age, country, and the type of publication (Abu Talib (2021), Al-Sabaila (2018) on the mean effect size of the effectiveness of the PECS. Twelve studies using the groups methodology were included according to four criteria. As the result of the present meta-analysis carried out, the overall effect size of the effectiveness of PECS on developing social communication was positive and high (0.789). In addition to the previous, there were no differences between the effect sizes of the studies according to the moderator variables.

**Keywords:** Autism spectrum disorder, Picture Exchange Communication System, Functional communication.

## فعالية نظام التواصل بتبادل الصور على التواصل الاجتماعي بين الأطفال ذوي الإعاقات النمائية: دراسة تحليل بعدي

إعداد

**د. حسين رشيدان الرويلي**

أستاذ التربية الخاصة المساعد – كلية التربية والآداب – جامعة الحدود الشمالية

**المستخلص:** نظام التواصل بتبادل الصور (PECS) هو تدخل ذو قاعدة أدلة متنامية تركز على تطوير التواصل الاجتماعي بين ذوي الإعاقات النمائية. تهدف دراسة التحليل التلوي الحالية إلى اكتشاف فعالية نظام التواصل بتبادل الصور (PECS) في تطوير التواصل الاجتماعي بين الأطفال ذوي الإعاقات النمائية في الدول العربية. بالإضافة إلى ذلك، تكشف الأدوار المعدلة لوقت الممارسة الإجمالي، وعدد الدورات التدريبية في الأسبوع، وعمر المشاركين، والدولة، ونوع المنشور (thesis, article) على متوسط حجم التأثير لفعالية (PECS). اشتملت على اثني عشرة دراسة استخدمت منهج المجموعات وفقاً لأربعة معايير. كنتيجة للتحليل التلوي الذي تم إجراؤه، كان حجم التأثير الإجمالي لفعالية PECS على تطوير التواصل الاجتماعي إيجابياً وعالياً (0.789). بالإضافة إلى السابق، لم تكن هناك فروق بين أحجام تأثير الدراسات وفقاً للمتغيرات المعدل.

**الكلمات المفتاحية:** اضطراب طيف التوحد، نظام التواصل بتبادل الصور، الاتصال الوظيفي.

## Introduction

The Convention on the Rights of Persons with Disabilities (United Nations General Assembly, 2016) establishes the basis for treating all individuals with disabilities as subjects rather than objects. Thus, it is consistent with the Individuals with Disabilities Education Act (IDEA) in the United States in ensuring equal opportunity and full participation for people with disabilities in all aspects of life, economic self-sufficiency, and independent living (IDEA, 2004; United Nations General Assembly, 2016).

Communication is essential to building and maintaining relationships. Individuals with developmental disorders, such as students with an autism spectrum disorder (ASD) or an intellectual disability, may have limited communication skills, such as receptive communication skills and abilities (Casella, 2004), difficulty in acquiring conventional language (Chezan et al., 2017) due to the impact of their disability. The social component of communication is critical to developing and maintaining peer friendships. It includes (a) social knowledge, (b) social interaction, and (c) social pragmatism (American Speech-Language-Hearing Association [ASHA], 2014). As students progress into adulthood, the role of social communication skills becomes more critical in finding and maintaining community connections, friendships, leisure activities, and employment (Ackerman et al., 2021).

Improving social communication behaviors is considered one of the most important intervention goals for these students (Marans et al., 2005; Paul, 2003; Paul et al., 2009). Hence, identifying ways in which social communication can be developed in children with developmental disabilities and evaluating the effectiveness of these interventions is critical to ensuring that classroom teachers, community workers, parents, and all other stakeholders have the skills and practices necessary to assist individuals in possessing appropriate social

communication skills. One intervention with a growing evidence base for increasing social communication for students with disabilities is the Picture Exchange Communication System (PECS).

Functional communication skills effectively use language in the real world (Doedens & Meteyard, 2022). PECS is a popular communication-training program for non-verbal children with developmental disabilities (Flippin et al., 2010; Howlin et al., 2007). PECS has been used to help children with developmental disabilities acquire functional communication skills (Preston & Carter, 2009). PECS uses basic behavioral principles, especially reinforcement techniques, to teach children the use of functional communication in different social contexts (Bondy & Frost, 1994, 1998). PECS begins with teaching how to communicate (Phase I) and moves through five other phases, which include increasing the distance from the communicative partner (Phase II), picture discrimination (Phase III), sentence structure (Phase IV), responding to “What do you want?” (Phase V), and commenting (Phase VI) (Hill & Flores, 2014).

PECS is a promising program for several reasons. First, it avoids the difficulties inherent in other systems by requiring too few requirements; in fact, the only prerequisite is that the individual can indicate what he wants in such a way that it can be formed in exchange for a physical symbol such as an image (Bondy & Frost, 2001). Other skills such as eye contact, motor or verbal imitation skills, the ability to sit quietly in a chair, sample matching skills, picture discrimination, or the ability to follow verbal prompts are not necessary for the first phase of the program (Bondy & Frost, 1994, 2001). Second, PECS does not require basic skills, such as pointing, marking, or matching, compared to other augmentative and alternative communication systems but rather teaches individuals to order preferred items. This functional skill is maintained through subsequent access to preferred reinforcers (Lancioni et al., 2007). Third, while PECS includes joint attention creation, tagging, and matching skills, these skills

are built into the protocol rather than taught before the intervention (Hourcade et al., 2004).

Although practitioners widely use PECS, and it has been shown, via single-case experimental designs, to be effective in increasing functional communication skills (Anderson et al., 2007; Chaabane et al., 2009; Nunes & Hanline, 2007), using many research databases, including Google Scholar, Psychinfo, Scencedirect, Springer, and Shammaa-educational data, the author did not find any meta-analysis study carried out in Arab countries regarding the PECS training program. Hence, no known comprehensive reviews of experimental and control group design studies have been conducted to explore PECS's effectiveness, especially in Arab countries.

Flippin et al. (2010) reviewed eight single-case experimental designs and three group studies between 1994 and June 2009 that published in English to examine the effectiveness of PECS for communicative outcomes, specifically for young children with ASD. Results indicated small to moderate gains in communication were demonstrated following training. Hart and Banda (2010) reviewed 13 published single-case experimental designs between 1994 and the end of 2007 to examine the effectiveness of PECS, the effects of PECS on speech and problem behaviors, and generalization beyond training conditions. Results indicate that PECS increased functional communication in all but one participant. Additionally, PECS decreased problem behaviors and increased speech in some individuals. A study by Lamb et al. (2018) aimed to explore the effectiveness of Picture Exchange Communication System (PECS) training among 19 selected studies during the period 2010 to 2018; the result indicated the mean effect size for the experimental design was small, and for individual case study designs the average effect size was large.

To date, only four meta-analyses have examined the PECS: Flippin et al. (2010), Hart and Banda (2010), Ganz et al. (2012), and Lamb et al. (2018).

However, most of these previous meta-analyses only examined data from 2007 and earlier, except Lamb et al.'s (2018) study. Most employed single-case experimental research (Flippin et al., 2010; Ganz et al., 2012; Hart & Banda, 2010) except Lamb et al. (2018). Most did not discuss the moderating variables of PECS training effectiveness except for Lamb et al.'s (2018) study. Since these studies were in western countries, the purpose of this study was to explore the effectiveness of PECS experimental and control group design studies in Arab countries and explore the moderators of training implementation. Specifically, two research questions were addressed in this review: (a) What level of the average/overall effect size do the studies conducted between 2007 and 2021 have on PECS intervention in enhancing social communication? and (b) How does overall practice time, the number of training sessions per week, participant age, country, and the type of publication moderate the average effect size of the effectiveness of the PECS?

## Methods

### *Research Model*

In this research, the meta-analysis method was used to explore the effectiveness of PECS. Meta-analysis is an organized quantitative method of producing information and presenting it among the results of numerous previous research in a field objectively, which helps to judge the effectiveness of these researches (Cohen et al., 2018). Furthermore, meta-analysis compares and combines experimental study findings in a similar area using statistical methods consistently and coherently and calculating the effect size (Cohen et al., 2018; Ergene, 1999; Glass, 1976; Hunter & Schmidt, 1990).

## Data Collection

The studies included in this research were from master's and doctoral theses, articles published in refereed scientific journals between 2007 and 2021 in Arab countries as "PECS strategy" and own research problems and needed statistical data.

An attempt was made to include all studies related to the effectiveness of the picture exchange communication system on social communication and implemented between 2007 and 2021 at the level of Arab countries. For this purpose, a survey of studies was carried out using the keywords "Picture Exchange Communication System," "PECS," and "training based on picture exchange" in both Arabic "نظام التواصل بتبادل الصور،" "بيكس" and English in the search engines and databases of Dar Al-mandumah, Shamaa Educational Base, and Google Scholar. As a result of the research process, 12 studies shown in Table 1 (one doctoral dissertation, one master's thesis, and 10 articles) were conducted matching the inclusion criteria in which pre- and post-tests were applied, and comparisons were made between groups. They were selected from among 32 studies.

**Table 1.**

### Characteristics of the Studies Included in Meta-Analysis.

| Study authors | Year  | Overall practice time | Numbers of sessions per week | Age of participants | Country  | Publication type | N1        | N2        | g ES |
|---------------|-------|-----------------------|------------------------------|---------------------|----------|------------------|-----------|-----------|------|
|               |       |                       |                              |                     |          |                  | Exp. Grp. | Cot. Grp. |      |
| Al-Sharman    | 2015  | 15 h                  | 3 s/w                        | 10 years            | Saudi    | Article          | 8         | 8         | 1.11 |
| Mohammad      | 2009  | 82 h                  | 4 s/w                        | 4 years             | Saudi    | Article          | 6         | 5         | 0.83 |
| Ayyash        | 2015a | 10 h                  | 2 s/w                        | 8 years             | Palesti. | Article          | 6         | 6         | 0.82 |
| Ayyash        | 2015b | 12 h                  | 2 s/w                        | 8 years             | Palesti. | Article          | 2         | 2         | 0.7  |



|                           |       |        |       |            |        |         |    |    |      |
|---------------------------|-------|--------|-------|------------|--------|---------|----|----|------|
| Taha et al.               | 2018a | 19.8 h | 3 s/w | 10.4 years | Egypt  | Article | 5  | 5  | 0.81 |
| Taha et al.               | 2018b | 19.8 h | 3 s/w | 8 years    | Egypt  | Article | 5  | 5  | 0.78 |
| Al-Sharman - Al-Ghasawneh | 2012  | 15 h   | 3 s/w | 10 years   | Saudi  | Article | 8  | 8  | 0.94 |
| Alsabelah                 | 2018  | 6.7 h  | 2 s/w |            | Jordan | Article | 8  | 8  | 0.83 |
| Aldipehy                  | 2019  | 18.3 h | 3 s/w | 10.5 years | Saudi  | Article | 10 | 10 | 0.62 |
| Ahmad                     | 2020  | 16.7 h | 3 s/w | 5.4 years  | Saudi  | Article | 10 | 10 | 0.59 |
| Abu Talib                 | 2021  | 14.4 h | 4 s/w | 6.3 years  | Egypt  | Thesis  | 9  | 9  | 0.89 |
| Ckichick                  | 2007  | 32.1 h | 3 s/w | 10.4 years | Egypt  | Thesis  | 4  | 4  | 0.54 |

### Inclusion Criteria

The inclusion criteria of inserted studies are (a) conducted between 2007 and 2021 in Arab countries, (b) published as master's theses, doctoral dissertations, or articles in scientific journals written in Arabic or English, (c) studies using experimental and control groups in the pretest-posttest control group model, and (d) ranks mean and sample sizes, values have been about social communication at experimental and control groups.

As a result of the analysis, which aims to identify which studies meet the inclusion criteria, 20 studies are excluded.

### Coding Process

The coding form developed in this study consisted of three parts. The first part, "study identity," presented the study code, title, author information, and study year. The second part included "data of moderator variables" such as overall practice time, number of training sessions per week, country, participant age, and publication type (thesis, article). Finally, the third part, "study data," provided the sample size of experimental and control groups, ranks mean, and *t*-value.

### ***Research Reliability and Validity***

On the other hand, the coding reliability value was calculated to obtain a certain level of reliability of the research outcomes in the meta-analytic part of the research (H. Cooper, 2017). Two researchers did codifications. The study author prepared the coding form. Then, another academically reliable coder was asked to examine all the review research and note the results in the final evaluation form. Miles and Huberman's (1994) formula,  $\text{Reliability} = \frac{\text{Consensus}}{\text{Consensus} + \text{Disagreement}} \times 100$ , was used to calculate the reliability coefficient. Using this formula, the reliability rate was calculated as 88%. This rate indicates that the coding was reliable Cohen (1988).

The literature indicates that the validity of the standardized effect size computed in the meta-analysis depends on the validity of the studies included in the analysis. For this reason, the validity of all the studies that were included in the meta-analysis made the meta-analysis performed valid. The methodology checklist for (randomized) controlled trials published by the Scottish Intercollegiate Guideline Network (SIGN; Harbour & Forsyth, 2008) was used as a guideline for study validity. The threats to the internal validity of each of these studies included in the meta-analysis were minimal. In the current research, 12 studies included in the meta-analysis were valid. Therefore, it can be concluded that this research is valid.

### **Calculation of Effect Sizes and Data Analysis**

To assess the effectiveness of the PECS, we calculated Hedges'  $g$  (Hedges, 1981) and 95% confidence intervals ( $CI$ ) with correction for the effect of bias (Hedges & Olkin, 1985). The use of ( $g$ ) is because when using small sample sizes, the effect size of Hedges ( $g$ ) provides a better estimate of the effect size to a certain extent than provided by the effect size of Cohen's ( $d$ ). The reason for that is when calculating the effect size ( $g$ ), the variances are grouped using ( $n - 1$ ), while when

calculating the effect size ( $d$ ), the variances are grouped using ( $n$ ) (Grissom & Kim, 2005). Effect size calculations were based on comparisons between groups of pre-post change scores using the pooled standard deviations of the pre-test, as recommended by Morris (2008). For studies that did not report mean and standard deviations, effect sizes were calculated based on  $F$ -test values (Darch et al., 2006; Oakland et al., 1998) and  $r$ -values using the formula  $r = Z/\sqrt{N}$ .

According to Cohen (1988), the classification of effect size is as follows: (a) if the effect size is around 0.20, then it is considered to be small, (b) if the effect size is around 0.50, then it is considered to be medium, and (c) if the effect size is around 0.80, then it is considered to be large. These classification values determined by Cohen are the most widely used to interpret effect sizes (Üstün & Eryilmaz, 2014).

For the analysis result of the random effect model, the average effect value was 0.7892 with a standard error of 0.155. At the 95% confidence interval, the minimum value of the effect size was 0.424, and the maximum value of the effect size was 1.138. As a result of the study, there was no significant difference between the sizes of the effect of PECS on social communication In terms of country, age of participants, the number of sessions per week, and overall practice time.

### Assessment of Publication Bias

Researchers in meta-analysis studies are interested in analyzing a group of scientific studies published in refereed scientific journals. There is a possibility of bias in their results compared to similar studies that did not have the opportunity to publish in those journals for many reasons. To test for publication bias, the researcher used Egger's regression test, a regression analysis test for funnel plot asymmetry, resulting in a  $t$ -test value of  $t = 0.0248$ , with degrees of freedom  $df =$

10, at the level ( $p = 0.9807$ ). The  $p$ -value of 0.981 ( $p > 0.05$ ) in Egger's regression test indicates no publication bias.

### Heterogeneity Test and Meta-Analysis Model

Several criteria are taken into consideration when determining a meta-analysis model. One of them is that the research has a homogeneous/heterogeneous distribution. Ellis (2010) states that if the distribution of effect sizes is heterogeneous, then a random effect model should be used; if it is homogeneous, then a fixed effect model should be used. Based on the heterogeneity analysis performed in this study ( $Q = 53.478$ ;  $p < .05$ ), the  $I^2$  value is 75.53. Therefore, 75.5% of the variance observed between studies is due to real differences in effect sizes. Therefore, 75.5% indicates high heterogeneity (Higgins & Thompson, 2002). The studies that are embedded into the current meta-analysis were carried out in different countries, with different sample groups, in different years. They include intermediate variables like overall practice time, number of training sessions per week, country, participant age, and the type of publication (thesis, article). Hence, the random effect model was the suitable research model for the current study. The random effect model is based on the idea that intermediate variables such as the age of the participants represent the reason why the true effect size varies from one study to another (Üstün & Eryılmaz, 2014).

## Results

### General Effect Size Results

Meta-analysis results are given about the effect of PECS on the social communication of children with developmental disabilities.

Results about the homogeneity of the studies and general effect size using the fixed effect model and random effect model are given in Table 2.

**Table 2.**

**The results of studies' effect sizes based on fixed effect model and random effect model.**

| Model | ES    | df | Q      | P     | SE    | I <sup>2</sup> | 95% CI          |
|-------|-------|----|--------|-------|-------|----------------|-----------------|
| FEM   | .7537 | 11 | 16.452 | .0984 | .1687 | .7553          | [.4482, 1.0591] |
| REM   | .7892 | 11 | 53.478 | .001  | .1553 |                | [.4235, 1.1381] |

*Note.* ES = Average Effect Size; df = Degrees of freedom; Q = Homogeneity; SE = Standard Error; CI = Confidence Interval [min, max]; FEM = fixed effect model; REM = random effect model

For the analysis result of the random effect model, the average effect value was 0.7892 with a standard error of 0.155. At the 95% confidence interval, the minimum value of effect size was 0.424, and the maximum value of the effect size was 1.138. This result is statistically significant with a *p*-value of .001.

### **The Effect Sizes of the Studies According to Moderators**

As a result of the study, it was found that overall practice time, number of training sessions per week, participant age, country, and the type of publication included in the study differed. Hence, it was aimed to examine whether the effect size values of the studies differed according to the variables mentioned. Table 3 shows the results of the moderator analysis according to the Overall practice time, number of training sessions per week, participant age, country, and the type of publication included in the meta-analysis.

**Table 3.**

**The effect sizes of studies on including moderators concerning social communication.**

| Moderator                   | Variables          | <i>k</i> | <i>ES</i> | <i>SE</i> | 95% <i>CI</i>    | <i>QB</i> | <i>df</i> | <i>p</i> |
|-----------------------------|--------------------|----------|-----------|-----------|------------------|-----------|-----------|----------|
| Overall practice time       | Fewer than 20h     | 10       | .77       | .1651     | [.4447, 1.0920]  | .0728     | 1         | .79      |
|                             | More than 20h      | 2        | .63       | .4718     | [.1293, 1.5583]  |           |           |          |
| Number of sessions per week | Fewer than 2s/w    | 3        | .7401     | .2984     | [.1551, 1.325]   | 0.0028    | 1         | .96      |
|                             | More than 2s/w     | 9        | .7588     | .1828     | [.4005, 1.1170]  |           |           |          |
| Age participants            | Fewer than 6 years | 2        | .7742     | .3997     | [-.0092, 1.5576] | 0.0031    | 1         | .95      |
|                             | More than 6 years  | 10       | .75       | .1693     | [.4182, 1.0817]  |           |           |          |
| Country                     | Egypt              | 4        | .7287     | .3048     | [.1313, 1.3262]  | 0.0291    | 3         | .99      |
|                             | Jordan             | 1        | .7847     | .5189     | [.0029, 1.8017]  |           |           |          |
|                             | Palestine          | 2        | .7180     | .3648     | [.3280, 1.4331]  |           |           |          |
|                             | Saudia             | 5        | .7256     | .2284     | [.4482, 1.2232]  |           |           |          |
| Publication type            | Article            | 10       | .7584     | .1688     | [.4275, 1.0893]  | 0.0053    | 1         | .94      |
|                             | Thesis             | 2        | .7265     | .4057     | [-.0687, 1.5217] |           |           |          |

According to Table 3, in terms of overall practice time, the intergroup homogeneity test value was found as  $QB = 0.0728, p > .05$ . When the studies were reviewed according to the overall practice time, it was found that there was no significant difference between the effect sizes of the effect of PECS on social communication.

According to Table 3, in terms of the number of sessions per week, the intergroup homogeneity test value was  $QB = 0.0028, p > .05$ . When the studies were reviewed according to the number of sessions per week, it was found that there is no significant difference between the sizes of the effect of PECS on social communication.

According to Table 3, in terms of age of participants, the intergroup homogeneity test value was found as  $QB = 0.0031, p > .05$ . When the studies were

reviewed according to the participant age, it was found that there was no significant difference between the sizes of the effect of PECS on social communication.

According to Table 3, in terms of country, the intergroup homogeneity test value was found as  $QB = 0.0291, p > .05$ . When the studies were reviewed according to the country where the study was conducted, it was found that there was no significant difference between the sizes of the effect of PECS on social communication.

According to Table 3, in terms of publication type, the intergroup homogeneity test value was found as  $QB = 0.0053, p > .05$ . When the studies were reviewed according to the publication type, it was found that there is no significant difference between the sizes of the effect of PECS on social communication.

## Discussion

Results indicate that PECS has been moderately effective ( $g = 0.78$ ) in increasing social communication skills among participants with developmental disabilities. However, this finding is inconsistent with the research of Flippin et al. (2010), Hart and Banda (2010), Ganz et al. (2012), and Lamb et al. (2018). This may be attributed to the fundamental differences in the research designs between single-case experimental designs used in most previous studies and the experimental and control pre-post designs used in the current study. Another reason for the current differences is due to inflation or deflation of the effect of the PECS intervention, which may be attributed to the statistical weight of an individual score in a single-case experimental designs design being greater than in multi-subject designs.

PECS might be an effective tool to teach social communication to individuals with ASD because key features of PECS, such as concrete visuals and preferred

reinforcers, build on the strengths of individuals with ASD. Charlop-Christy et al. (2002) concluded that the success of PECS was because of its structured, concrete format and the use of picture cards as visual prompts. Since individuals with autism learn better when information is concrete and presented visually (Quill, 1995), greater retention of skills might be acquired over time (Preis, 2006). Additionally, Ganz and Simpson (2004) recognized the power of using preferred items as reinforcers. children with ASD have distinct cognitive abilities in processing visual information versus auditory information. Therefore, pictures help them acquire coding skills and successfully store and process visual social information (Al-dawaideh & Al-Amayreh 2013).

The main idea of the PECS is to provide individuals with ASD with a system through which they interact with others to achieve their needs and desires. This social interaction is based on training them to initiate spontaneous communication within the social environment and share knowledge of the relationship between cause and effect as an act of communication. As a result, the child acquires the basics of the communication process as a whole (Bondy & Frost, 1994, 1998). Moderator analysis did not reveal any variation of PECS to be more effective than others.

Considering overall practice time of fewer than 20 hours and more than 20 hours, after the analysis, it was seen that there was no significant difference ( $QB = 0.0728$ ;  $p = 0.79$ ). However, the effect sizes of overall practices time of fewer than 20 hours (.77) are higher than those of more than 20 hours (.63). Therefore, it can be stated that PECS had a similar considerable effect on both groups. As the data for the more than 20 hours period was obtained from only two comparisons, and according to Rosenberg et al. (2000), Hedges'  $g$  value, which is used to calculate the effect size, can give valid results in the case of at least five comparisons, it was determined not to generalize the effect size of this period.



In terms of the number of sessions per week during PECS training, less than two sessions per week and more than two sessions per week, after the analysis, it was seen that there was no significant difference ( $QB = 0.0028$ ;  $p = 0.96$ ). The effect sizes of sessions less than two per week (.74) are lower than sessions more than two per week (.76). These results can be considered normal because the effectiveness may work with overall practices and training time.

In terms of participant age of fewer than 6 years and more than 6 years, after the analysis, it was seen that there was no significant difference ( $QB = 0.0031$ ;  $p = 0.96$ ). The effect sizes of participants fewer than 6 years (.77) are higher than more than 6 years (.75). This finding is consistent with the general theme that interventions used at the early stages of development frequently produce the best results (National Research Council, 2001). It can be attributed that the differences in the effect sizes between preschooler children (fewer than 6 years) and elementary school children (more than 6 years) were not statistically significant to the small sample sizes of primary age students compared to elementary age students (Ganz et al., 2012).

Considering the moderating role of the country where the study was conducted (Egypt, Jordan, Palestine, and Saudi Arabia), after the analysis, it was seen that there was no significant difference ( $QB = 0.0029$ ;  $p = 0.99$ ). The effect sizes of studies conducted in Jordan (.78) while in Saudi Arabia (.73), Egypt (.73), and Palestine (.73) are the same. These studies represent 11 of 12 studies. The PECS program was applied as a promising strategy for developing communication skills among children with developmental disabilities in Arabic countries at about the same time.

Considering the moderating role of publication type (article and thesis), after the analysis, it was shown that there was no significant difference ( $QB = 0.0053$ ;  $p = 0.94$ ). According to Coe (2002), there are essentially two kinds of relationships between effect size and significance value. For the results to be

significant, the effect must be very large (despite the small sample), or the sample must be very large (despite the weak effect size). In this research, it is seen that the effect sizes of the articles were moderate. The reason the effect sizes of articles (0.76) were larger than theses (0.73) can be explained by one of the limitations of the meta-analysis method—journals tend to publish articles that generally have a positive and high correlation (Cooper et al., 2019; Egger et al., 2001).

## Recommendations

1. PECS can increase a student's ability to communicate in the classroom. Thus, PECS can be used with students with limited communication abilities, whether students with developmental disabilities or typically, and does not require prior skills, such as eye contact, matching, or motor and verbal imitation skills.
2. This review indicates potential success with students who are in preschool or primary school; however, practitioners should be careful about generalizing the results of this review to students with developmental disabilities due to the small number of participants and variations in the wide range of characteristics.
3. As each student progresses according to their abilities, practitioners should start using early intervention to allow the student to reach the advanced PECS stages where functional language gains can be made.
4. To successfully implement PECS, practitioners must also learn to identify powerful reinforcers systematically. Additionally, practitioners should seek training to follow the recommended PECS protocol by Bondy and Frost (2001) while constantly documenting student progress (Frost & Bondy, 2002).

## References

- Abu Talib, H. M. (2021). *The effectiveness of the PECS program using the Android system to develop communication skills for autistic children.* (unpublished master's thesis).( in Arabic). Cairo University, Egypt
- Ackerman, K. B., Spriggs, A. D., & Rhodes, A. L. (2021). Peer mediators' use of prompting to increase social communication in students with disabilities. *Communication Disorders Quarterly*, 43(1), 42–50. <https://doi.org/10.1177/1525740120936999>
- Ahmed, F.I. (2020). *The effectiveness of the illustrated Pix program in developing some communication skills for children with autism spectrum disorder.* Journal of Arts, Literature, Humanities and Social Sciences,( in Arabic). Vol. 50, P.131-156
- Al-Dalbi, K. G. (2019). *The effectiveness of a training program for cognitive activities based on communication by exchanging pictures and its impact on increasing social interaction among autistic children.* Specialized International Educational Journal, Specialized International Educational Journal,( in Arabic). vol. 8, p. 2, p.p. 1-19.
- Al-Sabaila, O. A. (2018). *The role of the picture exchange program Pecs in developing non-verbal communication skills among a sample of children with autism spectrum in Jordan.* Childhood and Education Journal,( in Arabic). Vol. 10, P. 34, 111-145
- Al-Sharman, W. M. (2015). *The effectiveness of communication by PECS in the development of social skills among autistic children.* Journal of Educational and Psychological Sciences,( in Arabic). Vol. 16, p. 4, 159-186
- Al-Sharman, W., & Al-Ghasawneh, Y. (2013). *Building a training program based on behavioral theory to reduce self-harm behavior in autistic children and measuring its effectiveness in improving social skills in Taif Governorate.* Cairo, Childhood Magazine, (in Arabic). Issue (16).
- Al-dawaideh, A. M., & Al- Amayreh, M. M. (2013). *The effectiveness of Picture Exchange Communication System on learning request skills and the development of speech in Arabic-Speaking children with autism.* Life science Journal,10(2): pp.93129323.

- American Speech-Language-Hearing Association. (2014). *Components of social communication*. <http://www.asha.org>
- Anderson, A., Moore, D. W., & Bourne, T. (2007). Functional communication and other concomitant behavior change following PECS training: A case study. *Behaviour Change*, 24(3), 173–181. <https://doi.org/10.1375/bech.24.3.173>
- Ayyash, K. S. (2015a). *The Effectiveness of a Training Program Based on Picture Exchange Communication System (PECS) in Developing Communication Skills among Autistic Children in Nablus, Palestine*. Journal of Al-Quds Open University for Educational & Psychological Research & Studies, (in Arabic). Vol. 3: No. 10, Article 5.
- Ayyash, K. S. (2015b). *The Effectiveness of a Training Program Based on Picture Exchange Communication System (PECS) in Developing Communication Skills among Autistic Children in Nablus, Palestine*. Journal of Al-Quds Open University for Educational & Psychological Research & Studies, (in Arabic). Vol. 3: No. 10, Article 5.
- Bondy, A., & Frost, L. (1994). The Picture-Exchange Communication System. *Focus on Autism and Other Developmental Disabilities*, 9(3), 1–19. <https://doi.org/10.1177/108835769400900301>
- Bondy, A., & Frost, L. (1998). The Picture Exchange Communication System. *Seminars in Speech and Language*, 19(4), 373–388. <https://doi.org/10.1055/s-2008-1064055>
- Bondy, A., & Frost, L. (2001). The picture exchange communication system. *Behavior Modification*, 25, 725–744. <https://doi.org/10.1177/0145445501255004>
- Cascella, P. W. (2004). Receptive communication abilities among adults with significant intellectual disability. In *Journal of Intellectual & Developmental Disability* (Vol. 29, Issue 1, pp. 70–78). <https://doi-org.sdl.idm.oclc.org/10.1080/13668250410001662847>
- Chaabane, D. B., Alber-Morgan, S. R., & DeBar, R. M. (2009). The effects of parent-implemented PECS training on improvisation of mands by children

with autism. *Journal of Applied Behavior Analysis*, 42(3), 671–677. <https://doi.org/10.1901/jaba.2009.42-671>

Charlop-Christy, M. H., Carpenter, M., Le, L., LeBlanc, L. A., & Kellet, K. (2002). Using the Picture Exchange Communication System (PECS) with children with autism: Assessment of PECS acquisition, speech, social-communicative behavior, and problem behavior. *Journal of Applied Behavior Analysis*, 35(3), 213–231. <https://doi.org/10.1901/jaba.2002.35-213>

Chezan, L. C., Wolfe, K., & Drasgow, E. (2017). A Meta-analysis of functional communication training effects on problem behavior and alternative communicative responses. *Focus on Autism and Other Developmental Disabilities*. <https://doi.org/10.1177/1088357617741294>

Ckichick, R. A. (2007) *The effectiveness of a training program with the communication system by exchanging pictures in developing communication skills for autistic children*. (Unpublished doctoral dissertation). (in Arabic). Zagazig University. Egypt

Coe, R. (2002). *Effect size*. Paper presented at the Annual Conference of the British Educational Research Association, University of Exeter, England, 12-14 September.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge.

Cooper, H. (2017). *Research synthesis and meta-analysis: A step-by-step approach* (5th ed.). Sage.

Cooper, L. V., Hedges, L. V., & Valentine, J. C. (Eds.). (2019). *The handbook of research synthesis and meta-analysis* (3rd ed.). Russell Sage Foundation.

Darch, C., Eaves, R. C., Crowe, D. A., Simmons, K., & Conniff, A. (2006). Teaching spelling to students with learning disabilities: A comparison of rule-based strategies versus traditional instruction. *Journal of Direct Instruction*, 6(1), 1–16. <https://eric.ed.gov/?id=EJ755191>

Doedens, W. J., & Meteyard, L. (2022). What is Functional Communication? A Theoretical Framework for Real-World Communication Applied to

- Aphasia Rehabilitation. *Neuropsychology Review*, 1–37. <https://doi-org.sdl.idm.oclc.org/10.1007/s11065-02109531-2>
- Egger, M., Smith, G. W., & Altman, D. G. (2001). *Systematic reviews in health care: Meta-analysis in context* (2nd ed.). BMJ Books.
- Ellis, P. D. (2010). *The essential guide to effect sizes: Statistical power, meta-analysis, and the interpretation of research results*. Cambridge University Press
- Ergene, T. (1999). *Effectiveness of test anxiety reduction programs: A meta-analysis review* (Doctoral dissertation, Ohio University).
- Flippin, M., Reszka, S., & Watson, L. (2010). Effectiveness of the picture exchange communication system (PECS) on communication and speech for children with autism spectrum disorders: A meta-analysis. *American Journal of Speech-Language Pathology*, 19(2), 178–195. [https://doi.org/10.1044/1058-0360\(2010/09-0022\)](https://doi.org/10.1044/1058-0360(2010/09-0022))
- Frost, L. A., & Bondy, A. S. (2002). *The Picture Exchange Communication System training manual* (2nd ed.). Pyramid Educational Products.
- Ganz, J. B., & Simpson, R. L. (2004). Effects on communicative requesting and speech development of picture exchange communication in children with characteristics of autism. *Journal of Autism and Developmental Disorders*, 34(4), 395–409. <https://doi.org/10.1023/b:jadd.0000037416.59095.d7>
- Ganz, J. B., Davis, J. L., Lund, E. M., Goodwyn, F. D., & Simpson, R. L. (2012). Meta-Analysis of PECS with individuals with ASD: Investigation of targeted versus non-targeted outcomes, participant characteristics, and implementation phase. *Research in Developmental Disabilities*, 33(2), 406–418. <https://doi.org/10.1016/j.ridd.2011.09.023>
- Glass, G. V. (1976). Primary, secondary, and meta-analysis of research. *Educational Researcher*, 5(10), 3–8. <https://doi.org/10.2307/1174772>
- Grissom, R. J., & Kim, J. J. (2005). *Effect sizes for research: A broad practical approach*. Psychology Press.
- Harbour, R., & Forsyth, L. (2008). *SIGN 50: A guideline developer's handbook*.
- Hart, S. L., & Banda, D. R. (2010). Picture exchange communication system with individuals with developmental disabilities: A meta-analysis of single

- subject studies. *Remedial and Special Education*, 31(6), 476–488.  
<https://doi.org/10.1177/0741932509338354>
- Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, 6(2), 107–128.  
<https://doi.org/10.3102/10769986006002107>
- Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Academic Press.
- Higgins, J. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine*, 21(11), 1539–1558.  
<https://doi.org/10.1002/sim.1186>
- Hill, D. H., & Flores, M. (2014). Comparing the picture exchange communication system and the iPad™ for communication of students with Autism Spectrum Disorder and developmental delay. *TechTrends*, 58(3), 45–53.  
<https://doi.org/10.1007/s11528-014-0751-8>
- Hourcade, J., Pilotte, T. E., West, E., & Parette, P. (2004). A history of augmentative and alternative communication for individuals with severe and profound disabilities. *Focus on Autism and Other Developmental Disabilities*, 19(4), 235–244.  
<https://doi.org/10.1177/10883576040190040501>
- Howlin, P., Gordon, R. K., Pasco, G., Wade, A., & Charman, T. (2007) The effectiveness of Picture Exchange Communication System (PECS) training for teachers of children with autism: A pragmatic group randomised controlled trial. *Journal of Child Psychology and Psychiatry*, 48(5), 473–481. <https://doi.org/10.1111/j.1469-7610.2006.01707.x>
- Hunter, J. E., & Schmidt, F. L. (1990). *Methods of meta-analysis: Correcting error and bias in research findings* (1st ed.). Sage.
- Individuals with Disability Education Act. (2004).  
<http://www.p12.nysed.gov/specialed/idea/108-446.pdf>
- Lamb, R., Miller, D., Lamb, R., Akmal, T., & Hsiao, Y. J. (2018). Examination of the role of training and fidelity of implementation in the use of assistive communications for children with autism spectrum disorder: A meta-analysis of the picture exchange communication system. *British Journal of*

- Special Education*, 45(4), 454–472. <https://doi.org/10.1111/1467-8578.12243>
- Lancioni, G. E., O'Reilly, M. F., Cuvo, A. J., Singh, N. N., Sigafoos, J., & Didden, R. (2007). PECS and VOCAs to enable students with developmental disabilities to make requests: An overview of the literature. *Research in Developmental Disabilities*, 28(5), 468–488. <https://doi.org/10.1016/j.ridd.2006.06.003>
- Marans, W. D., Rubin, E., & Laurent, A. (2005). Addressing social communication skills in individuals with high-functioning autism and Asperger syndrome: Critical priorities in educational programming. In F. R. Volkmar, R. Paul, A. Klin, & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders* (3rd ed.). Wiley & Sons.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.
- Mohamed, K. S. (2009). The effectiveness of exchanging images and some behavioral exercises to develop joint attention and its effect on reducing withdrawal behavior among autistic kindergarten children. *Journal of the Faculty of Education in Qena*, (in Arabic). South Valley University.
- Morris, S. B. (2008). Estimating effect sizes from pretest-posttest-control group designs. *Organizational Research Methods*, 11(2), 364–386. <http://doi.org/10.1177/1094428106291059>
- National Research Council. (2001). *Educating children with autism*. National Academy Press. Division of Behavioral and Social Sciences and Education.
- Nunes, D., & Hanline, M. F. (2007). Enhancing the alternative and augmentative communication use of a child with autism through a parent-implemented naturalistic intervention. *Journal of Disability, Development, and Education*, 54(2), 177–197.
- Oakland, T., Black, J. L., Stanford, G., Nussbaum, N. L., & Balise, R. R. (1998). An evaluation of the dyslexia training program: A multisensory method for promoting reading in students with reading disabilities. *Journal of Learning Disabilities*, 31(2), 140–147. <https://doi.org/10.1177/002221949803100204>



- Paul, R. (2003). Promoting social communication in high functioning individuals with autistic spectrum disorders. *Child and Adolescent Psychiatric Clinics*, 12(1), 87–106. [https://doi.org/10.1016/s1056-4993\(02\)00047-0](https://doi.org/10.1016/s1056-4993(02)00047-0)
- Paul, R., Orlovski, S., & Marcinko, H. (2009). Conversational behaviors in youth with high-functioning ASD and Asperger syndrome. *Journal of Autism and Developmental Disorders*, 39(1), 115–125. <https://doi.org/10.1007/s10803-008-0607-1>
- Preis, J. (2006). The effect of picture communication symbols on the verbal comprehension of comments by young children with autism. *Focus on Autism and Other Developmental Disabilities*, 21(4), 194–210. <https://doi.org/10.1177/10883576060210040101>
- Preston, D., & Carter, M. (2009). A review of the efficacy of the Picture Exchange Communication System intervention. *Journal of Autism and Developmental Disorders*, 39(10), 1471–1486. <https://doi.org/10.1007/s10803-009-0763-y>
- Rosenberg, M. S., Adams, D. C., & Gurevitch, J. (2000). *MetaWin: Statistical software for meta-analysis*, v. 2.0. Sinauer.
- Taha, H. I., Al-Muzain, R., & Al-Basir, N.(2018a). *The effectiveness of a program based on the Picture Exchange Communication System (PECS) for developing spontaneous speech and its impact on improving social communication among autistic children*. Journal of Scientific Research in Education,( in Arabic). No. 19, Part 15, 537-574
- Taha, H. I., Al-Muzain, R., & Al-Basir, N.(2018b). *The effectiveness of a program based on the Picture Exchange Communication System (PECS) for developing spontaneous speech and its impact on improving social communication among autistic children*. Journal of Scientific Research in Education,( in Arabic). No. 19, Part 15, 537-574
- Quill, K. (1995). *Teaching children with autism: Strategies to enhance communication and socialization*. Delmar.
- United Nations General Assembly. (2016, December 13). *Convention on the Rights of Persons with Disabilities* [A/ RES/61/106]. Author.

---

Üstün, U., & Eryılmaz, A. (2014). A research method for making effective research synthesis: Meta-analysis. *Education and Science*, 39(174), 1–32. <http://doi.org/10.15390/EB.2014.3379>