

## **A Meta-Analysis of the Relationship between Information and Communications Technology and Academic Achievement in Iran**

Hossein Najafi<sup>1\*</sup>, Mohammad Jafar Rezaei<sup>2</sup>, Mohammad Ali Javadi Boura<sup>3</sup>,  
Zohre Mottagi<sup>4</sup>

<sup>1</sup>Assistant Professor, Department of Educational Sciences, Payame Noor University, Iran.

<sup>2</sup>Ph.D. Student, Department of Educational Sciences, Faculty of Educational Sciences and Psychology, University of Isfahan, Iran.

<sup>3</sup>Assistant Professor, Farhangian University, Mazandaran, Sari, Iran.

<sup>4</sup>Ph.D. Student, Department of Educational Sciences, Faculty of Educational Sciences and Psychology, University of Isfahan, Iran.

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**Abstract:** *The present research was to a meta-analysis of the relationship between information and communications technology (ICT) and academic achievement. The population consisted of all the research on this subject until 2013, and using systematic sampling, 18 research studies were selected as the sample. Structured review based on meta-analysis was used to answer the research questions, and Cohen's model was used to interpret the results. The results showed that the relationship between ICT and academic achievement is significant, because the effect size for this relationship was 0.581, which is above average based on Cohen's model.*

**Key Words:** *Information and communications technology, academic achievement, meta-analysis*

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### **I. Introduction**

An important problem in the area of teaching is lack of interest in learning among students. Using multimedia and information and communications technology (ICT) in learning is one way to bring about motivation and academic achievement in students (Zameni et al., 2010). Advanced technologies, educational media, and multimedia are increasingly used in the teaching-learning process (Najafi, 2012). Research has shown that ICT-based, learner-based, interactive, cooperative, and flexible teaching along with active learning strategies motivate learners and increasing teacher-learner cooperation (Farajollahi & Zarifsanayee, 2009) and create more learning opportunities (Mahdinejad & Amoe, 2011). By effectively using ICT, students demonstrate their abilities and skills faster and teachers have more alternatives in creative instruction. Other important features of ICT, including computers, the Internet, and multimedia, include capacity, variety, speed, automation, contingency, interoperability, precision, and validity which are of utmost importance in learning. These features change the role of the teacher and the learner, facilitate learning, and lead to interactive learning, learner autonomy, self-sufficiency, and self-confidence (Zameni et al., 2012). By integrating content and information literacy, often in textual and visual forms, ICT produces significant learning and academic achievement (Zofan, 2007). In other words, incorporation of ICT into the area of education has changed the role of teachers from a mere source of educational material to a manager supervising the learning process. This increases self-sufficiency and self-confidence in students (Zameni et al., 2012).

In this approach, teaching is accompanied by attractive visual materials, which increases students' interest in learning. Also based on research evidence, approximately 75 percent of human learning occurs visually, while only 25 percent occurs through auditory, olfactory, tactile, and gustatory senses (Zofan, 2007). ICT is a tool that involves the visual and auditory senses of the learners and thus it deepens learning in students. Research evidence mostly supports the positive effect of ICT on learning and academic achievement (Malekyan et al., 2011; Niyazazari and Hosseini, 2012; Shekari, 2012; Zameni and Kardan, 2010; Satari et al., 2012; Ahmadi et al., 2011; Momeni et al., 2012; Soleymanpour et al., 2010). However, some studies have shown that ICT is not very effective in teaching and learning processes (Chaney, 2003; Zare, 2009).

Therefore, there is an inconsistency in research evidence on the relationship between ICT and academic achievement. Also the size of the effect of ICT on academic achievement is not clear. The present research uses a meta-analysis methodology to provide new insights into this relationship. Meta-analysis focuses on contrasting and combining the results of different studies in order to discover new relationships that cannot be otherwise obtained (Hatami, 2006). The literature on ICT and its relationship with academic achievement mostly reports the significance of the relationships, but it does not provide much evidence about the extent to

which ICT influences learning and academic achievement (Khalkhali et al., 2011). Thus, this research tries to address the following questions:

1. Does ICT have a significant effect on academic achievement?
2. What is the size of the effect of ICT on academic achievement?

## II. Methodology

This research uses a meta-analysis methodology. In meta-analysis, the aim is to calculate the effect size of distinct variables and combine them to obtain the mean effect size (Jamali et al., 2012). The population of the research consisted of all the Iranian research on the effect of information and communications technology (ICT) on academic achievement during the period 2003-2013 indexed in Iranian Research Institute for Information Science and Technology (IRANDOC), Science Information Database (SID), Noor Magazines<sup>1</sup>, Iran's Publications Database<sup>2</sup>, and the National Library of Iran. Overall, 94 research papers about the effect of ICT on academic achievement were obtained. Since all of the studies conducted during the period of interest were not available, 18 documents were selected as sample using systematic sampling. Effect size was manually calculated. Finally, descriptive and inferential statistics (mean standard error, standard error, variance, upper and lower limits, and z-score) and fixed and random effects meta-analysis models were used for data analysis. Also Cohen's method was used to interpret the results.

## III. Findings

Before inferential analysis, we first describe the statistical methods used in the literature to examine the relationship between ICT and academic achievement (Table 1)

Table 1. Frequency of statistical analyses used in the sample research

Statistical Analysis	Frequency	Percentage
Variance and covariance analyses	6	%34
T dependent and independent	2	%11
The correlation coefficient	3	%17
Analysis of variance and T	2	%11
Correlation coefficient and T	1	%05
Independent t	4	%22
<b>Total</b>	<b>18</b>	<b>100%</b>

The data provided in Table 1 show that variance and covariance analyses are most widely used in the research on ICT and academic achievement. However, to obtain more accurate information from the sample studies, these data need to be presented in the form of a meta-analysis checklist (Table 2).

Table 2. Studies that meet the criteria for inclusion in the meta-analysis

No.	Researches	Location	Year	Test	Sample Size
1	Malekyian et al.	Tehran	2011	Variance analysis	25
2	Niyazazari & Hosseini	Babl	2012	Covariance analysis	76
3	Shekari	Kashan	2010	Variance analysis T dependent	193
4	Zameni & Karan	Mahmodabad	2011	T dependent	88
5	Zameni et al.	Joybar	2011	T dependent and independent	40
6	Niyazazari et al.	Sari	2012	Covariance analysis	217
7	Satari et al.	Heris	2012	The correlation coefficient	317
8	Ahmadi et al.	Sari	2011	T dependent and independent	40
9	Satari & Mohammadi	Parsabad	2011	The correlation coefficient	215
10	Solyamanpoor et al.	Ramsar	2010	T dependent	50
11	Safariyan et al.	Qaemshahr	2010	T dependent	60
12	Momeni et al.	Birjand	2012	Covariance analysis	60
13	Zare	Rodhen	2009	T dependent	160
14	Afkhami et al.	Yazd	2012		406
15	Aminifar et al.	Torkamanchay	2012	Variance analysis and T dependent	18
16	Najafi	Khalkhal	2008	Variance analysis	150
17	Qaznavi	Khash	2010	Covariance analysis	218
18	Dayinezhad et al.	Khash	2010	Variance analysis	320

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<sup>2</sup> www.magiran.com

1st Question: Can we decide about the relationship between ICT and academic achievement based on the meta-analysis of the relevant studies?

Effect sizes were combined to answer this question. Accordingly, effect sizes are individually estimated and then combined mixed and random effects were calculated (Table 3).

Table 3. Meta-analysis of the effect of ICT on academic achievement (random effects model)

No.	Researches	Standard Error of the Mean	Variance	Standard Error	Lower Limit	Upper Limit	Z	P
1	Malekyian et al (2011)	1.012	0.129	0.023	0.223	0.732	4.781	0.021
2	Niyazazari & Hosseini (2012)	0.432	0.390	0.034	0.172	1.021	0.984	0.032
3	Shekari (2010)	0.598	0.034	0.035	0.132	0.909	11.982	0.012
4	Zameni & Karan (2011)	2.120	0.034	0.021	0.182	0.897	1.012	0.001
5	Zameni et al (2011)	0.108	0.109	0.102	0.174	0.827	2.022	0.007
6	Niyazazari et al (2012)	0.349	0.339	0.017	0.199	0.423	6.715	0.003
7	Satari et al (2012)	0.849	0.435	0.082	0.042	0.857	3.301	0.021
8	Ahmadi et al (2011)	0.905	0.247	0.029	0.091	0.902	2.513	0.036
9	Satari & Mohammadi (2011)	0.505	0.190	0.020	0.117	0.272	1.369	0.000
10	Solyamanpour et al (2010)	0.298	0.398	0.062	0.084	0.948	1.231	0.004
11	Safariyan et al (2010)	0.127	0.098	0.098	0.108	1.072	1.820	0.002
12	Momeni et al. (2012)	0.356	0.309	0.041	0.318	0.855	1.723	0.009
13	Zare (2009)	0.397	0.275	0.009	0.392	0.443	2.290	0.023
14	Afkhami et al (2012)	0.744	0.332	0.029	0.247	0.630	0.987	0.043
15	Aminifar et al (2012)	0.188	0.179	0.167	0.056	0.716	2.992	0.012
16	Najafi (2008)	0.577	0.212	0.079	0.230	0.990	1.723	0.002
17	Qaznavi (2010)	0.489	0.290	0.032	0.225	0.321	1.153	0.000
18	Dayinezhad et al (2010)	0.213	0.412	0.029	0.024	0.024	1.024	0.002
19	Effects of a fixed combination	0.584	0.086	0.001	0.383	0.621	10.648	0.000
20	The combined effects of random	0.584	0.086	0.001	0.383	0.621	10.648	0.000

Considering the random effects model and the 95% confidence interval, the data in Table 3 show that the studies of Niyazazari and Hosseini (2012), Shakeri (2012), Zameni et al. (2011), Niyazazari et al. (2012), Satari and Mohammadi (2011), Soleymanpour et al. (2010), Momeni et al. (2012), Safariyan et al. (2010), Zare (2009), Aminifar et al. (2011), Najafi (2009), and Khaznavi (2010) were significant in terms of effect size. That is because the mean effect size is about 0.6 and studies where the effect size is less than this value are considered significant. On the other hand, effect size was not significant in the studies of Malekyian et al. (2011), Zameni and Kardan (2012), Satari et al. (2010), Ahmadi et al. (2011), and Afkhami et al. (2012). In these studies the effect size is greater than the mean effect size (0.6). The results of the research were also analyzed using fixed effects model, and the effect size was significant in studies number 2, 5, 6, 9, 10, 11, 12, 13, 15, 16, 17, and 18.

2nd Question: Based on the meta-analysis methodology, what is the size of the effect of ICT on academic achievement (i.e. to what extent can ICT predict academic achievement)?

Table 4. Meta-analysis of the relationship between ICT and academic achievement

	N	Sample Size	Fixed Effects	Random Effects	Explained Variance	CI (95%)	Test of Homogeneity	df	Sig.
ICT and academic achievement	94	18	0.608	0.608	0.109	0.383 0.608	0.231*	18	0.072

Based on the data in Table 4, the mean size of the effect of ICT (random effects) on academic achievement in the studied sample is 0.608. Because the estimated effect size is within the confidence interval, there ICT is significantly associated with academic achievement. The homogeneity test, however, does not yield significant values. Cohen's model is used to interpret the effect size data (Table 5).

Table 5. Interpretation of effect size data based on Cohen's model (Safiri and Sadafi, 2012)

Effect Size	Pearson Correlation Coefficient (r)	Cohen's d	Explained Variance
Small	0.2	0.3	0.01
Medium	0.3	0.6	0.09
Large	0.6	0.9	0.25

The results provided in Table 5 show that the calculated effect size is above the average level based on Cohen's model. Thus, there is a significant relationship between ICT and academic achievement.

#### IV. Discussion and Conclusion

The purpose of the present research was to conduct a meta-analysis of the relationship between information and communications technology (ICT) and academic achievement. In the knowledge era, ICT has been very effective for the advancement of societies, especially in terms of learning and education. Indeed the mere application of ICT does not guarantee learning, but according to Clark, ICT-based methods, approaches, and techniques influence the process. This research uses a meta-analysis methodology to provide a holistic view of this relationship. Meta-analysis is a statistical approach for integrating the results of distinct studies in order to come to more accurate and valid conclusions. The effect size of individual studies (standard error of the mean, standard error, variance, lower limit, and upper limit) and fixed and random effects were used to answer the first question of the research about whether ICT has a significant effect on academic achievement. Our meta-analysis of effect sizes reported in 18 research papers showed that there is a significant relationship between ICT and academic achievement with a mean effect size of 0.608. Since the mean effect size is within the confidence interval (0.383 to 0.621), the relationship between ICT and academic achievement is confirmed.

The second question involved the size of the effect of ICT on academic achievement. The mean effect size is almost above average (0.6) based on Cohen's interpretation. Therefore, the effect of ICT on academic achievement is medium. In other words, ICT is an important factor in learning and academic achievement. ICT is an essential aspect of the knowledge era and has been very effective in fostering and improving learning. Considering the effect size of 0.608, we can positively claim that providing sufficient the human, financial, physical, and administrative infrastructure for ICT and using it effectively can lead to significant increase in learning. Also students will demonstrate their capabilities and skills faster and teachers will have more alternatives for teaching creatively. Moreover, ICT integrates content and information literacy, often in textual and visual forms, and produces significant learning and academic achievement. Therefore, officials in Iran's higher education system, who are faced with the challenges of globalization and the information age, must prepare students with the components of this age by effectively integrating ICT into the teaching-learning process.

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