

Comparative Analysis of E-Learning Standard

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Abstract: *In this paper is presented a comparative analysis of standards in the field of e-learning, published both by ISO and International Organization for Standardization standards, as well as standards by local organizations in the countries of the region. The aim of the research is to analyze the current situation at the global and local level in the field of e-learning. The results obtained by the survey indicate similarities and differences both in terms of publication trends and the price values of standards published by the international ISO organization and local organizations of the countries of the region.*

Keywords: *e-learning; standardization; trend analysis; comparative analysis*

1. INTRODUCTION

It is important to note that standardization is a set of coordinated activities for the adoption of standards and related documents, while the standard is a publicly available document, determined by consensus, and adopted by a recognized body, in which rules, requirements, characteristics, instructions, recommendations, or recommendations are laid down for general and re-use, guidelines for activities or their results, in order to achieve an optimal level of regulation in a particular area in relation to existing or potential problems [1].

Within ISO / IEC international standardization, and according to the international standard classification, standards are organized in 40 groups. The e-learning group that will be considered in this paper is an information technology group (35), e-learning (35.240.99) and a group in which standards are defined service organization, quality management and administration (03) and 03.100.30 (e-learning from the aspect of human resources management) [2].

E-learning is standardized by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). In addition to the aforementioned organizations, there are many other e-learning standards, for example: AICC, IMS, DCMI, ADL-SCORM, ALIC, IEEE LTSC, ADRIADNE, CEN / ISSS WS-LT, CEN / ISSS CDFS, CEN / ISSS WS on Privacy, W3C etc.c [3]. The JTC 1 / SC 36 subcommittee for e-learning functions in the framework of the First Technical Committee (JTC1 ISO / IEC). This subcommittee contains seven working groups (Working group) and one advisory group [4].

The paper presents trends in the development of standards in the field of e-learning published by

both ISO and International Organization for Standardization standards, as well as standards by local organizations of the countries of the region: SRPS (Institute for Standardization of Serbia), HRN (Institute for Standardization of Croatia), BAS (Institute for Standardization of Bosnia and Herzegovina), SIST (Slovenian Institute for Standardization) and MKS (Institute for Standardization of Macedonia).

MEST standards (Institute for Standardization of Montenegro) have been derived from the countries of the region since there are no standards related to e-learning while searching at the official presentation.

2. RELATED WORK

In the paper [4], is presented a systematized analysis/synthesis and cross-section of the state of international and local (ISO / IEC and SRPS) standardization in the field of distance learning was presented, with the aim of presenting an analysis of the current state at the local (SRPS) and the global (ISO) level in sub-fields of e-learning. Authors working through the PDCA concept conclude that the price of access to standards and annual innovations exceeds the frameworks of individuals, that the development of national standards requires continuous teamwork, that DLS checks require adaptation of documentation for accreditation and provide a proposal for improvement in terms of the need for software development On-line access to local standards.

The authors in [5] observe the level of innovation by ISO and SRPS organization in the period from 2004 to 2012. In this paper is explained the correlation of the standards of e-learning and the standard number 12 accreditation documentation.

In the paper [3], the authors analyze the trend of publication of ISO and SRPS publication of e-

learning standards for the period from 2004 to 2015 as well as the connection of standards with the Massive open online courses as the standards have not yet been developed.

3. RESEARCH METHODOLOGY

The aim of the research is to analyze the current state and trends of publishing standards on global (ISO) and local (SRPS, HRN, BAS, SIST and MKS) level in the e-learning sub-area (ICS 35.240.90 / 99), and the price values between the observed standards.

Methods of research used in the paper are analysis, inductive-deductive method and comparative method. In the paper is used statistical analysis for comparing published and prediction of price values of the standards in preparation.

The data were collected on official web sites of the International Standards Organization (ISO), the Institute for Standardization of Serbia (SRPS), the Croatian Institute of Standards (HRN), the Institute for Standardization of Bosnia and Herzegovina (BAS), the Slovenian Institute for Standardization (SIST) for the standardization of the Republic of Macedonia (MKS).

According to [5], [6], [7], [8], [9] and [10], the number of e-learning standards in the period from 2004 to 2017 is 89. The following table gives an overview of the standards published by global and local organizations.

According to [4] standardized documents include indexes: Iqp - current published standards, Iv - value index.

Table 1. Overview of published ISO / SRPS / HRN / BAS / SIST / MKS standards by years

ICS 35.240.99		2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.	2013.	2014.	2015.	2016.	2017.	Σ
ISO	Iqp	1			1	3	6		8	2	2	4	9	4	2	42
	brStr	6			39	169	773		253	56	184	281	224	137	136	2258
	ΣIv	38			158	494	1048		1104	256	236	460	1072	470	356	5692
SRPS	Iqp										2	4				6
	brStr										144	142				286
	ΣIv										68	108				176
HRN	Iqp											7				7
	brStr											313				313
	ΣIv											272				272
BAS	Iqp							2	1	2	1	2	3	5	6	22
	brStr							160	59	74	38	94	71	87	350	933
	ΣIv							122	55	86	45	99	108	137	480	1132
SIST	Iqp						1		1			4				6
	brStr						/		/			/				0
	ΣIv						/		/			/				0
MKS	Iqp							1		1	2		2			6
	brStr							3		13	74		28			118
	ΣIv							8		15	50		23			96

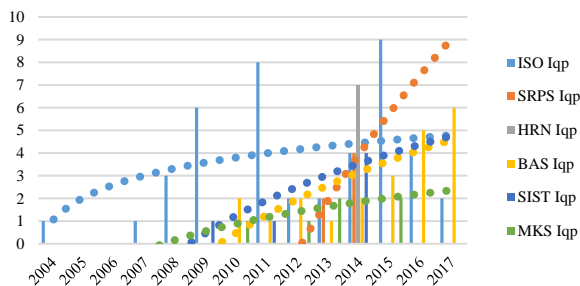


Figure 1. Number of published standards by years

Based on the previous table, it is possible to generate a chart of published standards (Iqp) by

years for international ISO and local standards (SRPS, HRN, BAS, SIST, MKS).

The mathematical expressions of the logarithmic functions in the function of the trend of published standards are as follows:

- $y_{ISO} = 1.4096 \ln(x) + 1.0689$
- $y_{SRPS} = 20.984 \ln(x) - 46.318$
- $y_{BAS} = 5.8713 \ln(x) - 10.91$
- $y_{SIST} = 5.0288 \ln(x) - 8.5087$
- $y_{MKS} = 2.1196 \ln(x) - 3.2324$

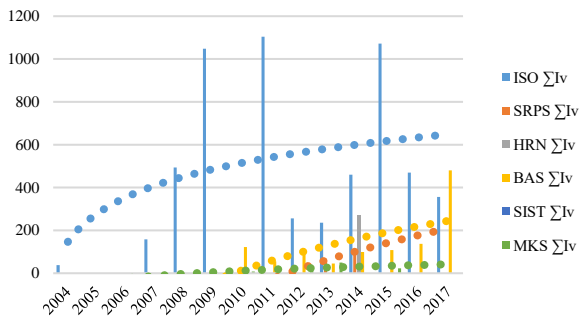


Figure 2. Graphically displayed values of published standards

The mathematical expressions of logarithmic functions in the function of the values of published standards:

- $y_{ISO} = 190.26\ln(x) + 146.39$
- $y_{SRPS} = 419.68\ln(x) - 898.35$
- $y_{BAS} = 330.12\ln(x) - 626.53$
- $y_{MKS} = 42.584\ln(x) - 71.075$

For SIST standards published by the Slovenian Standards Institute according to [9], there are no price values.

Based on the table, it can be concluded that the highest number of announcements was in 2014, a total of 20 standards were published by international (ISO) and local (SRPS, HRN, BAS, SIST, MKS) organizations.

According to the previous chart, in 2014, 21 standards with a total price of 939 CHF were developed. Unlike 2014, in 2015, seven standards have been developed, 14 have been developed. Although the total price of the standard is 1203 CHF published in 2015.

The lack of published standards in 2015 in relation to 2014 can be explained by a greater number of announcements by the international (ISO) organization.

The total price of the standard published in the period from 2004 to 2017 expressed in CHF is 7368, of which only the international (ISO) standard is 5692 CHF.

4. COMPARATIVE ANALYSIS OF PUBLISHED E-LEARNING STANDARDS

The prices of international and local standards are defined on the basis of price classes, the number of pages of the observed standard and the language in which the standard is published.

4.1. Statistical analysis

Based on the price values of the standard, it is possible to determine the value of the median, average value, mod, standard deviation and the minimum and maximum price value of the standard.

Table 2. Statistical values of the standard

	Standards				
	ISO	SRPS	HRN	BAS	MKS
Median	138,00	29,52	41,33	40,54	18,78
Average value	135,52	29,33	45,81	44,68	19,08
Mod	138,00	/	41,33	40,54	/
Standard deviation	47,96	14,83	9,43	16,28	8,41
Min	16,00	9,72	34,18	22,65	8,27
Max	198,00	50,89	62,00	90,61	30,80

From the previous table, it can be concluded that the highest price values of the standard are those published by the ISO organization, while observing the price values of organizations publishing standards in the region, it can be concluded that the highest price values (average) for HRN standards. The cheapest standards are the standards published by the Institute for Standardization of Macedonia (MKS standards).

On the basis of the price level, it is possible to:

- group data in the form of an interval numeric series
- calculate the rising and decreasing cumulant
- calculate the relative frequency and the cumulative frequency in percentages

for ISO standards:

Number of standards (samples) $N = 42$; Maximum value: 198.00; Minimum value: 16.00;

Number of intervals: $K=1+3,3 \cdot \log N = 6,357 \approx 6$

Interval width: $i=((X_{max}-X_{min}))/K = 30,30 \approx 30$

Table 3. Grouping of data in the form of an interval numerical series - ISO standards

Group interval		Frequency	Arithmetic mean	Increasing cumulant	Decadent cumulant	Relative frequency (%)	Cumulative frequency (%)
16,00	45,00	4	30,50	4	42	9,52	9,52
46,00	75,00	0	60,50	4	38	0,00	9,52
76,00	105,00	4	90,50	8	38	9,52	19,05
106,00	135,00	7	120,50	15	34	16,67	35,71
136,00	165,00	16	150,50	31	27	38,10	73,81
166,00	198,00	11	182,00	42	11	26,19	100,00
		42				100	

Based on the table 3, it is possible to create a relative and cumulative frequency graph

(expressed as a percentage) of the publication of the ISO standard.

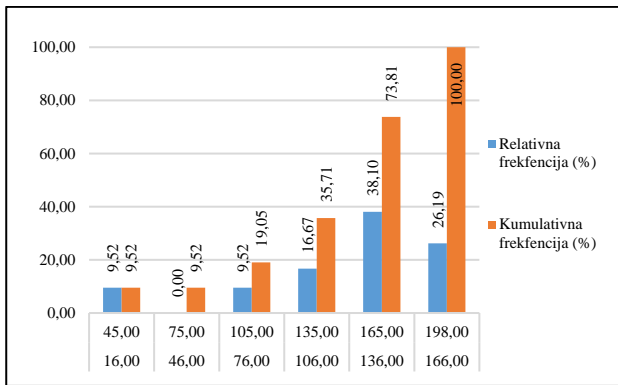


Figure 3. Frequency of publication of ISO standards

According to a figure 3, it is concluded that for most (38.10%) published standards, between 136 and 165 CHF should be allocated.

4.2. Testing to determine the difference between price levels

Table 4. Observed standards

Observed standards	Organization									
	ISO		SRPS		HRN		BAS		MKS	
	Price (CHF)	Number of pages	Price (CHF)	Number of pages	Price (CHF)	Number of pages	Price (CHF)	Number of pages	Price (CHF)	Number of pages
19788-1	178,00	55	38,85	65	62,00	59	50,42	65	30,80	55
19788-2	118,00	19	26,42	29	41,33	23	40,54	29	18,78	19
19788-3	138,00	28	9,72	3	48,48	32	40,54	25	22,53	28
19788-5	138,00	34	32,63	45	53,25	38	45,31	34	27,22	34
19796-1	178,00	67	50,89	131	40,06	125	76,30	121	8,27	3
Σ	750,00	203	158,51	273	245,12	277	253,11	274	107,60	139

The observed standards can be paired in order to test the zero hypothesis on the equality of arithmetic meanings ($H_0: \mu_1 = \mu_2$) according to the previous table based on price or page numbers. At the end of the previous table, the number of pages is quite equal. Standards are paired by price values.

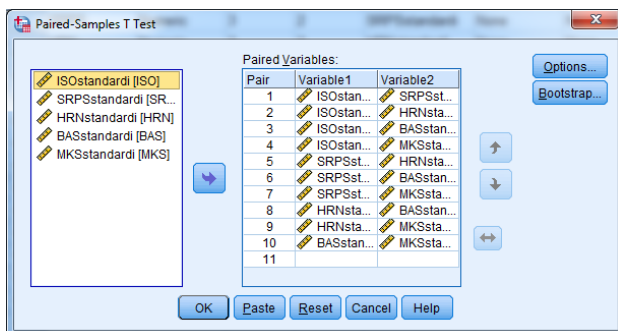


Figure 2. Paired standards

In order to determine the differences, it is possible to do statistical tests using the distribution over the observed standards. Student's t-test is the most commonly used parameter significance test for testing the zero hypothesis. One-Sample t-test is used when we want to know if our sample comes from a particular population, but we do not have complete information about this population. He tests whether the sample comes from a population with a specific mean value. Therefore, this test is also called the t-test difference of the mean value of the basic set and sample.

In order for the test to be adequately regulated, it is possible to observe from the table of published standards the standards published by all observed organizations, based on the above, it follows the following table.

During testing, SPSS program was used, and according to [11], it is representing software package used for statistical analysis.

By default, the level of confidence that is defined is 95%. As a result of the t-test test, three tables are obtained.

Paired Samples Statistics table shows the mean values of the tested variables, while the N column represents the number of observations observed, or the number of standards. In the next column, standard deviations are shown and in the last error of standard deviations for the observed standards.

Table 5. Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	ISO standard	150,0000	5	26,83282	12,00000
	SRPS standard	31,7020	5	15,25813	6,82364
Pair 2	ISO standard	150,0000	5	26,83282	12,00000
	HRN standard	49,0240	5	9,02888	4,03784
Pair 3	ISO standard	150,0000	5	26,83282	12,00000
	BAS standard	50,6220	5	14,92407	6,67425
Pair 4	ISO standard	150,0000	5	26,83282	12,00000
	MKS standard	21,5200	5	8,69912	3,89036
Pair 5	SRPS standard	31,7020	5	15,25813	6,82364
	HRN standard	49,0240	5	9,02888	4,03784
Pair 6	SRPS standard	31,7020	5	15,25813	6,82364
	BAS standard	50,6220	5	14,92407	6,67425
Pair 7	SRPS standard	31,7020	5	15,25813	6,82364
	MKS standard	21,5200	5	8,69912	3,89036
Pair 8	HRN standard	49,0240	5	9,02888	4,03784
	BAS standard	50,6220	5	14,92407	6,67425
Pair 9	HRN standard	49,0240	5	9,02888	4,03784
	MKS standard	21,5200	5	8,69912	3,89036
Pair 10	BAS standard	50,6220	5	14,92407	6,67425
	MKS standard	21,5200	5	8,69912	3,89036

In the next table Paired Samples Correlations table, the number of observations is given, while the

second column shows the correlation. Third column Sig. the value of the correlation coefficient is given.

Table 6. Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	ISO standard & SRPS standard	5	,708	,181
Pair 2	ISO standard & HRN standard	5	,324	,594
Pair 3	ISO standard & BAS standard	5	,762	,134
Pair 4	ISO standard & MKS standard	5	-,111	,858
Pair 5	SRPS standard & HRN standard	5	-,041	,947
Pair 6	SRPS standard & BAS standard	5	,836	,078
Pair 7	SRPS standard & MKS standard	5	-,359	,553
Pair 8	HRN standard & BAS standard	5	-,319	,600
Pair 9	HRN standard & MKS standard	5	,903	,036
Pair 10	BAS standard & MKS standard	5	-,683	,203

Paired Samples Test table, the first column presents the mean value, then the standard deviation and the standard deviation error, the confidence level of 95% (upper and lower limits). The last three columns of the table represent the realized test statistics (column t), the df column represents the number of degrees of freedom (the number of independent information units involved

in estimating the parameter representing the degrees of freedom of the parameter estimation are equal to the number of independent values that are included in the estimation minus the number of parameters used as intermediates in the evaluation of the parameter itself.) and the p-value of the test (Sig. (2-tailed)).

Table 7. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	ISO – SRPS standard	118,29800	19,32021	8,64026	94,30879	142,28721	13,691	4	,000
Pair 2	ISO – HRN standard	100,97600	25,38387	11,35201	69,45777	132,49423	8,895	4	,001
Pair 3	ISO – BAS standard	99,37800	18,23151	8,15338	76,74060	122,01540	12,189	4	,000
Pair 4	ISO – MKS standard	128,48000	29,11485	13,02056	92,32914	164,63086	9,867	4	,001
Pair 5	SRPS – HRN standard	-17,32200	18,04704	8,07088	-39,73036	5,08636	-2,146	4	,098
Pair 6	SRPS – BAS standard	-18,92000	8,65636	3,87124	-29,66829	-8,17171	-4,887	4	,008
Pair 7	SRPS – MKS standard	10,18200	20,09126	8,98509	-14,76460	35,12860	1,133	4	,320
Pair 8	HRN – BAS standard	-1,59800	19,75713	8,83566	-26,12972	22,93372	-,181	4	,865
Pair 9	HRN – MKS standard	27,50400	3,91024	1,74871	22,64880	32,35920	15,728	4	,000
Pair 10	BAS – MKS standard	29,10200	21,81455	9,75577	2,01565	56,18835	2,983	4	,041

From the obtained results (the last column of Sig. (2-tailed)) we conclude that there is a significant difference in the price values based on the observed pairs (seven of them), therefore we reject the zero hypothesis since they are less than 0.05.

5. CONCLUSION

Based on the previous presentation, it can be concluded that the publication of standards by local organizations depends on the publication of the global ISO organization. As a problem it can be noticed that until adoption or harmonization of standards of local organizations can pass several years from the moment of adoption of the global ISO standard.

The statistical analysis of the price level of the published standards is gupped into the interval numerical series, the increasing and decreasing cumulative as well as the relative and cumulative frequency are calculated in percentages.

Based on the statistical analysis, it can be concluded that for most of the published ISO standards (38.10%), between 136 and 165 CHF should be allocated.

Differences in the prices of the representative standards published by organizations have been proven using the t-test, the concordance between the standards concludes that most published standards differ significantly. Although the volume of published standards by the number of parties is not significantly different, differences in price values can be explained as differences in purchasing power and economic situation of countries that publish standards.

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