Comparative Analysis of the Efficiency of High-Quality Intellectual Capital Formation in Various Scientific Sectors

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Abstract: In the present situation of the formation of high-quality intellectual capital at scientific institutions in Latvia, the theme of the research is highly topical. The object of the research is the formation of high-quality intellectual capital at scientific institutions in various scientific sectors while the subject of the research is the comparative analysis of the efficiency of high-quality intellectual capital formation at scientific institutions in various scientific sectors of Latvia. The objective of the research is the comparative analysis of the efficiency of high-quality intellectual capital formation at scientific institutions in various scientific sectors of Latvia in the period from 2013 to 2018. The following tasks were determined to reach the objective: to study the formation of high-quality intellectual capital at scientific institutions in various scientific sectors of Latvia; to identify the concept of the efficiency of high-quality intellectual capital formation in various scientific sectors; to calculate main indicators thereof, and, to carry out the comparative analysis of indicators characterising the efficiency of high-quality intellectual capital formation at scientific institutions in various scientific sectors in Latvia. Research methods used in the paper are content analysis, economic analysis, and economic experiment.

Keywords: High-quality intellectual capital, Efficiency indicators, Comparative analysis, Scientific institutions, Latvia

1. Introduction

Every six years, the Ministry of Education and Science of the Republic of Latvia (IZM) shall organise an international evaluation of the scientific institutions (SIs) registered in Latvia (IESI). The last IESI took place in the period from 2013 to 2018. In order to establish the dynamics of the efficiency indicators of the academic staff involved in the formation of high-quality intellectual capital (HQIC) at the SIs of Latvia (IZM, 2021), the authors used the output data of findings across the set of SIs evaluations per period from 2013 to 2018 offered by "Technopolis-group" (TG). It provides an opportunity for the authors to calculate the HQIC indicators at the SIs of Latvia and to compare their dynamics during the period from 2013 to 2018.

Data of the comparative analysis will help to develop support and motivation programs to increase the efficiency of involvement of the academic staff in the HQIC formation. In addition, the comparative analysis will reveal whether the score on quality of research at the SIs of Latvia in the IESI of TG coincides with the place of the SI of Latvia in the ratings of the HQIC indicators, and whether the quality of research score of the SI of Latvia also reflects the efficiency of the involvement of the academic staff of the SI of Latvia in the HQIC formation.

Hypothesis: The quality of research scores of the SIs shows the efficiency of the HQIC formation in the SIs of Latvia.

2. Theoretical Background

The authors rely on research of understanding, adapting, applying IC in universities (Mercado-Salgado et al, 2016), and research of the role of human capital in educational-training process at the university (Contu, 2017) presented different aspects of IC. Spica et al (2017a) state that IC is an economic category, the spiritual value created by the human potential, and it can be accumulated and converted into the value of other capitals. By investigating certain information about the management of education, we can increase the capacity and significance of the country's total economic capital movement.

Scientific articles, monographs, and national and international patents form the totality of the IC of each SI. Rondeau et al (2022) remind that peer reviewed publications remain a traditional form of academic productivity. From this set of IC, scientific publications included in the international databases "Web of Science" (WoS) and "SCOPUS" are conventionally considered HQIC. Such scientific publications provide an opportunity to determine the international competitiveness of various scientists, SIs, and sectors of science in Latvia.

Spica et al (2017a; 2017b) have worked out four indicators of the efficiency of the formation of IC in the higher education establishment: (1)The efficiency of the involvement of academic staff in the formation of IC per year in percentages (AIK); (2)The efficiency of the involvement of academic staff with a Doctorate degree in the formation of IC per year in percentages (DIK); (3)The efficiency of the involvement of students in the formation of IC per year in percentages (SIK); (4)Mutual efficiency of the involvement members of the academic staff with Doctorate degrees and the academic staff without Doctorate degrees in the formation of IC per year in times, (DE).

In order to calculate the AIK, DIK, SIK, and DE of the HEE Spica et al (2017a; 2017b) have worked out four formulas: (1) AIK = (ZPS : AS) x 100; (2) DIK = (ZPS : DS) x 100; (3) SIK = (ZPS : SS) x 100; (4) DE = DIK : AIK. Where: ZPS represents the number of scientific publications of the HEE per year; AS represents the number of academic staff in full-time jobs per year; DS represents the number of academic staff with Doctorate degrees holding in full-time jobs per year; SS represents the number of students per year.

3. Methodology

In their study, the authors will conduct a comparative analysis of SIs involved in the formation of HQIC in various sectors of science in Latvia. It comprised evaluation of SIs of six sectors of science: 1)Engineering and Computer Sciences (E&CS); 2)Natural Sciences (NS); 3)Medical and Health Sciences (M&HS); 4)Agriculture, Forestry, and Veterinary Sciences (A&F&VS); 5)Social Sciences (SS); 6)Humanities and Art Sciences (H&AS).

The authors modified the above mentioned formulas for the purposes of the study. Namely, calculate HQIC efficiency indicators for total numbers of full time equivalent (FTE) academic and research personnel (KIK), for FTE academic personnel (AIK), for FTE academic research personnel (PIK) and for PhDs completed at the SI (SIK). In addition, all the authors of the above-mentioned HQIC efficiency indicators were calculated for total number of self-reported outputs of articles in peer reviewed scientific edited journals and conference proceeds included in WoS or SCOPUS (WS). The authors calculated mutual efficiency indicators (PE) regarding involvement of the FTE academic research personnel (PS) and the FTE academic personnel (AS) in the formation of HQIC in times.

In the present research, the authors used the following data from the IESI: output data on the number of FTE academic personnel (AS), the number of FTE academic and research personnel (PS), the total number of FTE academic and research personel (KS), the number of PhDs completed (SS), the number of articles in peer reviewed scientific edited journals and conference proceedings included in WoS or SCOPUS (WS) in period 2013-2018 per SI in Latvia. Authors revised the above WS for the year. TG analysed 62 SI of Latvia.

In this study, one WS are accepted as one unit of HQIC. Further, using the modified formulas 1; 2; 3; and 4, were calculated: KIK, AIK, PIK, SIK, PE. Then, according to the results obtained through the author's calculations, a corresponding rating place was assigned to each SI of Latvia per year and each of the above indicators KIK, AIK, PIK and SIK.

Each rating location was then assessed with an appropriate score, where the lowest score is 1 point, while the highest score is 5 points. The above mentioned assessment system makes it possible to compare the quantitative efficiency indicators of SI of various scientific sectors in Latvia calculated by the authors with IESI overall assessment criterion - quality of the research performance of the SI. The relevant Panel of the TG was a score of the research performance of each SI using the scale, where score 5 means outstanding level of research, score 4 means very good level of research, score 3 means good level of research, score 2 means adequate level of research, score 1 means poor level of research (IZM, 2021).

Next, the unified overview of all six sectors of science in Latvia was created. Here, the SIs were arranged according to the obtained rank in their sector of science. Furthermore, indicators of the efficiency of the involvement of academic staff of each SI in the formation of HQIC were added. The authors then selected one SI with the highest efficiency indicator of the involvement of academic staff in the formation of HQIC from the unified review of the sectors of science in Latvia, accepted it as the basic indicator, and equated it to 100%. Further, the authors calculated the proportion of the efficiency of the involvement of academic staff of each SI in the base indicator.

After that, a rating scale of the results obtained was created on five-score system, where the highest rating is five score, and the lowest rating is one score. The new efficiency rating system for the involvement of academic staff of SIs in the formation of HQIC created by authors provides for granting of one score for the obtained efficiency indicators from 1% to 20%, 2 scores - for the obtained efficiency indicators from 21% to 40%, 3 scores

- for the obtained efficiency indicators from 41% to 60%, 4 scores - for the obtained efficiency indicators from 61% to 80%, and 5 scores - for the obtained efficiency indicators from 81% to 100%,

The follow-up authors compared the results of their own estimates of SI quantitative indicators to the relevant Panel of the TG's results of qualitative indicators, calculated the difference between the indicators and the changes. For this purpose, the authors calculated for each SI sore of indicators recording efficiency of HQIC and average score of each scientific sector. After that, authors compared these scores with scores of quality of the research of each SI developed by Panel of the TG.

4. Results

To calculate the efficiency of the involvement of academic staff in the formation of HQIC, the authors used formulas that were developed and approbated already before and now modified.

AIK = (WS : AS) x 100 (1)

PIK = (WS: PS) x 100 (2)

KIK = (WS : KS) x 100 (3)

SIK = (WS: SS) x 100 (4)

PE = PIK : AIK (5)

Table 1: Performance indicators of the involvement of academic personnel of SIs in the formation of HQIC in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

AIK rating	E&CS AIK (%)	E&CS AIK (%) of base indicator	E&CS AIK score	NS AIK (%)	NS AIK (%) of base indicator	NS AIK score	M&HS AIK (%)	M&HS AIK (%) of base indicator	M&HS AIK score	A&F&VS AIK (%)	A&F&VS AIK (%) of base indicator	A&F&VS AIK score	SS AIK (%)	SS AIK (%) of base indicator	SS AIK score	H&AS AIK (%)	H&AS AIK (%) of base indicator	H&AS AIK score
1	1584	100	5	550	35	2	519	33	2	191	12	1	596	38	2	54	3	1
2	1264	80	5	494	31	2	426	27	2	0	0	0	556	35	2	49	3	1
3	933	59	3	415	26	2	230	15	1	0	0	0	345	22	2	39	2	1
4	833	53	3	389	25	2	21	1	1	0	0	0	289	18	1	23	3	1
5	706	45	3	0	0	0	0	0	0	0	0	0	226	14	1	19	1	1
6	467	29	2	0	0	0	0	0	0				217	14	1	10	1	1
7	301	19	1	0	0	0	0	0	0				169	11	1	9	1	1
8	274	17	1				0	0	0				109	7	1	5	0	0
9	236	15	1										105	7	1	4	0	0
10	221	14	1										92	6	1	0	0	0
11	201	13	1										77	5	1	0	0	0
12	74	5	1										76	5	1			
13	14	1	1										59	4	1			
14	0	0	0										0	0	0			
15	0	0	0										0	0	0			

AIK rating	E&CS AIK (%)	E&CS AIK (%) of base indicator	E&CS AIK score	NS AIK (%)	NS AIK (%) of base indicator	NS AIK score	M&HS AIK (%)	M&HS AIK (%) of base indicator	M&HS AIK score	A&F&VS AIK (%)	A&F&VS AIK (%) of base indicator	A&F&VS AIK score	SS AIK (%)	SS AIK (%) of base indicator	SS AIK score	H&AS AIK (%)	H&AS AIK (%) of base indicator	H&AS AIK score
16	0	0	0															
Average	392	25	2	733	46	3	456	29	2	478	30	2	144	9	1	23	1	1

According to Table 1 the highest AIK indicator in the formation of HQIC in a year is 1584% and was accepted by the authors as the basic indicator or 100%. The above indicator has been achieved by a SI representing the E&CS. Consequently, the efficiency indicator of the SIs of other sectors of science in Latvia were attributed to this higher efficiency indicator in order to determine their proportion as a percentage. Then, according to the new rating system developed by the authors, each SI was assigned a certain number of scores.

Table 2: Performance indicators of the involvement of academic research personnel of SIs in the formation of HQIC in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

PIK rating	E&CS PIK (%)	E&CS PIK (%) of base indicator	E&CS PIK score	NS PIK (%)	NS PIK (%) of base indicator	NS PIK score	M&HS PIK (%)	M&HS PIK (%) of base indicator	M&HS PIK score	A&F&VS PIK (%)	A&F&VS PIK (%) of base indicator	A&F&VS PIK score	SS PIK (%)	SS PIK (%) of base indicator	SS PIK score	H&AS PIK (%)	H&AS PIK (%) of base indicator	H&AS PIK score
1	833	4	1	173	1	1	20256	100	5	338	2	1	1650	8	1	354	2	1
2	627	3	1	159	1	1	485	2	1	80	0	0	729	4	1	121	1	1
3	468	2	1	128	1	1	472	2	1	77	0	0	556	3	1	73	0	0
4	337	2	1	113	1	1	252	1	1	70	0	0	545	3	1	53	0	0
5	292	1	1	74	0	0	199	1	1	51	0	0	514	3	1	52	0	0
6	234	1	1	66	0	0	82	0	0				474	2	1	44	0	0
7	219	1	1	26	0	0	70	0	0				290	1	1	42	0	0
8	202	1	1				52	0	0				242	1	1	41	0	0
9	202	1	1										218	1	1	35	0	0
10	194	1	1										155	1	1	28	0	0

PIK rating	E&CS PIK (%)	E&CS PIK (%) of base indicator	E&CS PIK score	NS PIK (%)	NS PIK (%) of base indicator	NS PIK score	M&HS PIK (%)	M&HS PIK (%) of base indicator	M&HS PIK score	A&F&VS PIK (%)	A&F&VS PIK (%) of base indicator	A&F&VS PIK score	SS PIK (%)	SS PIK (%) of base indicator	SS PIK score	H&AS PIK (%)	H&AS PIK (%) of base indicator	H&AS PIK score
11	180	1	1										136	1	1	22	0	0
12	161	1	1										92	0	0			
13	141	1	1										90	0	0			
14	124	1	1										89	0	0			
15	76	0	0										15	0	0			
16	54	0	0															
Average	242	1	1	109	1	1	160	1	1	96	0	0	256	1	1	39	0	0

Comparing the figures collected in Table 2, the authors conclude that the highest PIK indicator of 20256% is for the SI of the M&HS, while the lowest PIK indicator of 15% is for the SI of the SS. It follows that only one SI get the highest rating of 5 score, thirty six SIs get 1 score, but other SIs get 0 scores.

Table 3: Performance indicators of the involvement of PhDs completed at SIs in the formation of HQIC in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

SIK rating	E&CS SIK (%)	E&CS SIK (%) of base indicator	E&CS SIK score	NS SIK (%)	NS SIK (%) of base indicator	NS SIK score	M&HS SIK (%)	M&HS SIK (%) of base indicator	M&HS SIK score	A&F&VS SIK (%)	A&F&VS SIK (%) of base indicator	A&F&VS SIK score	SS SIK (%)	SS SIK (%) of base indicator	SS SIK score	H&AS SIK (%)	H&AS SIK (%) of base indicator	H&AS SIK score
1	654	98	5	659	99	5	494	74	4	547	82	5	667	100	5	450	67	4
2	516	77	4	625	94	5	336	50	3	477	72	4	647	97	5	344	52	3
3	467	70	4	606	91	5	284	43	3	354	53	3	550	82	5	130	19	1
4	413	62	4	578	87	5	209	31	2	303	45	3	327	49	3	58	9	1
5	360	54	3	255	38	2	188	28	2	237	36	2	236	35	2	49	7	1
6	288	43	3	239	36	2	171	26	2				222	33	2	42	6	1
7	279	42	3	179	27	2	127	19	1				156	23	2	36	5	1
8	257	39	2				75	11	1				148	22	2	34	5	1
9	252	38	2										103	15	1	24	4	1
10	247	37	2										81	12	1	13	2	1

SIK rating	E&CS SIK (%)	E&CS SIK (%) of base indicator	E&CS SIK score	NS SIK (%)	NS SIK (%) of base indicator	NS SIK score	M&HS SIK (%)	M&HS SIK (%) of base indicator	M&HS SIK score	A&F&VS SIK (%)	A&F&VS SIK (%) of base indicator	A&F&VS SIK score	SS SIK (%)	SS SIK (%) of base indicator	SS SIK score	H&AS SIK (%)	H&AS SIK (%) of base indicator	H&AS SIK score
11	209	31	2										71	11	1	0	0	0
12	202	30	2										61	9	1			
13	185	28	2										58	9	1			
14	154	23	2										0	0	0			
15	133	20	2										0	0	0			
16	0	0	0															
Average	296	44	3	241	36	2	209	31	2	316	47	3	112	17	1	51	8	1

In Table 3, according to the SIK indicators the first place and highest score is taken by the SI of the SS, while the lowest SIK indicator of 13% is for the SI of the H&AS. According to Table 3 follows that, at the SIs of the H&AS and the A&F&VS no one get 5 scores. In the E&CS and A&F&VS, only one SI get the highest 5 score, in the SS - three SIs get 5 score, but in the NS - four SIs get 5 score.

Table 4: Performance indicators of the involvement of total academic staff of SIs in the formation of HQIC in a year and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

KIK rating	E&CS KIK (%)	E&CS KIK (%) of base indicator	E&CS KIK score	NS KIK (%)	NS KIK (%) of base indicator	NS KIK score	M&HS KIK (%)	M&HS KIK (%) of base indicator	M&HS KIK score	A&F&VS KIK (%)	A&F&VS KIK (%) of base indicator	A&F&VS KIK score	SS KIK (%)	SS KIK (%) of base indicator	SS KIK score	H&AS KIK (%)	H&AS KIK (%) of base indicator	H&AS KIK score
1	449	2	1	128	1	1	20256	100	5	122	1	1	278	1	1	53	0	0
2	417	2	1	128	1	1	485	2	1	80	0	0	276	1	1	47	0	0
3	312	2	1	113	1	1	247	1	1	77	0	0	234	1	1	28	0	0
4	198	1	1	94	0	0	158	1	1	70	0	0	192	1	1	20	0	0
5	141	1	1	66	0	0	107	1	1	51	0	0	160	1	1	19	0	0
6	134	1	1	63	0	0	70	0	0				107	1	1	15	0	0
7	131	1	1	27	0	0	52	0	0				92	0	0	14	0	0
8	130	1	1				17	0	0				89	0	0	8	0	0

KIK rating	E&CS KIK (%)	E&CS KIK (%) of base indicator	E&CS KIK score	NS KIK (%)	NS KIK (%) of base indicator	NS KIK score	M&HS KIK (%)	M&HS KIK (%) of base indicator	M&HS KIK score	A&F&VS KIK (%)	A&F&VS KIK (%) of base indicator	A&F&VS KIK score	SS KIK (%)	SS KIK (%) of base indicator	SS KIK score	H&AS KIK (%)	H&AS KIK (%) of base indicator	H&AS KIK score
9	124	1	1										71	0	0	8	0	0
10	121	1	1										69	0	0	5	0	0
11	119	1	1										58	0	0	3	0	0
12	116	1	1										58	0	0			
13	114	1	1										49	0	0			
14	54	0	0										35	0	0			
15	53	0	0										15	0	0			
16	12	0	0															
Average	150	1	1	95	0	0	118	1	1	80	0	0	92	0	0	14	0	0

According to Table 4, the highest KIK indicator is 20256% and representing the SI of the M&HS. In the six scientific sectors twenty seven SIs get 1 score, but the other thirty four SIs get 0 score. It folows that total academic staff of SIs in various sectors of science in Latvia in period from 2013 to 2028 did not competitive in the formation of HQIC on international scientific environment.

Table 5: Performance indicators of the mutual efficiency indicators regarding involvement of total academic research personnel and total academic personnel of SIs in the formation of HQIC in times a year, quality of research (QTG) scores by TG, new total quantity KIK scores of SIs, and their comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

KIK rating	E&CS PE	E&CS QTG score	E&CS KIK score	NS PE	NS QTG score	NS KIK score	M&HS PE	M&HS QTG score	M&HS KIK score	A&F&VS PE	A&F&VS QTG score	A&F&VS KIK score	SS PE	SS QTG score	SS KIK score	H&AS PE	H&AS QTG score	H&AS KIK score
1	0,4	4	1	0,4	3	1	0	2	5	1,8	2	1	1,0	1	1	0	4	0
2	1,0	1	1	0	4	1	0	3	1	0	3	0	0,9	3	1	6,6	4	0
3	0,5	3	1	0,4	1	1	0,9	3	1	0	4	0	2,1	3	1	5	0	0
4	0,2	2	1	0,2	3	0	0,6	4	1	0	3	0	7,6	2	1	1,1	1	0
5	0	2	1	0	4	0	0,9	3	1	0	4	0	2,4	3	1	5,2	3	0
6	1,5	3	1	0,2	3	0	0	4	0				1,7	3	1	0,5	3	0
7	0,2	4	1	0	3	0	0	5	0				0	3	0	2,7	3	0
8	0,4	3	1				3,8	2	0				4,3	3	0	4,5	2	0
9	0	3	1										2,1	3	0	8,4	4	0

KIK rating	E&CS PE	E&CS QTG score	E&CS KIK score	NS PE	NS QTG score	NS KIK score	M&HS PE	M&HS QTG score	M&HS KIK score	A&F&VS PE	A&F&VS QTG score	A&F&VS KIK score	SS PE	SS QTG score	SS KIK score	H&AS PE	H&AS QTG score	H&AS KIK score
10	0,7	3	1										0,3	3	0	6,8	3	0
11	1,5	4	1										1,7	2	0	11,6	4	0
12	0,7	2	1										3,2	2	0			
13	0,9	2	1										1,8	2	0			
14	0	4	0										1,5	2	0			
15	2,6	2	0										0	2	0			
16	5,5	1	0															
Average	0,6	-	1	0,2	-	0	0,4	-	1	0,2	-	0	1,8	-	0	1,7	-	0

In Table 5, the PE indicators rests in the range from 0,2 to 11,6 in respect of the SIs in Latvia. The highest PE is held by the SI in the H&AS, while the lowest PE belongs to two SI's in the E&CS, and, to two SI's in the NS.

The highest average rate of the PE indicators is 1,8 in the SS, the second highest average rate of the PE indicators is 1,7 in the H&AS. It follows that academic research personnel of the SIs of the SS and the H&AS is more effective as theirs academic personnel in the formation of HQIC. Lowest average rate of the PE indicators is 0,2 in the NS and the A&F&VS. It follows that academic personnel of above scientific sectors is more effective in the formation of HQIC to compare with academic research personnel at the SIs of the NS and the A&F&VS. When comparing QTG scores by TG to new total quantity KIK scores calculated by authors, it can be concluded that they differ from 1 score to 5 scores in total. The assessment of the QTG scores and new KIK scores of each SI in various sector of sciences in Latvia results in a conclusion that new KIK scores were too lower, and, exept tor the one SI in the E&CS, one SI in the NS, and one SI in the SS, where QTG, KIK scores coincided.

Table 6: The summary of performance indicators of the involvement of total academic staff of SIs in the formation of HQIC in a year and their total margins of AIK, PIK, SIK, and KIK indicators comparative analysis in various sectors of science in Latvia in period from 2013 to 2018

Scores	Total margins of AIK (%)	Total margins of PIK (%)	Total margins of SIK (%)	Total margins of KIK (%)	Total average margins of AIK (%)	Total average margins of PIK (%)	Total average margins of SIK (%)	Total average margins of KIK (%)
0	4 - 5	15 - 92	-	3 - 94	-	39 - 96	-	14 - 95
1	9 - 301	113 - 1650	13 - 130	107 - 485	23 - 144	109 - 256	51 - 112	118 - 150
2	345 - 596	-	133 - 257	-	392 - 478	-	209 - 241	-
3	706 - 933	-	279 - 360	-	733 - 733	-	296 - 316	-
4	-	-	413 - 516	-	-	-	-	-
5	1264 - 1584	-	547 - 667	20256 - 20256	-	-	-	-

From the results summarised in the tables 6, authors conclude that for all AIK, PIK, SIK, KIK indicators whose score is 1, the total margins of PIK indicators and total average margins of PIK indicators are the highest. They are followed total margins of KIK indicators and total average margins of KIK indicators. Total margins for all indicators whose score is 5, belongs to KIK, AIK and SIK indicators. Total margins for all scores from 1 to 5, which finded is only for SIK indicators.

5. Conclusions

The study of the authors did not result in confirming hypothesis. The quality of research scores of the SIs do not shows the efficiency of the HQIC formation in the SIs of Latvia. When comparing the QTG scores of TG group to the new KIK scores by the authors, it can be concluded that they differ from 1 to 5 scores in total.

The study shows that new performance indicators KIK of the involvement of total academic staff of SIs in the formation of HQIC in various sectors of sciences in Latvia in period from 2013 to 2018 were lower as shown by the results compiled by the relevant Panel of the TG exept for the one SI of the M&HS, where the KIK score was highest per 3 scores.

The authors is encoraged to supplement the methodology for international evaluation of scientific institutions with the quantitative efficiency indicators AIK, PIK, SIK, KIK of the involvementof academic staff and PhDs completed at the SIs in the formation of HQIC per year in percentage, and, PE in times, and performance indicators of their comparative analysis in various sectors of sciences in country developed by the authors.

The methodology developed by the authors included five phases: (1)according to formulas previously developed by the authors, the efficiency indicators of each SI were calculated for AIK, PIK, KIK, SIK; (2)efficiency indicators for AIK, PIK, KIK SIK were ranked from higher to lower indicator, and each SI was given the rating in its science sector; (3)the comparative analysis of the individual efficiency indicators of each SI was carried out for the AIK, PIK, KIK, SIK between all scientific sectors, and the highest efficiency indicators of the AIK, PIK, KIK, SIK as a whole on the science were finded out; (4)the highest efficiency indicators for AIK, PIK, KIK, SIK were accepted as base indicator, equated its to 100%, and calculated the proportion of the efficiency indicator of each SI in the base indicator; (5)according to the rating scale developed by the authors, each SI was awarded an appropriate score based on the previously calculated efficiency indicators of the proportion of AIK, PIK, KIK, SIK in science as a whole.

Ethical Declaration: The authors declares that there are no ethical issues related to the research presented in this paper.

AI Declaration: The authors declares that no significant AI tools or technologies were used in the conduct the research for this paper.

References

Contu, E.G. (2017) “The Role of Intellectual Capital in Higher Education”, Proceedings of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April, pp. 66 -70.

Latvijas Republikas Izglītības un zinātnes ministrija (2021) “International Evaluation of Scientific Institution Activity, Latvia”, Report by the Technopolis group per period 2013.-2018 , Riga, 5 March

Mercado-Salgado, P., Cernas-Ortiz, D.A. and Gil-Monte, P. (2016) “Intellectual Capital Model for Mexican Public Universities”, Proceedings of the 8th European Conference on Intellectual Capital, 12-13 May, pp 172-177.

Rondeau, K., Dillon, J., Mansour, N. and Daniels, J. (2022) “Managing Knowledge and Identity across the Boundary of Academic and Commercial Science”, Proceedings of the 17th European Conference on Innovation and Entrepreneurship, Pafos, Cyprus, 15-16 September, pp. 432-440.

Spica, I., Garleja, R., Berzina, B. and Spics, E. (2018) “The Involvement of Students in the Formation of Intellectual Capital in Latvia”, Proceedings of the 19th European Conference on Knowledge Management, Padua, Italy, 6-7 September, pp. 811 -820.

Spica, I., Garleja, R. and Berzina, B. (2017a) “Intellectual Capital as the Performance Indicator of the University Studies”, Proceedings of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April, pp. 312 -320.

Spica, I., Garleja, R. and Berzina, B. (2017b) “The Efficiency of the Involvement of Academic Staff in the Formation of Intellectual Capital in Latvia”, Poster of the 9th European Conference on Intellectual Capital, Lisbon, Portugal, 6-7 April.