Current Situation of Teachers of Informatics at High Schools in Japan

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Abstract. In March 2018, the Japanese Ministry of Education, Culture, Sports, Science and Technology revised the curriculum guidelines for high school, which will be applied in 2022. The subject of Informatics has been drastically changed; 'Informatics I' and 'Informatics II' have a predominantly scientific approach. This could be problematic given that a lot of 'temporary teachers' and 'teachers without a proper license' teach Informatics, and more than half of the teachers that teach Informatics are in charge of multiple subjects. So, it may be difficult to implement new curriculum in the dozens of prefectures that have few teachers who specialize in Informatics. We report on the problems our investigation revealed.

Keywords: informatics education, elementary and secondary education, teacher license.

1. Introduction

In 2003, the subject of Informatics was introduced in Japanese high schools. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) revised curriculum guidelines in 2013. Under the current curriculum guidelines, each high school adopts either 'Information study for participating community' or 'Information study by scientific approach'.

In March 2018, MEXT revised the curriculum guidelines for high schools further (MEXT, 2018), (Kano, 2017). The latest curriculum guidelines will be applied in 2022. The subject of Informatics has been drastically changed, with 'Informatics I' and 'Informatics II' having a mainly scientific approach.

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Informatics is a field of science that investigates principles and technologies for defining semantics, creating value, and giving order to the world, by processing information. The principles and technologies for processing information include those of creation, generation, collection, representation, recording, recognition, analysis, transformation, and transmission (Hagiya, 2015). In order to teach Informatics to students at high schools, a wide range of knowledge and skills related to Informatics are required. Licensed teachers who specialize in the subjects related to Informatics are necessary.

However, there are many unlicensed teachers who teach Informatics. Researchers in educational administration have brought attention to this since Informatics first started being taught at high schools, but there has been little improvement (Nakano, 2006), (Kano, 2012), (Hagiya, 2016).

In 2003 when subject of Informatics was introduced, no licensed teachers existed because the subject did not exist until then. Since then, special rules have been applied to teachers assigned to teach Informatics. One of the special rules is a training course held from 2000 to 2003. A teacher who holds a license for another subject such as Mathematics, Science, etc. can obtain a license for Informatics by training for 15 days. Approximately 14,000 teachers have acquired licenses for Informatics.

Other special rules are 'temporary teachers' and 'teachers without a proper license'. These rules can be applied to other subjects, but since 2003 they have been widely used for Informatics. A prefectural board of education can hire 'temporary teachers' for up to three years if they cannot employ teachers with a proper license. In addition, the prefectural board of education can allow 'teachers without a proper license' to teachers who have a license for another subject.

In 2015, we requested the disclosure of administrative documents from the MEXT in order to obtain the number of 'temporary teachers' and 'teachers without a proper license' in 47 prefectures. So far, we have learned that a lot of 'temporary teachers' and 'teachers without a proper license' are applied for Informatics in comparison with other subjects (Nakayama *et al.*, 2017).

In this paper, we report the results of our latest request for disclosure of administrative documents from 47 prefectures and 19 major cities. It became clear that there are only a few teachers who specialize in Informatics (i.e., teachers who only teach Informatics) even among those who hold proper licenses for it, and more than half of the teachers who teach Informatics cover multiple subjects.

2. Procedure for Obtaining Disclosure of Administrative Documents and the Results

We have collected data on whether holders of Informatics licenses teach only Informatics or whether they also teach other subjects than Informatics.

In June 2015, MEXT required prefectures and major cities to report the recruitment, assignment, and training of teachers for Informatics. We collected the reports of 47 prefectures and 19 major cities. Although we have 20 major cities in Japan, we did not request disclosure for Sagamihara City, as they have no municipal high school.

Electronic applications were available in 44 prefectures and 18 cities. Data was provided electronically from 16 prefectures and 1 city, and paper documents were provided from the remaining prefectures and cities.

In showing how many teachers taught Informatics, only teachers at public schools were counted. National schools, private schools, schools with correspondence courses, and special support schools were excluded. Table 1 and Table 2 show the number of teachers who teach Informatics in 47 prefectures and 19 major cities as of May 2015.

Table 1

Teachers assigned for Informatics (Prefectures, May 2015)

Prefecture	Full-time teachers who teach Informatics					Public schools
	Total	Teachers with proper license		Temporary teachers	Teachers without proper license	
		Assigned only for Informatics	In charge of multiple subjects			
1 Hokkaido	289	37	134	0	118	237
2 Aomori	59	17	22	11	9	50
3 Iwate	99	2	47	15	35	74
4 Miyagi	101	13	43	3	42	76
5 Akita	75	12	42	13	8	58
6 Yamagata	45	3	39	0	3	28
7 Fukushima	120	9	50	61	0	96
8 Ibaraki	114	5	43	15	51	79
9 Tochigi	132	4	20	108	0	52
10 Gunma	130	3	111	3	13	63
11 Saitama	231	210	21	0	0	131
12 Chiba	327	22	305	0	0	124
13 Tokyo	163	163	0	0	0	233
14 Kanagawa	316	66	203	0	47	137
15 Niigata	126	0	58	3	65	95
16 Toyama	83	3	37	2	41	44
17 Ishikawa	105	1	25	20	59	45
18 Fukui	40	1	26	12	1	40
19 Yamanashi	50	1	27	0	22	30
20 Nagano	213	9	60	0	144	102
21 Gifu	149	5	56	5	83	48
22 Shizuoka	126	11	66	0	49	108
23 Aichi	435	57	152	1	225	176
24 Mie	82	30	40	0	12	66
25 Shiga	174	4	76	5	89	42
26 Kyoto	57	10	47	0	0	43
27 Osaka	266	140	116	0	10	142
28 Hyogo	294	74	105	0	115	116
29 Nara	67	10	35	11	11	33
30 Wakayama	86	7	30	11	38	46
31 Tottori	16	4	11	0	1	19
32 Shimane	53	2	39	0	12	38

Table 1 – continued from previous page

Prefecture	Full-time teachers who teach Informatics					Public schools
	Total	Teachers with proper license		Temporary teachers	Teachers without proper license	
		Assigned only for Informatics	In charge of multiple subjects			
34 Hiroshima	84	7	50	1	26	99
35 Yamaguchi	49	0	49	0	0	38
36 Tokushima	**61**	0	46	1	14	31
37 Kagawa	43	6	36	1	0	30
38 Ehime	90	0	88	0	2	51
39 Kochi	56	0	14	12	30	50
40 Fukuoka	123	13	93	4	13	87
41 Saga	45	9	30	0	6	22
42 Nagasaki	61	4	32	8	17	51
43 Kumamoto	48	17	20	7	4	45
44 Oita	42	17	4	5	16	35
45 Miyazaki	47	3	17	17	10	23
46 Kagoshima	92	1	48	36	7	48
47 Okinawa	48	39	1	0	8	45

Table 2

Teachers assigned for Informatics (Major Cities, May 2015)

City	Full-time teachers who teach Informatics					Public schools
	Total	Teachers with proper license		Temporary teachers	Teachers without proper license	
		Assigned only for Informatics	In charge of multiple subjects			
48 Sapporo	9	7	2	0	0	7
49 Sendai	3	1	2	0	0	3
50 Saitama	4	4	0	0	0	4
51 Chiba	7	0	4	0	3	2
52 Kawasaki	12	3	3	0	6	6
53 Yokoyama	28	25	1	0	2	9
54 Sagamihara	0	0	0	0	0	0
55 Niigata	7	0	4	3	0	3
56 Shizuoka	3	0	3	0	0	3
57 Hamamatsu	1	1	0	0	0	1
58 Nagoya	12	9	3	0	0	15
59 Kyoto	28	6	22	0	0	11
60 Osaka	27	4	11	0	12	20
61 Sakai	2	0	2	0	0	1
62 Kobe	23	4	19	0	0	7
63 Okayama	1	0	1	0	0	1
64 Hiroshima	4	0	4	0	0	4
65 Kitakyushu	1	0	1	0	0	1
66 Fukuoka	5	0	5	0	0	3
67 Kumamoto	1	0	0	1	0	2

Table 3
Teachers assigned for Informatics (47 prefectures and 19 cities, May 2015)

	Full-time teachers who teach Informatics					Public schools
	Total	Teachers with proper license		Tem-porary teachers	Teachers without proper license	
		Assigned only for Informatics	In charge of multiple subjects			
47 prefectures	5588 (100)	1059 (19.0)	2657 (47.5)	395 (7.1)	1477 (26.4)	3368
19 cities	178 (100)	64 (36.0)	87 (48.9)	4 (2.2)	23 (12.9)	103
Total	5766 (100)	1123 (19.5)	2744 (47.6)	399 (6.9)	1500 (26.0)	3471

Table 3 shows the total number for prefectures and major cities. We confirmed that a lot of 'temporary teachers' and 'teachers without a proper license' teach Informatics, as reported in (Nakayama *et al.*, 2017).

In 47 prefectures and 19 major cities, as shown in Table 3, about thirty percent of full-time teachers are 'temporary teachers' or 'teachers without a proper license'. In addition, about fifty percent of full-time teachers are assigned to multiple subjects, and only about twenty percent of full-time teachers specialize in Informatics.
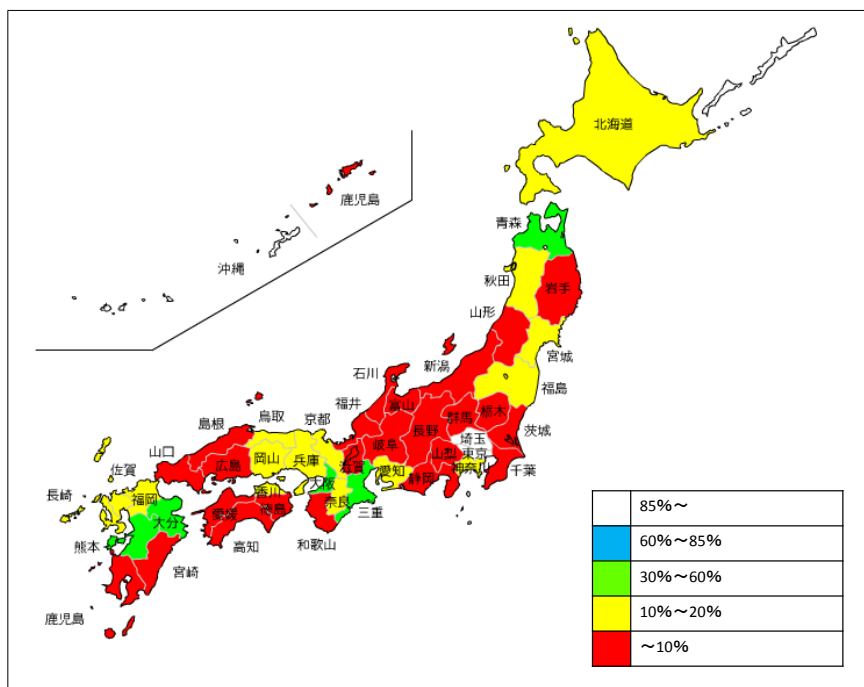

Fig. 1. Ratio of teachers who specialize in Informatics (May 2015).

The map in Fig. 1 shows the ratio of teachers who specialize in Informatics. The number of teachers who specialize in Informatics is more than half of the full-time teachers in Saitama Prefecture, Tokyo Prefecture, Osaka Prefecture, Okinawa Prefecture, Sapporo City, Saitama City, Yokohama City, Hamamatsu City, and Nagoya City (Table 4). The number of teachers who specialize in Informatics is more than half of the schools in Saitama Prefecture, Tokyo Prefecture, Osaka Prefecture, Hyogo Prefecture, Okinawa Prefecture, Sapporo City, Saitama City, Kawasaki City, Yokohama City, Hamamatsu City, Nagoya City, Kyoto City, and Kobe City (Table 5). These prefectures and cities are located in urban areas, except for Okinawa Prefecture.

The prefectures and cities that are not listed in Table 4 and Table 5 have zero or few teachers who specialize in Informatics. Many of these prefectures and cities are located in rural areas.

Table 4

Teachers who specialize in Informatics per full-time teachers (May 2015)

	Teachers who specialize in Informatics	Full-time teachers	Ratio
13 Tokyo Prefecture	163	163	1.00
50 Saitama City	4	4	1.00
57 Hamamatsu City	1	1	1.00
11 Saitama Prefecture	210	231	0.91
53 Yokohama City	25	28	0.89
47 Okinawa Prefecture	39	48	0.81
48 Sapporo City	7	9	0.78
58 Nagoya City	9	12	0.75
27 Osaka Prefecture	140	266	0.53

Table 5

Teachers who specialize in Informatics per schools (May 2015)

	Teachers who specialize in Informatics	Schools	Ratio
53 Yokohama City	25	9	2.78
11 Saitama Prefecture	210	131	1.60
48 Sapporo City	7	7	1.00
50 Saitama City	4	4	1.00
57 Hamamatsu City	1	1	1.00
27 Osaka Prefecture	140	142	0.99
47 Okinawa Prefecture	39	45	0.87
13 Tokyo Prefecture	163	233	0.70
28 Hyogo Prefecture	74	116	0.64
58 Nagoya City	9	15	0.60
62 Kobe City	4	7	0.57
59 Kyoto City	6	11	0.55
52 Kawasaki City	3	6	0.50

3. Discussion

As shown in Section 2, there are more Informatics teachers who specialize in Informatics in urban areas than in rural areas. In particular, a lot of 'temporary teachers' and 'teachers without a proper license' teach Informatics at high schools in rural areas.

In February 2018, MEXT announced the situation of 'teachers without a proper license' as of May 2017; across Japan 1,148 of 3,077 'teachers without a proper license' were assigned for Informatics. Licensed subjects for the above-mentioned 1,148 teachers are shown in Fig. 2. We find that teachers of another subject, such as Art, Geography and History, Home economics, Foreign languages, Health and Physical education, etc., teach Informatics.

In addition, more than half of the teachers with a proper license for Informatics teach multiple subjects as shown in Section 2. Teachers in charge of multiple subjects at high schools may be unaware that they are Informatics teachers and are responsible for Informatics education, so there is a concern that they will not participate in study meetings for Informatics, such as *Zenkojoken* (the study group for high school Informatics teachers across Japan, `http://www.zenkojoken.jp`).

In 2013, the Japanese government declared Japan to be 'the world's most advanced IT nation' (Declaration to be the world's most advanced IT nation, Cabinet Secretariat 2013). To this end, Japanese students will learn Informatics, and computer programming will be introduced even in elementary schools from 2020 (Kanemune *et al.*, 2017). In 2022, the curriculum guidelines for high schools will be drastically revised, with 'Informatics I' and 'Informatics II' having a predominantly scientific approach (MEXT, 2018), (Kano, 2017).

Given that a lot of 'temporary teachers' and 'teachers without a proper license' teach Informatics, and even most teachers who hold a proper license for Informatics are in
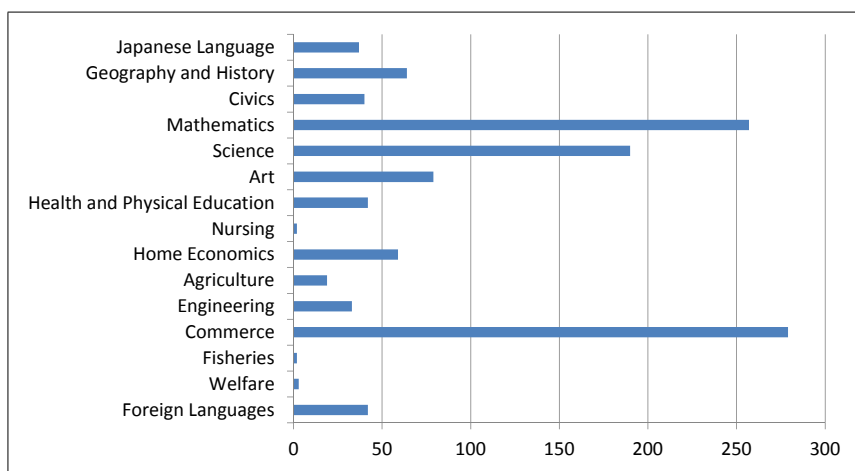

Fig. 2. Licensed subject for teachers who teach Informatics without proper license (May 2017).

charge of multiple subjects, it may be hard to implement new curriculum in dozens of prefectures that have few teachers who specialize in Informatics.

In order to enhance Informatics education, it will be necessary to develop laws like the 'Informatics Education Promotion Act'. We believe that it is important to allocate a budget for and assign at least one teacher who specializes in Informatics to each school. It is important to employ teachers who specialize in subjects relevant to Informatics and education method in teacher training course at university to follow the remarkable ICT innovation.

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