

FOREWORD

To young people, the school and the school system represent both an authority and a scene for social activities. The students often gather at school yards and in the vicinity of the school buildings during evenings and weekends. It must be noted that during school hours, the school must maintain its role in ensuring and promoting security. A statutory requirement also applies to schools: according to the Basic Education Act (*Perusopetuslaki*, no. 628 of 1998), “a pupil participating in education shall be entitled to a safe learning environment”.

This report is a part of the research operations related to the Fire Stop project, which is one of the projects preventing social exclusion, included in the national *Safety first – Internal Security Programme*. The programme aims to improve the Finnish culture of safety and to make Finland the safest country in Europe by 2015.

The increase in the number of school fires in Finland has been evaluated in the media for several years. In Sweden, more than 500 school and day care centre fires are set every year. Experts have also looked for signs of a similar trend in Finland. This report discusses the 236 fires in schools that provide general education that were set during the monitoring period of five years. Even though the trend apparent in Sweden is not as such visible in Finland, the report indicates that a significant number of school fires have been set by people who use the school building.

The report was produced in the Emergency Services College research unit. The material is based on information from the rescue services PRONTO resource and accident statistic system. The compilation of the report was made possible by the decision by the Fire Protection Fund to finance the Fire Stop project.

We would like to thank everyone who participated in the compilation of the report.

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1 INTRODUCTION

This report discusses the number and nature of school fires in schools that provide general education during the monitoring period of five years.

In Finland, this number was 236 between 2005 and 2009, of which approximately 32 per cent were assessed to be started intentionally. In 2008, there were a total of 517 school fires in Sweden, of which 52 per cent were set intentionally. (Räddningstjänst 2008.) In the 2007 Nordic fire statistics, Sweden had relatively the most school fires: 5.7 fires per 100,000 citizens. The corresponding figures for the other Nordic countries were 4.5 for Denmark, 1.7 for Norway, and 1.1 for Finland (Brandskyddsföreningen, 2010). In the same year, more than 6,600 school fires were reported in the USA (Flynn 2007).

During the past five years, school fires in Finland have caused material damages of over 12 million euros. The share of school fires of all structural fire and structural fire hazard assignments of the rescue services during the monitoring period was 1.3 per cent.

2 OBJECTIVES OF THE STUDY

The study aims to examine fires in schools that provide general education and their quantitative special features. The objective for the analysis of the school fires is to decrease their number in the future.

Research questions:

- What kinds of features can be discerned from the school fires and the way they were set between 2005 and 2009?
- What kinds of regional differences are there in the frequency of school fires?
- What kinds of costs have school fires caused between 2005 and 2009?

The school fire analysis can be used to clarify the safety communication of the authorities, draw attention to the safety of the school day and structural fire prevention, and to anticipate any trends related to school fires that may emerge as a part of youth culture.

3 SPECIAL FEATURES OF THE PRONTO SYSTEM

The information in the report is based on information from the Rescue services' PRONTO resource and accident statistic system. All events known to the Rescue services in Finland are reported in the system, with the exception of assignments that only consist of the transportation of a patient. It is estimated that only 17–22 per cent of fires are reported to the rescue services in the other Nordic countries. The same estimate applies for Finland as well.

The fact that the information is produced by hundreds of rescue service officers with varying levels of training can be considered a downside of the PRONTO system. The information always represents the individual rescue service officer's interpretation of the fire. The large number of people entering the information in the register may affect the reliability of the database, and there may be regional variation in the entry methods. The authority in charge of the rescue mission, such as the supervisor of the fire extinction, will enter the information in the database. This practice ensures that the data in the database always come as first hand information. The rescue service officer will enter their assessment of the cause of the fire. This assessment is later amended in the police investigation or the fire investigation, and the latest information is not always updated in the PRONTO system. The statistics are managed at the Emergency Services College.

The intensity of collecting statistical information in PRONTO has developed and stabilised during the past years because of the increased amount of expertise and education, as well as the improved accuracy and systematic development of the statistics.

4 SCHOOL FIRES IN FINLAND

The special features related to school fires are discussed here from two perspectives. The study presents information on the number of all fires in Finnish schools and educational institutes within a monitoring period of five years. In addition, detailed features of fires in schools that provide general education, including the cause, point of origin, time, and the losses caused by the fires, are examined.

In this study, *school fire* refers to a fire started inside or outside a building where teaching takes place. All uncontrolled fire incidents that cause visible smoke are classified as fires. Fires started in schools that provide general education are discussed in more detail. Light structures, such as sheltered waste containers not in the immediate vicinity of the school building, are not included in the report. Wildfires in forest areas in the vicinity of schools are also not included in this study.

The buildings and facilities are classified mostly based on what most of their gross floor area is used for. However, only buildings where over 50 per cent of the floor area is used for living space are defined as residential buildings. Therefore, if a fire starts for instance in an apartment of a teacher, located in the school's premises, the residential fire is recorded as a school fire.

4.1 *Development of the number of fires*

Educational institute buildings are classified based on the building type as follows in the rescue services PRONTO resource and accident statistic system: school building used for general education, vocational education institution building, higher education institution building, research facility, teaching building for e.g. an organisation, association or employer, and teaching building that is not otherwise classified.

In addition, children are taught and raised in day-care centres, children's homes and family centres, which in the statistics are referred to as community homes. Upper secondary schools are registered as schools that provide general education. However, in the current system, classes 0–10 as well as upper secondary school classes may operate in the same building.

Based on Table 1, the first impression may be that school fires doubled in 2009, but this is a question of a more consistent manner of collecting data for structural fires. From the beginning of 2009, fires that did not spread from the point of ignition have been registered as dangers of structural fire. Previously, the data on such events could not be reliably collected: they were included in the assignment types “structural fire”, “other fire”, and “investigation/check”. It should be noted that the building type is recorded in the statistics only in the case of structural fires and dangers of structural fire.

Table 1. Fires started in school buildings from 2005 to 2009.

Building type	2005	2006	2007	2008	2009	Total
Children’s home or community home	2	3	2	2	7	16
Day-care centre	6	5	12	10	20	53
School building used for general education	39	35	43	35	84	236
Vocational education institution building	7	15	5	14	20	61
Higher education institution building	6	2	3	4	5	20
Research facility	2	4	6	4	6	22
Teaching building for e.g. an organisation, association or employer	1	1	1	2	0	5
Teaching building that is not otherwise classified	0	2	1	1	4	8
Total	63	67	73	72	146	421

Most school fires seem to occur in buildings of schools that provide general education. 56 per cent of school buildings where fires were started were schools that provide general education, in other words, comprehensive or upper secondary schools. 14 per cent of school fires took place in schools that provide vocational education, and approximately the same amount (13 per cent) in day-care centres. Only few fires were started in other types of school buildings.

Table 2. Fires in day-care centres and schools that provide general education from 1996 to 2009.

Building type	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Day-care centre	6	10	10	7	5	4	7	5	10	6	5	12	10	20	117
Building of a school that provides general education	21	24	30	27	29	39	31	33	25	39	35	43	35	84	495
Total	27	34	40	34	34	43	38	38	35	45	40	55	45	104	612

Data on school building fires has been collected in the PRONTO system since 1996. The situation for day-care centres has remained almost the same, but there has been a slight increase in fires in schools that provide general education. The real difference is even more significant, because due to the reduced school network, the number of buildings of schools that provide general education has decreased. No lives were lost in school fires from 2007 to 2009. The collection of information on deaths in fires in the PRONTO system improved significantly in the beginning of 2007, and no comparable data exists before this.

4.2 *Ignition of fires*

In this report, ignition of fires in schools that provide general education is discussed using indicators from the cause of ignition, age of the igniter, intentionality, and the point of origin of the fire.

4.2.1 Cause of ignition

As in fires in general, fires in schools that provide general education are most commonly caused by people (Table 3). During the monitoring period, 66 per cent of fires in schools that provide general education were caused by actions by people. This

includes unauthorised handling of fire, sabotage, playing with fire, careless handling of fire, or negligence, meaning that the fire was started as a result of the actions of a person but not intentionally. A quarter of the fires were caused by a fault in a machine or piece of equipment. The most common fault in electrical equipment in schools was a blown inductor of a fluorescent lamp, causing smoke in the school facilities.

Table 3. Causes of fires in schools that provide general education between 2005 and 2009 according to the assessment by rescue service officers.

Assessment of the cause of the fire	2005	2006	2007	2008	2009	Total
Human actions	26	21	28	26	54	155
Natural event or phenomena	0	1	0	0	1	2
Fault in a machine or piece of equipment	5	11	12	7	23	58
Inflammable substance	0	0	0	1	0	1
Other cause	5	1	1	0	5	12
Could not be determined	3	1	2	1	1	8
Total	39	35	43	35	84	236

According to Table 4, matches or other fire making tools were the most common source of fire in schools that provide general education, and they made up a quarter of all school fires. Approximately one fifth of fires in schools that provide general education were caused by electrical equipment or negligent care of electrical equipment. In 2009, unauthorised handling of fire by children caused approximately one tenth of the fires in schools that provide general education. Statistical information on the unauthorised handling of fire by children is not available for the entire monitoring period. Candles or flames caused two fires in schools that provide general education during the monitoring period.

Approximately a quarter of fires in schools that provide general education were related to events that are difficult or impossible to influence. At least three quarters of the fires can be considered such that they could have been influenced by improving the safety culture of the school, intensifying the monitoring, increasing lighting and

locks, improving expertise, organising interventions or improvements in areas of the school where fire, electricity or inflammable substances are handled.

Table 4. Cause of ignition, according to the rescue service officers, of the fires in schools that provide general education between 2005 and 2009. (Please note: The codes were changed in the beginning of 2009. Data from the previous years is converted to the new codes.)

Estimated cause of ignition	2005	2006	2007	2008	2009	Total
Unmonitored cooking (frankfurters and mashed potatoes)	-	-	-	-	1	1
Intentionally set fire	-	-	-	-	7	7
Unauthorised handling of fire by children	-	-	-	-	8	8
Hot work	2	2	1	0	2	7
Campfire, barbecue	0	1	1	0	2	4
Match or other fire making tools	15	10	12	16	7	60
Cigarette or other tobacco product	1	1	4	0	3	9
Fireworks, pyrotechnical products	1	0	0	1	7	9
Candle, torch, flame	0	1	0	0	1	2
Incorrect use of a machine or piece of equipment	0	1	5	0	3	9
Fault, disturbance or neglected maintenance of electrical equipment or installation	6	9	7	6	17	45
Fault, disturbance or neglected maintenance of a machine or piece of equipment	-	-	-	-	5	5
Hot or glowing object or ash	0	0	0	4	3	7
Chimney fire	0	0	0	0	2	2
Insufficient safety distance	2	0	0	0	0	2
Disturbance in a production process	0	0	3	0	0	3
Spark from a machine or equipment	2	1	1	0	1	5
Mechanical spark	1	0	0	1	1	3
Frictional heat	2	1	1	0	2	6

Estimated cause of ignition	2005	2006	2007	2008	2009	Total
Spontaneous combustion	1	1	0	1	0	3
Re-ignition	0	0	0	0	1	1
Other cause	5	4	3	5	5	22
Could not be determined	1	3	5	1	6	16
Total	39	35	43	35	84	236

According to the assessment by the rescue service officers, approximately 32 per cent of fires in schools that provide general education were intentionally set (Table 5) and approximately one fifth were caused through negligence, meaning that the fire was caused by the carelessness of a person. A fire caused by melting stearine in a saucepan on a stove in a handicrafts classroom is an example of a fire caused by negligence. It should be noted that approximately one third of fires in schools that provide general education had other than human activity-related causes, and in these cases, intentionality was not assessed.

Table 5. Assessment of the intentionality of the fires in schools that provide general education between 2005 and 2009.

Assessed intentionality	2005	2006	2007	2008	2009	Total
Intentional	14	7	10	15	29	75
Negligence (carelessness)	4	5	8	6	11	34
Accidental or unintentional	9	13	12	3	10	47
Could not be determined	4	7	10	2	4	27
Not caused by the actions of people	8	3	3	9	30	53
Total	39	35	43	35	84	236

4.2.2 Places of ignition

Further information on the intentionality or negligence and the human factors behind the fire can be discovered through examining the primary source of ignition in schools that provide general education. In the five year monitoring period, 23 per cent of the fires were started in a classroom or other place of gathering, 12 per cent in other areas of the building, and 7 per cent in the toilets of the school. Approximately 4 per cent started in rubbish bins and 11 per cent outside the school building.

Table 6. Places of ignition of fires in schools that provide general education from 2005 to 2009.

Place of ignition	2005	2006	2007	2008	2009	Total
Kitchen	2	1	5	2	5	15
Living room	0	0	0	0	1	1
Attic	1	0	3	0	0	4
Basement or other underground part of the building	2	1	2	2	5	12
Sauna	0	0	1	0	2	3
Drying room	0	0	1	0	0	1
Staircase/stairs	0	2	3	0	1	6
Utility distribution room	1	1	0	0	2	4
Lift	0	2	0	0	0	2
Rubbish bin	2	1	0	3	3	9
Production facility	0	0	0	0	1	1
Storage facility	0	1	1	1	3	6
Outdoor storage facility	1	0	1	0	0	2
Office facility	0	1	0	0	2	3
Social premises	0	1	0	0	0	1
Classroom or meeting room	8	10	9	9	18	54
Changing room	0	0	1	0	0	1
Terrace	1	0	0	1	2	4
Entrance or exit	2	0	2	0	1	5
Lobby or hall	0	1	0	3	9	13
Toilet	3	2	2	4	6	17
Air-conditioning room	0	0	1	2	1	4
Electric equipment room	2	1	4	1	3	11
Other part of the building	9	5	3	5	6	28
Could not be determined	1	0	1	0	2	4
Outside the building	4	5	3	2	11	25
Total	39	35	43	35	84	236

The target that was assessed to have caught fire first is listed in Table 7. In approximately 68 per cent of the cases, movable property was the first thing on fire. It should be noted that the first item on fire is only recorded for structural fires. The first item on fire was introduced in the PRONTO system on 1 January 2008, and therefore, comparable data is only available for two years within the monitoring period.

Table 7. The first item on fire in schools that provide general education between 2008 and 2009.

The first thing on fire	2008	2009	Total
Structures	9	8	17
Movable property	25	14	39
Could not be determined	1	0	1

4.2.3 Age of the starter of the fire

In 41 per cent of the fires in schools that provide general education (64 cases), the age of the person responsible could not be determined.

Of the cases in which the age could be determined, the single largest group of people responsible for the fires was school children. 52 per cent (47 fires) were started by children between the ages of 7 and 15, and 30 per cent (27 fires) were started by adults (between the ages of 25 and 64).

Table 8. Ages of the persons responsible for the fires in schools that provide general education from 2005 to 2009.

Age of the person responsible	2005	2006	2007	2008	2009	Total
Under 7 years	0	0	0	0	0	0
Under 7 years	0	0	1	0	0	1
7–15 years	6	7	7	13	0	33
16–25 years	4	1	1	1	0	7
26–65 years	5	8	3	4	0	20
7–14 years	0	0	0	0	14	14
15–17 years	0	0	0	0	5	5
18–24 years	0	0	0	0	4	4
25–64 years	0	0	0	0	7	7
65–74 years	0	0	0	0	0	0
Over 74 years	0	0	0	0	0	0
Could not be determined	11	5	16	8	24	64

4.3 *Time of the fires*

Schools that provide general education are mostly used during daytime from autumn to spring. Most fires (14 %) occurred in January, and the second most in April (11 %). Increased heating, lighting, or lighting candles in December did not increase the number of fires. This is suggestive of the contribution of people in these fires. Fires also occurred during the summer, when the schools are not used as much.

Table 9. Fires in schools that provide general education per month from 2005 to 2009.

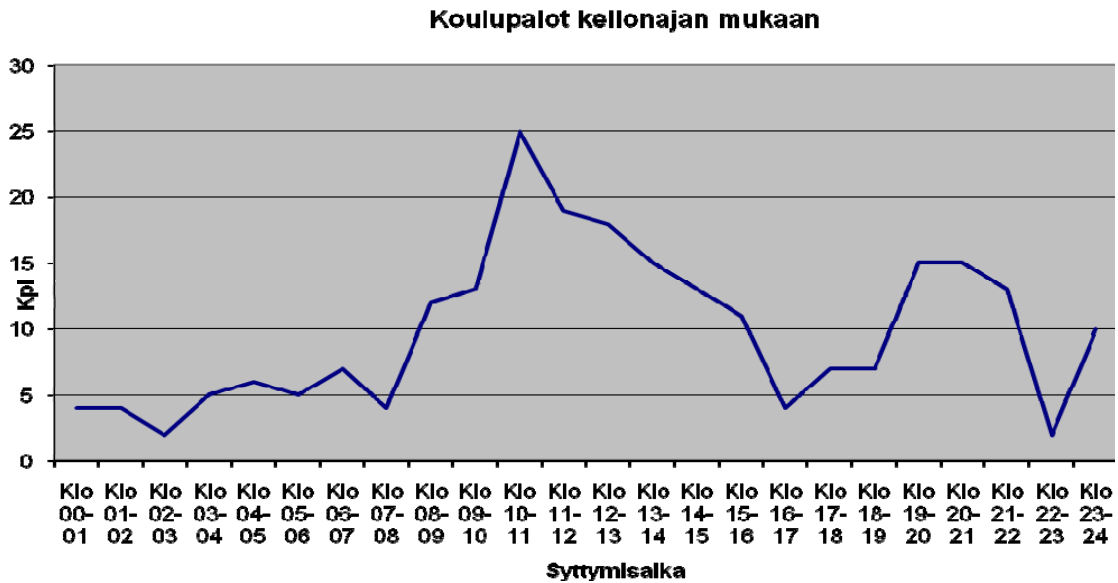
Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
2005	5	1	6	4	1	3	4	4	4	4	3	0	39
%	13	3	15	10	3	8	10	10	10	10	8	0	100
2006	6	0	4	3	3	1	3	2	2	4	4	3	35
%	17	0	11	9	9	3	9	6	6	11	11	9	100
2007	4	2	3	3	2	4	2	4	5	5	5	4	43
%	9	5	7	7	5	9	5	9	12	12	12	9	100
2008	4	3	0	7	2	3	3	2	1	2	4	4	35
%	11	9	0	20	6	9	9	6	3	6	11	11	100
2009	15	5	6	8	6	10	7	7	5	6	3	6	84
%	18	6	7	10	7	12	8	8	6	7	4	7	100
Total	34	11	19	25	14	21	19	19	17	21	19	17	236
%	14	5	8	11	6	9	8	8	7	9	8	7	100

The most common days for fires in a school that provide general education during the monitoring period were Tuesdays and Wednesdays, but the total fire statistics show a more evenly spread pattern during the week. Fires also occurred during weekends, even though the schools are not used as much as during the week.

Table 10. Fires in schools that provide general education per weekday from 2005 to 2009.

Year	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
2005	5	9	8	5	5	4	3	39
%	13	23	21	13	13	10	8	100
2006	5	10	8	3	4	3	2	35
%	14	29	23	9	11	9	6	100
2007	6	11	7	3	4	7	5	43
%	14	26	16	7	9	16	12	100
2008	4	9	6	5	6	2	3	35
%	11	26	17	14	17	6	9	100
2009	10	13	20	18	9	9	5	84
%	12	15	24	21	11	11	6	100
Total	30	52	49	34	28	25	18	236
%	13	22	21	14	12	11	8	100

Approximately half of the fires in schools that provide general education during the monitoring period started during the school day (8 a.m.–3 p.m.), and approximately one fifth during the evening between 7 p.m. and midnight. Picture 1 shows that fires occurred most commonly in the morning. The second most common time was in the evening. The smallest number of fires occurred during the first eight hours of the day. This is the time when the school building and its the outdoor areas are the most likely to be empty.



Picture 1. Fires in schools that provide general education per time of day from 2005 to 2009.

4.4 *Fires per rescue area*

When examining the fires per rescue area, the western Uusimaa region (32 fires, 14 %) and the Tampere Region (29 fires, 12 %) had the most fires in schools that provide general education. The smallest number of fires occurred in the eastern Uusimaa region and Kainuu.

The population structure of the rescue areas varies. In proportion to the population in each region, the Ostrobothnia, Oulu, Koillismaa and Jokilaaksot rescue areas have the most children between the ages of 0 and 17. Per 100,000 adolescents on each region, Table 11 shows that the most fires occurred in the North Karelia (35), western Uusimaa region (35) and the Tampere Region (30) rescue areas.

The number of children and adolescents also corresponds with the number of school buildings. The western Uusimaa region, Southwest Finland and the Tampere Region had the most schools that provide general education. Per 100 schools that provide general education, the largest share of school fires occurred in the central Uusimaa region (13), western Uusimaa region (13) and Tampere Region (11) rescue areas.

Table 11. Fires in schools that provide general education per rescue area from 2005 to 2009.

Rescue area	2005	2006	2007	2008	2009	Total
Helsinki	0	3	2	3	5	13
Western Uusimaa	4	4	6	4	14	32
Central Uusimaa	5	3	2	5	10	25
Eastern Uusimaa	1	0	0	0	0	1
Southwest Finland	4	0	4	0	3	11
Tavastia Proper	0	3	0	0	6	9
Päijänne Tavastia	1	1	1	3	4	10
Kymenlaakso	0	1	1	0	4	6
Southern Karelia	0	1	2	2	1	6
Southern Savonia	0	2	0	0	1	3
Central Finland	2	0	2	1	4	9
Tampere Region	5	4	8	8	4	29
Satakunta	4	0	1	0	3	8
Southern Ostrobothnia	2	1	0	0	6	9
Ostrobothnia	1	1	1	1	2	6
Central Ostrobothnia	0	2	0	0	1	3
Northern Savonia	5	1	4	3	1	14
Northern Karelia	1	4	3	0	3	11
Jokilaaksot	2	1	0	1	3	7
Kainuu	0	1	1	0	0	2
Oulu-Koillismaa	2	2	4	2	3	13
Lapland	0	0	1	2	6	9
Total	39	35	43	35	84	236

Rescue area	Schools that provide general education	School fires between 2005 and 2009	School fires per 100 schools	School fires per 100,000 children between 0 and 17	Children between 0 and 17 in 2009	Percentage of children of the entire population of the region in 2009
Helsinki	178	13	7	13	96,590	16.5
Western Uusimaa	247	32	13	32	99,637	23.5
Central Uusimaa	189	25	13	26	97,620	23.4
Eastern Uusimaa	90	1	1	5	21,259	22.6
Southwest Finland	293	11	4	12	89,942	19.4
Tavastia Proper	127	9	7	25	35,800	20.5
Päijänne Tavastia	107	10	9	26	39,106	19.4
Kymenlaakso	118	6	5	18	33,757	18.4
Southern Karelia	79	6	8	25	24,106	17.9
Southern Savonia	135	3	2	11	27,445	17.6
Central Finland	186	9	5	16	55,625	20.4
Tampere Region	275	29	11	30	96,339	19.8
Satakunta	169	8	5	18	43,395	19
Southern Ostrobothnia	200	9	5	22	41 010	21.1
Ostrobothnia	142	6	5	16	37,599	25.7
Central Ostrobothnia and Pietarsaari	102	3	3	13	22,982	23.1
Northern Savonia	165	14	8	29	48,073	19.3
Northern Karelia	115	11	10	35	31,314	18.8
Jokilaaksot	139	7	5	23	30,588	24.5
Kainuu	65	2	3	13	15,671	18.9
Oulu-Koillismaa	162	13	8	20	66,307	24.7
Lapland	152	9	5	25	35,950	19.5
Total	3,435	236	av. 6.8	21	1,090,115	

Table 12. Fires in schools that provide general education in proportion to the number of schools and the population, from 2005 to 2009.

4.5 Damages caused by the fires

In general, the damages caused by fires are evaluated as personal injuries and immediate property damage. Traumatic or mental damages related to loss, such as disability to work, and the costs of medical treatment are not estimated in the rescue services statistics. For property damage, only the immediate damages to the property are listed in the PRONTO system. The perspective of memories or uniqueness, for example, is not considered.

Table 13. Threat of personal injury in fires in schools that provide general education from 2005 to 2009.

Were people injured or in immediate danger or saved or evacuated by the department?	2005	2006	2007	2008	2009	Total
Yes	3	3	3	5	3	17
No	36	32	40	30	81	219
Total	39	35	43	35	84	236

During the monitoring period, 7 per cent (17 fires) of the fires in schools that provide general education caused personal injuries, a threat to human life, or a situation where the rescue department had to evacuate people from the school building. However, according to the estimate by the rescue service officers, people should have been or were evacuated in almost half of the fires (81). This number does not include the cases from 2009 where the fire did not spread from its point of origin. This increases the importance of the school personnel in the evacuation. It should be noted that no lives were lost in school fires in schools that provide general education during the monitoring period.

Table 14 describes the losses in fires in schools that provide general education. During the monitoring period, a total of 1,246 people were at risk in a total of 236 school fires, with 350 people being evacuated. During the monitoring period, no lives were lost in fires in schools that provide general education. Over 90 per cent of the proper-

ty value was saved every year. Table 15 describes the number of all structural fires and their damages. 1.3 per cent of all structural fire and structural fire hazard assignments within the monitoring period were school fires.

Table 14. Threatened, saved and lost personal and property values in fires in schools that provide general education from 2005 to 2009.

Year	Number of assignments	People in danger	Personal value				Property damage	
			Lives lost	Personal injury	Evacuated	Saved	Property damage (EUR)	Percentage of property value saved
2005	39	221	0	1	20	0	2,960,807	97
2006	35	273	0	1	230	0	2,113,950	99
2007	43	22	0	0	0	0	986,650	99
2008	35	529	0	0	0	0	1,436,470	99
2009	84	201	0	1	100	1	4,723,296	93
Total	236	1,246	0	3	350	1	12,221,173	98

Table 15. Threatened, saved and lost personal and property values in structural fires from 2005 to 2009.

Year	Number of assignments	People in danger	Personal injuries				Property damage	
			Lives lost	Personal injury	Evacuated	Saved	Property damage (EUR)	Percentage of property value saved
2005	3,715	3,414	73	428	1,262	349	150,644,224	98
2006	4,042	3,598	112	374	1,667	285	244,514,047	98
2007	4,072	9,897	79	491	7,878	377	188,181,728	99
2008	4,511	4,181	111	495	3,456	437	188,590,652	99
2009	6,303	5,511	98	665	2,106	599	131,279,449	96
Total	22,643	26,601	473	2,453	16,369	2,047	903,210,100	98

4.6 *Qualitative examination of the fires*

A qualitative examination increases the understanding of the factors related to school fires, particularly the social operating environment. This examination is based on the PRONTO database in which the authority in charge of the rescue mission has entered their estimate of the cause of the fire.

The unauthorised handling of fire by children or adolescents or playing with fire caused 75 fires (32 %) during the monitoring period. The cases are manually collected from the PRONTO system (Table 16).

Table 16. Unauthorised handling of fire by children in the fires in schools that provide general education between 2005 and 2009.

Year	Number of school fires	Caused by playing with fire	%
2005	39	8	21
2006	35	4	11
2007	43	15	35
2008	35	18	51
2009	84	31	37
Total	236	76	32

Here are some examples of school fires set by children and adolescents.

“Two 17-year-old boys set the rubbish containers next to the school on fire using a lighter.”

“Children, between approximately 10 and 12 years (estimated by people on the scene) lit the couch cushions on fire and left the scene.”

“A hand towel holder in the toilet was set on fire using some kind of fire making tool.”

“Burning spruce twigs were pushed in the venthole of the base floor approximately 1,000 mm in height. The fire was accelerated using a spray bottle, which created a flame throwing phenomenon, setting the expanded polystyrene insulation on fire.”

“Boys were spray painting in the paint shop facilities, after which a fire occurred in the fume cupboard. Butane is used as propellant in the bottles, and it may have caused the fire.”

“The boys in the class were playing with a lighter and spray paint. The flame from a spray bottle set the air-conditioning unit filter on fire.”

“The sandpit was moved to the side of the building and apparently set on fire.”

According to the reports, inflammable liquids and gases were used in 10 (13 %) of the school fires assessed to be set by children. Most commonly, the fires started in painting facilities.

Fires were set in the school toilets in 8 (11 %) cases. Most commonly, toilet paper was lit and then left to burn in a rubbish bin, or a roll of paper was lit using a lamp.

Frictional electricity or machine failure was assessed to have caused 91 (40 %) of the fires. Of these, 15 (6 %) were caused by faults in a lamp, most commonly a blown inductor of a fluorescent lamp.

5 DISCUSSION AND CONCLUSIONS

Generally speaking, Finnish schools are quite safe in terms of fires. Most fires and accidents are caused outside the school and at home. According to a survey in 2009, 1,100,000 accidents that caused bodily injury took place in Finland during the year. Of these, 73 per cent (800,000) took place at home or during free time. During a monitoring period of 30 years, the number of work-related accidents has decreased. According to cause of death statistics by Statistics Finland, the most common cause of death between people aged 15 to 45 was accident in 2008 (Accidents: National Institute for Welfare and Health).

56 per cent of school buildings where a fire was set were schools that provide general education and 20 per cent were day-care centres.

During the monitoring period, 66 per cent of fires in schools that provide general education were caused by actions by people. The most common source of fire was matches or another fire making tool, and the second most common was an electrical equipment. Slightly over one fifth of the fires were set in classrooms. Approximately one third of all fires in schools that provide general education were assessed to be set intentionally. In approximately 41 per cent of school fires, the age of the setter could not be determined. According to the accident statistics provided by the rescue services, school children were the single largest age group of people setting school fires. During the monitoring period, children between the ages of 7 and 15 set 52 per cent (47) of the school fires in which the age of the setter could be determined. 30 per cent of the fires were set by adults.

January was the most common month for fires in schools that provide general education. The second most common month was April. The most common weekdays for school fires were Tuesdays and Wednesdays, but there were no significant differences between the weekdays. Most school fires occurred during the school day, between 8 a.m. and 3 p.m. As regards fires, the first eight hours of the day were the safest time in schools that provide general education. This may be explained by the diurnal rhythm of the children and adolescents, together with the decreased use of electrical equipment during the night.

A total of three quarters of fires in schools that provide general education could have been prevented through preventive safety information of technical changes. Safety can also be increased through intensifying monitoring, increasing lighting and locks or technical improvements in areas where fire, electricity or inflammable substances are handled.

School fires may cost lives as well as causing property damage. During the monitoring period, people in schools that provide general education were evacuated from toxic combustion gases or other dangers caused by the fire in 81 cases. The total worth of the property threatened by the fires was over 795 million euros.

This study did not examine losses related to traumatic stress or other mental states or traditional value, which are always significant. During the past three years, no lives were lost in fires in schools that provide general education, but according to the estimate by the Rescue services, 1,246 people were in danger in the fires.

5.1 *Suggested actions*

This study suggests that most school fires are caused by people, during the school day and in the classroom.

Here are some suggested actions for the police, social and rescue authorities:

- Increasing safety information directed at the pupils.
- Intervening in the unauthorised handling of fire by children during the school day, for example through arranging a referral.
- Early intervention and creating the safety culture of the school environment: discussing fire safety and fire-setting already in day-care centres.
- Regular contact with the schools and creating social relationships through appointing a particular fire fighter as a friend of the school.
- Preventing school fires using early fire investigation, such as creating a joint scorch mark reporting system in cooperation with the school.

- Spreading information on the means of preventing fires to the adults working in the school buildings.

Here are some suggested actions for the authorities related to the technical aspects of the school's operations:

- Cleaning up scorch marks.
- Intensifying the maintenance operations in case of a disturbance in electrical equipment.
- Improved lighting, fencing and locking of the school area.
- Increasing the number of fire extinguishers and other safety equipment in the school environment.
- Improving the monitoring of the chemicals used in class, and considering fire safety aspects when handling inflammable liquids and gases.
- Technical solutions to prevent fires in the toilets: replacing the toilet paper holders with models where entire rolls cannot be removed, introducing automated hand towel feed or cloth hand towels and using rubbish containers with lids.

Suggested actions for the school authorities:

- Clearly prohibiting the students from bringing fire making tools to school.
- Intervening with unauthorised handling of fire in cooperation with other authorities, if necessary.
- Giving detention to students who light fires and entering the reason of detention in the school register.
- Increasing the amount of education on safety issues.

- Improving the safety expertise of the teachers through registering local operating models and training, for example.
- Increasing the cooperation with the school healthcare system and social authorities in cases of fires caused by children.
- Increasing the monitoring in shop classrooms, particularly when handling inflammable liquids and gases.
- Improving the monitoring of toilets to prevent fires.
- Registering the scorch marks on the school buildings and informing the local rescue and police authorities of them.
- Informing the parents of the procedures, consequences and support operations related to fire-related vandalism.

The authorities and officials working with children and adolescents and responsible for the safety of the school day should note that there are a large number of people with limited functional abilities in the school community at any given time. The ability of the school children to react to fires is high, but their ability to evaluate the dangerousness or spreading of the fire or the effects of the smoke is limited. Other limitations that must be considered in the evaluation of the dangerous areas of the school building include pupils' lack of experience in life in general and chemical phenomena in particular, curiosity, unpredictability, inability to control emotions and small physical size of the children.

In addition to the immediate actions, the importance of social and group dynamics-related cooperative projects, celebrations and processes that improve the general atmosphere of the school as a secondary means of preventing school fires must be considered.

5.2 *Reliability*

It should be noted that this study may not represent the school fires in Finland in the best possible way. Some fires are never reported to the authorities, particularly if the fire was entirely put out without official help, and if the damages were minor. If the

fire occurs during a time when the school building is empty, it is not always recorded in official databases. The method, place and cause of the fires may also be open to interpretations and cause variation in the statistics, as the training received by the people registering the data varies. The changes in the collection of the statistics in 2009 make it more difficult to compare the data between the years. However, the PRONTO accident statistic system can be considered the best and most reliable method for compiling statistics on the rescue services assignments.

If school fires are to be better understood as a social, psychological, legal and societal phenomenon, a quantitative report alone is not sufficient: a study should also be made on the phenomena and social context behind the fires and the ability of the rescue services to respond to it.

The school building represents societal authority. To the pupils, it represents a place where they can grow and develop their skills and knowledge, but also become social and a part of society. Furthermore, the school is related to the compulsory education and adapting to the disciplinary regulations.

Intentional fire-setting at school may also be interpreted as a message related to the macrostructures, such as authority and society, or individual social stories, including the human relationships in the learning environment, relationships to the adults in the school and phenomena related to group dynamics.

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