Projector and Interactive Whiteboard usage
in primary and secondary schools

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White Paper:
Projector and Interactive Whiteboard usage in primary and secondary schools

An end-user Market Survey to explore the energy saving opportunities and user-profile in the classroom for projectors that use ImageCare® brightness regulation for enhanced picture performance and energy saving

This white paper describes the results of a study of projector usage in schools in the UK conducted by Futuresource Consulting. Purposes of the study are:
A) to explore the energy saving opportunities in the classroom for projectors with lamp systems that can adjust image brightness based upon end-user requirements
B) To define a representative education lifetime test cycle for lamp systems with ImageCare®.
ImageCare® is an innovation of Philips Lighting that delivers enhanced picture performance, saves energy when possible and offers long lifetime performance.

All projectors in this study were used in combination with an Interactive Whiteboard (IWB). The results show that projector usage is quite similar across all schools and all classes visited. A cycle of 2 hrs usage followed by a break of at least 20 minutes is the typical norm in education. Projector usage was slightly higher in primary than in secondary education (64% of school-day versus 51% of school-day). This study showed that the average projector usage in education in the UK is 784 hours per year.

Teachers observed in this study, showed a great commitment not to waste energy: in all cases projectors were turned off at the end of the school day and in many cases also before (bigger) breaks. An interesting insight is that during the on-time the projector is not always actively used: mostly, it is showing static content. On average the same static image is shown for 25 minutes. Active projector usage such as showing a PowerPoint presentation or using the interactivity of the Whiteboard is only observed for 25% of the on-time lasting typically 12 minutes. Full screen movies are seldom shown in primary school and only during 9% of the on-time in secondary school, with an average length of 15 minutes. Philips Lighting used the user profile to calculate the potential energy saving of a ImageCare® lamp system as compared to a conventional lamp system. This shows that 48% of the power consumed by a projector lamp can be saved during a typical school day. Philips Lighting will use the lifetime test proposal from this research to perform end-user based lifetime tests with lamp-systems using ImageCare®.

1. Introduction

Philips Digital Projection Lighting commissioned Futuresource Consulting to perform research into actual projector usage in primary and secondary schools in the UK. Philips Digital Projection Lighting is a projection lamp provider and the inventor of UHP technology. Futuresource Consulting is an independent specialist market research and consulting company, providing its clients with expertise in consumer electronics, digital imaging, entertainment media, broadcast, education markets, optical manufacturing, storage media and IT.

ImageCare®technology is a Philips Lighting lamp operation innovation which results in optimal picture performance and maximum energy saving by using only the amount of light that is needed. This means that both the image content on screen and the projector usage determine how much lamp power is used. The ImageCare® lamp operation algorithm also has a positive effect on lifetime of the lamp which results in lower total cost of ownership and less maintenance. To explore the energy-saving and lifetime opportunities of lamp systems with ImageCare® it is necessary to have an insight into the actual projector usage and displayed screen content in the fast growing education market.

Projectors can be used standalone or in combination with an Interactive Whiteboard (IWB). Projector usage tends to be more intensive when combined with an IWB compared to standalone usage.

The research was conducted in the UK, because the UK is leading the way in the use of projectors in education. UK classrooms have a penetration of over 90% for projectors and over 75% for IWBs. As a comparison, in the USA 75% of classrooms have a projector and only 30% of classrooms have an IWB; the world average penetration of IWB is 7%.

Projector usage was mapped in both primary and secondary schools. In other research Futuresource found that almost equal quantities of IWBs were sold in primary and secondary education. Only small quantities were sold to other segments.

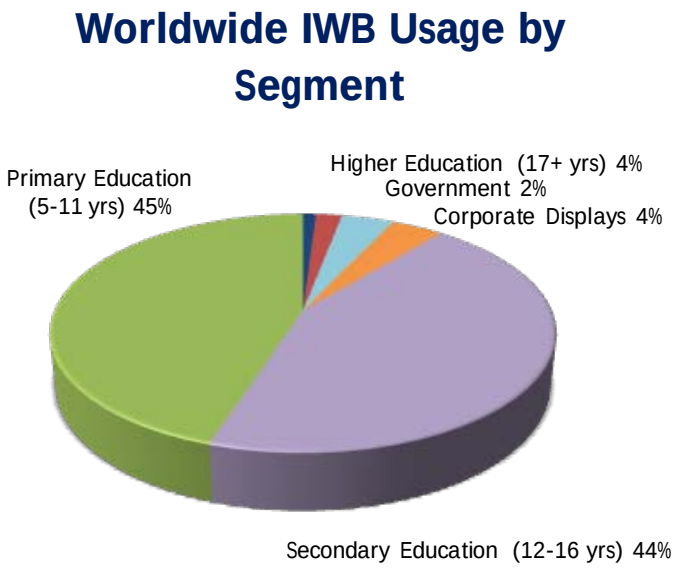

Figure 1.1 – Worldwide IWB usage per segment [source: Futuresource Consulting Interactive Whiteboard report 2009]

2. Research Methodology

2.1 Method and Sample

In total, 54 different classrooms were visited to observe projector usage, split equally between primary and secondary schools. A total of 18 school days were chalked up for this study. At the primary schools the researcher stayed in the same class for the whole day, at the secondary schools the researcher followed students from class to class. The researcher sat at the back of the class with a laptop and registered the type of screen content displayed on the projector every 5 minutes. At the beginning of the day or when students moved to another classroom, the researcher logged the following information regarding the projector set-up:

- Which type of projector is used, brand/model nr.
- Mounting of projector: upside down (i.e. from ceiling) or normal (desktop mode)
- Projector used in connection with IWB or projector used on its own.
- Projector/IWB fixed installation or moveable from class to class.

At the end of the lesson the researcher had a quick chat with the teacher to find out if this was a typical day and a short "2 minute" interview.

2.2 Projector usage modes

The following projector usage modes were defined which are relevant for exploring the energy-saving opportunities and lifetime test cycle for ImageCare®:

- OFF
- ON- searching for input/standard output screen of projector
- ON-other content -actively used
- ON-other content continuously same image for most of 5 minutes
- ON-full-screen film
- ON-full-screen photo
- ON-full-screen photo continuously same image for most of 5 minutes
- ON- content off

A further explanation of each of these modes is given below, together with the corresponding energy-saving opportunity for ImageCare® as indicated by Philips Lighting.

Mode *OFF*: Projector is off, not used.

Mode *ON- searching for input/standard output screen of projector*:

Figure 2.1 – Example of standard output screen of projector

Energy saving opportunity up to 70% depending on the implementation of ImageCare® by a projector manufacturer.

Mode *ON-other content -actively used*:

Definition of other content: This is everything, covering all kinds of content except for full screen photo and full screen video.

Definition actively used: display content is being actively referred to by the teacher and changes in the 5 minute time frame.

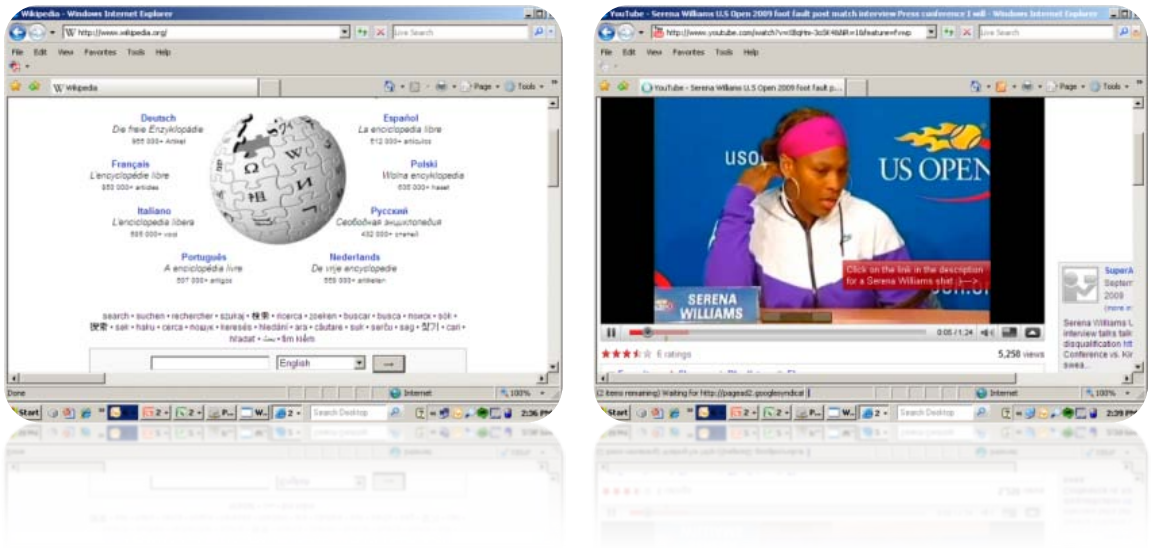

Figure 2.2 – Examples of on other content actively used

Energy saving opportunity: very limited energy saving opportunity, most cases will require full system brightness.

Mode *ON-other content continuously same image for 5 minutes*:

The same image is shown for the full 5 minutes time-frame. The image type covers all types of content except for full screen video and full screen photo.

Calculate the following sums:

8 + 10 =
9 + 9 =
6 + 3 =
9 + 4 =
7 + 3 =
5 + 10 =

Figure 2.3 – Example of ON-other content continuously same image for 5 minutes.

Energy saving opportunity up to 70% depending on the implementation of ImageCare® by the projector manufacturer.

Mode *ON – full screen film*:

A movie is shown on full screen mode. This could be a movie from DVD but also from the internet. Key is that it is shown in full screen mode.

Energy saving opportunity: 35% energy saving, using ImageCare® for vivid contrast performance. This energy saving indication is based upon extensive power monitoring of ImageCare® systems while displaying movie and/or photo content.

Mode *ON – full screen photo*:

A photo is shown in full screen mode. The photo is not used as background for text. The photo is used on its own.

Energy saving opportunity: 35% energy saving, using ImageCare® for vivid contrast performance. This energy saving indication is based upon extensive power monitoring of ImageCare® ess systems while displaying movie and/or photo content.

Mode *ON – full screen photo same image for 5 minutes*:

A photo is shown in full screen mode. The photo is not used as background for text. The photo is used on its own. The photo is left on for the full 5 minutes

Energy saving opportunity: 35% energy saving, using ImageCare® for vivid contrast performance. This energy saving indication is based upon extensive power monitoring of ImageCare® systems while displaying movie and/or photo content.

Mode *ON- content off*

The content is off, the projector shows:

- Screensaver
- Computer locked log in screen
- black screen/white screen

Figure 2.4 – Example of ON- content off

Energy saving opportunity up to 70% depending on the implementation of ImageCare® by a projector manufacturer.

2.3 The 5 minute interval

Every 5 minutes the researcher registered the type of screen content displayed on the projector during the last 5 minutes.

As the projector can show different images/content in the 5 minute period, the researcher wrote down the type of content she observed most during the 5 minute interval. The only exception is the "same image"-mode that needs to be on for the full 5 minutes.

Example:

During a 5 minute interval, the researcher observes that for 2 minutes the projector is searching for input and for 3 minutes a presentation is shown. In that case, the 5 minute interval is classified as: ON –other content actively used.

3. Typical installation

All projectors seen were fixed installations and used in combination with an IWB. All observed installations were upside down, either hanging from the ceiling (for standard projector) or hanging on an arm attached to the whiteboard/wall (for short-throw projector)

Figure 3.1 – Typical installation of a projector in a primary school class

Figure 3.2 – Typical installation for a projector in a secondary school class

4. Results

All observation results were collected in an excel file. (See appendix, table 4.1 for example). The results were analyzed across all schools and all classes (see appendix, figure 4.1).

Analysis of the data revealed that the results were similar across all schools (primary and secondary). The projector tends to be on for 2 hrs followed by a break of at least 20 minutes. After 15 minutes the system has completely cooled down. Therefore from a lamp point of view there is no difference between 15 minutes off-time or several hours off-time. This means that a representative cycle for lamp lifetime testing is 2 hrs on/15 min off. Table 4.2 shows the average occurrence of the different usage modes. A discussion of the results in table 4.2 follows

	Total time - hours	Total time - hours ave. school day	% of total day	% of ON time	Ave. time ON - in minutes
OFF	50.3	2.8	42.2%		60
ON – Searching for input/standard projector screen	1.1	0.1	0.9%	1.6%	33
ON – other content – actively used	16.2	0.9	13.6%	23.5%	12
ON – other content – same image for 5 minutes	38.0	2.1	31.9%	55.3%	25
ON – full screen film	3.1	0.2	2.6%	4.5%	15
ON – full screen photo	0.1	0.0	0.1%	0.1%	5
ON – full screen photo – same image for 5 minutes	2.3	0.1	1.9%	3.3%	18
ON – content off	8.1	0.4	6.8%	11.8%	18
	119.0	6.6	100.0%		
	0.0				
OFF	50.3	2.8	42.2%		
ON	68.8	3.8	57.8%		
	119.0	6.6	100.0%		

High number due to one instance in which the equipment remained on for an extended period

Table 4.2 – Average results over all schools and all classes

- During this study, the most observed projector usage mode was a static image, as described by *On-other content same image*. On average the same image is left on for 25 minutes. This "same image" mode is used twice as much as the "active content" mode. This presents an energy-saving opportunity for ImageCare® projectors in the classroom: if the projector allows the system to switch towards 30% of its full power energy consumption, the image is still available but not distracting attention from the subject at hand in the lesson.
- The interactivity options of the IWB are used for maximum 25% of the ON-time.
- Full screen photo is rarely used.
- Full screen film is seldom used in primary schools and in secondary school only during 9% of the on time. The average duration of a displayed movie is 15 minutes.
- Occasionally, projectors are used after school hours. Based upon the interviews this is estimated to be 1 hour per week outside school hours.

5. Implications for lifetime testing and energy saving opportunities

Lifetime cycle	Mins	% of ON time
OFF	15	
ON – Searching for input / standard projector screen	2	2%
ON – other content – actively used	30	25%
ON – other content – same image for 5 minutes	60	50%
ON – full screen film	10	8%
ON – full screen photo	1	1%
ON – full screen photo – same image for 5 minutes	2	2%
ON – content off	15	13%
Repeat Cycle		
Total time 1 cycle on time	120	

Table 5.1 – Proposal for representative end-user based lifetime testing of lamps for the education market 2hrs on/15 min off

Table 4.2 is used to derive a proposal for lifetime testing of projector lamp systems that represents the actual end-user behavior in the education market. The translation of table 4.2 into a lamp lifetime testing protocol is given in table 5.1. The proposal is based upon the observed 2hrs on/15 min off education cycle. The different ON-modes are divided proportionally over the 2 hours ON time.

Using Table 5.1 Philips Lighting calculated the energy saving opportunities for a projector lamp with ImageCare® as compared to a non ImageCare® system. The results are given in table 5.2 and show an energy saving opportunity of 48%. This is more than in the eco mode function of the average projector where the energy saving is between 20 and 30%. Note that ImageCare® is expected to have the same or better effect on lifetime as eco mode.

		No Imagecare®	Imagecare®
Lifetime Cycle	Mins	Average Power (W)	Average Power (W)
OFF	15	0	0
ON – Searching for input / standard projector screen	2	100%	75%
ON – other content - actively used	30	100%	100%
ON – other content – same image for 5 minutes	60	100%	30%
ON – full screen film	10	100%	65%
ON – full screen photo	1	100%	65%
ON – full screen photo – same image for 5 minutes	2	100%	65%
ON – content off	15	100%	30%
Average Energy		**100%**	**52%**
Total time 1 cycle on time	120		

Table. 5.2 – Energy consumption for a projector lamp system without ImageCare® compared to system with ImageCare®.

6. Average usage of projector per year in hours

The data was also used to calculate average usage of projectors per year in hours of operation. All classes visited in the UK used the projector in combination with an IWB. Most likely projectors are used more intensively in combination with an IWB than stand-alone.

At the end of the school day, in all cases the projector was turned off by the teacher. Even at longer breaks the projector is almost always turned off. Between subjects in secondary education the projector is often left on. Basically whenever the teacher left the classroom for a break or for end of school, the projector was turned off. Discipline to do so was demonstrated to be very high.

It was found that projector usage was higher in primary education than in secondary education (64% of schooldays vs. 51% of schooldays). Occasionally projectors are used outside school hours, this is estimated to be 1 hr/wk. The average projector usage per week resulted in 20 hours/week, with 39 school weeks in England per year, that results in an average yearly use of 784 hours

Primary Schools		
	Hrs	% of School day
Off	2.4	36%
On	4.3	64%
	6.7	100%
Secondary Schools		
	Hrs	% of School day
Off	3.2	49%
On	3.3	51%
	6.5	100%
Average Overall Schools		
	Hrs	% of School day
Off	2.8	42%
On	3.8	58%
	6.6	100%

Table 6.1 – Average projector usage per year.

7. Dim or Eco-mode versus full power mode

It was found in the research that the projector is either set in full power mode or in eco mode (=dim mode or low temp mode). Teachers do not change this setting during their lessons. The selected mode depends on the school. 67% of projectors observed used full power mode, 33% used eco mode. Teachers seem to be unaware that dim-mode results in a lower brightness performance compared to full power mode.

Clearly eco-mode is not used actively by the teacher, e.g. dimming when the situation allows it and full brightness when needed. A solution for this problem is ImageCare®.

8. Interview results: Advantages and disadvantages of using projectors / IWBs

After the lessons, the researcher had a short 2 minute interview with the teacher and/or ICT manager of the school.

"The Interactive Whiteboard with projector gets students involved, enhances learning and children get excited and it makes the lessons dynamic"

Geography Teacher, Secondary School, UK

Almost all teachers indicate that the biggest advantages of the IWB/projector are that it keeps the children's attention. Another frequent comment was that the IWB allows access and use of many different resources.

"The Interactive Whiteboard with projector is quicker, easier, and holds the children's attention. Any information you want to use is at your fingertips. Work can be stored from the previous week or year and can be used again"

Year 3 teacher, Primary School, UK

Teachers indicate a large variety of disadvantages. Most frequently it was stated that if the projector does not work it disturbs the lesson planning. Other comments included:

- Adjustment of projector with IWB is sometimes a problem.
- When a normal projector instead of short-throw is used, teachers also mention standing in the light as disadvantage.
- Board area is too small to teach different abilities.
- When it is bright the screen is a wash out.
- Bulbs (lamps) do not last very long.
- Bulbs are too expensive.
- Need to be prepared.
- Older generation fearful of using it.
- Teachers need support for technology.
- An ICT manager at a large secondary school states that biggest problem in his view is losing the remote controls for the projector, they can cost £60-70 to buy.

9. Conclusions

Projector usage in education in the UK was on average 784 hours per year. Projector usage was slightly higher in primary than in secondary education (64% of the school day vs. 51% of the school day). Occasionally projectors are used outside school hours, this is estimated to be 1 hr/wk. In all cases projectors were turned off at the end of the school day, in most cases projectors were also turned off before (bigger) breaks. Discipline to do so is very high.

The results also showed that projector usage is quite similar across all schools and all classes visited. The typical norm for usage in education for both primary and secondary schools was a cycle of 2 hrs usage followed by a break of at least 20 minutes. The most observed projector usage mode was a static image, as described by *On-other content same image*. The average time that the same static image is shown is 25 minutes. Active projector usage e.g. showing a PowerPoint presentation or using the interactivity of the Whiteboard is only observed for 25% of the on time for an average length of 12 minutes. Full screen movies are seldom shown in primary school and only during 9% of the on time in secondary school. The average duration of a full screen movie is 15 minutes.

The study revealed that the projector is either set in full power mode or in dim mode. Teachers do not change this setting during their lessons. The selected mode depends on the policy of the school.

Teachers mentioned that the biggest advantage of a projector/IWB is that it keeps the children's attention, the biggest disadvantage is that it disturbs the planning if it doesn't work properly.

The end-user usage pattern also reveals that there is a great opportunity to improve energy consumption in the education environment. Using the user profile of this research, Philips Lighting calculated that a potential energy saving of 48% can be realized with ImageCare® as compared to systems that don't use ImageCare®.

The lifetime test that was derived based upon this research will be used by Philips Lighting to perform end-user based lifetime tests with lamp-systems operated with ImageCare®.

10. Appendix

Table 4.1 – Part of an Excel file logging results of a typical school-day for a year 1 class in a Primary School in the UK:

Time	Screen Content	Subject Being Taught
0800	-	
0805	-	
0810	-	
0815	OFF	
0820	OFF	
0825	OFF	
0830	OFF	
0835	ON – other content – actively used	Teacher preparing for lesson
0840	ON – other content – actively used	Teacher preparing for lesson
0845	ON – other content – actively used	Teacher preparing for lesson
0850	ON – other content – actively used	Teacher preparing for lesson
0855	ON – other content – actively used	Teacher preparing for lesson
0900	ON – other content – actively used	Children entered classroom
0905	OFF	Register
0910	ON – Searching for input/standard projector screen	Registry
0915	ON – other content – actively used	Numeracy
0920	ON – other content – same image for 5 minutes	Numeracy
0925	ON – other content – same image for 5 minutes	Numeracy
0930	ON – other content – same image for 5 minutes	Numeracy
0935	ON – other content – same image for 5 minutes	Numeracy
0940	ON – other content – same image for 5 minutes	Numeracy
0945	ON – other content – same image for 5 minutes	Numeracy
0950	ON – other content – same image for 5 minutes	Numeracy
0955	ON – other content – same image for 5 minutes	Numeracy
1000	ON – other content – same image for 5 minutes	Numeracy
1005	ON – other content – actively used	Numeracy
1010	ON – other content – actively used	Numeracy
1015	ON – other content – same image for 5 minutes	“Carpet time”
1020	ON – other content – same image for 5 minutes	“Carpet time”
1025	ON – other content – same image for 5 minutes	“Carpet time”
1030	ON – other content – same image for 5 minutes	“Carpet time”
1035	OFF	Tidy Away
1040	OFF	Break
1045	OFF	Break
1050	OFF	Break
1055	OFF	Break
1100	OFF	Literacy
1105	ON – other content – same image for 5 minutes	Literacy
1110	ON – other content – same image for 5 minutes	Literacy
1115	ON – other content – same image for 5 minutes	Literacy
1120	ON – other content – same image for 5 minutes	Literacy
1125	ON – other content – same image for 5 minutes	Literacy
1130	ON – other content – same image for 5 minutes	Literacy
1135	ON – other content – same image for 5 minutes	Literacy
1140	ON – other content – same image for 5 minutes	Literacy
1145	ON – other content – same image for 5 minutes	Literacy
1150	ON – other content – same image for 5 minutes	Literacy
1155	ON – other content – same image for 5 minutes	Literacy
1200	ON – other content – same image for 5 minutes	Literacy
1205	ON – other content – same image for 5 minutes	Literacy
1210	OFF	Lunch

Figure 4.1 – Analysis of results

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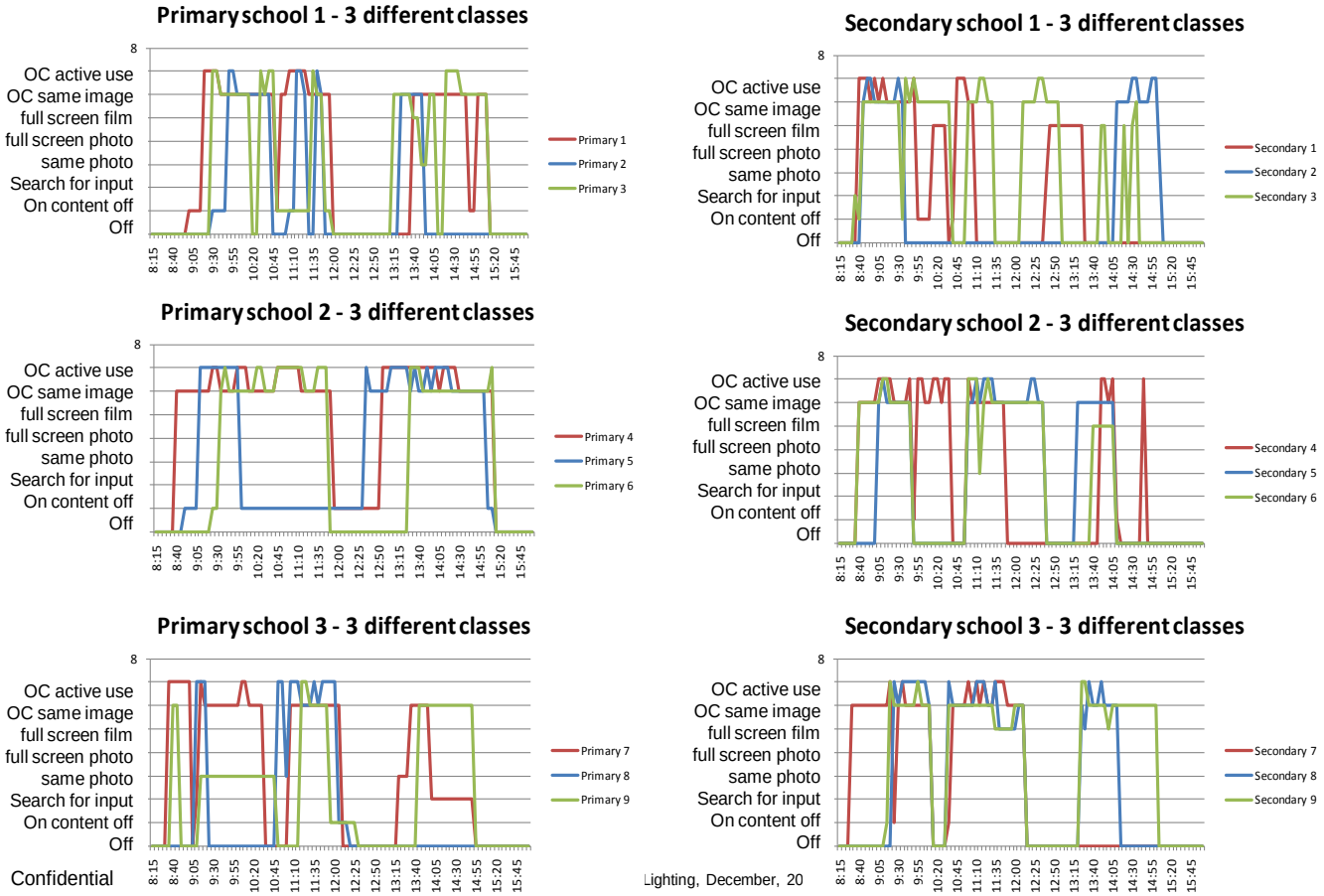
All schools show similar patterns. Projector is often on in blocks of 2 hrs



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