DESIGNING THE FUTURE
CLASSROOM

BYOD
Bring Your Own Device

A guide for school leaders

European Schoolnet

Future Classroom Lab
by European Schoolnet

Contents

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European Schoolnet

Executive Summary

This initial guide, an online version of which will be regularly updated, has been developed by European Schoolnet as part of the work of Ministries of Education in its Interactive Classroom Working Group (ICWG).

It is designed to provide school leaders, local education authorities and other decision makers with information about current Bring Your Own Device (BYOD) trends, options and examples from schools in Europe as well as relevant lessons from BYOD implementations in schools in other parts of the world.

Bring Your Own Device (BYOD) or Bring Your Own Technology (BYOT)

Employees or students bring personally owned mobile devices (laptops, netbooks, tablets, smartphones, etc.) to their workplace or educational institution and use those devices to access corporate, institutional and other information, applications and services.

While the primary aim is to inform school ICT strategy development and support decision making, the findings on good practice and case studies will also be of interest to many teachers who are interested in exploring the potential of BYOD on a smaller scale. It is also intended that this will be a continuing source of information and advice with further case studies being added and further refinement of guidelines taking place in the light of new data collected as well as feedback from readers

1:1 computing, the use of one portable ICT device per learner, is rapidly becoming the norm in many education and training contexts around the world. Schools are increasingly deploying laptops, netbooks, tablet computers or smartphones (as well as handheld portal media and gaming devices) to support teaching and learning both inside and outside classrooms. However, implementation of 1:1 computing by providing a dedicated (usually mobile) device for each student involves substantial capital investment by schools, or their funders.

Also the speed at which some of these technologies are superseded by new models and new types of devices, as well as the cost of providing support and maintenance, raises concerns about long term sustainability, especially in state funded schools. One result is growing interest in, and debate around, the concept of Bring Your Own Device or BYOD.

Research by European Schoolnet and its network of Ministries of Education, in partnership with Cisco Systems, has found *"Bring Your Own Device (BYOD) … is becoming more widespread and schools are developing policies that allow students and teachers to connect and use their own portable equipment (smartphone, tablet…) in school, as is now the case in 75% of schools [in Europe] on average".* However, although *"These figures are noticeably higher than the 2013 Survey of Schools: ICT in Education. The percentage of schools that provide services beyond basic connectivity is lower… at just 38%, with the highest percentages of schools in Denmark, Portugal and Sweden also providing services to support their BYOD policy".* In general BYOD seems to be most common at secondary and upper secondary school levels. Some emerging key messages, from desk research and interviews with national policy makers, regional education authorities, school principals and school teachers carried out for this guide, include:

- Excellent broadband and Wi-Fi able to maintain a good service for large numbers of concurrent users, are vital. The support of IT staff and/or contracting an appropriate IT support service is also very important.

- Although schools may make savings when students/ parents pay for mobile devices, a similar level of investment in upgrading and maintaining infrastructure will probably be required as for implementing 1:1 computing.

- Teacher training, continuing professional development and pedagogical as well as technical support for teachers are essential.

- In common with other school improvement strategies, engaged and informed school leaders are needed to drive culture change and realise strategy aims.

- Frequently expressed objections to BYOD, especially when the use of student owned devices is required rather than voluntary, concern issues of equality and inclusion. The emerging consensus among researchers, educators and policy makers seems to be that measures must be put in place to ensure that all students can access similar technology regardless of their socio-economic background. In some countries equality is a particularly sensitive concern as citizens and parents see BYOD as potentially undermining a local principle that education must be provided free of charge.

- Definitions of BYOD vary and a number of different approaches to BYOD are used in schools. Schools often allow only models of mobile devices specifically authorised for use in school or purchased via the school. This approach makes technical and pedagogical support easier to manage, helping principals, teachers and technical staff feel more comfortable with, and more accepting of, the culture change involved in BYOD.

- Approaches to implementing BYOD vary, including: very carefully planned and supported top down approaches; informal BYOD by individual innovative teachers in a few classes, leading to pockets of good practice; and rather casual approaches where students bring mobile devices to school but changes in pedagogy are not made to take full advantage of this technology to enhance teaching and learning. ●
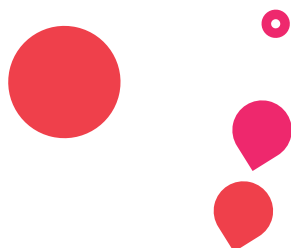
1. Introduction

Background

1:1 computing, the use of one portable ICT device per learner, is rapidly becoming the norm in many education and training contexts around the world. Schools are increasingly deploying or supporting laptops, netbooks, tablet computers or smartphones to support teaching and learning both inside and outside classrooms.

In some cases 1:1 computing has already expanded to 'many:1' where there may be several devices per learner (typically a laptop and/or tablet plus a mobile phone) with each being used in different ways in different learning contexts. Alternatively, some schools, especially at primary level, have found it beneficial to have students sharing devices in pairs or small groups. This is not necessarily due to a lack of resources, it can be because the teacher recognises the benefits of collaborative learning and team work. The use of technology in this way is aligned to active learning and a station teaching approach.

However, implementation of 1:1 computing by providing a dedicated (usually mobile) device for each student involves substantial capital investment by schools, or their funders. Also the speed at which some of these technologies are superseded by new models and new types of devices, as well as the cost of providing support and maintenance, raises concerns about long term sustainability, especially in state funded schools. One result is growing interest in, and debate around, so-called Bring Your Own Device (BYOD) approaches under which the cost of providing a device for personal educational use is transferred to families or students who may bring in a device already owned, select and purchase a new device, or pay for a device chosen by the school or local authority.

Gartner researchers have observed *"as technology consumerization and mobility has captured the user community – and an economic slowdown has crimped IT budgets – IT leaders in education have become increasingly open to leveraging personally owned devices and to delivering information and services beyond the firewall of their data centres and far afield from their physical campuses"* and they are now increasingly willing to consider leveraging student owned devices for use on campuses and in classrooms (Rust B et al, 2010). Also, Ambient Insight research into the *Western European mobile learning market* has identified the growing use of tablets and BYOD in schools as one of five major catalysts driving the adoption of mobile learning in Western Europe (Adkins S, 2013).

It should be noted that although schools may make savings when students and parents pay for mobile devices under BYOD policies, they still probably need to make at least the same investment in upgrading and maintaining infrastructure (including ensuring: adequate bandwidth, robust Wi-Fi for large numbers of concurrent users, network security and appropriate mobile device management systems) as schools which implement 1:1 computing.

A major objection to BYOD which is frequently expressed, especially when the use of student owned devices is required rather than voluntary, concerns issues of equality and inclusion.

The emerging consensus among researchers, educators and policy makers seems to be that, if BYOD is to be implemented, measures must be put in place to ensure that all students can access similar technology regardless of their socio-economic background. This can be achieved by arranging free devices, equipment loans or grants, payment by instalments or negotiation of affordable device prices including ensuring availability of lower cost options below the level of available grants. In some countries equality is a particularly sensitive concern as some citizens and parents see BYOD as potentially undermining the principle of education being provided free of charge.

An *infographic* developed by Securedge Networks compares 1:1 with BYOD under the headings of cost, equality, apps and maintenance and suggests that BYOD has advantages in the areas of cost and device maintenance whereas the 1:1 approach makes equality and apps issues easier to deal with.

European Schoolnet and its network of Ministries of Education, in partnership with Cisco Systems, launched a survey in Europe in autumn 2014 to *"find out more about a crucial but overlooked link in the digital learning chain: the school IT administrator"*. One of the challenges for

the IT administrator explored in the study was BYOD. An important finding, from the 20 countries where the response rate was considered sufficient to draw meaningful conclusions, was that *"Bring Your Own Device (BYOD) … is becoming more widespread and schools are developing policies that allow students and teachers to connect and use their own portable equipment (smartphone, tablet…) in school, as is now the case in 75% of schools on average"*. (Blamire & Colin, 2015)

However, the *IT survey report* notes that whilst, *"These figures are noticeably higher than the 2013 Survey of Schools: ICT in Education. The percentage of schools that provide services beyond basic connectivity is lower… at just 38%, with the highest percentages of schools in Denmark, Portugal and Sweden also providing services to support their BYOD policy."*

Emerging messages

The following key messages are emerging from the research and practice sources reviewed and the interviews carried out for this initial version of the BYOD guide.

- Some European educators and policy makers now see the introduction of policies that require parents to provide and/or pay for devices for use in publically funded schools as inevitable.

- However, others have expressed concerns about shifting the responsibility and cost of purchasing, and in some cases maintaining, learning technologies from governments and institutions onto parents. This concern is strongest in countries where the provision of education free of charge is a key element of education policy. In other countries concerns are often expressed about possible inequality, widening of the digital divide or even bullying, if some students and their families cannot afford a BYOD device or if other students can afford superior devices.

- School leaders and policy makers who have implemented, or plan to introduce, BYOD demonstrate an awareness of this potential equality issue and deploy various strategies to avoid it. These include negotiating prices for recommended devices that are below the total of an educational grant provided to all students, enabling payment by instalments via the school or a preferred supplier and loaning or giving devices to students

- BYOD seems to be more common in secondary schools than in primary schools. At upper secondary level interviewees for this guide reported some use of university-like models in which students bring any device and take responsibility for its maintenance and support.

- Approaches to implementing BYOD vary and include: very carefully planned and phased top down regional and/or whole school approaches; informal BYOD by individual, innovative teachers with a few classes; and rather casual approaches under which students are allowed to bring in and use certain types of devices without accompanying changes in pedagogy to take advantage of this technology.

- In common with other school improvement strategies, engaged and informed school leaders are needed to drive culture change and realise strategy aims.

- Excellent broadband and Wi-Fi, which can maintain a good service when used by large numbers of concurrent users, is extremely important in order to ensure successful implementation of BYOD as without it students and teachers can quickly become frustrated and demotivated. The support of IT staff and/ or contracting an appropriate IT support service is also very important.

- Teacher training, continuing professional development and both technical and pedagogical support are also essential. Teachers who are not comfortable with students using their own devices, and do not know how to make best use of these to enhance teaching and learning, are likely to oppose the introduction of BYOD or not allow or discourage use of the devices when they become available. Effective ways of encouraging and facilitating teachers' learning include practitioner led action research projects and social learning, i.e. teachers learning from observing the behaviour and results achieved of their peers who may include enthusiastic early adopters and/or teacher "champions" who are rewarded for supporting their colleagues. In the case of BYOD social learning may also include teachers learning from observing how technologically able students use their mobile devices.

Scope

This initial guide, an online version of which will be regularly updated, has been developed by European Schoolnet as part of the work of Ministries of Education in its Interactive Classroom Working Group (ICWG). It is designed to provide school leaders, local education authorities and other decision makers with information about current BYOD trends, options and examples from schools in Europe as well as relevant lessons from BYOD implementations in schools in other parts of the world.

While the primary aim is to inform school ICT strategy development and support decision making, the findings on good practice and case studies will also be of interest to many teachers who are interested in exploring the potential of BYOD on a smaller scale. It is also intended that this will be a continuing source of information and advice with further case studies being added and further refinement of guidelines taking place in the light of new data collected as well as feedback from readers.

The methodology used to collect data for this resource included:

- A literature review drawing on the findings of research funded by governments and groups of governments, published academic papers, commercial white papers and more informal online sources.

- Interviews with ICWG members, policy makers in national Ministries of Education and regional education authorities, school principals and school teachers. •

2. Drivers for BYOD in Europe

The decision to introduce BYOD to schools in Europe is driven by a combination of social, economic, educational and technological factors. The relative importance of these factors varies from country to country and according to the particular contexts in which individual schools operate.

Social drivers

The social landscape regarding technology ownership and use has changed significantly during the last 15 years and the pace of change has accelerated during this period. In all European countries most secondary school students now own mobile phones and many also own or have access to tablet and laptop computers. Most homes have broadband and free Wi-Fi is available in many locations in most towns and cities and is increasingly found in more rural areas. As a result, for most young people mobile technologies and the internet are simply a normal part of everyday life which they cannot imagine being without.

Technological drivers

Modern smart devices now provide their users with a vast array of useful tools whilst being very compact and convenient to carry around and, in view of their functionality, relatively inexpensive. They can replace all or much of the functionality of multiple devices some of which were previously both large and expensive, e.g. desktop computers, cameras, video cameras, tape recorders, TV/computer screens, music mixing and video editing equipment and satnavs. Mobile devices can also connect to larger screens when required to share, discuss and/or collaboratively edit in class (as well as online) material collected on mobiles, thereby supporting collaborative as well as individual work. However, the pace of technological change is very fast. New devices which are able to process and store more information faster and offer more functions, or are simply more attractive to consumers, are frequently launched, making previous types and models of device appear out of date.

Economic drivers

Most European countries have experienced financial difficulties in recent years and for some the effects have been severe. As a result, most publically funded schools' budgets have been reduced or frozen or at least the rate of annual budget increase has fallen. However,

generally schools are expected to provide the same or an improved level of service to their students. Consequently, all aspects of school budgets are subjected to careful scrutiny.

Concerning the economic drivers of BYOD in their school or schools, typical views (which were very consistent across all countries) of policy makers, school principals and teachers interviewed for this guide can be summarised as follows:

- BYOD is about efficient management of resources at a time when school budgets are tight. Schools would like to use ICT more but existing stocks of equipment and computer classrooms are insufficient. Also schools cannot afford to buy a mobile device for each student and replace it every two or three years. However, most students already own at least one device, and in the case of smartphones always have these with them, so it is a waste not to use these devices in school.

- A huge number of free, or low cost, learning apps, eBooks, videos and other learning materials are available for use on students' devices. These are cheaper, lighter, more convenient and more easily updated than traditional textbooks.

Some interviewees perceived BYOD as a low risk way of experimenting with the use of mobile devices for teaching and learning without having to first purchase large numbers of expensive devices.

Concerning the cost of learning resources, several interviewees saw the increased use and functionality of mobile devices as an opportunity to move away from reliance on expensive and relatively static text books towards greater use of learning materials developed by teachers and students.

Regarding apps, some schools include in the specification of BYOD devices for students a list of apps which need to be installed. This approach has the effect of including the cost of apps, where these are not free of charge, in the cost of BYOD to students or their families.

To assist schools to legally provide multiple copies of apps for use on students' devices, some suppliers have introduced volume purchase schemes. It has been observed that the costs incurred via these schemes are less than the older software licensing costs associated with desktop computers. However, some schools may have underestimated the cost of apps if, during pilot 1:1 or BYOD projects for example, they have previously distributed apps by replicating a standard device configuration across all devices via a synchronisation process.

Educational drivers

Schools in all European countries are under pressure to deliver improved outcomes for their students. The demise of many traditional industries that required large workforces, competition from other countries in an increasingly globalised world and the changing nature of employment (in many cases due to increased automation and digitisation), together with stalled or very low rates of economic growth have led governments to conclude their citizens need to be educated to a higher level in order to participate fully in a knowledge economy, contribute to business innovation and improve economic growth. National governments are acutely aware of their countries' rankings in the Organisation for Economic Co-operation and Development (OECD) *PISA (Programme for International Student Assessment)* surveys and a desire to improve these can drive education policy making in some countries. Individual governments have particular priorities for improving education but typically schools are being asked to:

- Improve: overall academic achievement; achievement in STEM subjects (Science, Technology, Engineering and Mathematics); digital literacy and ICT skills; literacy and numeracy; language skills; and opportunities to develop critical thinking, problem solving, communication and collaboration skills.

- Provide: differentiated teaching to meet the needs of individual learners and groups of learners including learners with disabilities or special educational needs; learning activities tailored to students' preferred learning styles or preferences; personalised learning resources and tools that meet the unique needs of individual learners; better preparation for employment.

Many educators and policy makers interviewed for this guide identified as an educational benefit ownership of, and the ability to personalise, the device used for learning, suggesting that this is an important element in moving towards more student centred learning.

Some schools mentioned drivers that are specific to the particular circumstances in their country or their school. These included:

- Digitisation of the Finnish final matriculation examinations by 2016 making the need to achieve 1:1 computing more urgent, with perceived advantages if students can use devices they are familiar with.

- Previous Norwegian Government decisions to digitise learning materials and to require schools to teach digital literacy, as well as counties and some municipalities implementing 1:1 computing in their schools. In most cases the Norwegian counties have implemented 1:1 computing by buying devices for students but Rogaland County decided to try BYOD, having carried out research which identified BYOD as an emerging trend in some other countries that could deliver educational benefits.

- A desire to test hypotheses concerning benefits that might be gained by enabling the use of personal mobile devices. For example, a Finnish school with a higher than average percentage of male students hypothesised that learning with mobile devices might improve the engagement and therefore achievement of male students in particular and that BYOD would enable this mobile learning to begin. This was in reaction to national statistics showing that boys typically achieve one grade lower than girls in literacy, especially in written work.

- The examples provided by other schools' successes, and/or lack of serious problems when implementing BYOD. This was the case in the UK where there are several BYOD schools whose successes have been widely publicised.

- Ecological concerns, e.g. schools in Switzerland (Projekt schule) and Austria involved in questioning the waste of resources represented by purchasing of mobile devices by schools when students already own personal devices with similar affordances.

3. What do we mean by BYOD?

BYOD/Bring Your Own Device (or BYOT/Bring Your Own Technology) is commonly used to mean permitting employees or students to bring personally owned mobile devices (laptops, netbooks, tablets, smartphones, etc.) to their workplace or educational institution and to use those devices to access corporate, institutional and other information, applications and services.

Companies or educational institutions often provide for visitors or contractors' "guest" access to a Wi-Fi network, which may be a separate network, providing access to no more than the public Internet. This type of access may be included in definitions of BYOD but this is a very limited type of BYOD and may exist in addition to more comprehensive models. School BYOD strategies may, and it can be argued should, go further than merely allowing students to use their own mobile devices in school and providing internet access for them. A more beneficial approach involves embedding the use of students' own devices into teaching and learning both within and outside the school.

School BYOD strategies may require parents or guardians to purchase mobile devices for students to bring into school. This approach can help to make technology enhanced learning more affordable for schools and more sustainable in the long term. Supporters argue that parents often provide stationery and other equipment for use in school, so why not mobile devices. However, this can be controversial, especially if parents are inadequately consulted or have concerns about the cost and in countries where parents contributing to the cost of education is thought to undermine the principle of free education. A common approach is for schools to implement schemes which assist parents, or the students themselves, to purchase mobile devices at discounted prices and, in some cases, to pay for these in instalments.

To make technical and pedagogical support more manageable, schools often apply restrictions; for example, only allowing students to bring in the types and models of mobile device that have been specifically authorised for use in school or purchased via the school. When schools dictate acceptable technical specifications for devices, or parents purchase BYOD devices via the school or an authorised supplier, schools are able to maintain a greater level of control and can ensure all students have the same, or similar, devices. This helps principals, teachers and technical support staff to feel more comfortable with, and therefore more accepting of, the culture change involved.

Picture: BYOD Control v Risk/Complexity

All students having the same device has advantages including:
- Simplifying technical support.
- Reducing the amount of teaching staff training required.
- Enabling teachers to plan teaching with a wider range of resources (including apps, Internet resources, etc.) but have less complexity to manage during lessons.
- Avoiding creating a digital divide between those students whose families can afford the most expensive devices and their less privileged peers, particularly students from disadvantaged backgrounds. Of course, when introducing any BYOD approach it is necessary for schools or education authorities to make arrangements to ensure that students whose families are unable to pay are able to access the same technology.

Alternative approaches to managing technical support workload associated with BYOD devices include:
- simply making this the responsibility of the student;
- and/or the school, or local education authority, negotiating on behalf of students/parents for a support service to be included in the cost of the devices purchased or covered by an insurance policy. ●

Bring Your Own Browser/BYOB and Bring Your Own App/BYOA?

Some teachers, e.g. Paul Hynes, Vice Principal of George Spencer Academy in the UK (see case study 9.8) and Thierry Maire, Head Teacher at Gymnase Intercantonal de la Broye in Switzerland (see case study 9.7), believe the type of mobile device a student brings into school is relatively unimportant nowadays provided it meets a minimum functionality specification which could be that it provides a camera, an internet browser and some means of taking notes.

Paul Hynes suggests that students 'bringing their own browser' (BYOB) may be what really matters for schools and advises teachers to avoid using apps because some may not be available on all the devices their students use. On the other hand some argue, e.g. Chris LaPoint (2014), writing for *District Administration* magazine, that "BYOD has led to BYOA, 'bring your own app', and focus must now shift from devices to software" as "for better or worse, our computing experience is now primarily based on apps".

Also the growing use of browser extensions, optionally installed software that extends the functionality of a web browser in some way, means that browsers are becoming less homogeneous. ●
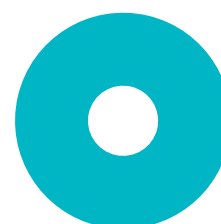
4. BYOD scenarios and implementation

It may be useful to consider other ways in which mobile devices are provided to and used by learners in schools in order to see BYOD in context.

Mobile devices may be chosen, paid for and supported by the school (or, dependent upon the location and context, by the school's funders, or the funders of a mobile learning initiative, which may include governments, local education authorities, sponsors or NGOs). In this situation the school usually specifies where the devices can be used i.e. only in the classroom, within the school or both in school and outside.

It is unsurprising that where devices have been purchased by a school, or their funders, staff may be reluctant to allow these to be used outside of school due to the risks of loss, damage or the device being left at home when needed in school. This restriction reduces the benefits to be gained by having mobile devices capable of supporting learning at home and in the community. When mobile device use is limited just to a classroom during lessons this further restricts the benefits which could be realised, many of which are dependent upon both the use of mobile devices in authentic learning situations and learners personalising and feeling ownership of their device.

Restricting access to supervised use in the classroom can also encourage a misconception by teachers that mobile devices do not offer any significant advantages over desktop computers.

In some schools BYOD may begin in an informal, ad-hoc way as teachers begin to recognise that students' own devices could be useful in the classroom. Alternatively, introduction may be a carefully planned, strictly controlled and monitored process with clear aims and objectives.

It may be helpful when thinking about BYOD to consider some example scenarios:

Scenario 1: Informal single teacher innovation

- One teacher in a school allows students to bring their smartphones into classes and collaborates with them to find ways to use these to support learning.

- The teacher is motivated by a desire to try something different to engage hard to reach students.

- The teacher does not seek permission and may even be acting against official school policy. School leaders may be unaware BYOD is occurring.

- The teacher may or may not share information with other teachers and encourage others to try BYOD but, if they do, BYOD can slowly spread and some benefit will be seen.

- Impact is dependent upon an individual teacher's ability to enthuse others and all BYOD may cease if that teacher leaves.

Scenario 2: Voluntary BYOD for older students

- A school principal decides to allow students in the senior years to bring mobile devices into school to support their learning.

- Teachers are encouraged but not required to allow use of the mobile devices in their classes.

- Teachers are offered technical training and may attend workshops on the pedagogical uses of mobile devices if they are interested.

- The IT department/administrator does not have any responsibility for the students' mobile devices but does allow them to connect to a school Wi-Fi network.

- Some ICT literate students are rewarded for providing support for their peers and advice to teachers.
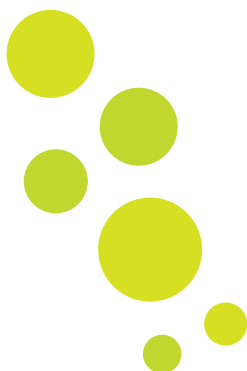
- Pockets of good practice will develop and some students will benefit. Some students will not bring devices to school and some teachers will not allow use in their classrooms or will not fully exploit the potential of the students' devices to enhance teaching and learning.

Scenario 3: Planned and controlled whole school approach

- A secondary school principal decides, in consultation with teachers and other stakeholders, to require all parents to fund tablets for their children to make the introduction of tablets for teaching and learning affordable and sustainable.

- In order to make technical support by school IT staff and staff training as easy as possible, to avoid any parental or societal concerns about potential inequalities and to obtain an attractive price for parents due to bulk purchasing, it is decided that all the devices will be identical.

- The school invests in enhanced broadband and upgrades the Wi-Fi network to cater for the planned increase in traffic.

- A project team plans and oversees implementation of the school wide BYOD strategy. Training courses and workshops plus both technological and pedagogical support are arranged for teachers. All teachers are informed that they will be required to use the tablets in their lessons. Arrangements are made to monitor progress and evaluate impact.

- BYOD is likely to be successfully implemented throughout the school. There may be issues with IT staff restricting how and when devices and on-line services are used and students may feel less ownership as the type of device was dictated by the school.

Where the introduction of BYOD has a clear aim this may be to support significant changes in the school's teaching methods in order to improve student engagement and achievement. Achieving such an aim involves working to ensure that the technology brought in is fully integrated into day-to-day teaching and learning throughout the school. This may involve significant culture change and is likely to be achieved in stages.

Processes for, or progress towards, transforming businesses or fully integrating technology into organisations or educational institutions are often illustrated using a four or five step transformation model, e.g. Venkatraman's five levels of business transformation achieved through the use of IT (Venkatraman & Henderson, 1993) or Puentedura's SAMR model (2009), which informed e-learning benchmarking and e-maturity work by UK education-sector agencies such as Becta (British Educational Communications and Technology Agency).

These models typically lead up through the **Enhancement** stages of:

- **Substitution**, where technology acts as a direct tool substitute with no functional change; and

- **Augmentation**, where technology acts as a direct tool substitute with functional improvements

and then the Transformation stages of:

- **Modification**, where technology allows significant task re-design (sometimes called the 'process and network redesign' stage); and

- **Redefinition**, where technology allows the creation of new tasks previously inconceivable

This type of model can be used to explore and review key strands of strategies for introducing BYOD, including for example key choices and how the process will be managed, how BYOD devices will be supported and access the internet, where they will and will not be used, their pedagogic use and the kind of training and professional development that will be provided for teachers. Consider the following example model. It should be noted that an individual school may be at different stages for each strand of their strategy. For example, a school could be at the status quo stage for 'governance and choice' but may be at the modification stage for 'teacher development'. ●

Category	STATUS QUO	STATUS QUO	Enhancement — SUBSTITUTION	Enhancement — AUGMENTATION	Transformation — MODIFICATION	Transformation — REDEFINITION
Governance and Choice	Student owned mobile devices are banned in school.	School tolerates/allows some devices in school, e.g. mobile phones, provided they are not used in lessons.	School advises that some devices can be brought into school.	School requires specific device to be brought into school. Parents purchase the device from the school or a specified supplier.	School requires students to bring a device to school and advises minimum specification or functionality. Parents buy from any supplier.	School requires students to bring in a device or devices. Students bring those they are most comfortable using to support their learning in particular locations and contexts.
Support and Control	School provides technical support for school owned devices only.	No technical support is provided and students' devices cannot access school networks.	No technical support is provided. Some students may use the school's guest Wi-Fi which provides filtered access to the internet only.	School, or outsourced service, provides technical support and implements strict safeguarding and administrator controls. Internet access is filtered and some websites blocked.	School or outsourced service provides technical support and students responsible for administration of device. More open internet access allowed and Wi-Fi network upgraded for increased demand.	Students responsible for device maintenance and insurance/service contracts encouraged with some school assistance if needed. Open internet access and student input to development of acceptable use policy. Internet bandwidth and Wi-Fi network capacity monitored and increased as necessary.
Locations	Student owned devices can only be used outside of school.	Student owned devices can be/are used on the school premises outside of lesson time.	Students' devices are sometimes used in the classroom and used at home.	Students' devices used in lessons when teachers allow. May be kept in lockers outside of lessons and may be left at school at night.	Students' devices are used in lessons when teachers allow and when the student wishes to use them around the school and at home.	Students are expected to use their devices in lessons and they are also used around the school, on field trips, at home and in the community. Traditional classrooms and classroom layouts replaced by more open, informal and ad hoc learning spaces.
Pedagogy	Teachers make no use of students' devices in the classroom or for assignments.	Teachers set some assignments that require students to use their mobile devices outside school.	Teachers occasionally allow students to use their devices in lessons for note taking or instead of booking time in computer classroom.	Teachers use students' mobile devices to add variety and internet use to lessons and to enable more differentiated learning activities within school.	Teachers use student mobile devices to breakdown classroom walls, encourage more active, collaborative inquiry learning and enhanced presentation of work.	Teachers and school leaders embed use of mobile devices into curriculum design and lesson planning. Textbooks replaced with eBooks and continually updated multimedia resources developed by teachers and students. Mobile apps enable learning activities in the real world not previously possible, e.g. using GPS.
Teacher Development	Teachers receive no training or staff development related to mobile technology.	Teachers may receive some technical training related to mobile technologies as part of a course.	Teachers may attend course on using a mobile device, e.g. a tablet, but do not use soon and therefore do not become confident users.	Teachers required to undertake technical training courses but little or no staff development regarding the pedagogical use of mobile devices.	Teachers attend technical courses and also workshops led by teacher champions or educational technologists on the pedagogical uses of mobile devices.	Teacher practitioner research projects explore new and best ways of using mobile devices for teaching and learning. Teachers are given time to plan and experiment and permission to fail. Teacher researchers supported by and collaborating with champions, IT support staff (or external providers of IT support), their peers in a community of practice and their students.

5. The benefits of BYOD for schools

The desk research and interviews carried out for this guide have enabled identification of a range of perceived benefits of BYOD which can be summarised under the following headings:

Improving the quality and effectiveness of teaching and learning

- The availability of students' devices facilitates innovative pedagogy and increases opportunities for learning through exploration and enquiry within and outside school.

- BYOD devices also increase the extent to which teachers can provide more differentiated learning activities for individual learners to meet their specific needs, learning styles and preferences, helping to:

  o improve the motivation and development of more able students who can become disengaged and demotivated in mixed ability classes;

  o motivate those students, perhaps particularly some vocational students, who may find traditional teaching methods and academic learning styles boring;

  o better support less able learners and students with disabilities and special educational needs.

- BYOD devices enable individual students to access digital textbooks and other learning resources in many different locations.

- Students using their own devices, rather than school computers, have a more comfortable and personalised experience. They can complete tasks more quickly and be more in control of their learning as they have their own software that they are familiar with and their own bookmarks. They can focus more on the content of learning activities rather than the technology used to support these.

- The use of mobile devices, and particularly the use of students' own devices, for learning provides more opportunities for students to create their own learning materials in addition to using the devices to access educational content created by others. The built in data collection functions of mobile devices, including the ability to take pictures, record video and sound,

input text and collect location information. A variety of sensors and apps can optionally be used with students' devices to collect other types of data, e.g. temperature or CO_2 levels for use in science education. Students can combine, edit, share and add to data collected and created, contributing to increased communication, collaboration, peer-to-peer learning and project team working.

- Combining students' own devices with school Virtual Learning Environments (VLE) and/or systems/apps like Showbie makes assigning, collecting, reviewing and feeding back on student work very quick, easy and not dependent upon location.

- Using students' own mobile devices provides more opportunities for formative assessment, and combining them with online response systems enables fast digital feedback on students' progress and on which topics require additional explanation by the teacher.

- When students' use their devices for learning, this helps to develop their digital competencies beyond the use they make of their mobile devices socially, which may be quite limited and involve only a small number of the functions and opportunities available.

- Knowing students have their own devices with them at all times means teachers can decide at short notice to try something new in addition to planned activities.

- Students having their personal digital device/s with them at all times, supporting their learning inside school and out, assists them in the development of 21st century skills like communication, collaboration and creativity as well as information and media literacy and technical skills.
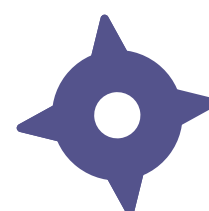
Improving the efficiency and sustainability of technology enhanced learning

- Improving the cost effectiveness of technology enhanced learning and enabling the introduction of 1:1 computing without increasing school spending on devices, are common goals of BYOD policies especially in times of austerity. Responsibility for purchasing mobile devices for learning is transferred to students/parents.

- BYOD can also enable the use of mobile devices for teaching and learning to continue beyond short term funded projects or pilots.

- Schools report that students/parents replace digital devices more frequently than school budgets allow. Thus making BYOD a more sustainable policy than school funded 1.1 computing. This results in the deployment of more up-to-date devices for learning.

- Buying, and/or developing locally, eBooks, digital learning materials and apps can be cheaper than buying and replacing conventional textbooks as well as enabling the addition of multiple media and an interactive learning experience. eBooks and digital learning resources can be more easily and quickly updated than printed material, helping to ensure that these are always up-to-date. They can also be designed to allow explanatory or enriching annotation by teachers, students and groups of students. There are health advantages where students have been required to carry many heavy textbooks in backpacks. However, in some countries, e.g. the French speaking part of Switzerland, few digital textbooks are available and these have to be purchased bundled with printed versions.

- The introduction of BYOD often results in reduced school spending on desktop computers and may enable some computer classrooms to be re-designated as general purpose classrooms, thus allowing more efficient use of school accommodation.

- When students use their own devices, especially if these are chosen by the students, there can be a reduction in the resources required for training students to use these.

- Incidents of device loss and damage are reported to be lower when students use their own devices as they take more care of their own property.

- Where BYOD enables every student to have a digital device, there is less need for printing and photocopying, leading to reduced expenditure on paper, ink and photocopier rental.

- Where the school is not responsible for repairs or maintenance of student devices (this applies in some European schools at upper secondary school level), savings can be made compared with the cost of supporting school owned devices or with shared responsibility BYOD models in which the school does provide ICT support. Interviewees have reported that, where students have responsibility for maintenance, they are required to have insurance and/or to subscribe to an external support service.

Organisational benefits

- Implementation of BYOD policies and associated benefits in improving teaching and learning can enhance a school's reputation for innovation in general and the use of ICT in particular.

- A whole school approach to training and staff development required for introducing BYOD should lead to improvements in the digital literacy and pedagogical skills of teachers.

- Any initiative which requires rethinking of the way in which the curriculum is delivered, students are supported and teachers are trained should result in organisational benefits.

- BYOD offers a unique opportunity to bring the students' world and digital media usage into a school's protected environment and thus encourages reflection on the impact of digital media on learning.

Improving family engagement

- The process of consulting parents/guardians concerning BYOD necessitates involving them in discussions of their children's learning and how the school is organised.

- Communication between students, teachers and parents can be improved as a result of combining the use of students' own mobile devices with the use of learning management systems to share timetables, lesson descriptions, study resources, assignments, grades and information.

- The introduction of BYOD also prompts detailed and active dialogue with parents on the subject of the ethical use of ICT, the internet and mobile devices.

- BYOD increases the possibility of other members of families gaining some educational benefit from the student's mobile device, especially in families with limited experience of both learning and technology. ●

6. Challenges and risks

The desk research and interviews carried out for this guide have highlighted a range of challenges and risks associated with, or believed to be associated with, BYOD and many sources have emphasised these rather more than the actual or potential benefits.

This is not unusual when exploring the potential of a new pedagogical approach, especially one involving ICT, and the situation may change as the number of successful cases of BYOD implementation increases.

National differences and language issues

Some concerns and challenges are specific to particular countries, for example:

- In several European countries school education is required by law to be free of charge. Therefore, asking parents to fund equipment for use in schools is very unusual and potentially problematic.

- In some countries or regions (e.g. France and Spain's Castile-La Mancha region) there are laws banning students from using their mobile devices in school and in other countries local or school level bans are common. This is currently a major obstacle to BYOD. However, even where there is legislation, some teachers have been able to obtain permission for students to use their mobiles for educational projects. In Portugal the law bans mobile devices unless they are used in an educational activity. Also, in many areas schools bans are frequently disregarded by students and also by some teachers who wish to utilise students' devices for learning activities.

- Some European governments are funding BYOD pilots or have a BYOD strategy but schools in other European countries say there is not a clear national direction on how to proceed and there are few BYOD good practice examples for teachers to learn from.

- There are very large numbers of apps available which can be used with BYOD devices. However, the largest number of these are in the English language and schools in many European countries complain of a shortage of apps and resources in their native tongue and aligned to their curricula.

- There is a general issue of availability of learning materials in some national languages. This applies especially to commercially published materials but also to open educational resources (OER). A _2014 report_ by the LangOER project found _"The existence of OER in less used languages ranges from languages with considerable OER to languages with few or no OER at all. The impression is more one of occasional initiatives without incentives for fully sustained development"_ (Bradley & Vigmo, 2014).

Challenges of diverse devices

Many of the concerns expressed by educators relate to BYOD models in which there is not a standard specification for the mobile devices brought into school, for example:

- Teachers may be concerned that if all students do not have the same or very similar devices there could be a risk of increasing the digital divide and problems of inequality and bullying.

- Where a variety of device types and models are used, lessons may have to be designed for the device with least functionality and opportunities offered by more sophisticated devices may be missed.

- Teachers need more training, support and preparation time to cope with their students using many different devices.

- If apps are used these may not work on all devices (i.e. including iOS and Android mobile devices, laptops and Windows tablets). Some schools and researchers have suggested that this problem can be avoided, or substantially reduced, by the use of browser-based apps (Stavert 2013). These apps are embedded within web pages and are therefore accessible via any device with a web browser with only minor rendering differences.

- Learning materials that use Adobe Flash may not work on some mobile devices and, combined with the national languages issue, this can limit the number of available good quality learning resources which can be used on students' BYOD devices.

Classroom management

Many educators have concerns about the use of any mobile device in classrooms as they suggest these could distract students from their normal learning activities. BYOD increases these concerns as students using their own mobile devices might access their own non-educational apps and games or use messaging services in class. Some schools or local education authorities have sought to prevent problems with students using online services not deemed appropriate, or seen as potentially time wasting, e.g. Facebook and YouTube, by blocking access to these on school networks. However, such controls will not address the issue of off-line games and many teachers regard YouTube, in particular, to be a useful educational tool providing access to a very large amount of valuable resources. The alternative to banning and blocking is educating students in responsible use of the Internet and mobile devices plus acceptable use policies and classroom management strategies which avoid, and as necessary address, misuse by individual students.

A particular concern of some interviewees was the potential of BYOD devices to facilitate cheating in tests. In most countries, even where mobile phones are not routinely banned from school or classrooms, very strict rules and harsh penalties are in place to prevent cheating in externally marked examinations. In the context of formative assessment, teacher observation, knowledge of their students and classroom management experience are normally employed to combat cheating.

Network capacity and traffic

The introduction of BYOD, even when this is on a voluntary basis and/or involves only a few classes, increases the number of

- users sharing internet bandwidth
- locations from which students and teachers use Wi-Fi to access the internet and school systems
- concurrent users accessing the Wi-Fi network
- potential concurrent users of mobile network cells
- items stored in and retrieved from cloud storage

Where schools have not anticipated these increases, and then continued to monitor use and demand, problems with response times have quickly arisen and teachers and students have become frustrated and discouraged. Some local education authorities and schools have decided, at least as an interim measure, to block or limit access to particularly popular and/or bandwidth greedy online services to reduce network traffic.

IT support challenges

The culture change of BYOD can be very difficult for technical support staff (in schools that employ IT support staff rather than outsourcing this service) and they may be reluctant to co-operate with BYOD plans. There are several reasons for this:

- If students not only bring in their own devices but are also responsible for the administration and maintenance of these, this can be seen as a threat to jobs.

- IT staff may worry about the increased demand on the network and bandwidth and potential negative impact on school systems.

- IT staff are used to being in control and being responsible for everything to do with ICT and may be reluctant to give up this control as well as concerned that, if problems arise, they will be required to resolve these.

- Preregistration of all devices and IP addresses which are to be allowed access to school networks is a large task that only IT staff can undertake.

- In some countries (e.g. Switzerland) the law requires a school operating BYOD to implement an MDM (mobile device management) system able to track which devices are connected to which content and to store this information for six months. This requires IT investment as well as IT staff expertise and effort.

When school IT administrators were responding to a _survey_ in late 2014 the most mentioned challenges were _"security, BYOD management, IT management, staff support and development"_ (Blamire & Colin 2015).

Schools which have successfully introduced BYOD or other mobile learning initiatives recommend involving IT support staff (or external providers of IT support) early in the planning stages, asking for their advice, providing them with devices to research potential issues and solutions and encouraging them to communicate with and learn from other schools' experiences.

If a school's BYOD strategy includes providing responsibility for supporting the students' devices, the number and knowledge of IT staff currently employed may be insufficient, necessitating additional investment in staff and staff training or outsourcing of ICT support to a company or organisation that provides a "managed service".

more experienced teachers are more confident in their role and, therefore, more likely to feel comfortable experimenting with new technology. This finding is supported by research carried out in Switzerland and Quebec (Akkar & Heer 2006; Karsenti & Larose 2005) which found that young teachers, although better trained in the use of technology, tend to use this less to innovate in the classroom than more experienced teachers (young teachers are too busy with classroom management issues).

- Teachers with less well developed ICT skills can find it difficult to support students with different device configurations or software versions and time available to participate in staff development activities may be limited.

- Some teachers find it difficult to cope with the culture change of having a reduced level of control when students are using their own devices.

Parents' concerns about BYOD

Typical parental concerns which can arise relate to:

- The cost of providing mobile devices for their children.

- Fears that expensive devices might be lost or stolen at school or between home and school.

- The possibility that some children may feel excluded if they do not have a smart device, or if it is not as good as those owned by their peers.

- The possibility of an increased risk of bullying.

- Concerns that increased student use of mobile devices when using them in school as well as at home might have adverse health implications, e.g. eyesight, posture, repetitive strain and sleep problems.

- Concerns that there might be health risks associated with mobile phones or Wi-Fi networks.

- A suspicion that mobile devices are not serious learning tools and a fear that their children are playing rather than learning. •
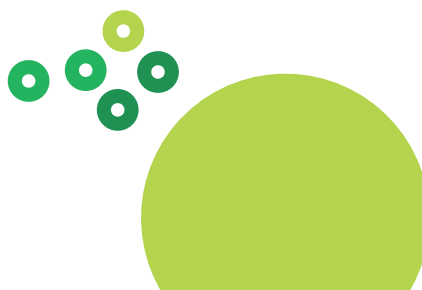
Teachers' engagement with BYOD

Engaging teachers and developing a whole school approach to BYOD needs careful planning.

- Involving a larger segment of teachers and students in BYOD beyond the initial enthusiasts can be a challenge in schools where BYOD is optional.

- Embedding the use of the BYOD devices so that it becomes an integrated part of teaching and learning rather than an occasional add on is a challenge that requires planning and development activities to overcome.

- Some interviewees have reported that upper secondary schools can find it difficult to engage teachers who teach older students, as some of these teachers may prefer to teach in a very traditional way when preparing students for important examinations.

- Persuading teachers to integrate mobile devices, including BYOD devices, into their practice can be a particular challenge where they are judged to be "excellent" or "outstanding" teachers. The attitude of such teachers can be, *"if my teaching and results are excellent, why should I change anything"*.

- Teachers who are not confident with ICT, and/or have previously had negative experiences when trying to use new technologies with their students, may be difficult to persuade to engage with BYOD.

- Some schools have found, counter to their expectations, that younger teachers are less likely to try BYOD than older teachers. It seems to be the case that

7. Safeguarding, security and risk

Implementing any technology related policy involves careful consideration of risks, which in schools includes safeguarding of children.

For BYOD implementation planning there are some important questions to be addressed:

Damage, loss or theft of student devices

A key decision that needs to be made when developing a BYOD strategy is the level of responsibility the school will have for students' devices that may be damaged, lost or stolen. Therefore, decisions need to be made regarding who is responsible for, and how to arrange: device insurance, device tracking, remote wiping of lost or stolen devices, replacement of lost, stolen or damaged devices. There are varying levels of cost associated with these arrangements.

Protecting data and system security

Providing access to school services from student owned devices increases the risk of compromising system security. Also, when students are using their devices at school with school provided and managed software, their personal data needs to be protected. For example, if the school remotely updates software on the students' device, personal data must not be lost. Managing secure access to school data and protecting students' personal data means an increased workload and responsibilities for school ICT support staff. IT departments supporting corporate BYOD, for example, are increasingly interested in the concept of, and tools that enable, "containerisation", i.e. separating corporate data from employee data on employees' BYOD devices. Such tools are currently relatively expensive and generally schools are not considering these. However, they were mentioned by one of the interviewees for this guide as possibly something to consider in future.

Safeguarding students and staff

Strategies and school policies for ensuring safe internet use and dealing with bullying, cyber-bullying and cheating need to be reviewed and updated to avoid new or different risks enabled by devices being both mobile and owned by the student. For example, inside school a student using the internet will be protected by the school firewall and filtering software but they may also be connecting to the internet via completely unmanaged and unprotected Wi-Fi in a local café. For older students it may be sufficient to argue that the school is not responsible for the use by students of their own devices outside of school. However, for younger students, and in situations where the school has actively encouraged acquisition of the device, responsibility may be less clear.

JISC, a charity that champions the use of digital technologies in UK education and evolved from the government funded Joint Information Systems Committee, previously funded 'JISC Legal', a legal advice service for educational institutions. JISC Legal (2013) produced an *online BYOD toolkit* which includes sections on "Your Staff, Mobile Devices, Law and Liability", "Your Students, Mobile Devices, Law and Liability", and "Risk, Liability and Mobile Devices". The advice included in the toolkit covers legal liabilities in the areas of copyright and learning resources, inappropriate material, e-safety, equality duties and freedom of information and ranks the risks involved by the likelihood they will occur and the severity of the consequences. This resource relates specifically to UK law but similar laws are likely to exist in other European countries. A template is also provided *"to help (education) providers write an effective policy that states what their institution's approach is to the use of personally owned devices by staff and learners"*.

Addressing concerns on health risks

Some parents, as well as some teachers and teachers' unions, have expressed concerns about possible health risks associated with the use of both mobile phones and Wi-Fi. People who express such concerns generally fear that there could be human health effects from using mobile phones and being exposed to Wi-Fi, both of which use low level, non-ionising, electromagnetic fields.

The governments of most developed countries have funded research in this area. For example:

- The Health Council of the Netherlands published a report "*Influence of radiofrequency telecommunication signals on children's brains*" in October 2011 that concluded: *"There is no scientific evidence for a negative influence of exposure to electromagnetic fields of mobile telephones, base station antennas or Wi-Fi equipment on the development and functioning of the brain and on health in children."*

- "*Health Effects from Radiofrequency Electromagnetic Fields: Report of the Independent Advisory Group of Non-ionising Radiation*", published by the UK Health Protection Agency in April 2012, concluded *"In summary, although a substantial amount of research has been conducted in this area, there is no convincing evidence that RF field exposure below guideline levels causes health effects in adults or children."*

- The French National Health Security Agency for Food, Environment and Labour (ANSES) published in 2013 an update on their 2009 report *Radiofrequency and Health*. This update, in order to take into account current and future deployment of new mobile communication technologies (e.g. 4G) and uncertainties concerning the long-term effects of exposure to radiofrequencies, recommended a precautionary measure of "encouraging only moderate use of mobile phones" by children "ideally with hands-free kits" but did not make any recommendations regarding Wi-Fi. However, French law includes a precautionary requirement for Wi-Fi equipment to be deactivated in primary school classes when it is not being use for educational activities.

The *current guidance* of the World Health Organisation (WHO) notes that, *"Over the course of the past decade, numerous electromagnetic field sources have become the focus of health concerns, including power lines, microwave ovens, computer and TV screens, security devices, radars and most recently mobile phones and their base stations"*. However, under the heading 'Conclusions from Scientific Research' they say, *"In the area of biological effects and medical applications of non-ionizing radiation approximately 25,000 articles have been published over the past 30 years. Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields. However, some gaps in knowledge about biological effects exist and need further research"*. ●

8. BYOD in Europe and around the world

It has been observed in a *report* published by The United Nations Educational, Scientific and Cultural Organisation (UNESCO) (Shuler et al, 2013) that, *"Globally, two of the most popular models for mobile learning in schools are one-to-one (1:1) programmes, through which all students are supplied with their own device at no cost to the learners or their families; and Bring Your Own Device (BYOD) initiatives, which rely on the prevalence of learner-owned devices, with schools supplying or subsidizing devices for students who cannot afford them"* and, *"As might be expected, the 1:1 model tends to be more common in poorer countries and regions, while the BYOD strategy is usually implemented in wealthier communities where mobile device ownership among young people is nearly ubiquitous"*.

However, use of students' own devices for learning is seen in many developing countries in situations where there is little or no state provision in schools and for informal learning outside of school.

Europe

The *Survey of Schools: ICT in education* published in April 2013, funded by the European Commission Directorate General Information Society and Media and undertaken by European Schoolnet and the University of Liège, found that, *"the ratio at grade 11 vocational is three and at grade 8 five students per computer. In some countries (e.g. Norway) the survey indicates that there is system-wide 1:1 computing and in others it is clear that student-computer ratios are no longer a handicap, but this is by no means universal in Europe"* and, *"In addition to school provision of laptops, increasing percentages of students are allowed to, and do, bring their own laptop and, to a lesser extent, mobile phone into school. This is particularly the case in Scandinavia and the Baltic countries, but also to some extent in Portugal and Austria".*

More recent research by European Schoolnet and its network of Ministries of Education, in partnership with Cisco Systems in late 2014 found that BYOD, *"is becoming more widespread [in European schools] and schools are developing policies that allow students and teachers to connect and use their own portable equipment (smartphone, tablet…) in school … in 75% of [respondent] schools on average, with Denmark, Portugal, Sweden, Spain, Romania and Estonia in the lead in this respect"* (Blamire & Colin, 2015).

However, *"the percentage of schools that provide services beyond basic connectivity is … just 38%, with the highest percentages of schools in Denmark, Portugal and Sweden also providing services to support their BYOD policy"*.

The following chart from the *survey report* shows the breakdown by country for the 20 countries where the response rate was considered sufficient to draw meaningful conclusions.

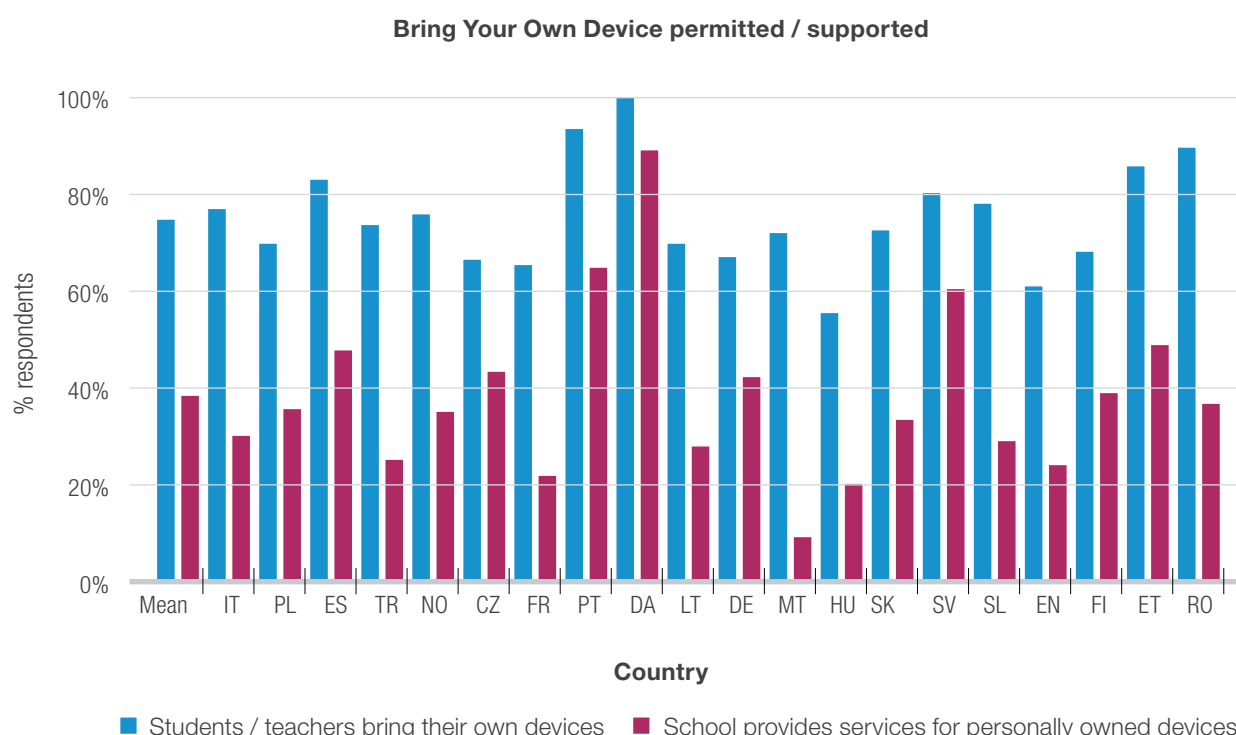**Bring Your Own Device permitted / supported**

Chart from Blamire, R & Colin, JN (2015) "The School IT Administrator: Analysing the profile, role and training needs of network administrators in Europe's schools", European Schoolnet

In Europe the increasing interest in BYOD is driven by the high levels of mobile device ownership, including by school students, the ubiquity of public Wi-Fi, high levels of fast home broadband and increasing availability of 3G and 4G mobile internet as well as by reductions in, or tighter control of, public spending on education resulting from the recent economic crisis and governments' austerity policies.

In some countries BYOD pilots or implementations are top down initiatives. Examples quoted in Ambient Insight's "*2012-2017 Western Europe Mobile Learning Market*" report (Adkins S, 2013) include Belgium, where the Flemish Government has launched BYOD in 30 schools to be, *"test beds for new pedagogical practices such as gaming, tablet computing, and the educational use of mobile phones"* and Denmark where government encouragement has resulted in over two-thirds of schools adopting BYOD. In other countries government policies require, or are having the effect of encouraging, more use of computers in schools. For example, the Italian and Finnish governments aim to digitise all school text books and the Finnish Government has decided to digitise the matriculation examinations taken by all upper secondary students. These policies have led to consideration of BYOD as a potentially more sustainable funding model than national, regional or school level procurement and replacement of computers. In the UK, Estonia and Portugal government initiatives have previously promoted,

encouraged and provided funding to increase the use of computers or mobile devices in schools and colleges. Now that this funding is no longer available, schools need to consider alternative ways of continuing with technology enhanced learning.

Some European governments, or government supported national advisory organisations, have carried out research and produced advice for schools on BYOD. The Norwegian Centre for ICT in Education commissioned a *review of BYOD in Norway* in 2013 and in Ireland PDST (Professional Development Service for Teachers) Technology in Education, which is funded by the Department of Education and Skills (DES), has produced *BYOD advice for schools* (2014). Government policies, or the prevailing culture, in some countries has slowed down or has the potential to slow down BYOD adoption. In Portugal it is currently against the law for students to use mobile phones in school unless permission is obtained for an educational project that requires this. In some countries, notably Scandinavian countries, many educators are concerned that BYOD may act against a general principle that education is provided free of charge.

Australia

It has been estimated that up to one-third of all Australian schools encourage students to bring their own digital devices (BYOD). Softlink, which carried out the _2013 Australian School Library Survey_, conclude that _"students want to learn using the technology they know and use at home and are driving schools to set a BYOD policy"_ and note that, _"In the past 12 months we have seen many large multi-site jurisdictions upgrade their school networks with the latest technologies to support 21st century eLearning and improve access to resources through modern digital devices. This will accelerate in the coming years."_ Tim Lohman, writing for the business technology news website ZDNet (_Lohman 2013_) in September 2013, predicted _"The cessation of the previous Australian government's laptops in schools program is likely to see the mass adoption of bring your own device (BYOD) programs by schools as they seek to shift the cost of purchasing and maintaining iPads and laptop PCs from the government to parents"._ In November 2013, following research including a _literature review_ (Stavert 2013), the New South Wales (NSW) Education and Communities department published a "_Student Bring Your Own Device (BYOD) Policy_" for schools and "_Student Bring Your Own Device (BYOD) Implementation Guidelines_" (NSW, 2013).

Canada

The Canadian province of Alberta's Ministry of Education has published a _BYOD guide for schools_ (Alberta Education, 2012) which states that schools in Alberta have been exploring BYOD for more than five years and that _"schools that are currently using a BYOD model were typically those that piloted one-to-one laptop learning and found it of value"._ Under the heading "Bring Your Own Device - A Vision for Education in Alberta", the guide notes, _"…for many school authorities BYOD models represent a viable strategy for achieving access immediately, in order to meet students learning needs"._ _Research_ in 2012 and 2013 explored the extent of BYOD policy making and implementation in all Canadian states. British Columbia was found to have an _Education Plan_ (2013) including implementation of BYOD in all school districts and this implementation was underway despite opposition by the _British Columbia Teacher's Federation_ which believed the policy to be _"inconsistent with the founding principle of public education"._

USA

As education in the USA is organised at district level it is difficult to gain a nationwide, or even state-wide, picture of the current situation. However, an increasing number of districts are deploying mobile devices in schools with some of these implementing BYOD policies. US mobile learning experts Norris and Soloway _observed in 2011_ that for a variety of reasons, _"examples of successful BYOD initiatives, particularly in primary and secondary institutions, are limited. However, as sophisticated mobile technologies become increasingly accessible and affordable, BYOD may form a central component of mobile learning projects in the future"._ Indeed they predicted, optimistically, that by 2015, _"each and every student in America's K12 public school system will have a mobile device to use for curricular purposes, 24/7. For the majority of schools, one-to-one will be achieved because they will have adopted a BYOD policy: Bring your own device. Schools simply can't afford to buy a computing device for every student"._

Currently there are many examples of US schools which have implemented 1:1 computing, many through school or district funded tablet initiatives and an increasing number using BYOD. The authors of the _Project Tomorrow's Speak Up 2012 survey_ noted that, _"Given the budget realities – with 74 percent reporting that they have smaller technology budgets than they had five years ago – administrators are re-thinking their opposition to the Bring Your Own Device (BYOD) approach and districts who are piloting such a program increasing by 47 percent in just one year. When asked in 2010 if they would allow their students to use their own devices at school for academic purposes, only 22 percent of principals said that was likely, 63 percent said it was unlikely for their school. Today, more than a third of principals (36 percent) say that a new BYOD policy for students is likely. The opposing view has now dropped to 41 percent. At the district level, an even more dramatic shift has taken place in the views of administrators on these BYOD policies. In 2011, 52 percent of district administrators said that they did not allow students to use their own mobile devices at school. This year, only 35 percent are still holding on to that district wide policy statement, with 32 percent saying that the use of student owned devices should now be at the discretion of the classroom teacher"._

A _survey_ of more than 500 IT professionals, from colleges, universities and K-12 school districts across the USA and the UK (Bradford Networks, 2013) found that, _"There is wide acceptance for at least some level of BYOD across all educational institutions. More than 85 percent of institutions surveyed allow some form of BYOD, and only 6 percent report no plans to implement it in the future"._ However, only 26% of the sample was made up of K-12 schools. ●

9. BYOD guidelines and recommendations

Representatives of European Ministries of Education who are members of the Interactive Classroom Working Group (ICWG) are working with EUN researchers to explore the current extent and future potential of BYOD and to identify and share good practice. ICWG members proposed interviewees at national, regional and school levels and shared information about policy development in their own countries.

The following case studies draw on the interviews carried out to date and further case studies will be added as the ICWG's work on BYOD continues. Additional case studies will be added periodically to the online version of this guide as the ICWG continues its investigation into BYOD strategies.

9.1. National initiatives help to kick start BYOD in schools in Austria

This case study looks at how one school is introducing BYOD in the context of a series of government initiatives which are helping to drive eLearning and mobile learning in Austria.

Secondary, upper secondary		Urban and rural	
Mobile phones, tablets, laptops		Mixed catchment	

Background, context and drivers

Two national initiatives are helping to drive eLearning, mobile learning and BYOD in Austria. About one third of Austrian upper secondary schools (160) belong to the Austrian eLearning Cluster and about a quarter of these have adopted BYOD. Mobile Learning Tutors (MLT) is a network of schools coordinated by the Federal Ministry for Education and Women's Affairs since 2009/10. This project, inspired by the Government's eFit21 initiative, aims to:

- enable innovative teaching and learning by using mobile devices

- develop students' digital competences, media literacy, social competence and self-organisational skills

Participating schools experiment with 1:1 pedagogy using mobile devices. Initially all the schools purchased these devices but in recent years they are increasingly implementing a BYOD approach.

BYOD drivers for MLT schools are:

- A desire to enlarge the MLT network to include schools previously deterred by the cost of providing a device for each student.

- Students' and parents' dissatisfaction with the laptops initially provided/specified by schools.

- An objective to enable new forms of innovative pedagogy involving students' use of more than one type of mobile device to support their learning.

Klosterneuburg is a lower and upper secondary school and one of the largest schools in Lower Austria with 1,200 students and 130 teachers. The school is situated in Klosterneuburg a small city near Vienna. The region is one of the wealthiest in Austria. Most families enjoy a high income and many parents work in Vienna. Around 98% of students come from these families and the majority have smartphones that are brought to schools. The drivers for BYOD at Klosterneuburg are demand from students and the principal's plan to introduce ePortfolios.

The mobile devices

MLT schools use a variety of mobile devices including laptops, smartphones and tablets. In some schools parents pay for a laptop specified by and provided by the school with links to industry helping to obtain the best purchasing prices. Most of the Klosterneuburg students have smartphones and bring these to school. Laptops are mostly provided by the school with student BYOD laptops being about 5% of the laptops used.

Funding arrangements

For many years it has been possible for parents in participating Austrian schools to enrol their children in laptop classes from the second year of upper secondary with the school specifying the type of laptop parents should purchase. Links to industry ensure parents obtain the best purchase prices. Around 638 of the total 5,000 classes from the 160 general & vocational education schools (around 13%) are laptop classes. Advantages of the laptop approach include all students having the same device with the same versions of software used. This simplifies for teachers the process of becoming familiar with devices and supporting students.

The more recent, and increasingly common approach of allowing students to bring in devices already owned by themselves or family members is seen as helpful in addressing the issue of affordability. However, it increases the diversity of devices being used.

In Klosterneuburg students are allowed to bring in their own mobile devices, paid for by parents. The school provides mobile devices for use in school for students who do not have their own device.

Participation in BYOD

Approximately 1,000 Klosterneuburg students bring in and use their own devices in school. However, they are estimated to use these for pedagogical purposes only once or twice a week and only 40 teachers actively exploit students' BYOD devices for learning.

Teachers can decide whether to use ICT in their teaching, if their students can use their smartphones and how and when these are used. Students' mobile devices are used most in science subjects for simulations and in language classes.

Advice, staff training and incentives

The Ministry regularly publishes guidelines for schools taking part in the MLT project including advice on using mobile devices:

- To create documents, presentations, databases and software.
- To communicate, access VLE's and carry out Internet research.
- As a tool for different ways of teaching and learning, including individual and collaborative work.
- As a way of creating flexible learning spaces and times for learning both in and outside the classroom and at home.

The guidelines describe organisational and pedagogical implementation as well as assessment practices with mobile devices.

The ministry supports peer-to-peer learning activities among teachers including two annual conferences for teachers: the eLearning Cluster conference and the eLearning Didactic conference (dealing with pedagogical issues). Teachers can also engage in local and regional clusters of different school types, e.g. primary and secondary.

At Klosterneuburg all teachers are required to check in electronically each day; they use ICT for lesson preparation and student organisation and each classroom has a computer and projector. However, there is no requirement to make use of mobile or BYOD devices and teachers are not incentivised to do so.

There is no specific mandatory staff development focussed on the pedagogical use of ICT. Instead there is an opt-in approach under which teachers can elect to join daily 45 minute peer-to-peer learning sessions and can also request individual assistance from the Quality Manager.

Technical support

The Ministry has funded infrastructure improvements at Klosterneuburg school. These include fast fibre optic broadband and a Wi-Fi network with special security providing instant connection without the student needing to log in.
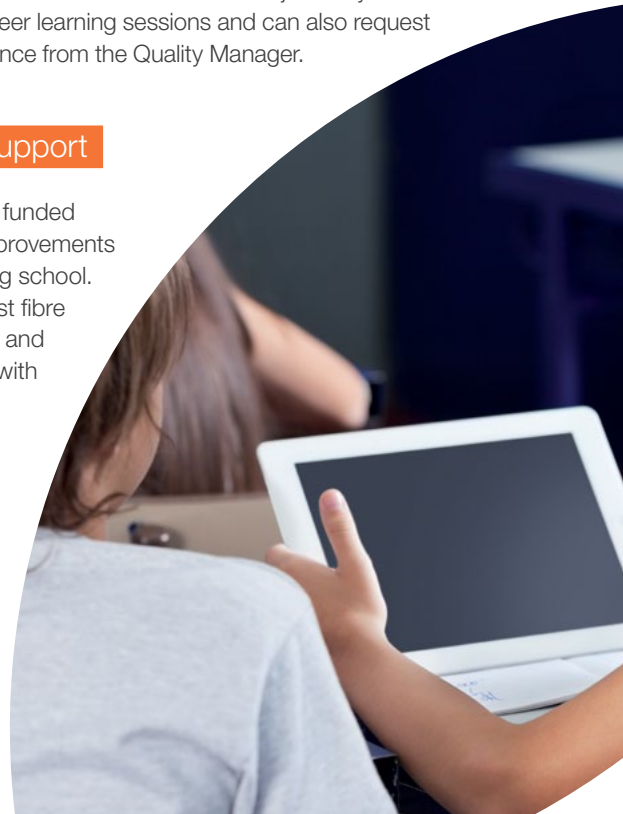
The school ICT department developed a minimum specification for BYOD devices and carries out device testing. The head of the ICT department is also a teacher and provides both technical and pedagogical advice to other teachers.

Successes

The Ministry believes the introduction of BYOD has achieved greater use of mobile devices by students and that this is an important driver for developing the digital competence of students. However, because of the long education pathway and many contextual factors, the benefits are not yet measurable according to empirically valid criteria.

Many teachers at Klosterneuburg now work mostly electronically and some teachers no longer use books in their lessons. 60% of the activity on students' smartphones is accessing the Internet and other online information. Teachers report that, "students like the fact that they have faster access to information than the teacher". Greater use of ICT for formative assessment is demonstrated by the 30% of smartphone activity related to assessment, e.g. online quizzes.

Challenges

Christian Schrack, who is responsible for IT and e-learning in vocational education at the Ministry for Education and Women's Affairs, identifies the limited availability of e-learning resources as an issue. The Ministry are looking into new licensing models to create "etapas" (smaller e-learning units) to support teachers to start using ICT. A challenge with this is ensuring the quality of resources created in teacher communities. It is also estimated that nationally only about half of teachers currently participate in technology enhanced learning.

Teachers of geography and history at Klosterneuburg have been slower to use mobile devices than, for example, science and languages' teachers. These teachers say they prefer more traditional teaching methods and, as they are not required to use them, BYOD devices are underutilised in these subjects.

The ICT co-ordinator believes they are also not used enough for student reflection and in future plans to encourage more use of the *TeamUp* collaboration tool (developed in the iTEC project) to support this.

Some examinations are now being taken on laptops but these currently have to be school owned laptops.

As more examinations move online over the next few years, schools will need to revisit their policies and secure connectivity arrangements. These may include allowing access to the school intranet but not the public Internet during examinations.

Lessons learned

Klosterneuburg school have found that attaching QR (Quick Response) codes to textbooks, linking to online lesson plans and learning activities, provides a simple way for teachers to start adopting a blended learning approach. It also provides very fast access to relevant resources via students' BYOD devices.

Another lesson the school has learned is that it is important to keep parents involved. A parent representative can meet with the head every Monday to discuss any issues.

National level reflections

Christian Schrack believes the BYOD approach and using mobile devices, including tablets, needs to be framed by specific learning environments and learning scenarios based on competence development and problem based learning with students driving their own learning processes. This also solves the issue of distraction common in traditional didactic teaching scenarios.

He also says, "Now there should be a push for mainstreaming these approaches in all classrooms and schools. In upper secondary education they are already well advanced, in the lower secondary education tablets can be a driver."

A teacher's advice to other schools

Hermann Morgenbesser, teacher and ICT department co-ordinator at Klosterneuburg school advises:

- Do not allow students to bring in just any device, provide minimum specifications to allow smooth integration with existing school infrastructure, e.g. very cheap devices may not fulfil the requirements.

- Discuss your plans and devices with parents during information events. Advise parents that, "these devices are currently being used in the school; if you have a different device consult us before your child brings it in".

- When capturing and storing information be aware of privacy and copyright issues.

9.2. BYOD maximising benefits from national infrastructure investment in Estonia

This case study looks at how five Estonian schools are building on past infrastructure investment and seeing BYOD as an efficient way of managing resources.

Primary, secondary, upper secondary

Urban and rural

Mobile phones, tablets, laptops

Mixed catchment

Background and context

Estonia has been described as "one of the most digitally visionary and internet-dependent countries" (*Harrison, 2014*). All Estonian schools have had fast broadband since the late 1990s and there are national strategies for ICT for learning research, e-learning/digital media literacy and teacher training. The *2013 'Survey of schools: ICT in education'*, conducted for the European Commission by European Schoolnet, found Estonian schools students' use of their own laptops or mobile devices in school is above the EU average. These five very different Estonian schools have shared information about the BYOD experiences of around 1,600 students and their teachers and the impact that BYOD is having.

- **Gustav Adolf** gymnasium (GAG) is a primary, secondary and gymnasium school of over 1,000 students in the capital city Tallinn. The school achieves excellent learning outcomes and students are partially selected on the basis of academic achievement.

- **Oskar Lutsu Palamuse** gymnasium and **Luua** elementary school are both located in Palamuse, a rural municipality in the East of Estonia.

- **Tartu Tamme** gymnasium is a large urban school in the City of Tartu specialising in science subjects and attracting students from across Estonia but especially from the South of the country. The school has been operating some BYOD since 2013.

- **Pelgulinna** gymnasium is a primary, secondary and gymnasium school in a lower middle/middle class area of Tallinn. It is not ranked very high in the academic ranking system but is growing fast, possibly due to a reputation for innovation and preparing students for life not just for university. The school has been testing and implementing BYOD since 2011.

BYOD drivers and aims

All the schools report similar drivers and aims. BYOD is seen as an example of efficient management of resources. The schools would like to make more use of technology but existing computer classrooms are insufficient and the schools lack funds to buy mobile devices for all students. Also, any devices purchased need replacing every two or three years. However, most students already own at least one device and, therefore, making educational use of these is seen as sensible. Also, the students are already in the habit of using their smart devices which is helpful. Other drivers for BYOD included wishing to:

- make lessons more interesting
- add variety to teaching
- implement active learning methods
- more efficiently achieve learning objectives
- improve participation
- improve access to information
- improve teachers' ICT skills

Four years ago Pelgulinna's ICT Development Manager wished to introduce mobile learning and approached a mobile network provider for support. The company was encouraging but only gave the school six smartphones. However, these enabled her and her students to start learning how to use the devices for teaching and learning and this positive experience informed the BYOD decision.

The mobile devices

Students in all the schools own smartphones, tablets and/or laptops and the smartphones and tablets are the most typical BYOD devices. The schools also own a small number of devices which can be lent to students as necessary.

Advice, training and support for teachers

At GAG each year training courses for teachers have focussed on using mobile devices, apps and learning environments for teaching and learning. Future plans include more courses and creating lesson plans and guidance for teachers. At Tartu Tamme some general ICT courses have been provided and teachers have been directed to participate in webinars, exhibitions and workshops. Also, more experienced colleagues are encouraged to support their peers in using ICT.

Teachers at Palamuse attend a training course on using iPads for teaching. Then the school educational technologist works with them individually on how to carry out basic tasks including creating Showbie accounts for their students, connecting to Wi-Fi, installing apps, using the camera and finding files. She then helps them to prepare, deliver and review the "smart" part of a lesson.

Pelgulinna provides professional development for teachers in the pedagogical use of mobile devices and online safety as well as training them to use tablets and search for apps.

Four years ago, using the smartphones donated by a mobile network provider, the ICT development manager worked with her students to develop mobile learning materials. These students then trained the teachers who were enthusiastic. ICT students continue to share ideas with teachers and help develop websites including lesson plans. Teachers then share with peers ideas about what to do in lessons and how to use mobile devices and apps.

Funding arrangements

In all schools parents, or the students themselves, pay for the mobile devices and the school pays for Wi-Fi. School broadband connections are provided by the government.

Participation in BYOD

About 500 GAG students at the secondary and gymnasium levels bring their own devices. GAG does not operate BYOD at primary level but the teachers sometimes use school owned tablets with these students, who, therefore, will have experience of using mobile devices in school when they move up to secondary level. 250 students and five teachers are involved in BYOD at Tartu Tamme. 50 students at secondary level and 12 at primary level participate in BYOD in Palamuse. Their implementation strategy is to start at primary level and then expand up. This is due to the tight schedules that apply for teachers and students preparing for examinations. At Pelgulinna there are approximately 960 BYOD students. 60 teachers have had training but only some are actively implementing BYOD including 14 primary teachers, six secondary and four gymnasium level teachers. However, the situation is changing rapidly and more than half the teachers are now demanding training in how to use mobile devices in their classes.

Benefits and successes

GAG report students participating more actively in lessons and that they perform tasks quicker using their own familiar devices. The digital skills of students and teachers are also improving. The school's reputation with regard to the implementation of IT has been enhanced. The school has been actively engaged in sharing their BYOD knowledge and good practice with other schools via a blog and five seminars on introducing ICT into the curriculum.

Riina Tralla, a teacher and educational technologist in Palamuse, has found that, "the devices allow for differentiated assignments which contribute to extended attention and development of the more accomplished students." She notes that, "all skills acquired in class should preferably be repeated as home assignments" and use of the students' own mobile devices both and in school and at home facilitates this.

Palamuse teachers find the *Showbie* app makes it very quick and easy for them to assign, collect, review and feedback on student work carried out on their tablets and smartphones. Estonian language students enjoy using the *Tellagami* app and the camera on their devices to make instant animated reports wherever they are.

Improvements in student motivation have been observed at Tartu Tamme and students are more interested in self-assessment and in acquiring subject knowledge. More participation in lessons has also been noted. Use of students' own mobile devices and the *Socrative* online response system provides fast automatic feedback on students' progress and which topics require additional explanation. In biology and physics lessons Socrative and *Padlet* virtual blackboards are "favourites for both teachers and students". In biology Socrative is used for self-assessment, discussing mistakes, learning new material and preparation for tests. Padlet is used for brainstorming, arranging ideas and collecting educational links discovered by students. Material collected on virtual blackboards can be collated and used as learning resources. Teachers say BYOD is helping develop students' digital competencies and enabling more economical use of time and resources including saving paper. Improved communication between Tartu Tamme students, teachers and parents has resulted from combining the use of students' mobile devices with the use of *eKool* a learning management tool used to share timetables, lesson descriptions, study resources, assignments, grades and information.

All primary level teachers at Pelgulinna use tablets (up from only four in 2013) and are responsible for their own maintenance with only occasional help needed.

Challenges

The schools would appreciate clearer national direction on how to proceed with the digital agenda and initiatives to encourage creation of apps and online digital teaching materials. Also, there are few BYOD good practice examples for teachers to learn from and a shortage of apps and resources in the Estonian language.

Providing adequate Wi-Fi is a challenge. GAG's old building has prevented installation of a whole school Wi-Fi network. The Wi-Fi network Pelgulinna installed three or four years ago, part funded by the Government, can effectively support 350 concurrent users but BYOD has increased demand, with potentially over 1,000 students wishing to use the Wi-Fi. As a result, many of the 60% of students who have mobile network data contracts choose to go online this way instead of using the school Wi-Fi. This is not considered to be the best long term solution and teachers are concerned that planned improvements to the schools' broadband and Wi-Fi

services may not happen for two years.

Some parents in Palamuse do not allow their children to take their mobile devices to school as they are expensive and parents fear they may be broken. Others worry that some children may feel excluded if they do not have a smart device, or if it is not as good as those owned by their peers. Some Pelgulinna parents expressed concern that student use of mobile devices in school as well as at home could have adverse health implications. Others worry about the cost of tablets and smartphones or bullying.

Tartu Tamme has found it a challenge to involve a larger segment of teachers and students in BYOD methods and to make the use of students' own devices an integrated part of teaching and learning. In Palamuse it has been difficult to engage the teachers who teach older students as they prefer to teach in a very traditional way when preparing for important examinations. Pelgulinna find that secondary level teachers are generally less ICT literate, use technology less and work in teams less than primary teachers and as a result are more difficult to involve in BYOD.

Most Pelgulinna gymnasium students own laptops but most of their teachers do not allow these in lessons. Students feel laptops are too heavy to bring into school if they may not be used, especially as they still have many books to carry.

All text books are planned to be digitised by 2018 and the school hopes to save money by having teachers develop their own workbooks that are very specific to their curriculum. However, many of the teachers require more training and more confidence in the use of the learning management system (*Moodle*).

Lessons learned

Some of the many lessons learned by the schools can be summarised as follows.

- Excellent whole school Wi-Fi network is vital

- It is necessary to make arrangements for students who do not have smart devices.

- Mobile devices can be used very effectively to support students working collaboratively in pairs or small groups.
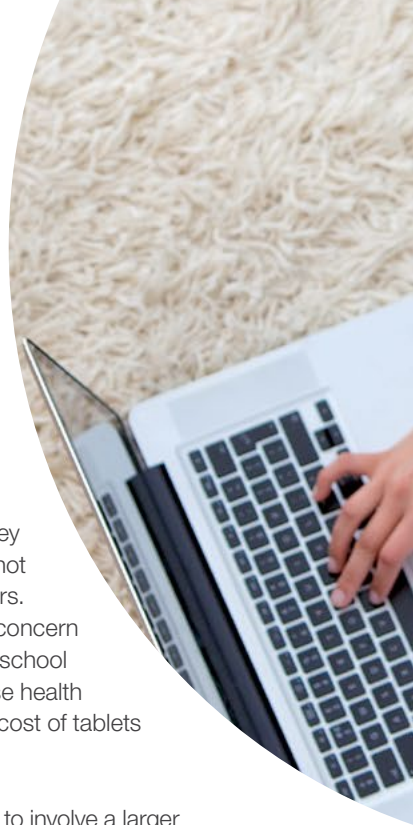
- A very effective way of promoting BYOD is to require tests to be carried out using technology; innovation in assessment can drive innovation in teaching practice.

- Teachers require training but they often have difficulty finding the time for this, especially if the training takes the form of set courses.

- Teacher "champions" who support their peers' use of BYOD are very helpful for staff development and embedding BYOD.

- Offering teacher champions incentives other than money (e.g. conferences attendance, spa or cinema tickets, devices or prizes) avoids changing conditions of service and can continue if funding to pay champions stops.

Teachers' observations and advice

Ingrid Maadvere at GAG says, "It is the school´s task to prepare students for their future and using technology is unavoidable."

Rinna Tralla in Palamuse advises that meticulous planning of the first lesson is important; teachers and students must have a chance to familiarise themselves with the devices. Preparation time always exceeds your original expectations. Apps to be used in class should be tested in advance in the same room and with the same internet connection and have extra chargers and power socket extensions available to recharge batteries.

Birgy Lorenz at Pelgulinna says: "It is usually a mistake to say 'this is fun'. It is not, it is serious learning and you can upset parents if they think using mobile devices in school is just a game". She advises teachers to tell students to load apps that will be used in lessons in advance to save time in lessons and so that the teacher need not worry about getting apps onto the students' diverse devices. Schools can avoid disconnected pockets of good practice by building a community of teachers (the innovators or teachers of particular subjects) who want to use technology. Give the community a name and recognised leaders to whom others will turn for help

Urmas Tokko at Tartu Tamme advises sharing the experiences with colleagues in other schools and among teachers of the same subject who are learning and testing new similar technologies and methods.

- Laptops still seem to be best at secondary and gymnasium levels whilst tablets are more convenient for primary students.

- Although some parents have, at least initially, some concerns, others are pleased that the school is teaching their children to do something useful with their mobiles.

- Acceptable use and behaviour rules are required; these help to prevent inappropriate use and reduce timewasting.

- Teachers need their own individual digital device as well as training and support from an in-house educational technologist.

- Teachers who are less experienced in ICT need both educational technologist support and inspiration.

- Some teachers prefer BYOD to using school owned devices with students as they do not want responsibility for setting up and maintaining devices or worrying about breakages. With BYOD, students are responsible for their own devices and look after them better than school devices and, as a result, damage is very rare.

- Teachers will not wish to allow the use of students' devices in class if they cannot perceive a benefit in doing so. It is necessary to find ways of motivating teachers.

9.3. Assessment and a desire to reflect societal norms as drivers for BYOD in Finland

This case study looks at how digitising assessment and a desire to reflect the real world students live in are acting as drivers for BYOD in some Finnish schools

Upper secondary		City centre	
Laptops, tablets, mobile phones		Mixed catchment	
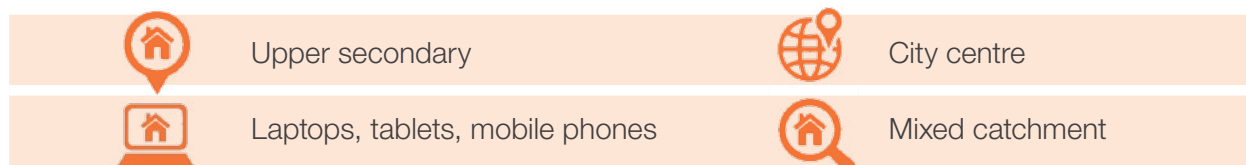
Background, context and drivers

The Finnish national Ministry for Education does not have a special policy on BYOD. However, the new core curriculum for schools gives guidance that students can be allowed to bring their own devices to school to support learning. The Ministry is aware that some cities have recommended that students at upper secondary school level should bring their own laptop or other device when they come to school. In primary and secondary schools there are few examples where BYOD requires students to bring a device. This is probably due to concerns that this may contravene the law stating that education must be totally free to all.

In Finland most schools are run by cities. Turku is a city on the southwest coast of Finland at the mouth of the Aura River. At upper secondary level in Turku students are told to bring their own device for use in school and the city is also encouraging primary and secondary school heads to allow students to bring their own device.

The drivers for BYOD in Turku are:
- all upper secondary students in Finland take final matriculation examinations and, over three years from 2016, digital examinations will be phased in
- the city wants 1:1 computing in schools but cannot afford to fund this
- students have mobile devices and want to use them in school

Kerttuli High School, a large upper secondary school in the centre of the city has been using ICT for 15 years and has a reputation for innovation, including encouraging students to bring in their own devices.

Unusually, Kerttuli offers specialist sports and ICT curricula as well as the general curriculum. It has 20 coaches in addition to 30 to 40 teachers. These specialist curricula attract students from across and

beyond the city. As the school is over-subscribed, they operate selection on the basis of academic or sporting achievements. This may make it easier for the school to make demands such as that students must provide their own computers for use in school.

An additional driver at Kerttuli is a desire to test a hypothesis (for which there is not yet any research evidence) that BYOD may contribute to improving the academic achievement of underperforming male students. Previous national research has found that in Finnish language boys typically achieve one grade less than girls, especially in written work. Typically in Finland approximately 50% of students go to vocational schools after grade 9 and the students who continue to High School usually include more girls than boys. However, perhaps attracted by the specialist ICT and sports curricula, Kerttuli attracts more boys; here 55% of the students are boys.

The mobile devices

In most Finnish upper secondary schools BYOD devices are laptops and mobile phones. Mobile phones are often preferred by students but seen by teachers as too small. Students are less concerned by screen size as using a mobile is so natural for them. There are occasional stories in the press about schools banning mobile phones but this is unusual and students can usually connect to school Wi-Fi with their own laptops, tablets and phones. In primary schools the devices used are more often tablets.

At Kerttuli in 2014 75% of students chose a laptop as their main BYOD device while 25% chose tablets. Most students also carry mobile phones and use them for some learning activities. The percentage of laptop users is expected to rise next year. Some students have complained that they were not able to do as much with their tablets as laptop users. Some expressed anger that

the school did not advise them to buy laptops rather than leaving the decision to them.

Funding arrangements

At upper secondary level in Turku schools students' families are expected to fund the purchase of a computer to use at school and for learning activities outside school. The city and schools purchase a small number of devices to be used by students whose families cannot afford to buy a device and to lend to students if their own device is forgotten or being repaired. The city provides broadband access for all schools. The schools order Wi-Fi hardware from the city and pay a monthly fee per Wi-Fi router.

Participation in BYOD

Turku's ICT in Education Centre, which trains and supports teachers in the pedagogical use of ICT, reports that in many upper secondary schools most students are not bringing their devices to school. They believe the reason for this is that teachers are not designing lessons that require the use of computers. In Finland teachers have a great deal of autonomy and cannot be directed to use ICT. They have to be convinced of the benefits and persuaded.

Advice, staff training and incentives

The ICT in Education Centre has continuing professional development (CPD) facilities in the city and also runs workshops in schools; 1,600 teachers participated in these last year. However, it can be difficult for teachers to arrange time away from teaching; so each school has one or two teachers who are paid to deliver weekly CPD lessons to their peers.

At Kerttuli all teachers have to use technology and so need to be ICT literate. Teachers don't have their own classroom; they bring along their laptop and link it to the systems and tools available in any classroom they are using. The school finds that there is a growing and on-going need for teacher training related to BYOD and the use of ICT for teaching and learning in general. BYOD introduces new questions, e.g. what software do we train staff to use in view of the different operating systems on students' devices.

Juho Airola, Deputy Head at Kerttuli says that the main focus of training needs to be, "how to use devices in a wise pedagogical way", and some subjects need special software which teachers must learn to understand, e.g. GPS for geography. He notes that,

"the life cycle of computers, and pedagogical tools, for example, whiteboards is three to five years". Furthermore, "the cycle is speeding up, so if you design training around a specific device then that training will be out of date when a new product comes along".

Technical support

In addition to the central city IT support centre, there is a technical service helpdesk in every school. These were initially very technically focussed but the ICT in Education Centre has worked to transform them to also provide advice and assistance regarding pedagogical use of ICT.

As the number and variety of student owned devices in schools increases, it is not possible for teachers to solve all the technical issues that may arise. Similarly, it will be increasingly expensive for school help desks to cope with the demand for support. Therefore, Kirttulin has tried to arrange for students to help each other. This is partly achieved by running "getting to know each other sessions and including in these sessions on getting your technology to work".

Benefits

At city level an identified potential benefit of BYOD is encouraging a move away from paper.

Both city and school recognise that, when students are able to use their own devices, the use of technology for learning is a much smoother, more comfortable and personalised experience. They have their own software that they are familiar with and their own bookmarks. Also, when students own a device and are responsible for it, they take more care not to damage or lose it. As a result of BYOD, Kerttuli expects to further reduce the number of computers the school buys, thereby saving on the cost of these.

BYOD can also extend the times when students can learn. Having their own devices means that students can potentially be learning more during school holidays, which include 10 weeks in summer and 5 weeks at Christmas. They may also be better prepared for real life, university and many work situations in which they will be responsible for their own ICT arrangements.

Challenges

BYOD is a big cultural change for teachers as they cannot continue to do what they have always done. It is easier if students all have the same device; if they do not, the teacher has to find ways to use ICT that everyone

can join in. This can cause problems as the teacher has to be very comfortable with the use of ICT. Also the rapid pace of technological change means that teachers cannot plan for the technology they will be using in three to five years. They can only really plan regarding technology for the next year.

The choice of software used by all students can be difficult and affected by external changes. For example, _Libre_ office software is free, saving money for students and the school. It was also planned to be the platform for the digitised matriculation examinations. However, Microsoft recently announced free licences for their _Office_ suite for all schools. Therefore, the decision regarding Libre needs to be re-evaluated.

At Kirttulin internet access is very open and increasing traffic may become a problem. This has led to discussion of whether some very high traffic websites should be blocked.

Some years ago there was city wide internet filtering, blacklisting of sites deemed inappropriate and blocking of high traffic services. However, the current consensus is that: high traffic should be catered for by improving the quality of the service; education on safety and appropriate use is better than blocking; schools should guide rather than limit use and they should reflect real life. Also, there will always be students who can find ways around restrictions and the few who "do stupid things" should be sanctioned individually.

Lessons learned

Jouni Paakkinen of the Turku ICT in Education Centre says that, "students should have online access whenever and wherever they need… we just renewed our whole Wi-Fi network in all schools; if there is a problem with capacity we will simply increase it".

Kerttuli has learned that renovation of older school buildings needs to be well planned with ICT in mind, even if this is not always very easy. When a newly renovated building at Kerttuli first opened, the Wi-Fi network was not ready and this quickly demonstrated how vital adequate and reliable Wi-Fi is for successful BYOD. Public Wi-Fi outside of school also helps to maximise the benefits of BYOD; Turku recently upgraded their public Wi-Fi which now includes 3,000 hotspots in the city.

It is important to provide somewhere for charging devices and safe places to store them, for example during sports sessions. Kerttuli have been very surprised that some students have brought in very expensive devices, e.g. MacBooks costing well over 1,000 euros. They have also found the "digital natives" theory unhelpful. Whilst it may be true that most students know how to use

Facebook and YouTube, it is unwise to assume they know everything about ICT and providing a course on how to use your devices in school is very helpful to the students.

Staff training needs to include recent graduate teachers. It used to be the case that younger teachers were more accepting of technology than their older peers but this is not the case anymore. More experienced teachers seem better able to cope with technological change whilst recently qualified ones are still becoming comfortable with the job and their subject and are least likely to use technology.

City level reflections

Jouni Paakkinen says that, "teachers need the courage to experiment and a passion for using ICT and then together with the students they can find meaningful ways of using the BYOD devices. If students are only using the devices for making notes, this doesn't add much."

A teacher's advice to other schools

Juho Airola says:

- "its hard work, it doesn't just happen, you need to plan and you need to advise your students."

- "Internet must be very good, that is fast and reliable, or don't try it."

- We must give students responsibility for their machines – they must "sharpen their own pencils."

Looking to the future

Digitisation of the matriculation exam is really guiding and forcing change and all schools will have to adapt and change.

In five years students will arrive from lower secondary more ICT literate, and come from homes in which ICT

is being used much more frequently. As a result of this, schools will need to provide less ICT induction. Students will be able straight away to concentrate on their subjects not the technology. This is likely to be helped by a new lower secondary curriculum which includes more emphasis on ICT.

Juho Airola believes that, "schools are currently waiting for school books 3.0". Students at upper secondary level traditionally buy their own books and, whilst eBooks are getting better, they are not yet good enough to take over from paper. Even without BYOD, he predicts a move away from textbooks as, "it will be best for students to develop their own [personalised collections of relevant learning resources] rather than using books that are used briefly and then thrown away. This is something which BYOD will support and the resources could be available and of on-going use beyond school".

9.4. Engaged and informed school leaders drive transformation in Ireland

This case study considers the example of an engaged, informed and innovative school principal in Ireland leading implementation of BYOD in his school.

🏠	Secondary, upper secondary	🌐	Semi-urban
🏠	iPads	🔍	Mixed catchment

Background, context and drivers

There is no national BYOD policy in Ireland, although the Department of Education and Skills (DES) is due to release a new Digital Strategy for Schools in 2015 which will make reference to BYOD. The general approach in Ireland is for the government to provide support and *advice* to schools in the area of ICT integration, which includes strategies such as BYOD. Ultimately the decision making takes place at school level. This support and advice for schools is mainly provided through the *PDST Technology in Education* support service which is funded by the Department of Education and Skills.

Confey Community College is a state school for 750 students aged 12-18 about 20km from Dublin in Leixlip, an attractive and fairly prosperous semi-urban village which is also the location for a very large Intel manufacturing facility. Of the socially mixed annual intake of students, typically a small percentage are from disadvantaged families.

The main driver for BYOD in Ireland is probably the limited funding at school level to purchase technology. It may be the only way some schools can implement a 1:1 policy or integrate ICT. Also, students' devices are generally more up to date than those provided by schools.

The mobile devices

In 2012, the school's local Education and Training Board (ETB) provided funding for iPads and training for teachers and BYOD started in the 2012/13 academic year.

The school specified devices have to be iPad 2 or above with a camera but no 3G. iPads were chosen mainly because of the large number of apps and eBooks available for them at the time the BYOD initiative was being planned. A tablet with a keyboard was considered but rejected as it was €100 more expensive. The school also decided to rule out "pure BYOD" involving students bringing any device they owned. This was perceived as being potentially problematic. The Principal wanted teachers to be familiar with and be able to use all the devices students would be using in class and this is easier to achieve if they are all using the same device.

Funding arrangements

Parents are asked to buy iPads for first year students starting at Confey along with a selection of eBooks instead of textbooks. Parents have found this acceptable as Irish parents are already expected to buy textbooks for their children and because many were concerned about the weight of the school bags their children were

carrying. The transition year from primary to secondary is probably also a time when parents are most receptive to making this sort of investment as their child moves into a new environment.

Participation in BYOD

Initially all new intake students were expected to arrive with their iPad. The scheme was then extended to Year 2 and is now being rolled out to Year 3 students. The decision to start with younger children was taken as it was seen as easier to introduce the change for students not yet involved in high stakes exams. In total, around 280 students are involved in BYOD and using their devices in all curriculum subjects. About 50 teachers qualified under the ETB tablets for teachers scheme. All these teachers teach first and second year students.

Advice, training and incentives for staff

A few years ago the Principal, Mike O'Byrne, was seconded to the national support service now called PDST Technology in Education. This led to him having a broader perspective than a single school, being well informed regarding good practice and knowing where to go for advice.

Following participation in the ETB tablets for teachers scheme, teachers took the iPads home over the summer break. This provided an opportunity to familiarise themselves with the technology prior to implementation of BYOD at the beginning of the next academic year.

Teachers were given five hours of training led by a commercial service provider at the start of the first school year with teachers working in groups using apps. In the second year a three-hour training session was added with teachers sharing information and experiences regarding the apps they had been using with their students.

Technical support

Administrative and logistical issues informed the choice of iPads as the device parents would be asked to provide for their children. In 2012 there were only one or two companies in Ireland providing managed services with support for tablet devices and these services were offered for iPads only. The school selected a company called Wriggle to provide their support service. The Principal says he would not have considered a BYOD roll out without the backup and support of a managed service provider.

Benefits

Using their own tablets in schools helps to address the disconnect between how children use technology inside and outside of school. The school see BYOD and use of technology as key to modernising education.

In school teachers no longer have to plan to go to a special computer room to use ICT. The Principal has also noted a marked advance in the teachers' confidence when using the devices.

The school building is 26 years old and there are limits to what can be done in terms of reorganising learning spaces but, with 1:1 devices and BYOD, it is possible to support new forms of collaboration and group working.

Camera equipped devices, apps and the internet provide students with new ways of being creative and communicating. Teachers have noticed: improved student digital literacy; more student collaboration; better research with students gaining experience in looking for content; and improvements in how students organise and present their work. Students with special needs also now have alternatives in terms of how they present their work, e.g. using the camera and videos.

The extent to which the combination of the tablets and the use of *Edmodo* has extended the classroom environment, in terms of the improved communication and collaboration between students and classes inside and outside the school, has exceeded the Principal's expectations.

Currently 2nd year students are already helping 1st year students and teachers expect peer to peer support to continue and expand as BYOD is rolled out across the whole school.

BYOD has opened up an active dialogue in school and with parents on the issue of use and misuse of ICT and the internet. Previously this was not really on the agenda but now, as students bring their own personal devices into school, "the ethics of online life" is much more of a hot topic.

Challenges

During the first year using the iPads it became clear that the Wi-Fi network was not adequate. Action was necessary and so three potential supplier companies were asked to carry out a site survey and a Wi-Fi specification was drawn up in line with school broadband recommendations provided by PDST Technology in Education. Following this, wireless access points were installed in each classroom, leading to a greatly improved service.

Teachers were initially very concerned that students might misuse iPad cameras, e.g. by uploading photos of the teachers to the internet. Possible sanctions for use against individual students were discussed in advance. However, this problem has not occurred. There was a problem of some students texting in class using iMessage which was solved by the school finding a way to block iMessage use.

Lessons learned

When starting the BYOD initiative, the schools decided to use eBooks from traditional publishers rather than insisting that teachers created their own content. This was in order not to alienate the teachers who were more comfortable with a textbook based teaching approach. However, in retrospect the Principal thinks it might have been good to have required teachers to create their own resources in the first year of the BYOD roll out rather than relying only on eBooks from publishers. Currently, the intention is to have many more teachers and students creating their own learning resources and to focus more on setting up online communities.

Schools should provide more training for staff during first year and generally invest more heavily in training so that teachers have more idea of what they can do with the iPad.

Monitoring and evaluation

The school carried out surveys of staff, students and parents in the first year. In the second year all staff were surveyed and a spot survey of parents was carried out. A major survey is planned for next year, the results of which will inform planning before extending the iPad scheme to the senior years.

National level advice

As mentioned above, the PDST Technology in Education support service have produced advice for schools concerning BYOD.

The first key message in this advice is that when considering introducing student devices such as tablets, "schools should first consider the school learning priorities and outcomes rather than focus on the technologies involved.

- As part of the school self-evaluation process, schools need to identify overall school learning priorities and outcomes.

- The school e-learning plan should form an integral part of wider school planning to achieve these outcomes.

- Schools should consider how introducing student devices as part of a BYOD approach could support achieving these learning priorities and outcomes."

PDST Technology in Education's key tips for success are summarised as:

- Planning, consultation and communication with stakeholders is critical.

- Form a small team to coordinate the initiative, include key stakeholders.

- Expect issues to arise, try and see these as learning opportunities for process improvement.

- Start small, possibly with two teachers working together, review before taking next steps.

- Seek advice from other schools and teachers.

A principal's advice to other schools

Principal Mike O'Byrne's three key messages are:
- "Don't put devices into classrooms until you have reliable Wi-Fi".
- "Don't think that there has to be constant use of the devices; there must be times when they are put away".
- "Don't rely exclusively on eBooks from publishers. Teachers should start developing their own content for BYOD devices as early as possible".

He also believes it was a good thing to start BYOD with all students in the transition year rather than by starting with a small pilot group.

9.5. A planned BYOD approach maintaining equality of provision in Norway

This case study looks at how clear vision and detailed planning at regional level supports schools in achieving BYOD goals whilst maintaining equality of provision.

Upper secondary		Urban and rural	
Laptops, tablets, smartphones		Middle and upper middle class	

Background and context

In 2008 the Norwegian government decided to implement 1:1 computing in all upper secondary schools. Drivers for the policy were the previous decisions to digitise all learning materials and to require schools to teach digital literacy. When tasked with implementing the 1:1 policy, most Norwegian counties decided to purchase and retain ownership of computers for students. However, the county of Rogaland decided to implement a BYOD strategy. Students/their families were given the opportunity to purchase a laptop from one of two suppliers at an advantageous price negotiated by the county.

Alternatively, students could bring in to school any laptop they purchased or already owned. Rogaland's decision was informed by research identifying BYOD as an emerging trend in education in some other countries.

Skeisvang is a Rogaland vocational upper secondary school with 850 students aged 16 to 18 and 170 staff, including 120 teachers. The school offers a broad range of vocational studies as well as academic subjects. The school's catchment area includes a city of approximately 40,000 people and an island of a similar size. The population consists mostly of people at the middle or upper end of the socio-economic spectrum and includes some minorities who arrived in Norway as asylum seekers.

The laptops and other mobile devices

Students in Rogaland schools can choose to purchase one of four models of laptop including two Windows and two Mac devices. The county has not arranged tablet computer options although some schools have trialled school-purchased tablets.

County officials believe laptops are currently better learning devices than tablets for upper secondary level.

Some subjects, especially some offered by vocational schools such as Skeisvang (e.g. technical drawing), use software not available on tablets and others require substantial quantities of written work. The use of tablets is not discouraged by either the county or school but students are recommended to use a keyboard.

Skeisvang school has found that most students prefer to use laptops and some who tried tablets have gone back to using laptops or use tablets in addition to their laptop, mostly for recreational activities.

Where Rogaland schools identify a need for specialist software requiring desktop computers, they are able to procure these. However, improvements in the power and functionality of laptops has increased the variety of software that can be supported and led to a decreasing demand for desktop computers.

Students can use their own tablets and smartphones in schools for learning related and social activities. However, only laptops are allowed during examinations. Skeisvang places no restrictions on the type or number of devices students bring into school. There are rules regarding the use of phones in class; the teacher's permission is required and phones must be set to vibrate not ring. Students are aware of, and generally abide by, the school's acceptable use policy which students have been involved in agreeing. Most students have a smartphone from the age of 10 or 11 in schools with similar rules and, therefore, are used to the restrictions involved.

Funding arrangements

The county subsidises laptop purchase with prices ranging from 2,000 to 3,000 Krone (up to approximately Euro 350). Many students purchase laptops with gift money received at church confirmation, or a secular celebration, in the year before joining upper secondary school.

In order to comply with national equality regulations, the county is obliged to have an option where students can have access to a device free of charge. This is achieved by ensuring that the price of the laptop with the most basic specification can be paid over three years using the annual grant which Norway provides to all students to pay for education related equipment. Higher specification devices can be partly purchased with the grant money. Some students choose not to buy a laptop through the county scheme as they prefer to purchase a different device.

Participation in BYOD

At Skeisvang school all staff teach students who bring their own devices into school. Some students do not have a device and some do not always bring their device into school. Laptops are available for these students to borrow.

Neither the county nor the school have the authority to require that all students buy a laptop. Participation in BYOD cannot be mandatory for students as a result of legislation which states that BYOD in school is limited to solutions where students can use their personal digital equipment. A BYOD approach where students must use their private equipment is not possible within current legislation.

Advice, staff training and incentives

The County publishes advice for schools, tailored according to the type of courses offered, and maintains a county portal from which schools can download software and resources.

Each school has one or more ICT pedagogical staff who may be full time or half time, depending upon the size of the school. These staff provide their fellow teachers with training and support in the pedagogical use of technology. This is especially important in Norway where ICT is embedded into every subject. Some schools are clustering ICT pedagogical support for knowledge sharing and to develop shared resources.

A modular programme for ICT competence focussed on the pedagogical use of ICT, and including modules on ICT in assessment and classroom management, has been developed with the University of Selanger. Approximately 350 teachers have taken one or more modules.

Teachers undertaking these modules accumulate grant points which can result in salary increases if they are not already earning the maximum salary for their role.

At the start of each year ICT pedagogical staff in Rogaland schools deliver training for teachers and students. They encourage teachers to make use of digital resources and aim to get all students to the same level of understanding.

Each year Skeisvang school run a 10-hour course over several weeks focussing on digital security, acceptable use and online safety. They encourage teachers to, "be creative, learn from students, suggest and allow different methods of learning and tools for learning, e.g. mind maps, Google docs, apps and web 2.0 tools". However, they find that formal training courses are not helpful if the skills learned are not put into practice immediately.

Technical support

ICT technical support arrangements and staffing vary between schools and may be outsourced. Schools used to be more autonomous regarding ICT and some staff are highly technically skilled. However, technical support is being centralised at county level with service level agreements to ensure all schools receive a consistent service.

Students are responsible for maintenance of their own laptops and these are insured against accidental damage. Schools help with installing software and online emergency assistance is provided.

Schools lend laptops to students when their own has been sent away to be fixed. Also, county level agreements with suppliers include repairs and temporary loans.

At Skeisvang school students training to be IT technicians help to support students on other courses as part of their training. This involves running workshops as well as maintaining and repairing students' BYOD laptops. These students have also delivered computer coding courses for visiting primary school students. This practical experience enhances the IT technician students' CVs and self-confidence.

Benefits

Advantages of BYOD reported to the county:

- Teachers and students focus more on the content of learning activities rather than the technology used to access or support these.

- Students have a closer relationship with a laptop they own and take more responsibility for it. There is less need for schools to deal with repairs and less lost time while students become familiar with school laptops; this time can instead be spent learning.

Skeisvang school have found that:

- Students are more careful with their own laptops than with school owned devices.

- As the school has no responsibility for repairs or maintenance of student laptops, they make "significant savings" compared with the cost of supporting school owned devices. These savings have not been quantified but schools in other counties are concerned about ICT support costs and are starting to express an interest in BYOD.

- When teachers had to reserve computers in a computer lab in advance of lessons, this created a barrier to use and this is still a problem in some lower secondary schools. Knowing students have their own devices with them at all times means that teachers can decide at short notice to try something new in addition to planned activities.

- Students can use their devices for more than just note taking; they can use functions and services such as filming and social media in a pedagogical way to assist in learning.

Challenges

Challenges reported to the county by schools, particularly in early stages of BYOD implementation included:

- Some teachers find it difficult to support students with different machine set ups or software versions, particularly those teachers with less well developed ICT skills.

- Some teachers find it difficult to cope with the reduced level of control.

Challenges mentioned by Skeisvang school are:

- The school would like to be able to provide more CPD for staff but this is constrained by the time available.

- Sometimes students do not bring their laptops into school because "they forget or it is broken or they can't be bothered".

- Some staff feel decisions made at county level, which they do not agree with, have been imposed on them, e.g. having no internet filtering. This might have been avoided or reduced by more staff training at an early stage. In practice there have been no significant problems with unfiltered internet access but some issues with excessive Facebook use have been experienced

Lessons learned

Skeisvang school find many students are not comprehensively ICT literate. They are good at playing computer games but need to learn about other ICT tools. In helping students to acquire additional skills and knowledge, teachers are encouraged to think of themselves as facilitators rather than experts. The teacher needs to "set the ball in motion and let the students run with it", then students learn additional skills quickly.

Regarding technical infrastructure:

- Fast and reliable broadband is vital. A 100 Mbps connection is provided by the county and operated by a national provider.

- Excellent Wi-Fi connectivity is needed and this requires planning, investment and monitoring to ensure that it is very stable.

- It is important to have areas with sufficient power sockets available to allow charging of students' devices. As students own the devices they use in school and take them home at night, it is not necessary to invest in charging cabinets or trolleys.

- A single sign on system makes access to all necessary services from BYOD devices easy and secure.

Skeisvang recommend the approach taken by Rogaland county which has avoided 31 schools duplicating effort and reinventing. New technologies and methods are piloted in one school first and rolled out to others if successful.

Evaluation and impact

No formal evaluation of the BYOD policy has taken place in Rogaland. A survey was undertaken after four years to explore why not all students were participating in the subsidised laptop scheme. Responses indicated a need to improve information provided about the scheme and that many students did not feel the laptops available met their needs. These needs related mainly to personal use of computers, for example for gaming. Some gamers brought in their own laptops. After improvements to laptop specifications, participation in the subsidised laptop scheme increased from 50 to 70%. Other Norwegian counties may be following Rogaland's lead on BYOD. An Ambient Insight mobile learning market report reported in 2013 that 'it's learning', a company providing a learning platform, has agreements with five Norwegian counties to support their schools' BYOD policies.

County level reflections

Rogaland officials report no significant problems implementing their BYOD strategy and have received no complaints that suggest BYOD is unfair. The system is now well embedded and contracts with laptop suppliers have recently been renewed. County coordinator Tore Wersland says: "Technology shifting can be a challenge but we don't have to follow every trend. It may be too early for tablets; we should not be running ahead of student needs. It is good for a county to be a little conservative but we love to see schools carrying out lots of projects to find new ways to innovate, including with tablets. We need a standard approach and also lots of exploration and testing". Regarding teachers' skills, Tore emphasises the importance of teacher training that "focuses on pedagogy including how and when to use ICT and how to use it wisely".

A teacher's advice to other schools

Timothy Scott Golding, a teacher and head of department at Skeisvang advises other schools implementing BYOD to:

- "Keep things open" - do not focus on restricting access to undesirable or potentially distracting online content and services. Instead educate students in responsible use and digital literacy.

- "Don't be afraid of trialling and failing", learn from mistakes, there will be mistakes but they lead to improvements.

- "Plan" – in Rogaland County there has been good planning including a staged approach.
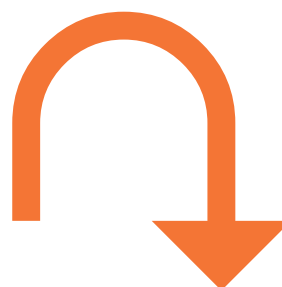
9.6. Policy makers' support is needed for teacher led innovation to grow in Portugal

This case study involving two schools in Portugal shows how individual innovative teachers can influence others but, without policy support, progress is slow.

Primary, lower secondary		Suburban	
Smartphones, tablets		Middle class/upper middle class	

Background, context and drivers

Carlos Gargaté School is a public primary and lower secondary school teaching students from 5 to 15 years of age. It is a suburban school in greater Lisbon near the sea and most of the adult residents are commuters. It is an economically strong area; most students have good homes, some with swimming pools, although since the economic crisis there is some unemployment.

Teresa Pombo works for the Ministry of Education as a project coordinator. She is also a researcher and teacher trainer who teaches Portuguese language at Carlos Gargaté. She is the first teacher in her school to try BYOD. Her work in this area is an experiment supported by the School Pedagogical Board for three years with the aim of gauging what schools need to do to introduce BYOD.

Carlos Amarante school is a public vocational secondary with elementary classes and adult night classes. It is a big school in the centre of the city of Braga which achieves good results in national exams. Most students live near the school but some students travel in to the school from the countryside and some vocational students live outside the immediate area in places that do not offer the courses they require. As a result of the economic crisis, some students and their families have financial difficulties.

Adelina Moura is a teacher and educational technology teacher trainer in the in-service training of teachers. She teaches Portuguese and French languages and is the only teacher in Carlos Amarante school using BYOD.

The mobile devices

Most Carlos Gargaté students have their own mobile phone or smartphone, and a laptop. Some also have a tablet, portable gaming device and/or handheld media player. However, Portuguese law dictates that students cannot use their own devices in school unless they are involved in an approved teaching project.

All Adelina Moura's students at Carlos Amarante have a smartphone, tablet or laptop which they bring into school. The school also has 10 tablets which are available to lend to students.

Funding arrangements

Students in Teresa's and Adelina's classes are permitted to bring into school devices they already own; so, funding is by students' families. The Ministry of Education provides broadband and Wi-Fi services.

Participation in BYOD

The official project at Carlos Gargaté is very small, involving just Teresa Pombo's class of 21 students from 7th to 9th grades (12 to 14 years old). However, there is evidence that some unofficial use of BYOD is starting to occur in other teachers' classrooms.

At Carlos Amarante about one hundred 14 to 19 year olds are involved in BYOD with just one teacher, Adelina.

Advice training for teaching staff

Teresa provides some training to her fellow teachers and provides examples that others can follow. Adelina provides training workshops for other teachers but, as the teachers who attend do not immediately put what they have learned into practice, she feels very little progress is made.

Portugal has good internet access following a 2009/10 initiative on infrastructure and many teachers already use internet and video in the classroom. However, if BYOD was used in all classes, the broadband would not be able to cope with so many concurrent users.

At Carlos Amarante lack of bandwidth is a big problem which damages students' motivation as response times are so slow.

In order to carry out her research in Carlos Gargaté, Teresa had to apply to the ministry for a special additional line to be installed in her school.

Most teachers in both schools are not very ICT literate. They use interactive whiteboards and PowerPoint but many still have a very didactic approach to teaching.

Adelina has found that it can be difficult to interest school management in the use of ICT for teaching and learning, including BYOD, if they perceive their existing traditional approach to teaching to be successful. In this situation they may not feel motivated to attempt culture change.

The teachers who are innovative and trying to update their teaching sometimes have their efforts derailed by external actions. For example, the Ministry department responsible for technical aspects of the school's portal blocking:

- Facebook and YouTube in the mornings, in order to reduce overloading of the service. This was a problem for teachers who had designed learning activities using these tools and whose classes take place in the morning.

- Access to app stores within the school. As a result, the librarian at Carlos Gargaté has to take tablets home to install apps.

- Websites related to computer games, thus preventing teachers from researching the use of educational games.

Benefits

Students are very involved and motivated when using their own smartphones for learning. Motivation is particularly important for the vocational students, many of whom do not like school or learning. Adelina has found that these students enjoy doing project work using their mobile devices, which they say is less boring than traditional lessons, and are pleased when they get good marks.

BYOD means students can be more active in, and more in control of, their learning activities. The teacher designs the tasks which the students carry out, learning through exploration and enquiry. The teacher's role is more concerned with briefing students and then resolving issues.

Challenges

The law banning students from using their mobile devices in school is currently a major obstacle to BYOD. Teresa needed special permission from the school director and the pedagogical council before she could start.

Clearly the Ministry department has the best of intentions. A problem, which almost stopped the project, was some parents complaining that they had heard students in school were accessing inappropriate websites. Although the school Wi-Fi has Ministry filtering, this did not prevent the problem which seemed to have arisen due to internet access via mobile networks not controlled by the school. This seems to be an issue best addressed by citizenship education.

Adelina has found that some parents become worried when students are preparing for a final examination. They worry that students may not be being prepared properly if they are using technology rather than books. Her advice to teachers is to talk with parents and encourage students to talk at home about what they are doing at school. Most parents are happy when they understand that mobile devices can help with learning.

Lessons learned

The way to make sure students concentrate on the task, and are not tempted to look at Facebook instead, is to build learning activities that are very student centred so that they are not bored. However, familiar systems and apps can be used to support learning and students enjoy this. Adelina's students engaged far more with analysing poetry when they worked collaboratively using Instagram and SMS to share thoughts, comments and pictures.

A great deal of thinking and planning is needed in order to gain the most benefit from the use of BYOD devices. This implies significant changes in teaching practice which needs to be more student centred. However, most practice in the schools is currently still very teacher centred.

BYOD cannot be successful if teachers are not well prepared, trained and supported. A previous Portuguese tablet project had problems as teachers did not get the time to prepare as originally planned and, therefore, were not well prepared or happy.

When teachers realise the potential benefits of using students' devices they are often willing to work very hard to make a BYOD initiative successful. Teresa gives an example of one teacher working until 3am in order to prepare a lesson using Google Earth. She notes that, with training and experience, less time was needed to prepare future lessons

Evaluation and impact

At the end of the three year experiment Teresa will share her findings with the Ministry, school management and the pedagogical board.

Meanwhile, Teresa has discovered that her students go to other classes and share what they are doing with other teachers. When this happens, other teachers are unsure whether they should allow the students to use their devices or not. However, some teachers do decide to allow students to make use of the devices in their class. Teresa says, "the science teacher has said yes, bring your laptops to the classroom; it's like an epidemic, it infects other classes and spreads and spreads".

There is no global evaluation of BYOD at Carlos Amarante but the outcomes of some of Adelina's experiences with BYOD devices in recent years are published online. Adeline's observation is that a set of tablets has been available for teachers to use for two years but only two teachers have taken advantage of these. Also, other teachers have not followed her example and allowed BYOD. Her fear is that, without intervention and encouragement from the government and school management, very little progress can be expected in the next few years.

Advice from teachers to teachers in other schools

Teresa advises: "Involve parents – it is impossible to start without parents". They need to agree to BYOD and to allow their children to access the internet at home for learning activities. Update parents on why mobile devices and the internet are useful for teaching and learning and share lesson plans with them. "Start small, with one or two teachers, monitor, share with other teachers and grow the good practice". However, "teachers will not be interested if the internet is slow", so good technical infrastructure is vital.

Adelina advises "experiment, trial and error is good. Try, and, if it doesn't work, try something else …we need to find out what are the good tools and the good practices" and also "don't be afraid to learn with and from your students and to ask for help when you need help. Sometimes I don't know how to resolve a technical problem, so I ask my students".

9.7. A long-term approach is needed to achieve change with technology in Switzerland

This case study shows that implementing a BYOD policy has helped two schools in Switzerland to embed technology and to progressively improve teaching and learning.

Upper and lower secondary		Urban and suburban	
Smartphones, tablets, laptops		Mixed catchment, diverse	

Background

In Switzerland, the main responsibility for education is delegated to 26 cantons (administrative divisions), which coordinate their work at national level. The Internet and mobile devices are an indispensable part of young people's lives; the 2014 JAMES Study (ZHAW 2014) found that 97% of Swiss teenagers own a smartphone. However, to date this ubiquity of mobile technology has had limited impact on the school environment at primary and lower secondary levels with most schools forbidding the use of smartphones and mobile other devices in the classroom. Few cantons or local authorities have produced policy recommendations for BYOD[1], but a small number of innovative schools have started BYOD pilot projects.

- **Gymnase Intercantonal de la Broye (GYB)** is a public upper secondary school for 1,100 Swiss French speaking students in a small market town close to the cities of Bern, Fribourg and Lausanne and serving two different cantons. It is a relatively new school, founded in 2005, with a record of innovation with technology. The GYB uses open source software solutions whenever possible and they were one of the first Swiss schools to have interactive solutions in every classroom.

- **Orientierungsschule Region Murten (OSRM)** is a lower secondary school for 500 Swiss German-speaking students in a small town close to Bern. It has a strong track record of embedding technology into learning and has made extensive use of the national VLE, educanet 2, with its students.

1 The Canton of Basel has recommended BYOD for its secondary schools: *http://www.baselland.ch/ Newsdetail-Bildung-Kultur-Sport.309168+M5f190993c94.0.html*;

The Canton Lucerne has produced BYOD policy recommendations for upper secondary schools: *http://www.lu.ch/-/media/Kanton/ Dokumente/BKD/Aktuelles/Paedagogisches_Konzept_BKD_Kanton_ Luzern.pdf*

The mobile devices

A survey by GYB prior to starting the BYOD project found that 75% of the entering students owned a laptop or tablet. When beginning upper secondary school, 75% of entering students/parents choose to sign up for the "iGYB" BYOD project. In iGYB students can use any computer or tablet device they own in the classroom if it meets basic requirements including a minimum screen size of 10 inches and Internet capability. Student equipment used includes: 30% iPads, 10 % Android tablets, 15% PC laptops, 15% Mac laptops and 5% a mix of various tablets and computers. All the devices are registered to monitor access to and usage of content as required by Swiss law. The school does not allow smartphones to be used during lessons.

At OSRM, a few innovative teachers take advantage of the opportunity offered to students to connect their personal smartphone to the school Wi-Fi for school-related activities. The only condition for usage is that devices have to be preregistered so that access can be monitored and filtered.

Funding arrangements

In both schools students or their families pay for the devices. GYB has invested in infrastructure by implementing an MDM (mobile device management) solution, improving Wi-Fi coverage and upgrading bandwidth to 100 Mbps thanks to a successful partnership with the National Telecom Carrier Swisscom that has been sponsoring *Swiss schools' Internet connections* since 2002. This has addressed the issue of limited Wi-Fi coverage that caused problems in previous pilot projects. OSRM has also improved its Wi-Fi coverage.

Objectives of BYOD in the schools

At GYB the school head teacher wished to extend access to portable technologies to more students and thus adapt his school to real world conditions. The *goals* set for the BYOD initiative are to: take advantage of available digital resources; make classroom learning more personalised; enrich the homework experience; and simplify administrative communication with the students.

The school head is cautious not to set overambitious pedagogical goals which may worry teachers. He sees opening the school to technology as a normalising process that will provide students with opportunities to develop a critical eye about the media-rich world they live in.

By opening up its wireless network to student devices, OSRM pursues its strategy of ICT integration into the curriculum. The teacher involved in BYOD wishes to facilitate the seamless integration of technology in different subjects. He encourages students to document their own learning process and develop their creativity. This he hopes will, in turn, bridge the gap between school and home and develop a more reflective culture in relation to the use of technology.

Participation in BYOD

The iGYB started in 2013 with year 1 students and will expand progressively to all students over a four-year period. Participation is voluntary. 20-25% of students/ families opt out of iGYB and choose the "classic" option. The school believes families that do not allow their children to participate are concerned about the cost involved, the difficulty of monitoring students' use of devices or the possibility that it may be bad for children to spend all day in a technological environment. At the end of each year, students can opt in or out, and more students are opting in than opting out.

At OSRM, involvement is more informal and depends on the interest and commitment of individual teachers. Only one or two teachers use the students' devices on a regular basis, for Internet research, multimedia and art projects.

Advice and staff training

Because a majority of GYB teachers are technologically literate and willing to experiment with technology in the classroom, there has been little formal CPD. However, several staff meetings have been dedicated to issues related to BYOD raised by teachers including: copyright and digital resources; the selection of appropriate apps and web resources; and the use of response systems to test student understanding of scientific concepts.

For the first two years of the project, teachers were not required to embed the technology into their teaching scenarios, only to "accept" student usage of the devices during their lessons. This was intended to give teachers time to adapt to the new environment and benefit from the examples of their more adventurous colleagues. For the coming school year, however, the principal has asked each subject group to pilot one implementation.

Science teachers are testing the *Socrative response system* for the evaluation of learning in sciences, English teachers are working with a digital textbook and *English File by Oxford University Press*, German teachers are using tools including *TopVoc* app to make students more autonomous in vocabulary learning, French teachers are switching to online reference tools and will test the impact of reading and analysing a work of literature as an e-book instead of a printed edition.

To help students make better use of the devices, a 'big brother' scheme was set up in which technologically literate students offered their help to their classmates. Some after school courses were organised but attendance was very low, suggesting that students do not wish to give up their free time and/or do not perceive they need the extra tuition.

Large scale BYOD requires new skills from the IT and administrative teams as they need to spend less time managing machines and more time managing the infrastructure, setting up online help and resource distribution.

At OSRM no formal staff BYOD training has been provided, as the few teachers involved have been integrating technology into the curriculum for many years, but a very active technology coordinator provides support, input and advice when needed.

Successes and Benefits

GYB's school head says that whilst it is still too early to judge the full impact on teaching and learning, BYOD offers teachers and students the opportunity to progressively adapt to the new tools, resources and opportunities to support learning in and outside of school.

Impact that has been informally observed includes improved communication between students and the school administration (distributing information, signing up for courses, etc.) and between students and teachers (e.g. electronic submission of homework). It is estimated that savings made by parents on resources and tools (e.g. dictionaries, books, calculators) can cover the initial cost of BYOD devices. These estimates do not include the

GYB have found that allowing students to bring any device, and allowing some students to opt out of BYOD, has disadvantages as it results in a situation where there is not a common platform to support learning. For the teachers involved, the diverse selection of devices in classrooms has increased the challenge and, for the less technically confident, reduced their motivation. The identification and distribution of learning resources that work for all students has been a major challenge. Flash is not supported on all devices but simulation software used in sciences is often based on Java and Flash and some apps are not available for all mobile platforms.

The direction team spends considerable time and energy selecting and organising the delivery of cross platform content and textbooks via the schools' intranet. Although editors could easily produce pdf versions of textbooks, a distribution system is lacking. The school plans to work with *Schooltas* next year to deliver eTextbooks.

Another challenge is teachers' concerns that BYOD may lead to students accessing games or social networking sites during lessons. Teachers need to develop new classroom management skills around when and how devices will be used. Limiting access to certain apps and websites via the school's MDM (mobile device management) solution is possible but this is not a substitute for good classroom management skills and digital media education.

cost of infrastructure and the additional work involved in organising the identification and distribution of digital resources.

At OSRM, the teacher involved in BYOD has commented that students have become more thoughtful in their smartphone usage and now see it as a tool for learning. There has been good acceptance from parents who are happy to see progress in the way students use their phones for learning, not just for communication and gaming. Students have committed to the rules about sharing content (images, video clips, etc.) and there have been no e-safety issues related to BYOD.

Issues and Challenges

At GYB, the more innovative teachers have already enhanced their teaching by using tools available on all mobile devices but getting the more reluctant teachers on board will take time.

The head teacher has observed that balancing, "the slow rhythm of change in education with the incredibly fast pace of change in technologies" is a particularly difficult challenge and, "BYOD is a better fit than 1:1 with school-owned devices that are often outdated before teachers have figured out how to use them".

Lessons learned

Good communication is key. This includes communication with:

- Teachers to develop confidence in the project

- Parents so they feel their needs are taken into consideration

- Students, for example via the students' union, to understand what works best for them.

GYB school leaders report that finding a balance in CPD between theory and practice, and finding the right people to support innovation, are complex challenges. OSRM have found that, "fear of safety issues frightens less able teachers", suggesting that staff training, development and support are required in this area to overcome such fears.

For a large scale BYOD project, the cost of installing appropriate infrastructure is significantly above standard school IT budgets. Planning ahead and looking for partnerships with businesses are key.

A BYOD project can also involve changing roles of school administrative staff. At GYB, for example, one of the secretaries is now in charge of a first level help desk.

Outcomes and Impact

The successes and benefits witnessed to-date at GYB have informed a management decision to roll out the project to all classes. There is little evidence of pedagogical innovation so far but it is hoped that investing in more structured teacher CPD may improve this situation. Although individual teachers at OSRM are very satisfied with the current situation, there are currently no plans to expand BYOD to all students.

A head teacher's advice to other school leaders

Thierry Maire, School Head at GYB says, "you have to give teachers freedom if you want them to be creative, but if you don't challenge them, they rarely leave their comfort zone".

Effort is required to widen the circle of teachers taking advantage of BYOD beyond the most enthusiastic and technically knowledgeable. To achieve this training and continuing professional development, focusing on technology, pedagogy and classroom management are very important.

A teacher's advice

Andreas Heutschi, BYOD teacher at OSRM, advises that successful implementation is possible if students experience benefits from using their own devices for learning in school. Also a safe environment can be created by negotiating acceptable use policies with students which then become an integral part of learning.

9.8. As national ICT for education initiatives end, BYOD seems the obvious next step in the UK

This case study shows that BYOD can be seen as the obvious next step when, as in this UK example, years of Government encouragement and funding of ICT in schools ends.

🏠	Secondary	🌐	Urban
💻	Smartphones, tablets, laptops	🔍🏠	Working and middle class
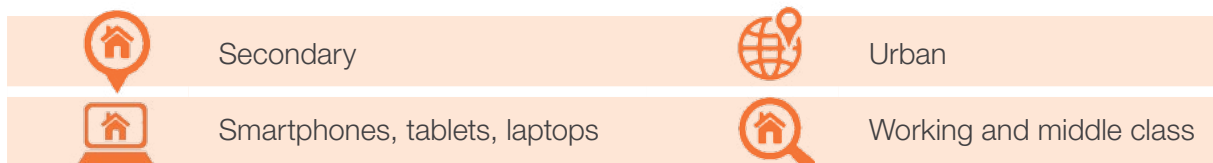
Background, context and drivers

For many years in the UK a series of Government actions sought to modernise publicly funded education by encouraging the introduction and embedding of ICT. From 1998 to 2010 the Government funded *Becta* (British Educational Communications and Technology Agency) was actively promoting and supporting the integration of ICT into education, the National Grid for Learning was providing access to online resources and funds were allocated for school internet connections and equipment.

From 2005 to 2010 an ambitious education infrastructure investment programme focussed on "Building Schools for the Future" and, in 2010, the national Home Access Programme provided funding for computers and connectivity for disadvantaged families with children. Under the latter initiative, 92% of the 27,000 recipient households bought a laptop with mobile broadband.

The local authority of Wolverhampton in the UK were early pioneers of BYOD with their Learning2Go initiative. After a pilot in 2002, Windows Mobile handheld devices were introduced into schools across the City during 2003 to 2007. In 2008 smartphones were deployed under the national "*Computers for Pupils*" and Mobile Learning Network (*MoLeNet*) initiatives.

The Learning2Go model included parents paying in small instalments to purchase a mobile device specified and procured by the local authority. The Learning2Go team still provides support and training to schools wishing to introduce 1:1 computing and BYOD.

Since 2010 there has been much less central government funding and encouragement available for ICT in schools. However, the influence of past initiatives, the role models provided by pioneer schools (for example *Essa Academy*), widespread ownership of powerful and reliable mobile devices by school students and concerns about the sustainability of school provision of ICT equipment and services in times of economic austerity are leading an increasing number of UK schools to adopt BYOD. In a *2013 British Educational Suppliers Association (BESA) survey* of 632 responding UK schools, 67% agreed that BYOD is "very important to tablet adoption in schools".

George Spencer Academy is a state secondary school near the city of Nottingham. Students come from two small towns, one working class and one more middle class and there is a small but significant group of disadvantaged students.

BYOD drivers at this school include school leaders wishing staff to explore the opportunities offered by mobile devices without the on-going cost of funding these devices.

The mobile devices

At George Spencer Academy students are encouraged to bring whatever mobile device they prefer to use into school. Most bring smartphones and some choose tablets, mini tablets or laptops.

The school considered dictating a minimum specification for devices but has concluded that this is not necessary as most modern devices have the functionality which they consider as the minimum specification for learning activities; i.e. they have a camera, a browser and the ability to take notes.

The Vice Principal, Paul Hynes, says schools should not insist or arrange that all students have the same device. He feels it is ridiculous to think one device can meet all the diverse needs of students including those that have special educational needs and those preparing for university.

People have personal preferences regarding the mobile device or devices they use and they may use more than one device, preferring to use a smartphone for some tasks and a laptop for others. Allowing students to work in the way and with the technology that suits them best prepares them for the real world.

Funding arrangements

George Spencer students or their families fund the mobile devices students use in school. The school's leadership decided not to fund mobile devices for all students as they feel very strongly that this is the wrong approach. As the Vice Principal explains, "schools can't afford it, technology has a short shelf life and there are more admin costs and, anyway, most students own better devices than the school would provide and update them more frequently".

The school uses "pupil premium" funding, which is provided by the government to schools to raise the attainment of disadvantaged students, to provide students from poorer families with a tablet and home broadband. However, the school reports that many students from poorer families already have mobile devices which can be more expensive models than those owned by their more affluent peers.

Participation in BYOD

BYOD begins for all George Spencer students in a formal way in year 9 (students age 13-14). Younger students can bring devices but BYOD is not emphasised in years 7 and 8. In year 7 (students age 11-12) all students take part in an intensive learning to learn programme and the teachers "don't want the extra hassle" of starting BYOD at this time. About 100 teaching staff are involved in BYOD. Some teachers use the devices in almost every lesson but others use them infrequently. Some teachers say they do not believe there is a need for mobile devices in the classroom.

Advice, training and incentives for staff

All ICT training for George Spencer students is delivered by students called digital leaders. There are currently 35 of these digital leaders and their involvement ensures a very student friendly learning experience. The digital leaders also run small workshops and showcases for teachers.

Technical support

George Spencer students look after their own devices and the school technicians deal with infrastructure and connectivity.

Benefits

The school reports improved student motivation and increasing differentiation in teaching. Activities can be tailored to individual students with instructions for these, or access to other digital resources, sometimes being via QR codes and QR reader apps on students' devices.

Upgrading of technical infrastructure to support BYOD has resulted in excellent Wi-Fi in every room. In some rooms no password is required; students and teachers have instant access to appropriately filtered internet.

Challenges

Persuading staff to integrate mobile devices into their practice is the greatest challenge reported by George Spencer Academy and this is most difficult with teachers who are judged to be "outstanding". Their attitude tends to be 'if my teaching and results are excellent why should I change anything'.

Culture change is difficult for technical support staff too; they have to learn to relax some of their controls and may worry about the security of their jobs when students are bringing in and looking after their own devices.

Lessons learned

The school has found that using internet based resources instead of apps avoids any problems of some apps only being available for specific device operating systems. Also students do need some training and advice about using their own devices in school and this is best delivered by other students.

Evaluation and Impact

George Spencer teachers are carrying out a number of small research projects and evaluations focussing on effective use of the mobile devices.

A teacher's advice to other schools

Vice Principal Paul Hynes says::

- "think BYOB or Bring Your Own Browser rather than BYOD; what the specific device is doesn't really matter"

- "don't block YouTube and Google Drive as these are great educational tools" •

10. BYOD guidelines and recommendations

The following recommendations have emerged from interviews and reviewing the outcomes of previous BYOD studies and initiatives. For some recommendations we perceive a strong consensus, whereas others are presented more as suggestions for approaches that 'may' be useful in some circumstances.

This initial guide does not attempt to include a comprehensive roadmap for implementing BYOD. The problem with trying to produce such a roadmap is that the context and culture of schools varies a great deal between and within countries and this is reflected in chosen approaches to BYOD.

The simple "Snakes and Ladders" infographic in section 10.3, therefore, is offered as one illustration of the journey that some schools are currently undertaking and a few

of the challenges they are meeting along the way as they try to develop and implement a BYOD strategy. It is not intended as a complete guide to implementation but may provide some useful pointers, reminders and talking points for school leaders, teachers and policy makers.

The Interactive Classroom Working Group will be further developing these recommendations as more case studies are collected and further work related to BYOD is carried out.

10.1. Top 15 tips for teachers getting started with BYOD

1 **Be clear about what you are trying to achieve;** what educational challenge(s) are you/ the school trying to address and how do you expect using students' devices to help?

2 **Check school regulations/policies;** students' mobile devices may be banned or use restricted, and discuss with your students acceptable use and acceptable behaviour. Develop, at least, an informal verbal agreement that, if this is to work, they need to be responsible.

3 **Discuss with IT support staff security arrangements to enable BYOD devices to get online in school;** how well will internet access perform with a whole class online at the same time? Are there restrictions you should be aware of? For example: are some websites blocked by school filtering?; is there adequate Wi-Fi in the classroom you will use?

4 **Ask students what devices they have** and consider how these can be used for learning.

5 **It is important that you familiarise yourself with tools/software/apps** you plan to allow students to use, although you do not need to be fully proficient with all possible devices. Read about privacy issues and age restrictions for these; some need parental agreement and some may not be suitable for children.

6 **Find out more about using students' mobile technologies in the classroom** by:

- Reading about the BYOD experiences of other teachers and projects.
- Joining an online forum or community of practice for advice and support (if one is available).
- Viewing online video exemplars of teachers using these technologies in their classrooms.
- Asking the school's teacher champions for help and support.
- Enrolling in a relevant online course if available (e.g. from the European Schoolnet Academy or national/regional ministry or agency).

7 **Very carefully plan the first lesson**, focussing on the learning outcomes and how the technology can help achieve these. Consider how you will assess the lesson and do not be too ambitious at first. If possible, try out your plans with other teachers. In some countries or schools specialist educational technologists or instructional designers may be available to assist with this planning.

8 **Consider the layout of the classroom**, and whether this needs to be changed to facilitate effective collaboration, communication and/or independent work. Test Wi-Fi and internet in the room in advance. Remind students to have their devices fully charged before the lesson starts and have extra chargers and power extensions available.

9 **Be sure that every student has a device**. If some students do not own a suitable device, arrange loans or for students to work in pairs or small groups. Be prepared to help students or find a tutor from among the students who is more familiar with specific devices.

10 **Carefully consider students with special educational needs**, including how using the device will help them achieve their goals and plan differentiated activities to suit their individual needs.

11 **Consider setting up an online classroom/ workspace, or how existing school systems can be used**, for students to store their work electronically and for you to assign and assess their work online. Using an online platform which parents can access will help to demonstrate to them the learning benefits of using these technologies in the classroom. It will also promote active involvement of parents in their children's learning.

12 **Select and practice using a small number of recommended apps** and make sure they work on all devices to be used. Getting students to install apps on their own devices before the lesson saves time and effort. You might find it easier to avoid using apps at first and just use online resources via the browser on students' devices.

13 **Have technical support available if possible and enlist the help of technically able students**. Do be willing to learn from your students but do not assume they are all "digital natives".

14 **Have backup activities in case things do not go as planned**. This can include using apps offline where they do not connect to online resources.

15 **Do not be afraid to make and learn from mistakes**. Evaluate how the lesson went, what worked and what you need to change next time.

And remember to share your experiences with other teachers.

10.2. 15 recommendations for school leaders implementing whole school BYOD

1 **Be clear about why you want BYOD**
- Is it part of a larger ICT school strategy and do you understand what is driving the idea?
- What are your specific aims and objectives, both short term and long term?
- Consider all aspects - pedagogical, organisational, technical and legal.

2 **Develop a funding model.**
A funding model needs to be in place to:
- fund the required school infrastructure improvements (e.g. upgraded broadband, Wi-Fi, online learning environment, new presentation technologies).
- provide a model which parents/students can engage with to provide /purchase devices and other associated resources.
- Ensure that all students are included regardless of parents' ability to pay.
- Do not assume BYOD will always save money, although it may do. Savings may be made on device provision but you may need to invest more in infrastructure and providing IT support within the school or as a "managed service" using an external supplier.

3 **Engage parents in discussions at an early stage**, they will want to know the benefits and costs and will have concerns that need to be addressed.

4 **Create a team of ICT champions, comprising enthusiastic teachers and other stakeholders**. Select a member of the school leadership team who is committed to the project to be the management 'champion'. Identify teachers and ICT staff who are keen, and can win the hearts and minds of reluctant colleagues concerning the implementation of the BYOD model in the school. Be aware that your plans may change teachers' professional responsibilities and may require careful discussion with teachers and possibly with their unions. Input from parents and student representatives should be encouraged.

5 **Review existing policies** concerning data and information security, privacy, safeguarding, inclusion and acceptable use in discussion with teachers, ICT staff, students and parents. Consider carefully where policies lie on the continuum between over protecting and unacceptable risk and be clear how you will address risks.

6 **Do not start without fast, robust connectivity and adequate technical support**. Early technical failures can damage staff confidence and motivation. Audit your ICT infrastructure and upgrade as necessary:
- Do you have reliable and fast broadband?
- Does the construction of your buildings block Wi-Fi signals? Are there any regulations concerning making changes to your buildings, e.g. listed/historical building status? What strategies are needed to overcome these difficulties?
- Do you have Wi-Fi in all classrooms and in areas where students congregate? Can this Wi-Fi serve a large number of concurrent users?
- Will current ICT support staff be able to implement and support a larger, enhanced network? Will you need to outsource some of the work involved? Investigate different options for mobile device management (MDM) systems which will automate or simplify some aspects of technical support. Do you need external expert advice?

7 **Analyse your catchment area and survey students/parents to ascertain socio-economic context** and existing nature and level of device ownership within each year group. This information will inform your choice of
- BYOD model.
- Supplied/supported devices.
- Arrangements for loaning devices and/or providing financial assistance to less well-off students and their families.

8 **Consider alternative BYOD models** (see Section 4 "BYOD Scenarios and implementation models"). Which is most appropriate for your school? A SWOT analysis may be helpful:
- What are the school's Strengths and Weaknesses in terms of preparedness for implementing BYOD?
- What are the Opportunities offered by different BYOD models? What are the Threats or risks associated with each model?

9 **Will students be able to bring any mobile device to school** or will you insist that they use a specific or limited number of devices as recommended by the school?

10 **Consider different implementation strategies** and select one which best fits the culture and context of your school. A phased, 3-step approach has the advantage of providing time to try out BYOD, identify and share best practice, iron out issues and decide and communicate necessary changes in teaching methods. The 3 steps are:

- Start with one or a few classes (using existing infrastructure) and informal experimentation.
- Implement for a whole year group (having upgraded the infrastructure, delivered staff training and put in place on-going professional development and support), then review. If the desired learning outcomes were achieved and the project was successful, move to step 3.
- Progressively roll out to the whole school (with on-going monitoring, adjusting and evaluation).

Some schools have taken a "big bang" approach, implementing across the whole school at the same time. This is a high risk strategy which requires very clear vision coupled with substantial and comprehensive preparation in the areas of institutional culture, pedagogy and technology.

11 **Develop policies for choosing, buying/ licensing and distributing digital learning resources, apps and tools** in cooperation with teachers and ICT staff:

- What are the pedagogical quality requirements?
- What are the technical requirements?
- How will you ensure compliance with security and privacy policies?
- Are there costs for using resources and tools in the long term or with more students?
- How will the support and maintenance of chosen resources and tools be handled?
- What are the procedures for distributing resources and tools to new students/ teachers and, if necessary, for recovery of these from students and teachers no longer at the school?

12 **Provide training and on-going professional development for teachers**, including:

- Project based training opportunities with peer mentoring rather than a single course with limited follow up.
- Opportunities for staff to share their practice with other teachers at staff meetings in the form of short presentations/how-to's.
- Organisation of in-house continuing professional development led by members of the team of ICT champions.
- Providing opportunities for teachers to visit each other's classrooms, observe lessons and engage in peer to peer learning.
- Helping teachers to develop their own learning resources.

13 **Provide pedagogical as well as technical support for teachers**. Where possible, provide time for teachers to plan collaboratively within their subject disciplines how they will incorporate the use of BYOD devices to enhance learning.

14 **Enable teachers to spend time experimenting and give 'permission to fail'**.

15 **Continually review** your BYOD implementation plan and make changes and improvements where necessary. Encourage on-going feedback from all stakeholders. How will you recognise and measure success?

10.3. BYOD Snakes and Ladders: a prompter for BYOD strategy discussions

50 Not the **END**, 1st phase in continuous improvement process	**49** Good practice showcase and awards' event	**48** Evaluation finds improvements in students results and 21st century skills	**47** Reduction in printing and copying costs noticed	**46** Improvements in attendance and punctuality recorded
41 Teachers report more homework completed	**42** Parents report children enjoying learning more	**43** IT overwhelmed by support calls	**44**	**45** Teachers report students more engaged
40 Mobile network access problems when many concurrent users	**39**	**38** BYOD device accesses confidential data	**37**	**36** Whole school roll out of BYOD scheme
31 2nd parents' information evening	**32**	**33** Implement Mobile Device Management system	**34** Training for teachers	**35** Agree evaluation framework
30 Mobile stolen during games lesson	**29** Teachers, IT and students develop acceptable use policy together	**28** Newspaper reports parents' complaints about cost and device theft risk	**27**	**26** On-line use stops as Wi-Fi inadequate
21	**22** Consult local police on student/ device security precautions	**23** Install lockable charging cabinets	**24** Training for teachers	**25** Start teacher-led pilots
20 Consult operators on expected mobile network use	**19** 1st parents' information evening	**18** Agree funding/ support and/or device purchase and loan scheme/s	**17**	**16** Upgrade existing Wi-Fi infrastructure
11 Carry out audit of student device ownership	**12** Agree type of BYOD model to implement	**13** Review and update IT systems, security, policies and processes	**14** Review IT staffing levels, skills and training needs	**15** Decide devices to be supported/minimum device specification
10 Agree teacher and teacher champions incentives	**9** Identify teacher champions	**8** Teachers express concerns	**7** Start researching available/adaptable learning materials	**6** Seek device, networking and other technical partners/ potential suppliers
1 **START**, with the vision…	**2** Appoint project champion and project manager	**3**	**4** All staff awareness/ consultation event	**5** Set up Implementation working group

10.4. Technical recommendations

The recommendations for school leaders (Section 10.2) advise "do not start without fast, robust connectivity" and the obvious questions which will be asked are, "what is fast?" and "how do we ensure our service is fast and robust?".

Ministries of Education in the Interactive Classroom Working Group plan more work in this area in collaboration with industry partners. Meanwhile this guide can provide a few pointers.

It is difficult to provide precise guidance on technical infrastructure and services as they are very context specific; for example bandwidth available to end users varies according to factors such as:

- the size and structure of school buildings

- the number of students, teachers and other staffs' devices used in school

- the curriculum, which may include particular specialisms, and the teaching methods employed plus the resulting amount of online activity, including how much material is uploaded and downloaded and the nature of this material, e.g. how much is bandwidth hungry items such as high quality images and videos

- school policy regarding access to bandwidth hungry services, e.g. do staff and students need to, and are they permitted to, access social networking sites like YouTube and Facebook, video conferencing services such as Skype and cloud storage such as Dropbox, Google Drive, Microsoft OneDrive, Apple iCloud etc.

- the nature of administrative and operational processes

The Education Network (NEN), who describe themselves as "A group of not for profit and public sector regional organisations working across the UK to bring high quality, future proof broadband services, independent ICT advice and online educational content to schools, academies and other educational settings", have published useful *advice* on a number of technical issues of interest to school leaders including: Selecting Broadband Connectivity; Protecting your school network; Cloud computing; eSecurity issues and BYOD (NEN 2013).

The Government of Alberta in Canada have also published *BYOD advice for schools* which includes useful information on Access and Infrastructure Considerations (Alberta Education 2012) as well as an earlier guide on *Wireless Local Area Network (WLAN) Best Practices* (Alberta Education 2011). ●
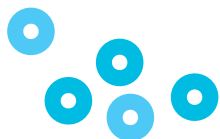
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BYOD – Bring Your Own Device
A guide for school leaders

The publication, "BYOD Bring Your Own Device – A guide for school leaders guide", has been developed by European Schoolnet as part of the work of Ministries of Education in its Interactive Classroom Working Group (ICWG). It is designed to provide school leaders, local education authorities and other decision makers with information about current BYOD trends, options and examples from schools in Europe as well as relevant lessons from BYOD implementations in schools in other parts of the world.

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