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Lesson study as a framework for delivering assistive technology content for teachers of students with disabilities

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Abstract
The main goals of lesson study are to assist teachers become lifelong learners and to create engaging and motivational lesson units for their learners. Information and Communications Technologies (ICT) similarly has seen to have the potential to radically change teaching and learning in classrooms. However, research has shown that one of the limiting factors in the take-up rate for ICT has been the confidence levels of teachers in using the varied IT tools in their lessons as well as the lack of peer support in developing strong lessons that tap on the affordances of ICT. This paper seeks to explore how lesson study will allow teachers to develop higher level models of teaching units that incorporate ICT across subjects. It will investigate how teachers can begin to discover, share and verify what works well within a student-centric learning environment.

Keywords: ICT, lesson study, student-centric, special education, teaching

Introduction
The widespread adoption of information and communications technologies (ICT) in schools is now ubiquitous in many countries around the world. Many educationalists see ICT as one possibility to enhance student success rates, raise access to opportunities for learning, increase cost efficiency in managing educational resources and enhance learners' capabilities for participation in the global workforce upon graduation from school, the latter becoming even more important in our ever-increasing competitive workforce.

With the power and computing capacities of our current computers, the inter-connectedness of learners, coupled with the free and easy access to knowledge and resources, the participation and interaction of students and educators has increased tenfold, with costs coming down, particularly in developing nations.

With global economies moving towards the focus on knowledge creation, the implication for this on educational systems to keep pace and follow suit are great. ICT can be seen as one force in achieving these changes necessary for schools to be able to churn out productive 21st century workers.

ICT in Education
In line with this, ICT now becomes a need in education, rather than an afterthought. Hepp, Hinostroza, Laval and Rehbein (2004) [4] discuss reasons why the application of ICT in education is so pertinent. New graduates need to be skilled in the ability to process information via ICT tools. Thus, they need exposure to computers and online resources as part of their schooling experiences. Schools are seen as knowledge-management institutions and so ICT has become the fundamental component in processing and handling all forms of information required by school authorities, personnel and students. Schools need to also constantly be reviewing their pedagogical practices and techniques and resources in an effort to create more efficient and effective learning experiences for their students. ICT is vital in providing life-long learning skills and habits in students.

To further look at how ICT can be utilised to support education and so be a part of continued economic development and social transformation, one needs to be aware of the approaches that can be adopted by schools in their quest to infuse ICT into their curriculum. ICT can be tapped on to enhance the delivery of education and the access to educational resources (Kozma, 2005) [6]. This approach allows for education to now reach a wider population, while reducing substantial costs. There is no need for many changes to the system when this approach is used.

According to Kozma (2005) [6], the cultural, social and professional roles of ICT can be exercised by tapping on extensive databases of information and services made available through the Internet, Intranet or stand-alone resources such as CDs and DVDs open for use by students. ICT also plays a pertinent role in making administrative processes less burdensome. It can allow for more inter-connectivity, hence streamlining standard operating processes to allow for easier information flow on budgets, school-based activities, teacher and student management and curricula matters.

ICT for special education
As we move towards the creation of an information age, equality of involvement despite ability levels, background and social status must be allowed for. This is in line with the principles of social engagement. This implies that with the application of technologies for teaching and learning that must be the transformation of methods of education to follow suit. In this vein, ICT now becomes suitable for people with different learning needs to access the right for education, employment, enhanced quality of life and access to information. All this points towards greater possibilities of marginalised populations now being able to achieve greater levels of independence integration and equal opportunities.

In line with this, the inclusion of learners with disabilities is part of a global movement towards human rights. The Salamanca Statement on special needs (1994) noted that societies should adopt the principle of inclusivity in education. Persons with special needs experience learning difficulties that are either permanent or otherwise, just acquired or congenital, changing or circumstantial. Hence, there may be social, physical and economic challenges to learning that need to be taken into account.

External social barriers can be difficult to overcome. These come about as a result of society's unwillingness or inability to adapt to meet the needs of special learners. Equally difficult to breakdown are internal social barriers which include perceptions of society influenced by cultural factors. Economic challenges can be dealt with either via the state or private organisations that are willing to accommodate the needs of the needs of persons with disabilities. Physical barriers are typically the easiest to eradicate as they are tangible and can be dealt with at a social and government level. However, the ease of removal of such physical barriers can depend on influence of internal social barriers as well as economic provision such as government funding.

Merely including students with disabilities in the education without adequate or appropriate support may not be beneficial. Responsible inclusion requires much fore-thought, resources and paradigm shifts for students and teachers to effectively work together.

The needs of persons with disabilities in education can be vastly diverse. In this context, ICT provides quality education in supporting curricular changes and learning experiences to meet the specific needs of learners with disabilities in three main categories: compensation purposes; didactic use in the classroom and communication usage.

When ICT is used for technical support, students with special needs are given the fresh opportunities to participate actively in classroom interaction and communication. For example, learners with mobility challenges can use touch-screens or in-built cameras in computers to turn pages, make choices and even type. Students with visual disabilities can use on-screen assistive applications to alter text colour, size or even have the computer read back to them, in a voice and language that is understandable to them. Hence, in this case, ICT is able to support, recoup and replace the lack of natural functions of learners.

ICT in the classroom for pedagogical use has brought about new dimensions in teaching and learning. With the varied application software for teaching, even assessment modes can be adjusted for students with special needs. Thus, inclusivity, in and out of the classroom, can now reach greater heights as ICT can cater to unique and differentiated learning needs. One good example of this is the fact that with online learning, varied formats of lessons can be pumped out to different learners in the classroom. Hence, learners with audio impairments can now have lessons adjusted to suit their needs such as subtitles for online audio forums and videos. Learners with mobility challenges can choose to remain in one location and still the join their peers in the classroom remotely via video-conferencing facilities, which are either free or cheaply available nowadays.

More specifically, ICT can be tapped on for the mediation of communication between persons with disabilities and the wider community. Distance teaching classes can help provide support learning services for students who are unable to be physically present in school. With online sharing made widely accessible, teachers and students can work collaboratively across the miles, without even meeting each other in person. A hearing impaired learning can sign his teacher via the camera on his laptop to participate in a lesson. A visually impaired learner can listen to the lesson with his headphones and chat with his teacher using the attached microphone. Online applications that allow sharing give students and teachers shared spaces to meet and work through lesson activities.

Raskind and Higgins (1999) [13] found that speech recognition software actually served to remediate and improves students' reading and spelling abilities. Computer-assisted instruction (CAI) has been increasingly used to improved literacy skills in students with disabilities (Lee & Vail, 2005) [8]. Fluent readers are individuals who read with quick, effortless and accurate reading of words (Vaughn & Bos, 2009) [15]. Struggling readers lose the meaning of the passage as they name the words. Research has shown that fluency instruction can be an effective means of enhancing understanding of the text (Meyer & Felton, 1999) [9]. ICT can play an important role in providing learners with specialised practice for developing fluency skills through research-based activities such as listening to others read text aloud, reading books aloud and silently at and independent reading level and using guided oral reading.

In line with this, reading comprehension is the ultimate goal of reading and is a major challenge for many students with learning disabilities (Boon, Fore & Spencer, 2006) [1]. Students with literacy problems benefit from both remediation and ICT tools that compensate for the difficulties they experience with literacy (Lange, McPhillips, Mulhern & Wylie, 2006) [7].

The mechanical aspects of writing involve skills in the areas of spelling, handwriting, punctuation and capitalisation. Problems in these areas are not unusual for students with disabilities and incorporating ICT adaptions into the instructional delivery may assist these students (Johnston, Beard, & Carpenter, 2007) [5]. Spelling continues to represent an important area of instruction for students with disabilities (Polloway, Patton, & Serna, 2008) [12].

Supporting special needs learners requires careful planning and implementation. Technology on its own cannot overcome learning barriers. There needs to be key ways in which ICT provides beneficial opportunities for learners, instead of becoming barriers themselves. Educators must first identify the entry level of skills and competencies of learners prior to the selection of ICT. This is a common mistake made by educators, parents and allied professionals in their earnest to purchase equipment for their clients.

There is also the assumption that since ICT can be used over a broad spectrum of potential learning needs, every learner can benefit from the use of some form of ICT in the teaching and learning process. To get off on the right foot, an inventory of the learner's current levels of knowledge and learning needs have to be articulated very clearly. Once this has been done, learning goals are to be set. This should be done with a team of professionals who are familiar with the learner to provide balanced learning outcomes. There should also be the identification of possible pathways towards the improvement of access to information as part of the learning process and this is where ICT can be suggested as a vehicle to assist learning.

The next outcome of this process involves all personnel in the educational process of the student. Educators, allied professionals and parents must be willing to adopt innovative teaching strategies in an effort to assist the person with special needs to move forward with his learning goals. Alternatives should be designed in case current methods don't work. Sometimes funding doesn't come in and ICT devices cannot be purchased in time for learning. Hence, it is always good to design for other options.

For ICT to take a firm root in education there needs to be a paradigm shift in the way educators deliver their lessons, both in and out of the classroom. With the infusion of ICT into the curriculum, new teaching strategies and methodologies have to be worked into the day-to-day teaching. New teaching and learning resources also need to be created in an effort to align them with the supporting ICT firmware and software selected for each student. This is where lesson study fits in for the professional development of all teaching staff.

ICT in special education and lesson study

Since Lesson Study is a type of classroom inquiry in which teachers plan, teach, observe, revise and share the outcomes of their lessons together, (Cerbin, 2011) [2], it is an excellent model for the assimilation of ICT in special education. In the eight steps of lesson, teachers are able to effectively and efficiently bring the level of teaching and learning to a higher plan via the infusion of ICT into the context of their classroom (Stigler & Hiebert, 1999) [14]. The Eight Steps of Lesson Study are briefly discussed below.

Step 1: Define the Problem or Main Issue of Concern

Teachers need to always begin with the individualised lesson plans and consider the learning outcomes set in place for each learner. They will need to decide which areas need to be addressed further with ICT support. As earlier noted in this chapter, ICT can be utilised in three ways for teaching and learning: compensation purposes; didactic use in the classroom and communication usage. ICT support tools are not meant to take over the place of the teacher, rather assist in the learning process. Hence, it will be good for teachers to discuss each learner's potential for greater learning and how this can be overcome via ICT, as noted in the tenets set by the Zone of Proximal Development (ZPD) Theory (Vygotsky, 1978) [16].

This theory notes that the "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p.86) [16]. ICT works very much to assist learners move through their ZPD in maximising their potential for learning as the ICT tool now becomes the appropriate assistance or scaffolding to provide learners with the much needed boost to achieve tasks set out for them by their teachers. The scaffolding provided can be removed, scaled down progressively or even amended based on the progress or development shown by the student. Lesson study, being iterative, provides excellent avenues for educators to constantly review the performance of the learner, with the ICT supports, and check if changes need to be made. This process is strengthened by the collaborative process which teachers use within the lesson study model as they work together on their students, providing many alternatives and coming in from various angles, providing valued input in support of each other's work with the student.

Step 2: Planning the Lesson

With the learning outcomes in mind and the ICT tools for scaffolding, the teachers now need to put their heads together and craft lesson plans to bring their ideas into fruition. At this stage, there should be lots of discussion on which types of ICT tools are to be used, at which points of the lesson they are to be used and the frequency of usage. Other issues such as extending learning to the homes of the students have to be talked about as this will impact financial considerations. It would be ideal to get feedback from teachers who have already adopted similar ICT tools within the same school, with similar type of learners or even in other environments and schools. This will provide a deeper insight into how to avoid pitfalls and plan for possible challenges as the lesson unfolds in the classroom and beyond. Teachers can consider adopting a structured lesson plan that incorporates the features of ICT as part of the curriculum as illustrated in Figures 1 and 2.

In planning for the use of ICT as part of the lesson, focus on materials developed by teachers as these have a greater chance of enhancing the success of the lesson. Using commercially prepared supporting resources such as worksheets from off-the shelf workbooks may not be augment the individual educational plans of each learner and may fall short in providing appropriate or relevant content for the local context.

When selecting ICT for integration into the curriculum, keep in mind the following:

- Choose technology that allows for customisation and individualisation which allows for the growth and progress of the student. This is also means adaptions and compensation for learning can be made along the way.
- Begin with one tool at a time. Evaluate the efficacy of this tool before incorporating more technologies. This helps in documenting the outcome of each ICT utilised with students.
- Link ICT with learning objectives and keep in mind the learning styles of students.
- Use ICT to encourage as much authentic learning as possible.

LESSON PLAN TEMPLATE I

Overview of Lesson: _____
Target Audience: _____
Pre-requisite Skills: _____
Learning Objectives: _____

Scaffolding for students	Lesson Activity	ICT Tool Employed / Purpose of tool for teaching	Instructional Strategies Deployed

Learner Management issues:
Specifications required for ICT Tools:

Fig 1: Lesson Plan Template I

Lesson Plan Template

Name of Learner: _____ Date/Time of Lesson: _____

Subject:	Topic:	Duration:
Instructional Objectives:		
Learner Analysis:		
Tools/ Resources/ Software/ Materials employed:		
Classroom Rules and Routines:		
Roles of Teacher:		
Instructional/ Learning Activities	Implementation	

Fig 2: Lesson Plan Template II

In planning for the lessons, some of the questions educators can refer to include:

1. What are the student's IEP goals and short-term objectives?
2. How will the instruction be delivered?
3. What teaching techniques will be used?
4. Will the groups for instruction be large or small?
5. How will materials and adaptations be integrated into the instruction?
6. What evaluation methods will be used to determine student progress?

Selection of ICT Tools

Factors relating to user compatibility are essential in considering ICT to support a lesson. These include the learner's age, the curriculum to be taught, current and future learning goals, learning preferences, current performance levels as well as any previous experiences of ICT use (Parette, 1998) [11].

Software needs to be developmentally and age appropriate. For example, language software developed for pre-schoolers would be age-appropriate for a teenager who has language deficits. Even though the content of the software may contain reading materials that are suited to his reading levels, it may be demeaning for him and not relevant to his real-world life.

In addition to this, the learner's learning preferences point to the need that different individuals learn using varied styles (Gardner, 1983) [3]. Knowing how students learn allow educators to present knowledge that will be easily comprehended.

Understanding the current performance levels of a learners helps in the selection of the appropriate ICT tools. This is so that software and hardware chosen are not either beyond or beneath the learning capacities of students.

Step 3: Implementing the Lesson

Even during the implementation of the lesson, the collaborative aspect of lesson study should be on-going. Peer teachers can be asked to sit in the class, take notes, record observations of the learners and, where permission has been obtained, video-taping of the lesson would be a good idea. All this will be great points of reference when there is discussion and analysis of the lesson once the session has ended. Feedback from learners is also crucial. This can be done first hand if students are able to articulate and voice out their opinions. Otherwise, observers could take note of the participation of learners and document their reactions to the learning activities and ICT tools used by the teacher. In fact, some ICT tools allow for recording of completed lesson tasks, such as the *i*pad's Print Screen facility.

In the final delivery of the lesson it is imperative that teachers are adequately and appropriately trained in the use of ICT for teaching and learning. They need to feel suitably comfortable in managing and adapting their instruction to integrate ICT into their teaching methodologies.

There are three approaches that educators can consider in their implementation of ICT-infused lessons:

a) The Rehabilitative Approach

This approach can be used to plug in gaps of what was previously taught or has been forgotten due to memory loss or the inability to retain a lot of knowledge at one go. This approach includes teaching methodologies such as modelling and repetition, which can be done via ICT tools, for example, videos can be watched as many times as needed and online software applications that allow for drill and practice provide learners with the needed repetition.

b) The Compensatory Approach

This approach is good for students who have rather severe disabilities. Basic functional knowledge and skills can be established first before moving on to improving more complex skills via technology. For example, basic speech patterns can be learnt through the use of an "listen and read" software where students first listen to sounds or words and then get a chance to practise themselves by speaking into a microphone. Teachers can then playback the recorded audio for immediate feedback to learners.

c) The Specialised Approach

This approach is ideal for students who have multiple disabilities such as speech, language and communication disorders coupled with behavioural or learning disabilities. In this case, specialised devices are required such as programmed software applications made specifically for the student.

Step 4: Evaluation of the Lesson - Outcomes and Implications

This should be done as soon as possible so that the next round of revision can be done quickly for immediate implementation. Evaluations can be done individually first and then shared as a group; or done as a focus group session on its own. Either way, time should be given for all educators to be able to share their concerns, feedback and suggestions for the next round of lesson planning. Thus, it is a good idea to ensure that the evaluation sessions are not done in between lessons or during meetings when time may be short. Educators need to also first reflect on what they would like to share at such sessions, prior to the commencement of each evaluation.

If needed, evaluation sessions can also be video-taped for future documentation and archival purposes. Teachers who

cannot be physically present at the session can join in via online modes of communication such as videoconferencing facilities. Such online communication devices also allows for external concerned parties, such as parents, to participate. This would be crucial if the learning is extended beyond the classroom and into the home environment.

Peer learning is best done via a community of practice. This helps to sustain any efforts in implementing ICT into the curriculum as working alone can be difficult for teachers. Thus, educators should set up platforms that enable them to share their opinions, experiences and teaching materials with each other. This can be done via an online secured environment such as via a Learning Management System.

To monitor and evaluate the use of ICT in the classroom, the following elements can be used (Wagner, Day, James, Kozma, Miller, & Unwin, 2005) [17]:

a) Input indicators: these measure the basic conditions at the start of the project. They can include ICT skills of teachers and students and ICT tools and devices used.

b) Process indicators: these track the progress of the students and teachers development during the project. They can include learning goals crafted for students to measure student achievement.

c) Outcomes: these elements are a measure of the direct impact of the project on all stakeholders. It could include any kind of data that can be computed to monitor the progress of student attainment as well as any kind of learning outcomes attained by teachers relating to their participation in this project.

Step 5: Review the Lesson and Make Amendments

These revisions are intended to ensure that the next lesson taught is one step better than the previous lesson. It should take into consideration all points discussed earlier in Step 4, especially in terms of the raising the learning efficacy levels of all students.

At this point, educators need to appreciate the fact that they might also need to adjust their teaching styles and strategies to incorporate feedback given by their peers. ICT tools will need to be re-aligned accordingly.

Step 6: Conduct the Revised Lesson

The revised lesson now will be implemented in another class or to another group of students. Once again, other educators are invited to observe the lesson and document the progress of the learners as well as the impact of the teacher on the students.

Step 7: Further Evaluation, Refinement and Reflection

At this point, there is a need to hone in on particular weak spots that keep repeating themselves or new challenges that may have surfaced as a result of previous revisions. A fresh set of reviewers would be a good idea too. Hence, inviting teachers from other classes or institutions to join in this review and reflection session is a great way to elicit new perspectives on the lesson and its outcomes.

Step 8: Share the Results with other Teachers

When the final version of this lesson is taught, besides inviting other teachers to come in and observe, sharing the lesson and its results will be a good way to broadcast your findings for the larger community who will benefit from the lessons learnt. Online sharing would be ideal via the school's website, community-mediated websites such as educators' blogs and even social networking sites like Facebook. However, before all this is done, it is imperative that permission has been obtained from all the relevant parties concerned.

Conclusion

ICT is here to stay and to overlook it or avoid its influences is not an option to educators. It has been proven that ICT enhances students' independent access to learning resources and materials (Moore & Taylor, 2000) [10]. As noted earlier in this chapter, ICT can raise the inclusivity levels of students with disabilities. In turn, this increases student motivational and confidence levels that can have a positive boost in school work.

Lesson Study assists in the integration and infusion of ICT into special education as it provides an excellent professional development platform for teachers to share and reflect on their teaching practices and methodologies. The 8 steps outlined above, when worked through progressively, can provide a much needed community-built model in an effort by educators to work towards the sustainability of the ubiquitous use of ICT with the learners with disabilities. The iterative loop within lesson study helps in aligning the needs of the student with that of the selected ICT tools, with the input of professionals who observe the progress of the teacher and student in the classroom environment. To move forward in enhancing lesson study for ICT in special education, more investigation and research is required which teachers and allied professionals can refer to.

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