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Learners Multitasking (Task Switching) during a Virtual Classroom session. Should teachers be concerned?

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The use of virtual classrooms (VC) in the Vocational Education and Training (VET) sector is becoming increasingly popular due to the ability for learners from any location to access education online in real time with a teacher, and to participate in an environment that simulates a face to face classroom. However, a major area of concern that has emerged is the tendency for learners to multitask (task switch) rather than remain attentive and focused on the content being delivered. This paper reports on findings from a study which investigated whether learners are task switching while participating in a VC and whether this affects the teaching and learning that occurs.

Keywords: Virtual classrooms, multitasking, task switching, learner engagement, Vocational Education and Training (VET).

Introduction to Task Switching

Helping learners to "pay attention" has always been a major focus for educators. The ability to focus the mind is a prerequisite to learning and a basic element in classroom motivation and management. However, one important feature that is becoming more prominent in education is the prevalence of learners to do two things at once. This is a particular issue with today's youth, who have grown up with the internet and are media task switchers who switch between watching television, texting, making a posting on their Facebook page and studying.

There is much debate about the definition of multitasking and even whether human multitasking is possible. Rosen (2008) a fellow at the US Ethics and Public Policy Centre claimed that "when we talk about multitasking we are really talking about attention: the art of paying attention, the ability to shift our attention and more broadly to exercise judgment about what objects are worthy of our attention" (2008, p. 109).

Gasser and Palfrey (2009) conducted research as part of the Digital Natives project conducted at Harvard University. They contended there are two types of multitasking:

- Parallel processing – this is defined as doing two things at once; however, one task is usually automatic for example reading a book while listening to music
- Task switching (divided attention) – this is defined as the process of rapidly changing from one task to another for example reading a book and responding instantly to a text message (Gasser & Palfrey, 2009).

This article will focus on the area of task switching or the issue of dividing attention as this is the area that concerns learners using the VC.

General Literature on Task Switching

The last decade of research has discovered that learners are often task switching. Research conducted by McMahon and Pospisil (2005) found that 'multitasking' was evident, with two thirds of the learners reporting that they task switch and have lots of things "on the go" at once. A more recent Australian study by Judd (2014) investigated 3372 computer session logs of 1279 university learners. Judd found that 70% of sessions involved some 'multitasking'.

While it is becoming clear that current learners are task switching there is also mounting evidence that task switching has an effect on learners' ability to accomplish tasks effectively, with studies recording a reduction in performance levels and/or an increase in errors (Ralph et al., 2014; Kirschner & van Merriënboer, 2013; Junco & Cotten, 2011; Lin et al., 2009; Ophir et al., 2009; Strayer, 2001) and a reduction in knowledge retention (Levitin, 2015; Risko et al., 2013). There is also evidence that task switching may have a negative effect on the time taken to complete a task (Bowman et al., 2010; Judd, 2014; Gasser & Palfrey, 2008; Rubinstein et al., 2001).

Reduction in performance levels and increase in errors
Research by Strayer (2001) confirmed that talking on the phone while driving a car is as dangerous as driving while intoxicated. Findings included decreased attention and increased reaction time so that drivers missed half the things they would normally see, like billboards or pedestrians. This study has convinced many countries, including Australia, that using a mobile phone while driving is dangerous and many have subsequently made it illegal. This is a strong argument that task switching has a negative effect on performance.

A Stanford University study conducted by Ophir, Naas and Wagner (2009) put 100 learners through a series of three tests to investigate what happens to people who 'multitask'. The research found that people who are regularly bombarded with several streams of electronic information do not pay attention, control their memory or switch from one job to another as effectively as those who prefer to complete one task at a time.

Lin et al. (2009) studied media 'multitasking' capabilities by comparing novice and expert reading skills in both 'multitasking' and monotasking conditions. Findings confirmed that all participants performed worse in the test 'multitasking' condition. These findings are supported by a study by Junco and Cotten (2011) who examined the effects of learners 'multitasking' while doing their schoolwork on their grade point average (GPA). This study found that learners who task switched (for example Facebooking and/or texting while doing schoolwork) did achieve a lower GPA and argued that regular task switching can have a negative impact on academic performance.

Kirschner and van Merriënboer (2013) argued that people are not capable of 'multitasking' and can at best switch from one activity to another. They claimed that switching requires a person to juggle her or his limited cognitive resources to accomplish the different tasks successfully. This juggling leads to greater inefficiency in performing each individual task, namely, that more mistakes are made and it takes significantly longer as compared to sequential work (2013, p. 172). A further study by Ralph et al. (2014) found that media 'multitasking' leads to an increase in attention related errors.

Reduction in knowledge retention
A more recent research into learners task switching in education is that of Risko, Buchanan, Medimorec & Kingstone (2013) who researched learners engaging in media non-lecture related activities while participating in a lecture. Sixty- four United States university learners were observed, and results demonstrated that engaging in these activities takes attention away from the lecture and this impairs retention of lecture material. They argued that "one of the greatest challenges is to better understand, given our knowledge of the demands of dual tasking, how the distraction posed by this technology influences educational outcomes" (2013, p. 2).

Levitin (2015) argued that task switching comes at a neurobiological cost. It depletes essential neuro-resources that are needed for actually doing things and thinking things. He explained that if children text message and study at the same time, the information from their schoolwork goes into the striatum, a brain region that stores new procedures and skills, rather than facts and ideas. If there is no distraction, however, the information goes into the hippocampus, where it is catalogued in a variety of ways, making it easier to retrieve.

Increase in time taken to complete tasks
Rubinstein, Meyer and Evans (2001) conducted extensive research which involved participants alternating between different tasks or performing the same task repeatedly. The findings revealed that participants lost time or made errors when they had to switch from one task to another. Gasser and Palfrey (2008) argued that task switching increases the amount of time needed to finish a task. They further argued that it may be impossible to prevent learners task switching. Rather, they believed educators should help learners take control of their learning by educating them about the negative effects of task switching. Judd (2015) supported this argument about the importance of educating learners and suggested learners should be given guidance and tips on how to influence their study habits and better manage their study time.

Bowman et al. (2010) examined the effects of learners using instant messaging while in a classroom. The results indicated that while learners think they are accomplishing more when task switching, findings suggest that they will actually need more time to achieve the same level of performance on an academic task. Judd (2014) found that all evidence indicates that 'multitasking' is more likely to negatively, rather than positively, impact on learning. He argued that "more time and effort will be required to result in the same level of memory encoding, and learning, during a 'multitasking' session than a focused or sequential one" (2014, p. 366).

Virtual Classroom Research on Task switching

The above research clearly shows that the tendency by learners to task switch can impede their learning. One of the first studies of learner task switching in VCs was conducted by the eLearning Guild (2005) in a report focusing on the current trends in e-learning. The Guild surveyed 4200 respondents asking if they task switched (term used in the question was 'multitasking') during a VC session and only 13% said "rarely" or "never" while exactly half (50%) said "always" or "often". The survey also polled the respondents if they thought this task switching (term used in the question was 'multitasking') interfered with their learning, with 14% reporting it did "always" or "often", 52% reporting sometimes and only 31% reporting that it "rarely" or "never" interferes.

In 2011 a United Kingdom research study into virtual learning (Towards Maturity, 2011) asked respondents what they believed were major barriers to adoption of the VCs and 28% listed the issue of users 'multitasking' in training. (Towards Maturity 2011, p. 14). While no other statistics could be found about task switching, many VC practitioners discuss the importance of discouraging learners from task switching. Clark and Kwinn (2007) argued that the main frustration with the virtual classroom environment is 'multitasking'. No matter how engaging you are as an instructor, you must still battle the learner's constant temptation to check emails and multitask (2007, p. 5). Courville (2010) argued that "the reality is that today's audience is 'multitasking' during your presentation, perhaps even twittering about it in real time. Assume they're 'multitasking' (2010, p. 149). Clay (2012) argued that you "must engage learners repeatedly to keep them from 'multitasking' (2012, p. 3).

The Research Study - Encouraging Learner Interaction, Engagement and Attention in the Virtual Classroom (an investigation into the phenomenon of multitasking)

There is very limited research literature about the issue of learners multitasking while participating in a VC and no research available on this issue in the VET sector. This paper reports on a doctoral study which aimed to add to this body of research by investigating the phenomena of VET learner's task switching in virtual classrooms sessions and if this did affect the teaching and learning that occurred.

The study was conducted at the Canberra Institute of Technology (CIT). At the time of the study, CIT was a large multi-campus institute comprising five teaching colleges situated across six campus locations in the Australian Capital Territory in Australia. CIT is a part of Australia's Vocational Education and Training system (VET) and delivers qualifications ranging from Certificate 1 to Bachelor degrees under the Australian Skills Quality Authority (ASQA). It is a registered training organization (RTO). Twelve individual case studies were analysed, each comprising one teacher and their learner cohort in their use of the Virtual classroom (Wimba was the platform used). Note – complete data was collected from only 6 of the case studies. A design based methodology involving two iterations was conducted, with the first being held in semester 2, 2011 and the second in semester 1, 2012. A mixed methodology was selected to ensure the richness of the data. Instruments for data collection included an entry and exit survey for teachers and learners, an end of session poll from the learners, a blog journal from the teachers, an e-diary from the researcher, a Wimba analytic tracking log, a detailed session observation tool and interviews from support staff.

The first section of the Task Switching research investigated the following:
- Are learners task switching in virtual classroom sessions and if so how much?
- What task did the learners switch to while attending a VC session?
- Which part of the session were the learners least engaged?

The second section of the study explored methods and strategies teachers can employ to focus learner attention on the relevant learning activity and limit their tendency to engage in distracting activities.

Findings

Are Learners Task Switching and if so how much?
The following Table 1 records the level of task switching the learners reported during the VC sessions.

Table 1: Learner task switching frequency.

Case study	Results of learner end of session poll	Results of learner exit survey	Average numbers of task switchers
1	43%	100%	71.5%
2	40%	75%	57.5%
7	100%	50%	75%
8	87%	100%	93.5%
9	64%	71.5%	67.7%
10	88%	NA	88%

N/A = not applicable

The above results indicate that learner's task switched with an average percentage of 75.5% across all case studies (the above data was collected from six teachers, 72 responses from the end of session poll from the learners and 27 learners completing the exit survey). Therefore, the answer to this question is yes, approximately 75% of all learners task switched while participating in a VC session.

What task did the learners switch to while attending a VC?
The following Table 2 displays the tasks learners switched to while attending a VC.

Table 2: Tasks performed by learners during a VC session.

Case Study	Results from teacher exit survey	Results from learner end of VC poll	Results from learner exit survey (multiple responses allowed)
1	e, fb	**tp** 33%, **w** 25% **e** 17%, **cri** 17%, **o** 8%	**tp** 50%, **e** 50%
2	e	**w** 60%, **d** 20%, **c** 20%	**e** 50%, **tp** 25% **nts** 50%
7	nts	**fb** and **tp** 100%	**tp** 50%, **e** 50%
8	tp, fb	**tp** 60%, **w** 26%, **tv** 7% **o** 7%	**tp** 25%, e 25%, **fb and tp** 25%, **e and fb** 12.5%, **e, fb, tp and o** 12.5%, **two of the following fb, tp, e)** 25%
9	N/A	**tp** 65%, **w** 21%, **o** 14%	**tp** 20%, **fb** 40%, **e** 20%, **two of the following (fb, tp, e**) 20%
10	tp, fb	**tp** 50%, **w** 20%, **e** 10%, **tv** 10%, **o** 10%	N/A

e = email, fb = Facebook, cri = course related information, o = other, w = included all websites (Facebook, YouTube etc.), tp = text and phone, c = children, tv = television, nts = no task switching, N/A = not applicable

The most common task listed was the text/phone with the second being email, followed by the websites (including the use of Facebook and YouTube). Other tasks listed including looking after children, having dinner and watching television.

There were issues with correlating these data. When this study commenced, Facebook was still gaining in popularity and therefore the tasks listed in iteration one were different from the tasks listed in iteration two with survey questions changing in iteration two to include Facebook. The questions were also changed from learners able to provide open answers to having to select specific tasks.

The amount of task switching increased from iteration one where the learners recorded an average 64.5% task switching compared to iteration two at 81.05%. This increase in the amount of task switching may have been due to the increase in the use of smart phones and the increase in the use of social media during this time. The researcher suspects if this survey was completed now the use of social media would be the most common task and would include the use of Facebook, Twitter and Instagram. The role of social media should be investigated in further research on task switching.

Which part of the session were the learners least engaged.
Table 3 displays the results from learners and teachers of when they felt they learners were the least engaged.

Table 3: Learner engagement measure.

Case no.	**Results of learner end of poll**	**Results of learner exit survey**	**Marked decline in engagement by learners**			**Results of teacher exit survey**
			Session 1	**Session 2**	**Session 3**	
1	end	middle	NA	1 start, 5 middle 9 end (11 LT)	0 start, 0 middle 5 end (5 LT)	start
2	start	start and end	0 start, 2 middle, 1 end (5 LT)	0 start, 2 middle 3 end (3 LT)	NA	start
7	end	end	0 start, 5 middle 2 end (8 LT)	0 start, 4 middle 0 end (10 LT)	NA	end
8	end	middle and end	1start 2 middle, 6 end (14 LT)	1start 3 middle 2 end (7 LT)	0 start, 3 middle 1 end (7 LT)	middle
9	start	end	1 start, 1 middle 5 end (10 LT)	N/A	N/A	N/A
10	middle	NA	0 start, 1 middle 0 end (2 LT)	2 start, 0 middle 0 end (3 LT)	1 start, 0 middle 0 end (3 LT)	end

LT = learners in total, N/A = not applicable

Case study one learners listed either the end or middle as being the least engaging, and the teacher stating it was the beginning. However, in the two sessions there was a marked decline in participation at the end of the sessions. The teacher changed her delivery methodology for the last session as previously she had encouraged a great deal of interaction with the use of emoticons, chat or group activities on the whiteboard. However, in the last sections of both sessions the delivery methodology was straight lecture slides. This would allude to the importance of encouraging regular interactions to maintain the attention of the learners. The teacher stated that she suspected they were task switching in these last sections but she could not be sure.

Case study two results were more consistent with both learners and teachers listing the beginning as least engaging. However, there was a decline in participation in the middle of one session and the end of the other. The teacher predominantly used a webcam as her main engagement tool rather than slides. This worked well as she was very positive and enthusiastic. However, the researcher suspects if the teacher was less confident or enthusiastic the sessions would not have been so successful. The teacher encouraged participation by inviting learners to use the whiteboard tools and by asking many questions. However, there were times during the session where the teacher called on learners by name and they did not respond. The teacher commented "were they task switching or just trying to work out how to use the tools – hard to tell?" The teacher could have encouraged more attention by regularly using emoticons to ensure the learners were paying attention. The teacher also did not use PowerPoint slides to post information or questions and instead typed on the whiteboard. While she was doing this the learners could easily have switched to another task. The teacher commented that there was "lots of quiet time which can lose the learners [attention] – so should have set time limits, and issue of typing over should have set PPT, or quickly put in lines, or just used chat". She included PowerPoint slides in the second session and this session ran more smoothly than the first.

Case study seven results were also consistent with learners and teachers listing the end as least engaging, although the results show there was a reduction in participation in the middle of both sessions. It was straight after multiple lecture slides in a row with no interactivity that there was a major delay in responses from the learners. One learner started to type text on the slides when not prompted and demonstrated that they were bored. When the teacher asked individuals or the group for responses there were delays at the end of these lecture slides, but there did not seem to be delays at other times. One learner also put up the "speed up" emoticon, which demonstrated that he was becoming bored. There was also a four minute delay while the teacher had to reload slides and directly after this silence one of the learners stated that they had to leave. This may have been due to the delay. All these issues could have been dealt with by asking for emoticons or a tick-yes/cross-no at the end of each slide to ensure the learners remained attentive. The teacher realised after the delay in responses in session one that she needed to make her session more interactive and varied, and for the second session she included more interactivity and a video.

The results from case study eight showed similar perceptions with the learners and teacher as they both listed the middle as least engaging. In sessions two and three there was a very small decline in participation in the middle. The teacher maintained the attention of the learners throughout the session. She was one of the only teachers who believed that learners always task switched and this may have helped the engagement of the sessions as she designed the session to include a great deal of interaction with multiple tools. She regularly called learners by name throughout the session so all learners knew they could be called on at any time. If she sensed they were bored she addressed this by telling them how long there was left to go or what was coming next. She also asked them to use the emoticons and chat. She continuously encouraged the learners when they participated with the tools. This worked well with the international learners, who were hesitant to use tools at the commencement of the sessions, but by the end of the sessions, were interacting with all tools regularly. One learner was disruptive and typed without invitation on a slide and the teacher brought the learner back on task by encouraging him to be active in the lesson by posting up a web link.

Case study nine results had a mix of perceptions with the learners listing the middle as least engaging, the teacher the end, and the data indicating the end of the session. This decline was due to the teacher displaying the webcam and therefore no interaction was required by the learners so these statistics may not be accurate. However, the teacher could have asked for a tick-yes/cross-no to ensure they could view an image correctly and to maintain attention. There was a delay in the session while the teacher was trying to get the USB microscope images working, although, as all learners were aware that this was new innovative technology, they all remained focused on the room. However, they became restless and started using the drawing tools on the displayed whiteboard screen. If this delay occurred regularly the learners could be tempted to task switch.

Results from case study ten once again presented a mix of perceptions, with learners listing the middle as least engaging, the teacher the end and the data marked the middle of one session and the beginning of the other two sessions. These lessons were designed to be lecture based. The teacher maintained attention by adding text regularly to the screen. He asked questions and if no response was given he added a hint, but there were silences while he waited for responses and the learners could have lost focus. He adjusted this for the second and third session and asked individual learners to answer questions. In the second session one learner was called to answer a question and when she did not reply the teacher called on her a second and third time. She then responded with "was on the phone but still listening." The fact she did not hear the teacher calling her name three times could mean she was distracted from the content. During the first session there was a significant delay when the teacher typed text on the screen. This could have allowed learners to task switch. However, the teacher resolved this by writing text one line at a time. The teacher also realised after the first session he required more interactivity to keep the learners focused and did start asking the learners to use the emoticons. He did comment that "one possibility I might try in the future is allow learners to use the whiteboard as well. Just to make the lesson more interactive for them. At the moment, the experience for the learners is pretty passive".

There were issues with the collection of these data. The first was the difference in an exact definition of what constituted the beginning, middle and end of each session. This was not specified to either the teachers or the learners and this may have resulted in incorrect responses. From the researcher's perspective the sessions were equally divided into three sections based on the length of the session. However, this discrepancy may have skewed the results. For example, a section towards the end of the beginning section may have been analysed as the beginning from the perspective of the researcher but may be been seen as the middle from the learners. With the issues in data collection the above statistics cannot conclusively answer the question of when the learners were the least engaged. However, it does suggest that a teacher's perspective can be very different from a learner's perspective.

Summary of Findings

The findings from the data indicated that learners definitely task switched, with 75% of the learners reporting that they did. The most common task listed was texting/using the phone, the second was using email and the third using websites including Facebook and YouTube. This study showed that the section of the session that the learner's task switched varied depending on the teachers, learners and sessions. So the exact time frame could not be conclusively answered. However, the above discussion suggests that the learners appeared to task switch when there was limited interactivity.

The above data suggests that learners were doing other tasks and were therefore not actively participating in and absorbing the content being delivered by the teacher or participating in the discussions. This was highlighted by the learner in case study ten who when called on to participate in the discussion did not hear the teacher ask her the question initially and then admitted she was on the phone. Learners task switching and not paying attention caused a delay in content delivery of the sessions as in some cases the teachers were waiting for responses from these learners.

Solutions - methods and strategies teachers can employ to focus learner attention on the relevant learning activity

The following solutions were proposed according to the issues that were raised in this study.

Designing for Regular Interactions

It is critical that teachers design their sessions to include regular interactivity with the learners to maintain attention. This could be as simple as asking for a tick-yes/cross-no, asking the learners to post a comment in the chat or encouraging active participation through a group whiteboard drawing tool activity. From the results of this study CIT now encourage all teachers to have no more than four slides without interaction, e.g. tick or cross, emoticons etc. In addition, teachers are advised that they should not have a slide displayed for longer than four minutes. Another method to gain regular interaction is to call leaners by their names, to avoid delays and to ensure all learners remain attentive when asking questions.

The Importance of Instruction Design

A teacher must recognise the importance of good instructional design when developing a VC session. Particular importance must be placed on the planning of all aspects of the session, including having a session that is well structured and includes clear guidelines and ground rules and uses a variety of delivery methods. Slide design must also be considered and should include frequent slide changes, use of relevant graphic images with limited text, slides that encourage interactivity by the learners, and if possible provide group activities and regular movement on the slides by using tools such as the pointer tool or the drawing tool. A teacher should avoid wherever possible displaying consecutive heavy text lecture slides.

Using additional Platform Plugins

Current virtual classrooms platforms such as Adobe Connect are constantly improving, evolving and incorporating new and additional tools and plugins. Additional Adobe Connect tools currently available to assist engaging learner attention include the 'randomiser'. This tool collects all learner names from an attendee lists and uses a randomised spinner that selects a name. This encourages learners to remain engaged at all times as they cannot anticipate when their names will be called. Adobe Connect also has a tool available at an additional cost called the 'engagement metre'. This tool is a quick way for teachers to view how engaged their learners are during the session.

Use of Nanny Software

Learners could be encouraged to use "nanny" software. This software can allow the learners to set time restrictions that block web access to certain sites, for example Facebook or email. The learners could set this to block access to these sites during the time they are participating in the VC. Common nanny software programs include K9 Web Protection and Self-Control.

Educating Teachers and Learners about the negative impacts of Task Switching

The teacher in case study eight commented that she believed the learner's task switched always and therefore made sure she designed for interaction. This highlights the importance of educating teachers that their learners will be task switching and that this task switching can affect the learning experience. It is equally important that learners are also educated on task switching and how it affects their retention of knowledge in these sessions.

Conclusion

This study concluded that learners are task switching while using VCs. Findings from the studies discussed in the literature review and this study suggest task switching has a negative effect on the teaching and learning that occurs. This paper provided some possible solutions, however it is hoped these findings will lead to additional discussion and research on the use of VCs; and in particular the issue of how to retain the attention of learners while they are participating in a VC session.

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