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About the Journal

Founded in 2013, the Journal of Teacher Action Research (ISSN: 2332-2233) is a peer-reviewed online journal indexed with EBSCO that seeks practical research that can be implemented in Pre-Kindergarten through Post-Secondary classrooms. The primary function of this journal is to provide classroom teachers and researchers a means for sharing classroom practices.

The journal accepts articles for peer-review that describe classroom practice which positively impacts student learning. We define teacher action research as teachers (at all levels) studying their practice and/or their students' learning in a methodical way in order to inform classroom practice. Articles submitted to the journal should demonstrate an action research focus with intent to improve the author's practice.

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INCORPORATING AUTONOMY IN AN ANALYTICS MODULE: VISUALIZING SELF-DIRECTED LEARNING

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Abstract To instill self-directed learning (SDL) in post-secondary learners, there has to be a transfer of the responsibility of learning to the learners themselves. However, a transfer of autonomy in learning from the teacher to the learners may not always be feasible especially in traditional classroom setting with tight teaching schedules and pre-defined syllabus to cover. Furthermore, post-secondary learners may be perceived to yet have the maturity to decide on what they want to learn, how they learn it and to evaluate their own learning. This study examines the impact of an increase in autonomy of learning on learners' conception of SDL. A group of 40 participants enrolled in a visual analytics module are asked to decide on a learning aspect, set learning goals and evaluation criteria to evaluate their own learning. This study offers two visualizations to illustrate how learners make sense of SDL in a minimalist autonomy learning environment and conclude with some thoughts on the role of autonomy in facilitating self-directedness in learners.

Keywords: teacher action research, self-directed learning, autonomy, post-secondary, analytics

Introduction

The economic uncertainty due to the pandemic, as well as the rapid acceleration of automation, has prompted a growing number of people making career switch to new fields (Russo, 2020). Such transition requires workers to have the capability in identifying their own knowledge gaps and to close these gaps to meet the demands of new careers. Hence, it is critical for pre-employment training of post-secondary learners for such workforce to be equipped with learning agility to upskill and reskill. This includes the necessary thinking tools on how to diagnose their own learning needs, set learning goals and conduct self-evaluation on their own learning. In short, post-secondary learners need to know how to be self-directed learners. One of the essential components to instil self-directedness is autonomy. It involves the transfer of learning responsibility from the teacher to the learner. While the literature does not lack in research on self-directed learning, there are limited studies in showing the process between the extent of autonomy in learning and the development of self-directedness. This study sets out to find the answers for two aspects of autonomy and self-directed learning, which are, learner readiness in embracing the transfer of responsibility of learning to themselves, and the indicators of self-directedness in the process of learning.

Literature Review

Self-Directed Learning and Autonomy. A self-directed learner is an attribute that every educator aspires for persons schooled in the Singapore formal learning institutions (MOE Singapore, 2015). This is because self-directed learners are self-actuated learners taking responsibility for their own learning that moves them from their current states to where they want to be (Piskurich, 1993). Learners who are self-directed are seen to be “taking initiative, diagnose their learning needs, formulate learning goals, identify human and material resources for learning, choose and implement appropriate strategies and finally evaluating their learning outcomes” (Knowles, 1975, p.18).

The notion of SDL has its roots in adult education which began to receive much attention in the 1960s (Knowles, 1980). Adults are observed to prefer more self-directedness in learning in which a majority of all their learning projects are planned out by the learners themselves (Tough, 1971, as cited in Knowles, 1973). Such preference for independence is associated with adults’ accumulation of life experiences and their needs to solve problems in their social roles such as in their jobs. Children and youths are seen to be lacking such life experiences and are missing the responsibilities of social roles. Therefore, children and youths are deemed to require much dependency on external support like a teacher, to plan, manage, monitor and evaluate their learning.

However, Knowles (1980) argued that youths especially do start early in life to accumulate experiences that have values for learning. Such observation can be seen in youths taking on social roles like part-time jobs, internships as well as taking on responsibility in managing their own lives. Children too could show signs of self-directedness in one area, such as learning a new game, but may show dependency in other areas such as when it comes to deciding how to learn a skill. Hence, rather than seeing self-directedness as a dichotomous entity, it should be viewed in a situation-dependent continuum entity regardless of age maturation (Knowles, 1980).

There seems to be unanimous agreement amongst researchers on the “freedom and the agency of the learner as steward of creation” (van der Walt, 2019, p.1). That is, whether SDL is associated with the characteristics of a learner (e.g., Douglas & Morris, 2014; MOE Singapore, 2015), the process or an approach to learning (e.g., Bartholomew, Reeve, Vion, Goodridge, Lee & Nadelson, 2017; Knowles, 1980; Peine, Kabino & Sprecklesen, 2016) or as training designs (e.g., Piskurich, 1993, Gibbons, 2002), the emphasis on independence of the self is strong. As such, the notion of autonomy is central in SDL.

Ryoo (2011) describes the notion of autonomy from four different perspectives - origin, directionality, boundary, and treatment. In terms of origin, autonomy can be initiated by the self (*autogenic*) or prompted by an external stimulus (*heterogenic*). For example, a person who wants to be an entrepreneur due to his or her own desire displays autogenic autonomy, and a person who wants to be an entrepreneur due to persuasion of the society displays heterogenic autonomy. In terms of directionality, autonomy resulted in freedom from external hindrance is known as *negative* autonomy. In comparison, autonomy resulted in freedom to exercise internal capacity to fulfil one’s freedom is known as *positive*

autonomy. For example, a person with no admission restrictions to choose from different entrepreneurial courses has negative autonomy, whereas a person who knows the rigor of each entrepreneurial course has positive autonomy in choosing.

Ryoo describes the boundary of an autonomy as *strong* when it strives for an outcome beyond socially, traditionally, and culturally defined parameters. On the other hand, *weak* autonomy seeks to preserve independence within such parameters. For example, a learner who proposes a new objective, deadline, and rubrics to replace an existing assessment shows strong autonomy, whereas a student who decides not to complete an existing assignment shows weak autonomy. Finally, in terms of treatment, autonomy can be *descriptive* or *ascriptive*. Descriptive autonomy involves suppressing a person's own freedom to decide on the next course of action due to perceived incapacity of this person in making a good decision. Ascriptive autonomy involves the respect for a person's free will to decide even though this person is perceived to be incapable of making a good decision. An example of descriptive autonomy includes imposing what a learner needs to learn in an entrepreneurial course, and in contrast, a course that allows learner to decide what modules to take is exercising ascriptive autonomy.

Taken altogether, Ryoo suggests that there exist two views each at one end of a spectrum of autonomy - maximalist and minimalist. The maximalist view subscribes to autogenic, negative, strong and ascriptive autonomy, whereas the minimalist view adopts the heterogenic, positive, weak and descriptive autonomy. It is tempting to perceive that learners will be motivated to learn when they are given the autonomy to decide what they want to learn, how they want to learn it and how they would like to be assessed in their learning (Balser, 2018), but Ryoo argues that instead of an absolute decision of all or no autonomy, the practical approach in education is to adopt the stance to offer varying degree of autonomy transfer to learners depending on the levels of education.

Although SDL is a natural psychological progression as people mature (Knowles, 1980), there may be resistance amongst learners (even adult learners) when the responsibility of teaching is transferred to the learners to encourage autonomy. SDL is no easy feat for many learners especially for those who are conditioned by their previous experiences to have dependency on external influence in learning (Knowles, 1980), those with low self-esteem or those who had experienced a series of failures in their learning journey (Gibbons, 2002). Such responsibility to take charge of one's own learning may also be overwhelming even for capable learners as the responsibility to keep track of learning starts to accumulate (Gibbons, 2002).

Methodology

Research Questions. This study examines how the increase in autonomy is associated with learners' engagement in SDL. Specifically, the research questions for this study are as follows:

1. To what extent did the participants in this study embrace (or resist) an increase in autonomy of learning?

2. What are the differences in how learners make sense of SDL in a module designed using Ryoo's (2011) minimalist view on autonomy?

Participants. Forty second-year full-time diploma learners between the ages of 18 to 23 years participated in this study. The participants, comprising 23 males and 17 females, are enrolled in a visual analytics diploma module. The lessons are conducted in 15 weeks, four hours per week from which an hour is scheduled for the participants to learn on their own from pre-recorded video lectures. In the three hours face-to-face lessons, the participants solved scenario-based visual analytics problems by generating visualizations using the *Tableau* software. The content coverage in this module includes introduction to the analytics thinking process, the different types and purposes of visualizations as well as best practices in building dashboard and storyboard. Participants need to complete five assessment components designed to include some degree of autonomy in learning. The weightages of these assessment components range from 15% to 35% of the overall grade in the module. Due to space limitations, only one of the five assessment components will be discussed in this paper. Henceforth, this assessment component would be referred to as assignment. At the end of the semester, participants are required to complete a reflection survey on their perceptions of SDL. Twenty-six participants completed all the required components of the assignment. Fourteen participants did not complete the reflection survey in which eight of them also did not complete the assignment. All these data are consolidated to form the data for the main study.

Research Instrument. The aim of the assignment is for the participants to explore areas of their interest and to extend their learning beyond the content taught in this visual analytics module. Specifically, participants are given the autonomy to decide what they want to learn, how they wish for the learning to occur and at the end, they would do a reflection on their learning. Generally, this assignment allows for controlled exploration within the pre-defined parameters adopted from Ryoo's (2011) minimalist view on autonomy - heterogenic, positive, weak, and descriptive. Since the onset of exploration for this assignment is external which is to fulfil the requirement of this module, the autonomy is heterogenic in nature. The assignment allows for participants to exercise positive autonomy in determining how they want to fulfil the requirement of this assignment. Due to administrative constraints, the assignment offers weak autonomy as it requires participants to work within the pre-determined structure and does not encourage participants to change the weightage and deadline set. In addition, the assignment includes descriptive autonomy as it requires participants to trust that by completing the assignment as designed, they would attain a greater educational goal in return for suppressing their own personal desires for the time being.

This minimalist autonomy designed assignment is divided into three phases. Participants' responses in each phase are gathered as evidence of their SDL.

Phase 1: Goal setting. At the start of the semester, the participants are briefed on the aim of the assignment. After the participants clarify the scope and deliverables of the assignment, they proceed to individual goal setting. In this first phase, the participants describe their

areas of interest and set own learning goals. Then the participants set learning milestones and assessment rubric to evaluate their own learning.

Phase 2: Monitoring own learning. Following the completion of Phase 1, participants are encouraged to keep a weekly e-journal in a learning management system to monitor their own learning and to document all evidence of milestone achievements. In this Phase 2, the participants are encouraged to communicate with their tutor regularly to get feedback on their learning.

Phase 3: Evaluating own learning. The final part of this assignment is the evaluation process where participants meet with their tutor to reflect on the goals set, their self-monitoring of the learning process and to perform a self-assessment. Finally, participants complete a reflection survey as a signal for the completion of this assignment.

On average, participants are given about 10-12 weeks to complete Phases 1 to 3. Figure 1 maps the overall roll-out of this assignment against the academic term of this module which begins in mid-April and ends by mid-August.

Academic calendar	April		May		June		July		August	
		Term		Exam	Term break		Term			Exam
This study		PHASE 1 Start of Assignment (Briefing and goal setting)	PHASE 2 Assignment in Progress (Monitoring own learning)					PHASE 3 End of Assignment (Evaluation of learning)		
			Reminder 1		Reminder 2		Reminder 3			

Figure 1. The implementation timeline

Data collection and analysis. There is a two-fold interest in this study. First, I would like to know if participants embrace or resist a transfer of the responsibility of learning from the teacher to the learners themselves. This would inform me of their readiness for more of such activities in subsequent design of curricular content. Second, I am interested in the process of how learners engage in a more autonomous way of learning. Participants are deemed to resist the increase in autonomy when they do not participate in this assignment or, they express anxiety in learning on their own. Participants who embrace the autonomy would set goals. What they set as goals, as well as their responses to the survey questions would uncover what values in this assignment that are consistent with their own values in learning. It would also shed light on whether the participants adopt positive stance towards such an increased in autonomy, or they face a lot of anxiety.

All the data in Phases 1 and 2 of the assignment are collected and stored in an online LMS. These data are part of participants' course work requirements. Survey data collected via Google Form in Phase 3 are similar to feedback that are routinely asked of learners for module delivery improvement. Hence, participants are not disadvantaged in any way by the data collection. The data are compiled into a single file and all sensitive information are de-identified for further analysis. Table 1 summarizes the data analysis methods on data collected to answer the research questions.

Table 1: A summary of research questions, data collection and the data analysis methods.

Research questions	Data collection	Data analysis	
To what extent did the participants in this study resist or embrace an increase in autonomy of learning?	Number of participants who submitted or did not submit the assignment.	Descriptive statistics	The responses gathered are analyzed per variable and then analyzed per participant to give rise to the different profile of self-directed learners in a learning environment designed with minimalist view on autonomy.
	Responses from goal setting <i>What do I want to learn?</i>	Qualitative coding	
	Responses from the survey questions <i>Which part of this assignment makes sense to you?</i>		
What are the differences in how learners make sense of SDL in a module designed using the minimalist view on autonomy?	Lapses (in days) between goal setting and the first e-journal submission	Descriptive statistics	
	Number of e-journals submitted		
	Median days between e-journal submissions.		
	E-journal submissions on whether the reflection of learning was directed towards achieving the goals set.	Qualitative coding	
	Responses from the survey questions <i>When did you feel a sense of success when you did this assignment?</i>		
	Responses from survey questions <i>To me, self-directed learning is _____.</i>		

Quantitative responses such as number of submissions and the date of submissions collected from LMS are analyzed and reported using descriptive statistics. Subsequently, open-ended responses from the e-journal submissions and final survey are analyzed qualitatively. The e-journal submissions are analyzed for evidence on whether the participants constantly reflected on how their efforts are directed at achieving the goals set. The e-journal submissions with strong evidence on effort directed at achieving goals are coded as *Monitor-Focused*. On the other hand, responses are coded as *Monitor-Distracted* when there is evidence of effort but not directed at goals, or with no evidence of effort identified. Responses from the survey question - *When did you feel a sense of success when you did this assignment?* are coded as *Success-Completion* when the sense of success is derived from completing the task, as *Success-Beliefs* when the sense of success came from a held belief that is changed, and *No-Evidence* when there is no evidence on the sense of success in which reasons will be discussed instead. Finally, each participant's conception of SDL is derived from his or her response to the survey question *To me, self-directed learning is _____*. Responses are coded as *Holistic-SDL* when there is an emphasis of self, with or without external help, in goal-setting, monitoring and evaluating own learning. When some

of these elements are mentioned, the responses are coded as *Partial-SDL*. If none of the SDL components are mentioned, then the responses are coded as *No-Evidence*.

The following section will first discuss the evidence gathered to answer the first research question, and subsequently, the discussion will focus on answering the second research question.

Results and Discussion

To what extent did the participants in this study resist or embrace an increase in autonomy of learning? Ten out of 40, or 25% of the participants showed some levels of resistance towards an increased in autonomy of learning. Two of these participants expressed their apprehension to take on additional learning on their own. Instead, they expressed their desire to master the basic skills taught in class. This shows that they are not yet ready to explore learning on their own beyond what is taught in the classroom and needed more guidance from an authority. An example of such is given by participant S36: "I would like to learn the basic skills on [software] as I am still very unsure on where to put the datas from Measure to the CARD, I need extra guidance for the basic skills so that i can go further ahead to use the skills without having any difficulties."

Eight other participants hinted subtle resistance towards an increase in autonomy of learning by not completing the assignment. These participants chose not to complete this assignment despite repeated reminders to complete it, and that the assignment carried significant weightage to the overall grade received for this module. The lack of participation in this assignment hinted at their unwillingness to devote time in setting own learning goals, monitor their own learning and to evaluate their learning. It is possible that participants may be apprehensive towards such an unfamiliar assessment structure that transfer the responsibility of learning from the teacher to the learners themselves. Such apprehension could be due to previous schooling experiences have conditioned them to expect structure and dependency on a figure of authority (Knowles, 1980) or lack of self-confidence that they could direct and validate their own learning (Gibbons, 2002). Besides that, it could also hint at their beliefs that such assignments with increased autonomy generate little values and are indulgence for those who have time to explore learning on their own. As such, when there are other tasks that compete for their limited time and attention, it is possible that those that they place higher values than this assignment would capture their attention and interest first. Participant S38 offers a glimpse of such a reason: "After the first stage, which is to collect my data for my "Laughter" project, i became a little busy and occupied by my other modules and completely lost track of time (...) It happened when i had projects and assignments from other modules. Therefor i have decided to focus on the "more important" assignments as i had dateline to catch."

The remaining 30 out of 40, or 75% of the participants seemed to embrace an increase in autonomy of learning. The goals that these participants set were technical in nature and related to the module curriculum content. These goals mentioned the desire to explore different types of visualizations, animation in visuals and the symbols and signs in the

visualizations, as indicated by S29 and S18 respectively. Others described how they want to apply what they have learnt in an area that interests them, such as an example given by S3.

- S29: “ (...) after watching Hans Rosling Ted Talk video, i have learned that how visuals and colors and animation play a big part in data visualization. I have watched the video about him explaining the data about child fertility rate and life expectancy, i am keened to learn how to use visuals and colors as well as animation to help myself and others understand the dat[a] that I have been give[n] a bit more.”
- S18: “Able to learn at least 3 new charts which are not taught within our module. Would like to learn them as i get to explore more choices of charts when doing future analytics.”
- S03: “I would like to apply the knowledge and skills that I've learnt in class and use them to present data related to one of the sports in which I am rather interested in, Formula One (...) data in a visual way would be rather interesting and may also help me to understand the sport better.”

The other two goals that were not technical in nature described soft skills as their goals, as indicated by S02 and S19:

- S02: “I want to learn on how to improve on time management by doing a survey. I wish to do so as I would want to implement an effective method of time management for my daily life as I would usually procrastinate on work and rush things last minute, stressing me out.”
- S19: “Presentation skills for analytics. I feel that to be able to show and explain data through words and body language is a good skill for this module, and that I should improve in my current abilities as I have stuttering problems and get flustered during speeches.”

At the end of the assignment, the participants are asked to complete a reflection survey to gather their thoughts on the whole learning process. Only 24 participants' responses are analyzed because two of the 26 participants who completed both the assignment and survey submitted identical survey responses. Hence, both these responses are discarded.

The survey question *Which part of this assignment makes sense to you?* is set as open-ended for participants to share their feedback on this independent learning journey. Based on past experience of doing similar studies, it was expected that if participants resisted such assignment, their open-ended responses would indicate their objections towards the transfer of responsibility of learning from the teacher to the learners themselves, or that negative sentiments would surface. As the survey carried no additional marks to their overall score, the participants are encouraged to express their views honestly.

There was no evidence of negative sentiment from participants' open-ended responses. In fact, approximately 30% of the participants who completed the reflection survey also described parts of SDL in the assignment that made sense to them. Such responses are shared by participants S13, S18, S28 and S34:

- S13: “Actually I have never try to do this kind of assignment before so it is like a whole new experience. At this point of time, reading through some of the goals i write many weeks ago is kind of amazing.”
- S18: “When you're marked based on goals which we set on our own. This really shows whether someone took the initiative and heart to put and learn something when given the opportunity to.”
- S28: “(...) The setting of goal showed me how I am achieving it like what mistake did I did wrong and what I am success.”
- S34: “Setting milestones for myself and grading myself.”

As a large majority of the goals were directed at learning technical skills, it is not surprising that what made sense to the participants are also largely associated with the attainment of technical skills. Response by S38 gives one such example: “Everything made sense. From the visualisation to pre attentive features and collecting of data.”

As a summary, three-quarters of the participants in this study embraced an increase in autonomy in learning, and approximately 30% of these participants also seem to be in agreement that an increased in autonomy is associated with positive perceptions of SDL.

The following section presents the findings on how participants made sense of self-directed learning. First, *Figure 2* summarizes the quantitative data aggregated using simple descriptive statistics and establishes two clusters of participants in responding to the tasks with increased autonomy. Then, *Figure 3* maps the analysis from the quantitative data to the coded qualitative data and offers detailed discussions on how the participants internalized SDL through the assignment.

What are the differences in how learners make sense of SDL in a module designed using Ryoo's (2011) minimalist view on autonomy?

Table 2: Numerical summaries for goal setting and monitoring of learning (e-journal submissions)

	No. of e-journal submissions	Lapses between goal-setting and first e-journal submission (in days)	Median days between e-journal submissions
Total	128	-	-
Minimum	1	1	0
Median	4	55	3
Maximum	10	70	68

Table 2 gives a general overview on number of e-journal submissions, the lapses in days between participants' goal setting and subsequently monitoring of their learning through e-

journal submissions. The participants' first e-journals are submitted generally about 50-70 days after the goals are set. This may imply that perhaps the participants believed such assignment should not require prolonged effort and sustained interest and would not warrant such demands too. In addition, participants seemed comfortable and confident with short-term goals as seen in the long lapses between goal setting and first e-journal submissions. Furthermore, the participants commonly submitted one to 10 e-journals and the aggregated number of days that lapsed between two e-journal submissions is approximately 3 days. It was of interest to analyze deeper how participants spent their time doing this assignment.

Figure 2 shows further analysis on the relationship between three variables - Lapses in days between goal setting and the first e-journal submission (x-axis), median days between e-journal submissions (y-axis) and the number of e-journal submissions (size of the bubble). At least two clusters seem to appear - one cluster indicated by bubbles at the bottom right hand corner in, coded as *Delayed-Start* and another on the left side in Figure 2 coded as *Prompt-Start*.

Delayed-Start cluster indicates participants who submitted their first e-journals approximately 50-70 days after the goals are set. About 60% of the participants fall in this cluster. There are small bubbles and bigger bubbles in this cluster. Smaller bubbles indicate fewer e-journal submissions. Most of the smallest bubbles like the one indicated by 'A', are in this cluster. This means the participants' first e-journals are also their only e-journals. Participants from this group likely forgot about the deadline of this assignments, sought quick closure to complete the assignment when the deadline is near, and/or could likely have over-estimated their capabilities in completing the assignment as desired. A few bubbles in the *Delayed-Start* cluster are also big in size, some resting very near the horizontal axis. This means the participants submitted many e-journals within a very short period of time. It may be possible that participants did their reflections in another platform and transferred their reflections over to LMS at the end of the assignment period. Another possible explanation hints at participants tried to gain more credit by compensating for their lack of regular effort with high number of submissions at the end. Generally, *Delayed-Start* cluster submissions imply lack of evidence in consistently monitoring their learning effort.

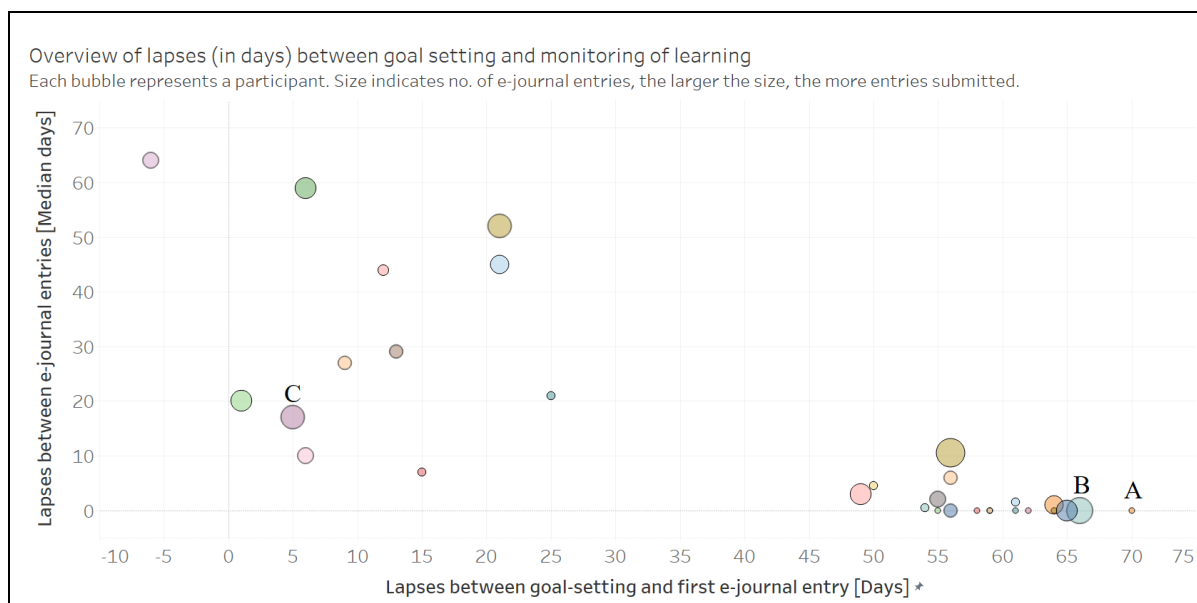


Figure 2. A comparison between the lapses in number of days between goal setting and first e-journal submission (x-axis), median number of days between journal submissions (y-axis) as well as the number of submissions that each participant submitted (size of the bubble - the bigger the size, the higher number of submissions).

Prompt-Start cluster indicates participants who submitted their first e-journals within a month of goal setting. Unlike *Delayed-Start* cluster, the median number of days within *Prompt-Start* e-journal submissions were also more dispersed. Bubbles towards the top left-hand corner may indicate longer breaks in between e-journal submissions. Bubbles bigger in size towards bottom left-hand corner are the most desired, like those indicated by 'C'. These bubbles showed evidence of more frequent e-journal submissions, which could suggest more regular reflection of their learning. The aggregated median number of days between e-journal submissions coincides with two to four major learning units in this module. This suggests that some participants in the *Prompt-Start* cluster can set goals and monitor their own learning consistently.

Subsequently, participants' qualitative responses from the e-journal submissions and final survey are scrutinized for evidence on how they have monitored and evaluated their own learning, as well as how they have internalized the concept of SDL through this assignment. *Figure 3* uses a parallel plot to map the quantitative data analyzed (verticals D to G) to the coded qualitative data (verticals H to J).

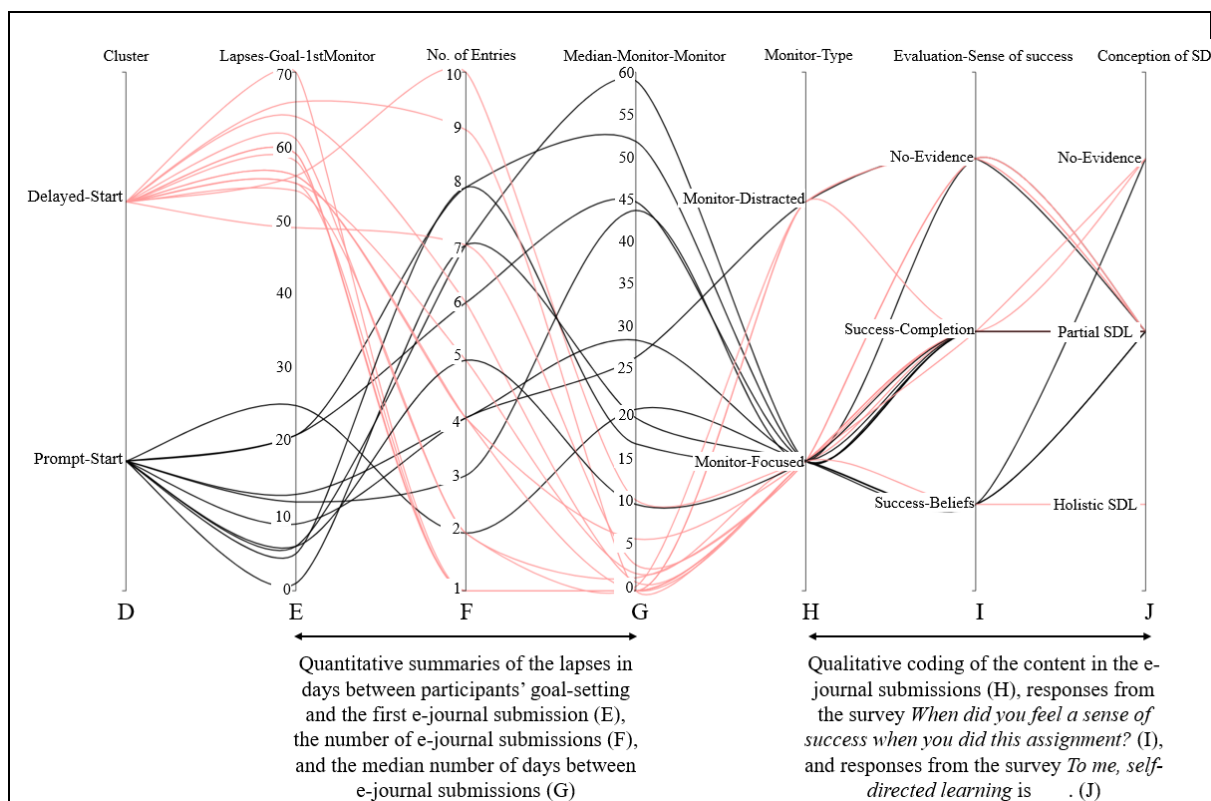


Figure 3. Each line traces the characteristics of one participant's monitoring of own learning (verticals F to H), evaluation of own learning (vertical I), and ultimately his or her conception of SDL as experienced through this assignment (vertical J). The lighter line represents Delayed-Start participants who submitted their first e-journal about 50-70 days since goal setting, whereas the darker line represents Prompt-Start participants who submitted their first e-journal within a month of goal-setting (verticals D and E).

Monitoring own learning (Figure 3 verticals F to H). Generally, Prompt-Start participants submitted a slightly smaller number of e-journals compared to Delayed-Start participants. Almost all the e-journal submissions are focused on achieving the goals set. These e-journals are coded as *Monitor-Focused* where the goals set at the beginning are evident and learning done are directed towards achieving the goals. There is also evidence that the participants know how to self-evaluate their own learning by awarding marks to themselves when a milestone set has been achieved. A summarized example of *Monitor-Focused* submissions is given by S33 during the assignment period: "I watch 2 YouTube video on how to create animated visuals in tableau, which I am supposed to complete it by week 6 as part of my milestone 1 (...) I have shown [tutor] the animation hence milestones 1 and 2 are completed. Marks awarded to myself: 3 (...) i have completed my milestone 3 which was to create a animated visual for my group project (...) Marked awarded to myself : 2 marks. i have completed all my milestones."

On the other hand, e-journals coded as *Monitor-Distracted* do not show evidence of the goals set as the center of focus in their learning effort. The common reason given is the lack of proper time management - where they admitted that they forgot about the assignment,

or that they decided to work on assignment which they place higher values on. An example of an e-journal submission that was coded as *Monitor-Distracted* is given by S38: “This is my first journal entry for the Assignment Milestone which was supposed to keep track of my progress throughout the making of the dear data (...) The whole process of dear data should have been done by 31 May 2019(...) i became a little busy and occupied by my other modules and completely lost track of time (...) Today, 3/7/2019, i have only started to start sketching my raw data on a postcard to be given to [tutor] just in time for my submission.”

Although most of the e-journals submissions are focused on the goals set, those submitted by *Prompt-Start* participants show median days between e-journal submissions to be in the range of 10 to slightly below 60 days. As such there could be evidence of a more distributed practice or reflection on their learning and working towards the goals. As a comparison, *Delayed-Start* participants generally has a much lower median days between e-journal submissions, many show median to be zero day. This means there was mass submissions within a very short period of time, or that the participants only submitted one e-journal. This point was also shown in *Figure 2* and discussed in the previous section.

Evaluating own learning (Figure 3 vertical I). In terms of evaluating their own learning, some 58% or 14 out of 24 participants reported that they felt a sense of success when they have completed the assignment. The completion tasks, especially those that they are able to compare against an external standard, give the participants a sense of achievement regardless of whether the participants started on their goals promptly or not, and how frequently they submitted e-journals to monitor their progress. Participants S28 and S32 share their reflections on when they felt a sense of success when doing this assignment:

- S28: “When I complete the drawing and by looking at it, it feels like is almost the same as the dear data website sample.”
- S32: “I feel a sense of accomplishment when I finish my storyboard and see the things I learn are put into use.”

However, a few participants did not provide convincing evidence that they felt a sense of success. When probed further, one of the reasons given is that they did not manage to achieve the goals set. Responses by S35 and S27 provide such examples:

- S35: “I feel that the amount of effort I had put in could have been more as I did not manage to achieve the goals I had set.”
- S27: “I was not able to use the data to find out the difference in what makes a good climber and what makes a bad climber.”

Some other participants who reported a sense of success are also coded as *No-Evidence* because the achievement is focused on attaining the outcome of an unrelated goal. There is no evidence that the goal set in the beginning has been achieved or that this achievement gave them a sense of accomplishment. An example is given by S02 who had set goals on improving his time management but the sense of success he reported is when he was able to prepare the data set properly for his project. There is no indication whether his goal in managing time better is attained. These participants whose responses on sense of achievement are coded as *No-Evidence* are largely from the *Delay-Start* cluster. Perhaps

because they had delayed the start of working on their goals, there is no ample opportunity for them to gather some initial evidence to assess the feasibility of the goals that they set, re-evaluate the resources needed to achieve those goals, or even to regulate their thinking on whether their effort is directed appropriately towards achieving the goals set.

In comparison, a few participants from the *Prompt-Start* cluster reported a sense of success not only in the completion of the tasks but also in how the completion of the tasks changed their prior beliefs about their own capabilities and challenges they assumed the tasks held. Examples are given by S18 and S33:

- S18: "I've managed to [l]earn something out of class, by doing my own respective research, which made me proud when I've managed to achieve what i set out to do from the beginning."
- S33: "I feel a sense of achievement, initially I felt that creating animated visual is a challenging process, I doubted myself. However, I am able to create one animated visual."

Conception of SDL (Figure 3 vertical J). In general, almost all the participants' conception of SDL are coded as *No-Evidence* and *Partial-SDL*. These responses originated both from the *Delay-Start* and *Prompt-Start* cluster. In other words, there seem to be little evidence from this study that the promptness in getting started on achieving a goal, the consistency in monitoring own learning and the confidence to evaluate own learning are strong differentiators in how participants conceptualized SDL. Two possible explanations could be offered for this observation. The first explanation may be linked to the limitation of collecting data from a typed-written survey in which participants may not be predisposed to elaborate on their conceptions of SDL. The second explanation may be gleaned from tracing the characteristics of monitoring and evaluating own learning of the response coded as *Holistic-SDL*. There seems to be some evidence to suggest that short-term intensive and focused practice, rather than longer term prolonged and sustained effort may likely lead to a more holistic view of SDL. Conception of SDL coded as *Holistic-SDL* emphasizes an end-target and stresses on the self in the monitoring and evaluating of own learning. Response by S18 is an example: "To me, self-directed learning is taking the initiative to learn and enhance your knowledge at will. It is also when you need to have a goal set out in mind, and know what you want/need to do. Then focus on what you've set out to do, and follow it with a end goal in mind. Only then, upon accomplishment on what you've set out to do during SDL, will you feel a sense of achievement."

Figure 4 traces S18's evidence from his qualitative and quantitative responses on monitoring and evaluation of learning, and then a mapping to his conception of SDL. It is noteworthy to observe that S18 whose SDL conception coded as *Holistic-SDL* is from the *Delayed-Start* cluster. S18 submitted five e-journals containing evidence of focused learning effort directed at achieving the goal set. The median days between e-journal submissions is two. S18 reported a sense of success when he could independently extend his learning beyond the class by setting and achieving goals.

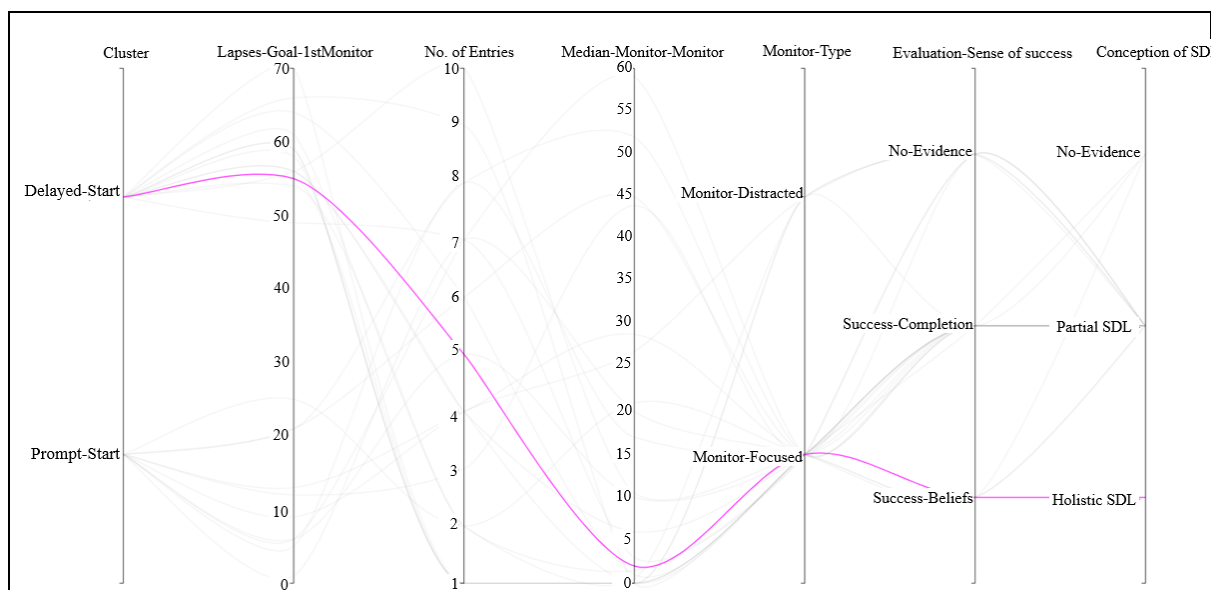


Figure 4. S18's monitoring and evaluation of learning and the mapping to his conception of SDL.

The data collected from S18 seem to suggest that focused and intensive effort regardless of how promptly they start working on their goals could be associated with a more holistic conception of SDL. Perhaps the gratification derived from achieving a short-term goal serves as validation to the capability of independent learning and could likely spur subsequent SDL. Hence, the pre-conceived notion that consistent effort over a pro-longed period of time needs for SDL to be developed should be re-examined as short-term intensive and focused effort could also be linked to a more holistic conception of SDL, as portrayed by S18.

Approximately 80% of the participants provided evidence that they could describe some important components of SDL such as the emphasis of self in taking the initiative, with or without the help of others, in goal setting, monitoring, and evaluating their own learning. But at the same time, such responses also lack the mention of self as just as an important source of validation of their own learning. It seems that a majority of the participants have not yet internalized that evaluation, especially self-evaluation, is an important component in SDL to validate those goals have been achieved through intentional and purposeful learning. As such, these responses are coded as *Partial-SDL*. Some examples are given by the S04, S29 and S33:

- S04: "Taking the initiate and motivating yourself to do it"
- S29: "[B]eing able to be independent and learn on your own without the need of a lecturer to guide you."
- S33: "Is having a good time management and having the right mindset. Step by step process to track on my learning."

Three out of 24 participants responded in a general way of what SDL meant to them:

- S13: "[A] new way of learning"
- S28: "Important and it can be difficult at the start"

- S30: “[A] test for self-discipline”

Since their responses on SDL were rather general and did not make references to the important components of goal setting, monitoring, and evaluating learning, these are coded as *No-Evidence*. The omnipresence of an end-goal is important because it directs learning effort purposefully, serves as a validation for learning and subsequently when end-goal is attained, it releases a sense of achievement that may motivate or reinforce a desired follow-up learning behavior. All these are contained in self and can be activated with or without the need for direction exerted by an external force. As such, participant may then get a sense that SDL is a skill regardless of the type of learning to be done, if the process components of goal setting, monitoring and evaluation are in place.

Conclusion

This study offers three important insights into incorporating autonomy for self-directed learning. First is in the use of simple visualizations to inform teachers about their learners SDL characteristics. This study uses a scatterplot in *Figure 2* as well as parallel plots in *Figure 3* and *Figure 4* to trace each participant’s quantitative and qualitative responses and mapped it to their conceptions of SDL. Both these visualizations can be generated effortlessly from readily available commercial visualization software like Tableau, Power BI and KNIME. Second, a minimalist approach to autonomy incorporated in tasks could encourage learners to develop substantial conception of SDL. The most important element is then to encourage participants to always keep the end-goal in mind, and to direct effort purposefully in achieving the goal. As a side note on this point, the role of technology is important in both supporting the increase in autonomy by documenting and managing evidence of learning properly to avoid any conflict in the evaluation phase. This study chooses a LMS system for such purpose. Lastly, the findings in this study seem to suggest that learning tasks that incorporate autonomy for self-directed learning could be designed as short-term tasks that require intensive and focused effort rather than one that requires prolonged effort and sustained interest.

About the Author

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