FORBES-MCKAY, K.E., BREMNER, P.A.M., JOHNSTON, P. and AIR, C. [2024]. Exploring independent learning (IL) and its relationship to mindset, motivated strategies for learning and academic performance. *Journal of applied research in higher education* [online], EarlyCite. Available from: https://doi.org/10.1108/jarhe-06-2023-0253

Exploring independent learning (IL) and its relationship to mindset, motivated strategies for learning and academic performance.

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2024

This is the accepted manuscript version of the above article. The published version of record is available for purchase from the journal website: https://doi.org/10.1108/jarhe-06-2023-0253

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Title: Exploring Independent Learning (IL) and its Relationship to Mindset, Motivated strategies for learning, and Academic Performance.

Abstract

Purpose: This study addresses gaps in the existing literature on students' understanding of Independent Learning (IL), whilst exploring the link between levels of IL, growth mindset, motivated strategies for learning, and academic performance.

Methodology: Three hundred and eighty-six university students recruited via opportunistic sampling completed an online survey to measure: understanding and level of IL, Motivated Strategies for Learning (MSL) (Duncan and McKeachie, 2005) and growth mindset (Dweck, 2000). Interaction with the university Virtual Learning Environment (VLE) and academic grades were also measured. A correlational design was implemented, and a Spearman Rho was calculated to explore the relationship between level of IL, MSL and growth mindset. A between-subjects design using independent measures t-test was employed to determine the significance of any difference in level of IL and VLE engagement according to academic grade.

Findings: Whilst most students: considered themselves an IL and understood what IL was, the majority erroneously believed it meant learning alone or without help. Level of IL, however, was positively associated with motivational beliefs (self-efficacy, and mindset), cognitive strategies (rehearsal, elaboration, organisation, and critical thinking), together with metacognitive strategies (time management and self-regulation). Further, those with grades A-C scored significantly higher than those with grades D and below on cognitive strategies (elaboration and organisation). Those attaining higher grades also interacted with the VLE significantly more frequently and regularly than those attaining lower grades.

Originality: This study adds to the existing literature by highlighting the positive relationship between level of IL, MSL, mindset and academic achievement. It also addresses the under-explored potential for VLE engagement in predicting grades amongst on-campus courses. Given that cognitive strategies and VLE engagement differentiate the high and low achievers, interventions to develop such skills may enhance academic achievement.

Keywords Independent-Learning, Self-regulated learning, Motivational Strategies for Learning, VLE Engagement, Academic Achievement

Paper Type Research Paper

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Background

There is increasing interest in the role of independent learning in higher education and its impact on academic performance. Indeed, Anthonysamy et al. (2020) note that self-regulation has been recognised as one of the most vital competencies for the twenty-first century (OECD, 2013). Independent or self-regulated learning is a process which includes meta-cognitive, motivational, emotional, and behavioural strategies that students employ to master their academic skills (Zimmerman, 1986) and which are thought necessary for lifelong learning. Self-regulated learners are motivated to plan, set goals, and engage in strategies to achieve those goals, they also, however, monitor and adapt these strategies to enhance their progression toward goal achievement (Pintrich, Smith, García, & McKeachie, 1993).

Cognitive strategies include rehearsal, elaboration, critical thinking, and organising to acquire knowledge and retain information (Broadbent & Poon, 2018). Metacognitive strategies, on the other hand, refer to the strategies used to monitor, regulate, and plan learning (Yukselturk & Bulut, 2007). Motivational skills refer to expectancy, value and affect (Duncan and McKeachie, 2005), this relates to learners' belief in their ability to accomplish a task (self-efficacy), the belief that outcomes are contingent on their own actions (expectancy), and the value they place on such outcomes (value). According to the self-regulated learning model, students have the potential to actively monitor and therefore adapt their goals, learning strategies, and motivation (Lynch & Trujillo 2010).

This aligns with Bandura's Social Cognitive Theory (2009). According to Bandura (2009), people seek to develop a sense of agency over their lives and such agency is influenced by their self-efficacy, outcome expectations, goal setting, and self-regulation (Schunk, 2012). Bandura (2009), notes that nothing is more influential than one's belief in their personal efficacy, that is the belief that one can successfully perform specific behaviours and produce desired outcomes. According to Schunk (2012), individuals actively influence their learning by interpreting the outcomes of their actions, which, in turn, impacts their environment, and informs their future actions. Rather than see learners as passive recipients, the social-cognitive view proposes that learning is more than a fixed trait, and instead that motivation and learning strategies can be improved to achieve success (Duncan & McKeachie, 2005, Broadbent & Poon, 2015).

~~While there is consensus on the benefits of developing students as "independent learners", there is no simple definition of what the term means (McKendry and Boyd, 2012) and limited research to explore students understanding of it. As a result, students may fail to understand~~

~~what is expected of them as independent learners, whilst institutions and academic staff fail to develop effective interventions to enhance IL.~~

~~Although difficult to define, it seems that IL is beneficial in the academic environment According to Zimmerman (2008) I~~ This aligns with Zimmerman (2008), who proposes that learners who are self-regulated have the skills necessary to monitor, control, and adapt to the demands of their learning environment whilst also achieving academic success. Indeed, numerous studies have found important differences between high and low-achieving students in relation to self-regulated learning strategies (Richardson *et al*., 2012), especially in terms of goal setting, monitoring, self-efficacy (Difrancesca *et al.,* 2016, Pintrich and De Groot, 1990; Zimmerman, 1990, 2008) and critical thinking (Broadbent, 2017). Difrancesca *et al.,* (2016) for example found that high-achieving students were more likely to: set specific goals and employ more effective study strategies such as spaced studying (Son and Simon, 2012). On the other hand, low-achieving students were more reliant on repetition and flashcards. This is supported by the findings of a meta-analysis conducted by Richardson *et al.,* (2012) who found that critical thinking, elaboration, concentration, time/study management, effort and peer learning were positively correlated with GPA within the traditional learning environment. These findings were replicated in a systemic review, by Broadbent and Poon (2015), whereby metacognition, time management, effort regulation, and critical thinking were found to be significantly associated with academic achievement among online learners.

Furthermore, research suggests that motivational beliefs can also foster and support IL (Yan *et al.*, 2014), which in turn enhances academic progression, retention, and the student experience (Pintrich, 2004). Indeed, research by Schunk and Zimmerman (2008) noted that self-efficacy beliefs are positively related to persistence, effort, and achievement; whilst Broadbent *et al*., (2021) found self-efficacy to be the strongest predictor of assessment task performance for both online and blended learners.

Another factor thought to impact student achievement and progression is a growth mindset. Those with a growth mindset adhere to the incremental theory of intelligence, believe that people can become more intelligent with effort (Dweck *et al.,* 1995) and are likely to experience greater academic achievement (Karlen *et al.,* 2021, Sisk *et al.,* 2018). Indeed, numerous studies note a positive correlation between a growth mindset and academic achievement in primary and secondary school pupils (Dweck *et al.,* 2000 in Bazelias *et al.,*

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2018, Blackwell *et al.,* 2007). The effect of mindset on academic achievement among university students, however, remains unclear (Bazelias *et al.,* 2018). Bahnik and Vranka (2017), found a very weak and non-significant association between scholastic aptitude and mindset among university applicants. However, Aronson *et al*., (2002) found that a brief intervention to encourage a growth mindset led to greater enjoyment, engagement, and higher grade point averages among university students. Further, a meta-analysis by Sisk *et al.,* (2018) found a very small correlation between mindset and academic achievement among children, adolescents, and adults. This was especially true, for students who had failed previously and those with a low socioeconomic status.

One reason that mindset influences academic achievement is its relationship to motivation and adaptation (Burnette *et al*., 2013; Karlen *et al*., 2019). Those with a growth mindset are more likely to adapt their learning strategies, persevere when things are challenging (Lou and Noels, 2016), use deeper processing strategies (Grant and Dweck, 2003; Ommundsen, 2003) and engage in self-directed learning more easily. This is supported by research by Yan *et al.,* (2014) who found that those with a growth mindset were more likely to understand the pedagogical importance of self-testing, restudying learned materials and revising 'old' course materials than those with a fixed mindset. Similarly, Bai and Wang *et al*., (2023) found that a growth mindset was significantly related to monitoring, effort regulation, goal setting and planning.

Further evidence of the importance of IL comes from the increasing use of learning analytics data in pedagogical studies (Romero and Ventura 2020). Indeed, numerous studies have reported a link between levels of online engagement and academic success in online courses (Namoun and Alshanqiti 2020, Rogers *et al.,* 2008, Ryabov 2012, and Soffer and Cohen 2018). Soffer and Cohen (2018) for example, found a significant difference in VLE engagement, between students who completed the course and those who did not. They also found that engagement with course materials and reading online forums predicted exam success. Many on-campus courses, now make use of the VLE to supplement face-to-face teaching and as a platform to deliver course materials. There is little research, however, that explores the influence of VLE engagement on academic performance among on-campus students.

While there is consensus on the benefits of developing students as "independent learners", there is no simple definition of what the term means (McKendry and Boyd, 2012) and limited research to explore students understanding of it. As a result, students may fail to understand

what is expected of them as independent learners, whilst institutions and academic staff fail to develop effective interventions to enhance IL.

The Uniqueness of the Study

This study adds to the existing literature by increasing our understanding of the relationship between levels of IL, MSL, mindset and academic progression, whilst exploring the less studied understanding of IL and the impact of VLE interaction among on-campus university students. The findings of this study can inform the development of tools and teaching resources to be employed by universities to improve and support academic achievement, progression, and retention by enhancing the growth mindset, level of IL (including VLE interaction) and MSL of its learners.

Objectives and Hypotheses

This study aims to determine students' understanding and level of independent learning, whilst exploring the relationship between IL, MSL, growth mindset, and academic achievement. The following four hypotheses were tested:

1. There is a positive relationship between the level of IL and MSL
2. There is a positive relationship between the level of IL and MSL with mindset
3. The level of IL and MSL are higher amongst those with higher grades, and
4. The level of VLE engagement is higher amongst those with higher grades.

Method

Research Design and Context

This study employed an online survey design. Hypotheses 1 and 2 were tested using correlational design to determine the relationship between the level of IL, MSL and growth mindset. Hypotheses 3 and 4 were tested using a between-subjects design to compare levels of IL, MSL and VLE engagement between students with lower and higher grades. The study was conducted University-wide, and the survey was distributed across a range of undergraduate and postgraduate modules at a Scottish University via email and the VLE. The courses were delivered using a blended learning model whereby on-campus teaching is supplemented by materials and activities via the VLE.

Participants

Opportunistic sampling was used to recruit 386 students who completed the questionnaire,

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which included 148 males, 233 Females, 2 who preferred not to say, and 3 who identified as other. Age ranged from 16 to 56 with a Mean age of 32.08 (SD 8.43). In terms of ethnicity, 118 identified as White, 8 as Mixed Race, 21 as Asian, 183 as African, 27 as Caribbean, and 14 as other ethnic groups. Seventy-five were undergraduates and 311 were postgraduates. Of the 386 participants, 180 gave permission to access their grades and VLE engagement levels. This sub-sample included 64 males and 114 females, 156 postgraduates and 24 undergraduates with a mean age of 32.87 (SD 7.50).

Materials

An online questionnaire was designed to measure students' understanding and level of IL, Motivated Strategies for Learning (MSL), Mindset, academic performance and VLE engagement. To measure their '***understanding of IL'***, students were presented with the 7 definitions of an independent learner listed in Table 1 and asked whether or not they agreed. They were also given closed questions to determine if they considered themselves to be an independent learner and whether they had heard of the term before. '***Level of IL'*** was measured using a self-report question on the number of hours they engaged in IL per 15-credit module per week. '***MSL'*** were measured using 7 scales from the Motivated Strategies for Learning Questionnaire (MSLQ) (Duncan and McKeachie, 2005), a self-report instrument designed to assess students' motivation, cognition, and metacognition. *Motivation* was measured in terms of expectancy for success and judgments of one's ability to accomplish a given task through the scale for self-efficacy for learning and performance (Cronbach's alpha 0.93). *Cognition* was measured in terms of the strategies employed by students to process the information gained through reading and teaching. The latter included scales for rehearsal (strategies to enhance attention and encoding of material in working memory; Cronbach's alpha 0.69), elaboration (strategies to enhance long-term memory storage by connecting information with previous knowledge; Cronbach's alpha 0.75), organisation (selecting the appropriate information and making connections between materials to be learned; Cronbach's alpha 0.64), and critical thinking (applying previous knowledge to new situations or making critical evaluations of ideas; Cronbach's alpha 0.80). *Metacognition* was measured in terms of strategies that help students control and regulate their own cognition, namely self-regulation (Cronbach's alpha 0.79) and time management scales (Cronbach's alpha 0.76). The MSLQ, was selected based on its previous use in research on university students (Duncan and McKeachie, 2005), its high validity and the option to use each sub-scale independently (Roth, Ogrin & Schmitz 2016). Indeed, the MSLQ is the most used measure of self-regulated learning (Roth *et al*., 2016) and

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self-efficacy (Honicke and Broadbent, 2016) in students. '***Mindset'*** was measured using the 8-item Intelligence Questionnaire (Dweck, 2000) which was scored on a 6-point Likert scale from Strongly Agree to Strongly Disagree. The score was then calculated by averaging the response to each question, with a maximum score of 6 (indicating a growth mindset) and a minimum score of 0 (indicating a fixed mindset). Students also provided permission to access and use their academic performance and VLE engagement. '***Academic performance'*** was measured in terms of the module grade achieved, which ranged from A to F. '***VLE engagement'*** was measured in terms of average clicks each day on the module VLE page. The number of days accessing the VLE was also examined. Both the number of clicks and the number of days were also measured as a percentage of the cohort mean. This allowed for comparison across modules, given that some modules will have more engagement opportunities than others. The survey also included questions about age, gender, ethnicity, level of study, and school of study.

Ethics

Full ethical approval was granted by the researcher's School Ethical Review Panel. Participation was voluntary and students completed the survey in their own time. Only those providing informed consent took part in the study.

Data Collection

The survey was administered online using Jisc Online Surveys (Jisc, 2023). A link to the survey was shared via the University bulletin and was embedded in several modules via the VLE.

Data Analysis

Data were analysed using SPSS v.28. Descriptive statistics were used to determine Means (SD) and Frequencies, whilst the Spearman correlation coefficient was used to determine the significance of any relationship between the variables. Based on Cohen (1988), the strength of the relationship was categorised as small (r=.10-.29), medium (r= .30 to .49) or large (r = .50 to 1.0). To test for differences between groups, a series of independent t-tests were employed. Statistical significance was deemed to have been reached where $p < 0.05$.

Findings

Understanding of Independent Learning

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Most students (84.2%) had heard the term 'Independent Learning', considered themselves to be independent learners (66.8%) and demonstrated a good understanding of what IL is in terms of responsibility and motivation (See Table I). Their understanding of autonomy, however, is limited with the majority erroneously believing it meant: 'being able to learn on their own' (87%) and completing assessments without any help (56%).

Insert Table I here.

Motivational Strategies for Learning (MSL) and Mindset

As shown in Table II, students scored highest on the measures of self-efficacy, elaboration, and time management, followed by organisation, critical thinking and self-regulation. The lowest score was for rehearsal, indicating that this was the strategy least used.

Insert Table II here.

In terms of Mindset, students scored a mean of 4.61 (SD 0.83) indicating a growth as opposed to a fixed mindset.

Hypothesis one - There will be a positive relationship between the level of IL and MSL

In terms of the level of IL, students reported a Mean of 8.52 (SD 6.54) hours of 'IL' per module per week.

Results indicated a small, positive relationship between hours of IL and the motivation subscales [self-efficacy (r^s (n=368) = 0.13, p = 0.05)], the cognitive subscales [rehearsal (r^s (n=368) = 0.19, p < 0.001), elaboration (r^s (n=368) = 0.16, p < 0.01), organisation (r^s (n=368) = 0.24, p < 0.01), critical thinking (r^s (n=3.68) = 0.13, p < 0.05)], and the metacognitive subscales [self-regulation (r^s (n=368) = 0.13, p < 0.05) and time management (r^s (N=368) = 0.23, p < 0.01)]. This suggests that those who engage in more hours of IL are more motivated to learn and employ more cognitive and metacognitive skills to organise and enhance their learning.

Hypotheses Two - There will be a positive relationship between mindset with level of IL and MSL

Results indicated a small and positive relationship between mindset and 'hours of IL (r^s (N=368) = 0.20, p < 0.01), the cognitive subscales [elaboration (r^s (N=368) = 0.15, p < 0.01), organisation (r^s (N=368) = 0.12, p < 0.05), critical thinking (r^s (N=368) = 0.16, p < 0.01)], and the metacognitive subscales [self-regulation (r^s (N=368) = 0.14, p < 0.05) and time management (r^s (N=368) = 0.13, p < 0.05)]. This suggests that those with a higher growth mindset engage in more hours of IL, and employ more elaboration, critical thought and self-regulation whilst employing more strategies to organise and connect their learning materials.

Hypothesis Three –The level of IL and MSL will be higher amongst students with higher grades.

As shown in Table III, results from a series of independent t-tests indicated that those who pass their module at C or above (N=168) scored significantly higher than those who failed (N=12) on elaboration (t (178) = 1.99, p < 0.05) and organisation (t (178) = 2.13, p < 0.05). Although those who passed the module reported more hours of IL (M 8.95, SD 6.66) compared to those who failed (M7.75, SD 5.94), this was not significant (t (170) = 0.60, p = 0.27). This suggests the measures of cognition as opposed to motivation or metacognition are more significant in differentiating those who pass and fail.

Insert Table III here.

Hypothesis 4 – The level of VLE engagement will be higher amongst those with higher grades.

As shown in Table IV, results from a series of independent t-tests indicated that those who passed at C or above (N= 128) engaged with the VLE significantly more than those who failed (N=12) in terms of average clicks as a percentage of cohort (t (138) = 1.70, p <0.05), average days as % of cohort (t (138) = 2.94, p <0.01) and days clicked (t (138) = 2.98, p <0.01).

Insert Table IV here

Results from a series of Spearman correlations further support the positive relationship between Grade and VLE engagement. Results indicated a small and positive relationship between grade and average clicks as % of cohort (r^s (n=140) = 0.21, p < 0.05), average days as % of cohort (r^s (n=140) = 0.24, p < 0.01), and days clicked (r^s (N=140) = 0.26, p < 0.01). These findings

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suggest that higher-achieving students interact more frequently than lower-achieving students. As shown in Figures I and II, further exploration indicated that higher-achieving students' VLE interactions are also more regular, consistent, and timely. Figure I, for example, indicates that A-grade students show more regular activity throughout the module with a gradual increase in the lead-up to the assessment and ongoing activity during the feedback period. D-grade students on the other hand take longer to engage with the module, show less frequent or regular activity, demonstrate a spike in activity at the assessment point and very limited activity during the feedback period.

Insert Figure I and II here

All four hypotheses were supported by the data.

Discussion

Understanding of IL

Although most students have a good understanding of IL, the majority erroneously believe it means 'the ability to learn on your own' and 'complete assessments without help'. This has potential implications for students seeking help and fits with research by Thomas *et al.,* (2015), whilst supporting the need for further work to enhance students' understanding of the term.

Level of IL and motivational strategies for learning

The findings are also consistent with Yan *et al.,* (2014) in that those who engage in more hours of IL were more likely to revise and revisit course materials, use techniques to expand and elaborate their learning, engage in more critical thought, use strategies to organise their study whilst adapting their learning to enhance their understanding. This indicates that motivational, cognitive, and metacognitive factors are important. In line with DiFrancesca *et al.*, (2016), they also scored higher on self-efficacy, which supports the proposal that those who believe they will be successful are more motivated to engage in IL.

Mindset

In line with research by Yan *et al., (*2014), the results indicate that those with a higher growth mindset engage in more hours of IL, more revision and rehearsal, use techniques to expand and elaborate their learning, and are more organised in their approach to studying. The findings also support Zimmerman (2008) and Sisk *et al.*, (2018) in that those with a growth mindset are

more likely to regulate their learning to enhance their understanding**.** This could reflect the proposal by Blackwell *et al.,* (2007) that those with a fixed mindset tend to believe that ability alone is sufficient for learning, and the need for additional effort reflects poor ability. Indeed, the results suggest that those with a lower growth mindset engage in fewer strategies to enhance or drive their learning.

Academic Achievement

In line with previous research (Zimmerman, 2008, Sisk *et al.,* 2018 and Karlen *et al*., 2020) that individuals who are independent learners achieve more academic success, the current results indicate that higher-achieving students spend more hours learning independently and are more likely to elaborate on and organise their course materials. Interestingly, the measures of cognition as opposed to motivation or metacognition are more significant in differentiating those who pass and fail.

This study expands upon previous research among on-line students (Rodgers, 2008 and Soffer, 2019), indeed the current study indicates that VLE engagement is related to academic grade even amongst on-campus students. Those who achieved higher grades engaged with the VLE significantly more frequently in terms of average clicks and days clicked over the duration of the module. This study makes a unique contribution to the literature by further exploring the timing and regularity of such interaction. Indeed, the higher-achieving students, interacted with the VLE in a more regular and timely fashion, especially during periods of assessment and feedback.

Overall, the findings indicate that students who engage in more IL (including interactions with VLE at crucial points), employ learning strategies which are more elaborative, critical, organised, and adaptive. They also have a stronger belief in their own ability, have a higher growth mindset and tend to achieve higher grades. Unfortunately, however, the majority believe that IL means learning alone.

Implications for Practice

To improve academic progress and teaching success therefore, universities need to enhance students' understanding of IL especially in relation to autonomy, employ an e-learning platform that is engaging, and enhance the growth mindset of their students. According to Rattan, *et al.,* (2012) and Karlen, *et al.,* (2020), providing feedback that focuses on strategies which students

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could use to improve performance or overcome challenges may be more useful than feedback that focuses on ability. Our findings suggest that tools and interventions to enhance students' use of organisation and elaboration strategies, together with a growth mindset could lead to significant improvements in academic achievement. Which in turn could help enhance the equality and educational opportunities for lower achieving students (Binning *et al*., 2020). The findings also suggest that the timing, frequency, and regularity of VLE interaction could be a useful tool in predicting academic achievement or identifying the need for intervention even amongst on-campus students. Regular monitoring of engagement together with the use of the MSLQ could inform timely interventions from professional support teams to enhance both engagement and learning strategies.

Limitations of current study.

The main limitations were the small sample size, the limited number of participants who gave access to their academic grades and VLE engagement, and the small number of low-achieving students. The study could therefore be limited by self-selection bias. Nonetheless, the study does include a heterogeneous sample of postgraduate and undergraduate students from a diverse range of backgrounds.

Recommendations for future research

This study indicates that differences exist between higher and lower-achieving students, to develop effective tools or interventions to enhance IL (including VLE engagement), mindset and motivation, however, we need to understand why this difference occurs. Future studies should, therefore, explore the underlying reasons for lower-achieving students' lower engagement with the VLE and motivational strategies for learning.

Conclusion

In conclusion, the study findings provide valuable insights into the benefits of effective independent learning (including VLE engagement) and motivation to learn. These have potential implications for educators and online developers. By making VLEs more interactive and engaging, enhancing student motivation to learn, and improving opportunities to engage in IL, universities could potentially enhance academic achievement, retention, and progression. To do so, however, universities must ensure that students understand what IL is.

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Table I – Number (%) of students agreeing with the definition of IL

Definition of 'IL'	No. of Students (%)
Takes ownership, control and a desire to develop their own learning	379 (98.2%)
Learns by their own actions and direct, regulate, and assess their own learning	349 (90.4%)
Sets goals, make choices, and decisions about how to meet their learning needs	367 (95.1%)
Takes responsibility for constructing and carrying out their own learning, monitor their progress towards achieving their learning goals	367 (95.1%)
Reflects on, seeks out and actions feedback	338 (87.6)
*Can learn on their own	336 (87%)
*Can complete their assessments without any help	217 (56%)

*Demonstrates poor understanding

Source: Author's own creation/work

Table II Mean (SD) Scores for MLS and Mindset

Measure	Mean (SD)
Self-Efficacy	5.42 (1.21)
Rehearsal	4.76 (1.38)
Elaboration	5.55 (1.14)
Organisation	5.08 (1.24)
Critical Thinking	5.10 (1.22)
Self-Regulation	4.95 (0.92)
Time Management	5.21 (0.97)
Mindset	4.61 (0.83)

Source: Author's own creation/work

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Table III Mean MSL scores according to grade category

MSL Strategy	Grade C or above Mean (SD)	Grade D or lower Mean (SD)	t value	p-value one tailed
Hours of IL	8.95 (6.66)	7.75 (5.94)	0.60	0.27
Self-Efficacy	5.64 (1.10)	5.58 (0.77)	0.20	0.42
Rehearsal	5.00 (1.44)	4.85 (1.53)	0.35	0.36
Elaboration	5.87 (1.04)	5.25 (1.15)	1.99	0.02*
Organisation	5.30 (1.24)	4.50 (1.62)	2.13	0.02*
Critical Thinking	5.36 (1.17)	4.96 (1.24)	1.10	0.14
Self-Regulation	5.16 (0.92)	4.91 (0.74)	0.89	0.19
Time Management	5.35 (0.98)	5.19 (0.81)	0.53	0.30

* $p < 0.05$

Source: Author's own creation/work

Table IV Mean VLE interaction according to Grade Category

VLE Interaction	Grade C or above Mean (SD)	Grade D or lower Mean (SD)	t value	p-value one tailed
Average Clicks	0.90 (0.64)	0.65 (0.22)	1.16	0.12
Average clicks as a percentage of cohort	55.06 (36.14)	36.44 (19.23)	1.89	0.03*
Average days as % of cohort	107.74 (36.48)	76.35 (35.42)	2.95	0.002**
Days Clicked	35.41 (11.94)	24.66 (11.21)	2.99	0.002**

* $p < 0.05$ ** $p < 0.01$

Source: Author's own creation/work

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Table V Mean VLE interaction for those achieving Grades A-B compared to C or below

VLE Interaction	A-B Mean (SD)	C or below Mean (SD)	t value	p-value one tailed
Average clicks	0.97 (0.74)	0.78 (0.44)	1.61	0.055
Average clicks as % of cohort	60.12 (42.73)	45.92 (24.57)	2.38	0.009**
Average days as % of cohort	115.06 (40.03)	96.06 (31.72)	3.09	0.001**
Days clicked	37.82 (12.97)	30.98 (10.44)	3.35	0.0005**

** $p < 0.01$

Source: Author's own creation/work

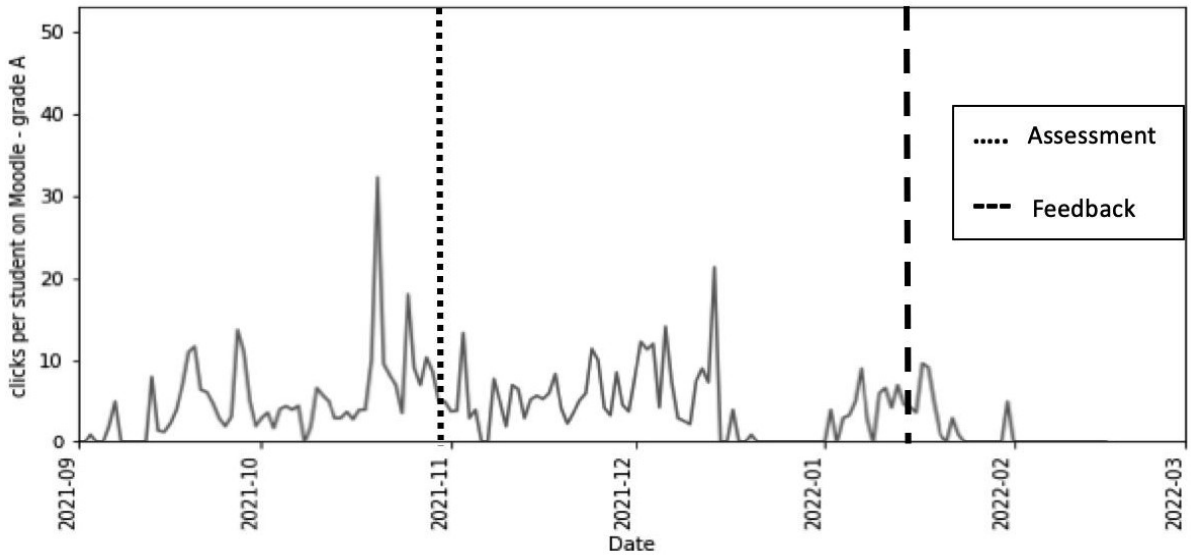

Figure I – VLE interaction for A-grade students

Source: Author's own creation/work

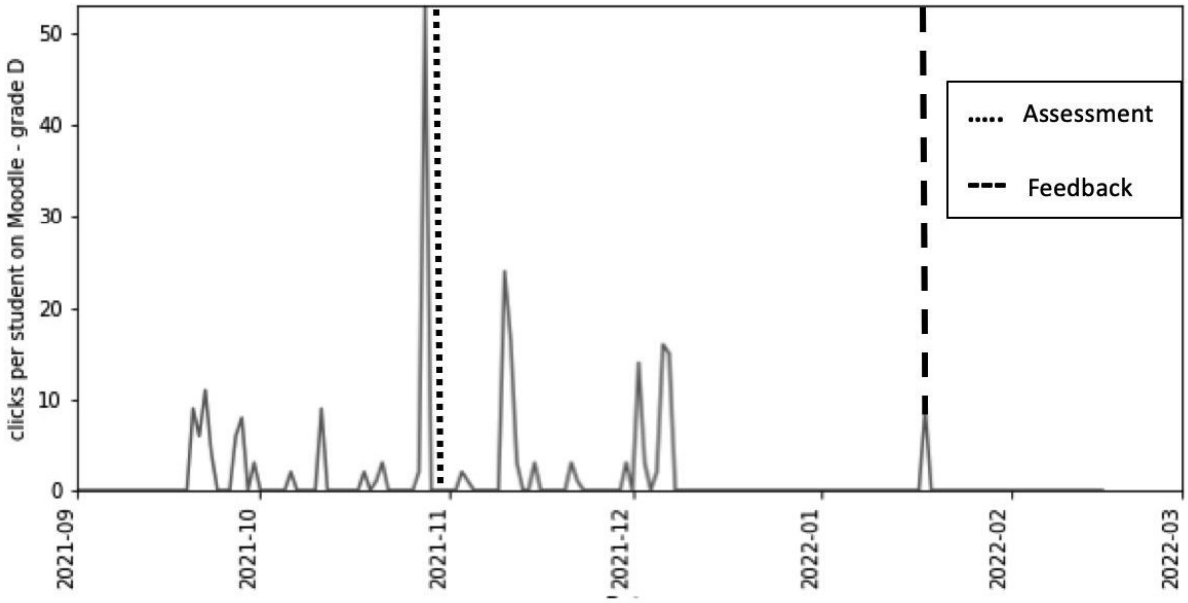

Figure II – VLE interaction for D-grade students

Source: Author's own creation/work