Stated Briefly

An analysis of student engagement patterns and online course outcomes in Wisconsin

Angela M. Pazzaglia
Education Development Center

Margaret Clements
American Institutes for Research

Heather J. Lavigne
Erin T. Stafford
Education Development Center

In collaboration with the Midwest Virtual Education Research Alliance

This study used administrative data from Wisconsin Virtual School to identify patterns of student engagement in online courses (defined as the amount of time students were logged in to their course each week and how this varied over time). The study also examined whether the patterns were associated with course outcomes (defined as the percentage of possible points earned and the percentage of course activities completed). Six patterns of engagement were identified, and most students in five of the six engagement groups earned a high enough percentage of possible points to pass their online course. Students with low but steady engagement in their online course had better outcomes than students with low initial engagement that diminished throughout their course. Students who engaged in their online course for two or more hours per week had better outcomes than students who engaged for fewer than two hours per week.

This brief summarizes findings of Pazzaglia, A. M., Clements, M., Lavigne, H. J., & Stafford, E. T. (2016). *An analysis of student engagement patterns and online course outcomes in Wisconsin* (REL 2016–147), Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. That report is available at http://ies.ed.gov/ncee/edlabs/projects/project.asp?projectID=4514.

ies NATIONAL CENTER FOR EDUCATION EVALUATION AND REGIONAL ASSISTANCE
Institute of Education Sciences
U.S. Department of Education

REL MIDWEST
Regional Educational Laboratory
At American Institutes for Research

Why this study?

Student enrollment in online courses has increased in the past 15 years and continues to grow (Watson, Pape, Murin, Gemin, & Vashaw, 2014). However, little is known about students' educational experiences or online course outcomes. Student attrition and course failure are problems for some online learning programs (Angelino, Williams, & Natvig, 2007; Carr, 2000; Freidhoff, 2015; Freidhoff, DeBruler, & Kennedy, 2014; Roblyer, 2006; Roblyer & Davis, 2008; Rovai & Wighting, 2005; Simpson, 2004). A recent study found that two of the greatest challenges for online teachers at Wisconsin Virtual School—a state-level online learning program for middle and high school students—were keeping students engaged throughout the course and getting students to complete the course (Zweig, Stafford, Clements, & Pazzaglia, 2015).

This study builds on recent research using learning management system and student information system data to identify factors that predict student success in online courses. Hung, Hsu, and Rice (2012) found that students with higher engagement (as measured by the total number of learning management system activities across the span of the course, including frequency of logins, frequency of modules accessed, frequency of clicks, and frequency of discussion board posts) tended to have higher final grades. Liu and Cavanaugh (2011) found that the number of times a student logged in to the learning management system throughout the course and the total number of minutes a student was logged in throughout the course were associated with students' final scores in two online biology courses offered through a Midwestern state virtual school. They also found that the total number of minutes that a student was logged in throughout the course was the strongest predictor of final scores in a model that accounted for student demographics and the number of teacher comments throughout the course. Because these studies were correlational in nature, it is not possible to determine the direction or extent of causality between engagement and course outcomes. It is possible that factors such as motivation or academic ability cause both student engagement and course outcomes.

A collaboration between the Midwest Virtual Education Research Alliance and Regional Educational Laboratory Midwest, the current study builds on these earlier studies by identifying distinct patterns of student engagement within online courses over time and exploring whether the patterns are associated with online course outcomes. It used learning management system and student information system data collected by Wisconsin Virtual School, a state-level online learning program that partners with districts in the state to offer supplemental online courses for middle and high school students. The goal of the study was to determine whether patterns of student engagement (defined as the total amount of time a student was logged in to the course each week) are associated with the percentage of possible points earned in the course and the percentage of course activities completed (see box 1 for a summary of the data and methodology). Such information may help inform policymakers, state education agencies, local education agencies, and online course providers as they develop or refine online programs and promote student success in online courses. In addition, the study provides a framework for how online learning programs can use the data available in their learning management and student information systems to examine student engagement and online course outcomes.

What the study found

This section discusses the key findings of the study.

Student enrollments in online courses followed one of six engagement patterns

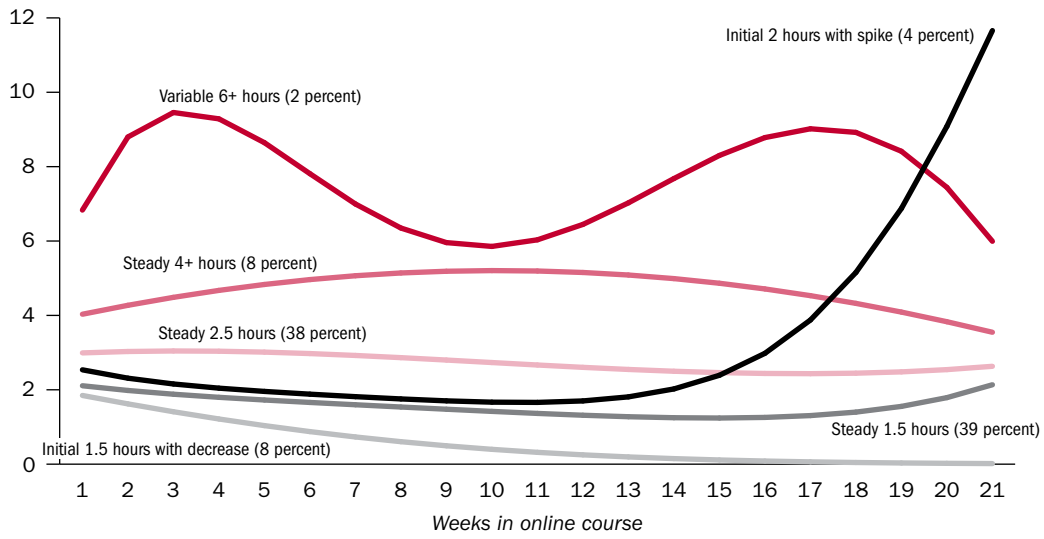
The amount of time a student was logged in to the online course each week was best represented by a model with six distinct patterns of student engagement (figure 1). The two most common patterns each accounted for nearly 40 percent of student enrollments.

Box 1. Data and methodology

The study sample included all Wisconsin Virtual School Advanced Placement, core, and elective high school course enrollments from the fall 2014 semester. This sampling strategy excluded enrollments in credit recovery courses because students have 12 weeks to complete those courses, compared with five months to complete other types of courses. The sample included 1,512 student enrollments in 109 online courses, with 1,179 unique students, 170 of whom took more than one online course. Fifteen percent of enrollments were in Advanced Placement courses, 36 percent were in core courses, and 49 percent were in elective courses. Sixty percent of student enrollments were female students, and 40 percent were male students. The majority of student enrollments were in grades 9–12; 11 percent were in grade 9, 25 percent were in grade 10, 28 percent were in grade 11, and 32 percent were in grade 12. Three percent of student enrollments were in grades 5–8.

A statistical approach that analyzes patterns of individual outcomes across time and classifies the patterns into unique groups (group-based trajectory modeling; Nagin, 2005) was employed to estimate the number and shapes of engagement patterns. Next, an analysis that accounts for the ways in which students are related to each other within online courses (hierarchical linear modeling; Raudenbush & Bryk, 2002) was used to test the associations between student engagement patterns and student outcomes, while accounting for student and course characteristics. Appendix A of the full report explains the analytic approach in more detail.

Figure 1. Student enrollments in Wisconsin Virtual School online course followed one of six engagement patterns, fall 2014



Note: Analysis is based on 1,512 student enrollments. The maximum number of data points for each student enrollment is 21 weeks, though some students finished their course in fewer than 21 weeks. This approach uses all available data for each week. Values in parentheses are the percentage of the sample that followed each engagement pattern; percentages do not sum to 100 because of rounding. The engagement patterns depicted were stylized using the predicted values for each week.

Source: Authors' analysis of Wisconsin Virtual School data (fall 2014 semester).

The six patterns of student engagement are:

- Initial 1.5 hours with decrease (8 percent): Engagement of approximately 1.5 hours per week at the beginning of the semester that drops off to near 0 hours midway through the semester.
- Steady 1.5 hours (39 percent): Steady engagement of approximately 1.5 hours per week, with a slight increase toward the end of the semester.

- Initial 2 hours with spike (4 percent): Engagement of approximately 2 hours per week at the beginning of the semester that increases steadily after the midpoint of the semester to nearly 12 hours per week in the final week.
- Steady 2.5 hours (38 percent): Steady engagement of approximately 2.5 hours per week across the semester.
- Steady 4+ hours (8 percent): Consistent engagement of approximately 4 hours or more per week across the semester.
- Variable 6+ hours (2 percent): High but variable engagement ranging from approximately 6 hours per week at the beginning, middle, and end of the semester and peaking to near 10 hours between those periods (during weeks 3 and 17).

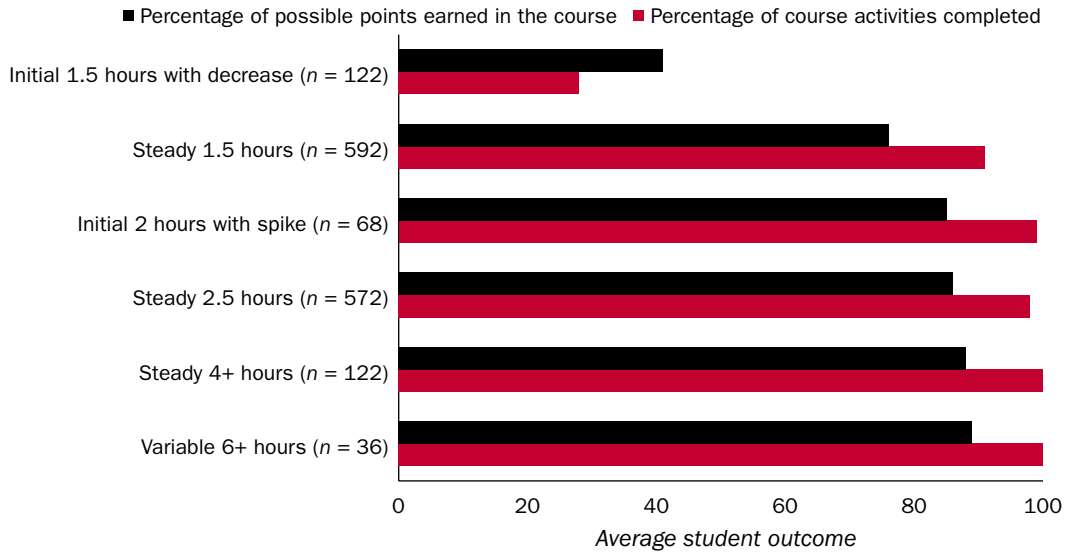
Most students in five of the six engagement groups earned a high enough percentage of possible points to pass their online course

Most students in the engagement group with average engagement of at least 1.5 hours per week (which includes all groups except the initial 1.5 hours with decrease group) earned a high enough percentage of possible points to pass their online course, though average total time logged in each week and the change in that average over time varied across groups (figure 2).

Students with low but steady engagement in their online course had better outcomes than students with low initial engagement that diminished throughout the course

The steady 1.5 hours group had better course outcomes than the initial 1.5 hours with decrease group after student and course characteristics were controlled for (table 1). The average percentage of possible points

Figure 2. Most students in five of the six engagement groups earned a high enough percentage of possible points to pass their course, though their engagement patterns differed, fall 2014



Note: Data were statistically adjusted for student demographic characteristics and course type taken (Advanced Placement, core, or elective). Wisconsin Virtual School provides the percentage of possible points earned in the course to students' home schools, which then assign a letter grade based on the local grading scale, so benchmarks for passing grades can vary across schools or districts. For Wisconsin Virtual School, students must complete 95–100 percent of the possible course points to obtain a certificate of completion. The home district then determines whether 95–100 percent course activity completion with a passing grade, which is determined locally, provides an earned credit or advancement.

Source: Authors' analysis of Wisconsin Virtual School data (fall 2014 semester).

Table 1. Students who engaged for two or more hours per week outperformed students who engaged for fewer than two hours per week, and students who engaged 1.5 hours per week steadily across the semester outperformed students whose engagement decreased over the semester, fall 2014

	Percentage of possible points earned in the course		Percentage of course activities completed	
Engagement group	Mean[a]	Standard deviation	Mean[a]	Standard deviation
Initial 1.5 hours with decrease	41***	35	28***	27
Steady 1.5 hours	76	21	91	18
Initial 2 hours with spike	85***	14	99**	10
Steady 2.5 hours	86***	13	98***	7
Steady 4+ hours	88**	14	100**	10
Variable 6+ hours	89*	8	100*	0.5

* is statistically significantly different from the mean for the steady 1.5 hours group at $p < .05$; ** is statistically significantly different from the mean for the steady 1.5 hours group at $p < .01$; *** is statistically significantly different from the mean for the steady 1.5 hours group at $p < .001$.

a. Statistically adjusted for student demographic characteristics and course type taken (Advanced Placement, core, or elective).

Source: Authors' analysis of Wisconsin Virtual School learning management system data (fall 2014 semester).

earned in the course was 35 percentage points higher for the steady 1.5 hours group than for the initial 1.5 hours with decrease group, and the percentage of course activities completed was 63 percentage points higher for the steady 1.5 hours group than for the initial 1.5 hours with decrease group.

Students who engaged in their online course for two or more hours per week had better outcomes than students who engaged for fewer than two hours per week

After student and course characteristics were controlled for, students who engaged for 2 hours or more per week (the initial 2 hours with spike, steady 2.5 hours, steady 4+ hours, and variable 6+ hours groups) had better course outcomes than students who engaged consistently over the semester with less time each week (the steady 1.5 hours group; see table 1).

Of particular interest is the comparison between the steady 1.5 hours group and the steady 2.5 hours group, which account for a large majority of the sample and had similar engagement patterns, with the exception that the steady 2.5 hours group was logged in an average of approximately one additional hour per week. The average percentage of possible points earned in the course was 10 percentage points higher for the steady 2.5 hours group than for the steady 1.5 hours group, and the average percentage of course activities completed was 7 percentage points higher for the steady 2.5 hours group than for the steady 1.5 hours group. The differences were statistically significant.

Implications of the study findings

This study provides state policymakers, state education agencies, local education agencies, and online learning providers with needed information about student engagement in online courses and how patterns of engagement are associated with course outcomes. Because the findings are based on correlational data, they cannot be used to make causal connections between student engagement and online course outcomes.

Wisconsin Virtual School directors and directors of other online learning programs may be able to use information from this study as they seek ways to support student success in online courses, especially students in the initial 1.5 hours with decrease and steady 1.5 hours engagement groups, which had poorer course outcomes.

Supports might include targeting students who log in for fewer than two hours per week to see whether they are struggling with course content or contacting the student, parents, or the brick-and-mortar school to provide notice that the student is at risk of failing the course based on his or her limited participation.

Other online learning programs across the country may be able to use the findings as a framework for investigating the data available in their learning management systems and student information systems. In combination with future studies investigating how much these findings can be generalized to students in other online learning programs, the results may be able to inform the provision of support to students who demonstrate engagement patterns that are associated with poor course outcomes.

Study limitations

The study has three main limitations:

- The findings may not extend to other types of online courses, including credit recovery courses or other online learning programs.
- The amount of time a student is logged in to a learning management system is an imperfect measure of student engagement because students are not necessarily actively working while logged in, and some courses may require that students engage in academic activities outside the system. The learning management system logs students out after five minutes of inactivity, which should reduce some of this error.
- The analysis methods did not fully account for the complex structure of online course data. The analyses accounted for the relationships among students only within online course sections, which does not capture all possible relationships among students, onsite facilitators, brick-and-mortar schools, online courses, and online teachers.

References

Angelino, L. M., Williams, F. K., & Natvig, D. (2007). Strategies to engage online students and reduce attrition rates. *Journal of Educators Online, 4*(2), 1–14. http://eric.ed.gov/?id=EJ907749

Carr, S. (2000). As distance education comes of age, the challenge is keeping the students. *Chronicle of Higher Education, 46*(23), A39–A41. http://eric.ed.gov/?id=EJ601725

Freidhoff, J. R. (2015). *Michigan's K–12 virtual learning effectiveness report 2013–14*. Lansing, MI: Michigan Virtual University. Retrieved July 29, 2015, from http://media.mivu.org/institute/pdf/er_2014.pdf.

Freidhoff, J. R., DeBruler, K., & Kennedy, K. (2014). *Michigan's K–12 virtual learning effectiveness report*. Lansing, MI: Michigan Virtual Learning Research Institute at MVU. Retrieved March 28, 2014, from http://media.mivu.org/institute/pdf/effectiveness_report_2013.pdf.

Hung, J.-L., Hsu, Y.-C., & Rice, K. (2012). Integrating data mining in program evaluation of K–12 online education. *Educational Technology & Society, 15*(3), 27–41. http://eric.ed.gov/?id=EJ992501

Liu, F., & Cavanaugh, C. (2011). Success in online high school biology: Factors influencing student academic performance. *Quarterly Review of Distance Education, 12*(1), 37–54.

Nagin, D. S. (2005). *Group-based modelling of development*. Cambridge, MA: Harvard University Press.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd edition). Newbury Park, CA: Sage.

Roblyer, M. D. (2006). Virtually successful: Defeating the dropout problem through online school programs. *Phi Delta Kappa, 88*(1), 31–36. http://eric.ed.gov/?id=EJ758059

Roblyer, M. D., & Davis, L. (2008). Predicting success of virtual school students: Putting research-based models to practice. *Online Journal of Distance Learning Administration, 11*(4). http://eric.ed.gov/?id=EJ1065647

Rovai, A. P., & Wighting, M. J. (2005). Feelings of alienation and community among higher education students in a virtual community. *The Internet and Higher Education, 8*(2), 97–110. http://eric.ed.gov/?id=EJ803728

Simpson, O. (2004). The impact on retention of interventions to support distance learning. *Open Learning, 19*(1), 79–96. http://eric.ed.gov/?id=EJ694817

Watson, J., Pape, L., Murin, A., Gemin, B., & Vashaw, L. (2014). *Keeping pace with K–12 digital learning: An annual review of policy and practice*. Durango, CO: Evergreen Education Group. Retrieved January 13, 2015, from http://www.kpk12.com/wp-content/uploads/EEG_KP2014-fnl-lr.pdf.

Zweig, J., Stafford, E., Clements, M., & Pazzaglia, A. M. (2015). *Professional experiences of online teachers: Training and challenges* (REL 2016–110). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. http://eric.ed.gov/?id=ED561235

REL 2016–157

The National Center for Education Evaluation and Regional Assistance (NCEE) conducts unbiased large-scale evaluations of education programs and practices supported by federal funds; provides research-based technical assistance to educators and policymakers; and supports the synthesis and the widespread dissemination of the results of research and evaluation throughout the United States.

July 2016

This report was prepared for the Institute of Education Sciences (IES) under Contract ED-IES-12-C-0004 by Regional Educational Laboratory Midwest administered by American Institutes for Research. The content of the publication does not necessarily reflect the views or policies of IES or the U.S. Department of Education; nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Pazzaglia, A. M., Clements, M., Lavigne, H. J., & Stafford, E. T. (2016). *Stated Briefly: An analysis of student engagement patterns and online course outcomes in Wisconsin* (REL 2016–157). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest. Retrieved from http://ies.ed.gov/ncee/edlabs.

This report is available on the Regional Educational Laboratory website at http://ies.ed.gov/ncee/edlabs.

The Regional Educational Laboratory Program produces 7 types of reports