

INTRODUCTION

Enrollments in teacher-prep programs at colleges and universities have seen a huge decline in recent years (Derringer 2017). Because of low pay and budget cuts, the teaching profession has not been able to attract college graduates resulting to a higher student-to-teacher ratio and more work for the teacher. Teachers work an average of 53 hours per week (Strauss 2012). Most of these extra hours (night and weekends) are spent on necessary planning, preparation, and grading papers. Rob Manning (2012) noted that, in some districts, the average class size is 35 students and grading papers for just that class can take almost four hours. On average, public school teachers teach three to five classes per day. Some teachers have adapted to a larger grading load by not grading homework assignments (Manning 2012). Rather, teachers evaluate students for homework behavior, not content learning. Moreover, a significant number of teachers work second jobs to compensate for low pay, along with also being full-time parents.

There must be a way to reduce teachers' workload. By use of technology, we can design a software, driven by AI, to grade papers, generate learning content, analyze a student's algorithm on problem solving, and generate data on deficit skills. This would make teachers' life simpler, reduce their workload, and enhance their efficiency and effectiveness. Teachers would be able to use the generated data created by the technology and allow them to create lessons that will target skill deficits. Instead of spending an enormous amount of time grading papers, that time can be better spent on figuring out ways to improve student learning outcomes and pedagogy. In short, data will drive their instruction, resulting in a richer, more individualized education for their students. My research will attempt to alleviate the problems teachers face everyday by designing an educational technology application and exploring how the application can reduce their workload and increase their efficiency and effectiveness.

SPECIFIC AIMS

- To develop a software that will grade student papers, generate learning content (e.g. worksheet), analyze a student's algorithm on problem solving, and generate data on deficit skills.
- To determine whether this technology can reduce teachers' workload and increase their efficiency and effectiveness.

BACKGROUND

AI technology has permeated every facet of society ranging from smart phones to smart cars to smart homes. With the rise of smart technology, a phone can now monitor your daily schedule, a car can now self-park, and a home can now be commanded to lock doors remotely. Despite the breakthroughs in AI, data mining, neural networks, and machine learning; smart technology for teaching and learning is vastly unexplored (Miltiadis 2019). While a technology-design tutoring systems have shown promise in education as demonstrated by AlgoTutor (Yoo et al 2013), it is rather ironic that our society does not have smart schools or classrooms.

One might argue that integrating AI technology in education seems like a simple or natural process. However, incorporating AI into the classrooms comes with challenges such as budget, professional training, teacher resistant to change, and inadequate infrastructure, among others. Despite the challenges, for a revolution to occur in adopting new technologies, now is the time to begin the design process to make this new educational paradigm inclusive so that all people can benefit from these new learning resource. This design process should combine the ideas behind the AlgoTutor (Yoo et al 2013) and Miltiadis (2019) notion of cognitive computing model in education. My project will certainly build on these ideas to create a technology to help enhance teacher performance.

Can an Educational Technology Design, Driven by Artificial Intelligence, Assist Teachers Enhance their Performance?

Edward DeMesa, Graduate Student, Computer Science
Dr. Suk Seo (Advisor) Computer Science

ABSTRACT

The teaching profession is not attracting enough college graduates due to low pay. This means a higher student-to-teacher ratio and more work and time spent on necessary planning, preparation, and grading papers. Additionally, many teachers have second jobs to supplement their incomes. Some are also full-time parents. Consequently, these responsibilities and lack of time for anything else adversely affect their mental health. One remedy for these dilemmas is to use smart technology. Breakthroughs in artificial intelligence, data mining, neural networks, and machine learning have made it possible to create personalized and customized teaching and learning environments beneficial to enhancing teacher and student performance. This research explores how designing an educational technology driven by artificial intelligence could decrease teachers' workload and increase their efficiency and effectiveness. The results of this study have demonstrated that the use of the math application not only reduced teachers' workload significantly, but also increased their efficiency. The math application decreased teachers' grading time by 4.6 hours, their analyzing data time by 8.4 hours, and their lesson planning time by 19 minutes. In short, the use of technology freed over 10 hours. The study was not able to address the question of teacher effectiveness because the Covid-19 pandemic prevented students from participating.

Methods



Figure 1 – Image of math application designed by researcher.



Figure 2 – Graph of years of teaching experience by the participants.

Research Approach & Design — The researcher utilized a combination of quantitative and qualitative research design.

Research Setting — The study was virtually conducted via Zoom video conferencing technology in Nashville Tennessee via Metro Nashville Public Schools (MNPS).

Participants – The researcher recruited ten MNPS teachers from three different schools. Originally, the researcher targeted participants (teachers and students) at the math department of John Overton High School. The limitations placed by the Covid-19 which resulted in school closings altered the participants.

Materials – Materials include a 20-question completed worksheet, an answer key, a timer, two data sheets, two teacher questionnaires, a math application designed by the researcher, and an exit interview questionnaire.

Data Collection – primary and secondary data sources.

Limitations – Covid-19 pandemic, no student participation, small sample size, time constraints, and setting geographically confined.

RESULTS

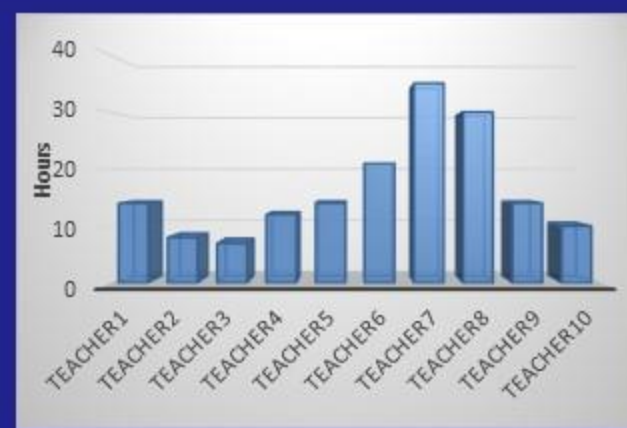


Figure 1: Amount of time participants spent outside of school hours grading papers, analyzing student work, and lesson planning, which averaged to 16.5 hours per week.

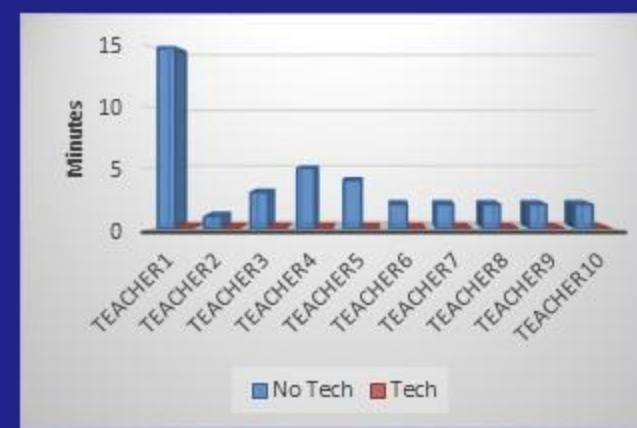


Figure 2: Amount of time participants spent grading student work. Teachers in the control group took an averaged of 3.8 minutes per student, while teachers in the experimental group spent no time grading because the technology graded the work for them.

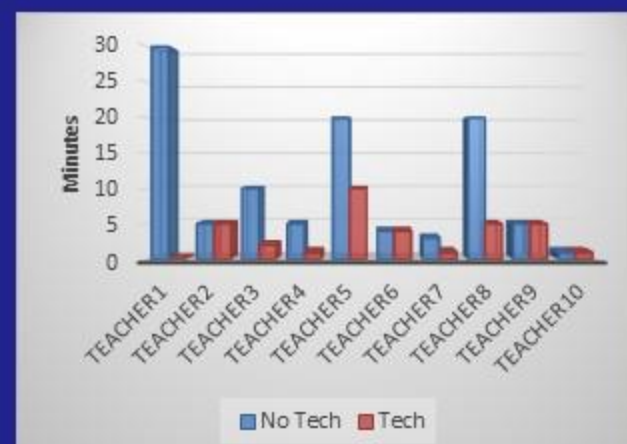


Figure 3: Amount of time participants spent analyzing student work. Teachers in the control group took an average of 10.3 minutes per student, while teachers in the experimental group took an average of 3.4 minutes per student.

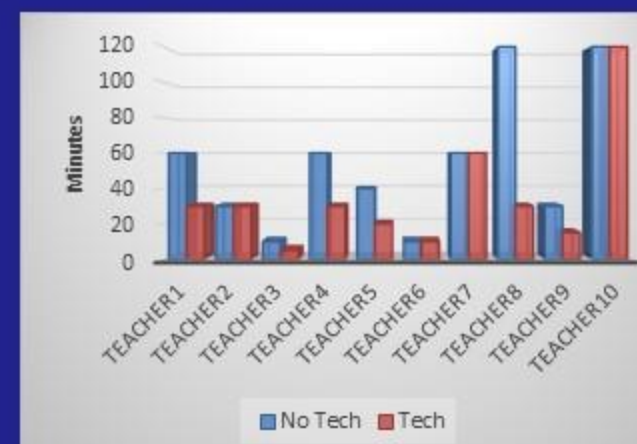


Figure 4: Amount of time participants spent lesson planning. Teachers in the control group averaged 54 minutes, while teachers in the experimental group averaged 35 minutes.



Figure 5: Data report generated by the math application of Analysis



Figure 6: Data report generated by the math application of Student algorithm

DISCUSSION

This study examined whether a math technology application can decrease teachers' workload and increase their efficiency and effectiveness. The result of this study has confirmed an earlier finding that has suggested that teachers work an average of 53 hours per week (Strauss 2012).

When determining the amount of time teachers spent grading, the result of this study has found that teachers spend an average of 3.8 minutes per student. Thus, for an average class size of 24, this totals to roughly an hour and a half per class grading student work assignments. This translates to a teacher spending 277 minutes or 4.6 hours grading class assignments for three classes. By contrast, teachers who used the math application spent no time grading because the application graded the work for them. Therefore, the findings has revealed that using the math application has saved the teacher 4.6 hours of work.

When determining the amount of time teachers spent analyzing data, the result of the study has found that teachers spend an average of 10.3 minutes per student. This translates to around 250 minutes or 4.2 hours per class and 12.5 hours per day for three classes. By contrast, the result of the study has found that teachers who used the math application spent 3.4 minutes per student. This translates to roughly 82 minutes or an hour and 22 minutes per class and 4.1 hours per day for three classes. Therefore, the findings has demonstrated that using the math application has saved the teachers 8.4 hours of work.

When determining the amount of time teachers spent on lesson planning, the result of the study has found that teachers spend an average of 54 minutes. By contrast, the result of the study has found that teachers who used math application spent 35 minutes lesson planning. Therefore, the result of the study has found that the application has saved the teacher 19 minutes of work.

The researcher did not find data on whether the application improved teacher effectiveness because the Covid-19 pandemic prevented students from participating.

REFERENCES

- Jennifer Calfas. I didn't really have a choice. meet the teachers quitting their jobs due to low pay and dwindling benefits. *Money*, 2018.
- Nancy Derringer. Fewer college students want to be teachers, and why it matters (searchable database). *Bridge*, pp. Talent & Education, 2017.
- Benedict du Boulay. Artificial intelligence as an effective classroom assistant. *IEEE Intelligent Systems*, 31(6):76–81, 2016.
- Kenneth R. Koedinger, John R. Anderson, William H. Hadley, and Mary A. Mark. Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education (IJAIED)*, 8: 30–43, 1997.
- Rob Manning. Learning with less: Even teachers want to spend less time on homework. *OPB*, pp. Local, 2011.
- Don Douglas McMahon and Zachary Walker. Leveraging emerging technology to design an inclusive future with universal design for learning. *CEPS Journal*, 9(3):75–93, 2019.
- Lytras Miltiadis. The cognitive computing turn in education: prospects and application. *Computers in Human Behavior*, 92:446–449, 2019.
- Boran Sekeroglu, Kamil Dimililer, and Kubra Tuncal. Artificial intelligence in education: application in student performance evaluation. *Dilemmas Contempor'aneos: Educaci'on, Pol'itica y Valores*, 7:1–21, 2019.
- Valerie Strauss. Survey: Teachers work 53 hours per week on average. *The Washington Post*, pp. Local, 2012.
- Jungsoo Yoo, Sung Yoo, Suk Seo, Zhijiang Dong, and Chrisila Petthey. Teaching algorithm development skills. *International Journal of Advanced Computer Science*, 3(9):466–474, 2013.