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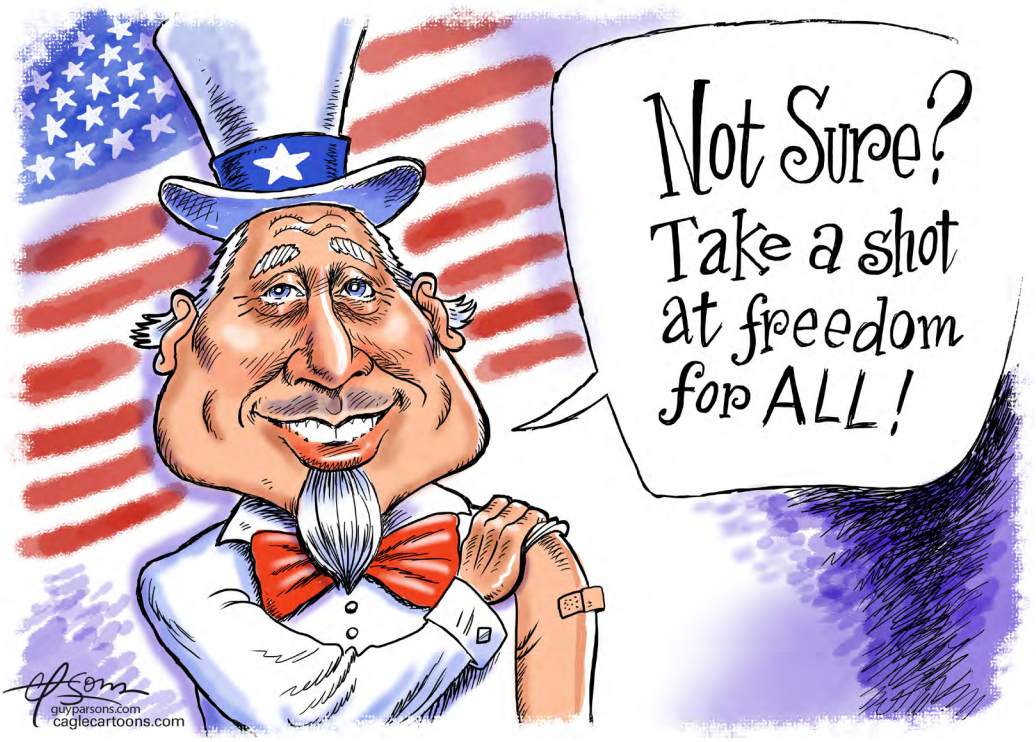
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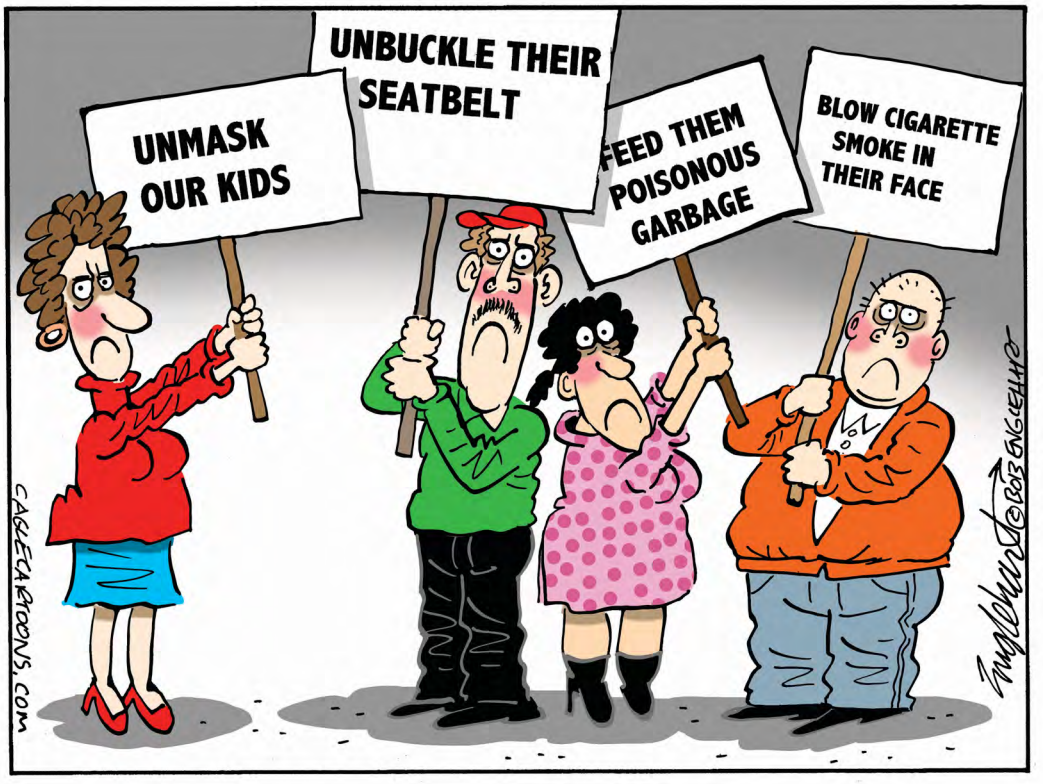
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Editors and Editorial Board

Editor's Preface

Kathleen J. Tate, Ph.D.

The articles and features in this issue address questions related to careers in online teaching, online pedagogies, administration of online programs, and technology-assisted learning. Some themed topics include teacher education, supporting faculty, and meeting the needs of diverse students, especially those with special needs. These areas are explored through a book review, two media reviews, perspectives from the field, a practical article, and a research piece.

Drs. Cramer and Polanska conducted a descriptive, nonexperimental study and present their findings about factors that shape online faculty members' decisions to seek and keep online teaching positions. The implications indicate the flexibility of such positions may help with recruiting and maintaining diverse faculties with diverse needs.

A practical article focused on online STEM learning and related barriers was written by me and two colleagues: Drs. Mangahas and Harris. Solutions are provided for policymakers, leaders, and educators to assist with lack of student skill development and resources to attend better to diversity (e.g., cultural, linguistic, special needs), digital divide issues, and other college-specific challenges (e.g., networking, remote learning, etc.) for more successful STEM learning. The article includes recommendations for teaching approaches as well.

In the From the Field section, Dr. Jeremy Dickerson, Assistant Provost, Office of Distance Education and eLearning, University of North Carolina (UNC) Wilmington is featured in *3 Questions for an Online Learning Leader*. Dr. Dickerson emphasizes the importance of higher education leaders to have the knowledge and understanding needed to successfully launch and support new online programs. He offers guidance for adopting enterprise-level technologies and designing effective online learning experiences.

This issue includes two book reviews. In the review of Growth Engineering, Ltd.'s (2017) *Mobile Learning and the Future of L&D*, Dr. Theresa Melenas highlights the benefits of mobile learning, including its attractiveness to digital natives and implications for teacher education students. The emphasis is on mobile learning as a tool to increase student engagement and achievement. Dr. Ashley Gleiman's book review of Bellanca's (2020) *Personalized Deeper Learning: Blueprints for Teaching Complex Cognitive, Social-Emotional, and Digital Skills* gives insight to planning instruction that prompts deeper, wider, and more critical thinking among students. Though the book focuses on teacher education, there are broader applications for adult learners across a variety of instructional settings.

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Dr. Caroline Gomez's media review feature explains how assistive technology supports students with disabilities in being more successful. Dr. Gomez reviews digital tools for specific areas of reading/literacy/writing, note-taking/study, and dictation/speech-to-text/speech recognition.

This issue provides a range of practices and tools for university constituents to consider. Articles capture examples, theory, and experience from the field. As always, I hope you extract discussion points that you can share with your own students, colleagues, or supervisors to prompt new directions in discourse, research, and practice.

Enjoy!

Dr. Kathleen J. Tate,

Editor-in-Chief of *Journal of Online Learning Research and Practice*

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Bellanca, J.A. (2020). *Personalized deeper learning: Blueprints for teaching complex cognitive, social-emotional, and digital skills*. Solution Tree Press.

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Prefacio de la editora

Los artículos y reportajes de este número abordan cuestiones relacionadas con las carreras en la enseñanza en línea, las pedagogías en línea, la administración de programas en línea y el aprendizaje asistido por tecnología. Algunos temas temáticos incluyen la formación de docentes, el apoyo a la facultad y la satisfacción de las necesidades de diversos estudiantes, especialmente aquellos con necesidades especiales. Estas áreas se exploran a través de una reseña de un libro, dos reseñas de medios, perspectivas del campo, un artículo práctico y un trabajo de investigación.

Drs. Cramer y Polanska realizaron un estudio descriptivo no experimental y presentan sus hallazgos sobre los factores que dan forma a las decisiones de los profesores en línea para buscar y mantener puestos de enseñanza en línea. Las im-

plicaciones indican que la flexibilidad de dichos puestos puede ayudar a reclutar y mantener diversas facultades con diversas necesidades.

Dos colegas y yo escribimos un artículo práctico centrado en el aprendizaje STEM en línea y las barreras relacionadas: los Dres. Mangahas y Harris. Se brindan soluciones para los formuladores de políticas, líderes y educadores para ayudar con la falta de desarrollo de habilidades de los estudiantes y recursos para atender mejor la diversidad (por ejemplo, cultural, lingüística, necesidades especiales), problemas de brecha digital y otros desafíos específicos de la universidad (por ejemplo, creación de redes, aprendizaje remoto, etc.) para un aprendizaje STEM más exitoso. El artículo también incluye recomendaciones para los enfoques de enseñanza.

En la sección Desde el campo, el Dr. Jeremy Dickerson, rector asistente, Oficina de educación a distancia y aprendizaje electrónico, Universidad de Carolina del Norte (UNC) Wilmington, aparece en 3 preguntas para un líder de aprendizaje en línea. El Dr. Dickerson enfatiza la importancia de que los líderes de la educación superior tengan el conocimiento y la comprensión necesarios para lanzar y respaldar con éxito nuevos programas en línea. Ofrece orientación para adoptar tecnologías de nivel empresarial y diseñar experiencias de aprendizaje en línea efectivas.

Este número incluye dos reseñas de libros. En la revisión de Mobile Learning and the Future of L&D de Growth Engineering, Ltd. (2017), la Dra. Theresa Melenas destaca los beneficios del aprendizaje móvil, incluido su atractivo para los nativos digitales y las implicaciones para los estudiantes de formación docente. El énfasis está en el aprendizaje móvil como una herramienta para aumentar la participación y los logros de los estudiantes. La reseña del libro de la Dra. Ashley Gleiman de Aprendizaje profundo personalizado de Bellanca (2020): Blueprints for Teaching Complex Cognitive, Social-Emotional, and Digital Skills brinda información sobre la planificación de la instrucción que impulsa un pensamiento más profundo, más amplio y crítico entre los estudiantes. Aunque el libro se enfoca en la formación docente, existen aplicaciones más amplias para estudiantes adultos en una variedad de entornos educativos.

El texto de revisión de medios de la Dra. Caroline Gomez explica cómo la tecnología de asistencia ayuda a los estudiantes con discapacidades a tener más éxito. La Dra. Gomez revisa las herramientas digitales para áreas específicas de lectura/alfabetización/escritura, toma de notas/estudio y dictado/conversión de voz a texto/reconocimiento de voz.

Este número proporciona una variedad de prácticas y herramientas para que los constituyentes universitarios las consideren. Los artículos capturan ejemplos, teoría y experiencia del campo. Como siempre, espero que extraiga puntos de discusión que pueda compartir con sus propios estudiantes, colegas o supervisores para impulsar nuevas direcciones en el discurso, la investigación y la práctica.

¡A disfrutar!

Dra. Kathleen J. Tate,

Editora Principal de *Journal of Online Learning Research and Practice*

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Bellanca, J.A. (2020). *Personalized deeper learning: Blueprints for teaching complex cognitive, social-emotional, and digital skills*. Solution Tree Press.

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编者序

本期收录的文章和专题研究了关于网络教学事业、网络教学法、网络项目管理以及技术辅助学习等一系列问题。部分主题包括教师教育、为教师群体提供支持、以及满足不同学生需求，尤其是那些需要特殊照顾的学生。通过一篇书评、两篇媒体评论、领域视角文章、一篇实证文章和一篇研究文章，对上述主题进行了探究。

Cramer博士和Polanska博士进行了一项描述性、非实验研究，研究结果有关于影响网络教师成员决策（寻找和保留网络教学职位）的一系列因素。研究表明，这类职位的灵活性能帮助招聘和保留具备不同需求的多样化教师群体。

我与两名同事：Mangahas博士和Harris博士共同撰写了一篇实证文章，聚焦于网络STEM学习及相关障碍。为决策者、领导者和教育者提供了一系列解决方案，用于协助解决学生技能发展和资源的缺乏、更好地照顾多样化需求（例如文化需求、语言需求和特殊需求）、解决数字鸿沟问题以及其他具体的、为实现更成功的STEM学习的大学挑战（例如社交和远程学习等）。文章还为教学方法提供了一系列建议。

《领域视角》的“网络学习领导者三问”版块采访了北卡罗来纳大学（UNC）威明顿分校远程教育和电子学习办公室助理教务长Jeremy Dickerson博士。Dickerson博士强调了高等教育领导者需具备的知识和理解力的重要性，以期成功启动和支持新的网络项目。他为“采纳企业技术和设计有效的网络学习体验”一事提供指导。

本期内容包括两篇书评。Theresa Melenas博士评论了Growth Engineering公司2017年出版物《移动学习和L&D的未来》，强调了移动学习的益处，包括其对数字原住民的吸引力以及对教师教育学生的意义。重点在于将移动学习作为一种工具增加学生参与和提升学习成绩。Ashley Gleiman博士评论了Bellanca（2020）的著作《个性化深度学习：关于教授复杂认知、社会-情感和数字技巧的蓝图》（Personalized Deeper Learning: Blueprints for Teaching Complex Cognitive, Social-Emotional, and Digital Skills），并就规划教学一事提供见解，以期促进学生形成更深、更广泛且更批判性的思维。尽管该书聚焦于教师教育，但却为不同教学情境下的成年学习者提供了更宽泛的应用。

Caroline Gomez博士的媒体评论解释了辅助技术如何支持残障学生获得更好的学习成绩。Gomez博士评论了一系列用于具体领域的数字工具，包括阅读/识字/写作、记笔记/学习、听写/语音转文本/语音识别。

本期内容提供了一系列供大学教师考量的实践和工具。文章描述了网络学习领域实例、理论和相关经历。一如既往，我希望读者提取一些能和学生、同事或导师共同分享的探讨点，以期在话语、研究和实践中推动新方向。

享受阅读！

Kathleen J. Tate博士

《网络学习研究与实践杂志》主编

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Professional and Personal Factors that Shape Online Faculty Careers

Jennifer Danzy Cramer *ROC USA* and
Katarzyna Polanska, *American Public University System, USA*

Abstract

Tremendous growth in online classrooms and universities has offered flexible and accessible learning and teaching opportunities to both students and faculty. Online classrooms offer more personalized freedom with time and location, making them more attractive to learners managing a range of personal and professional commitments and priorities. The online classroom potentially provides a supportive, inclusive employment opportunity for faculty who are also balancing competing professional responsibilities and personal priorities. In this descriptive study, we examined why faculty seek out and remain in online teaching positions. Using an online survey, we asked faculty what factors played a role in them choosing to start and remain in a part-time or full-time online faculty position. Geographic challenges and caregiver responsibilities were the two major factors that contributed to faculty choosing to work online. Our findings suggest some faculty members choose and prefer online teaching positions because of the flexibility to balance personal and professional commitments.

Keywords: online teaching, online faculty, work from home, work life balance

Factores profesionales y personales que dan forma a las carreras docentes en línea

Resumen

El tremendo crecimiento en las aulas y universidades en línea ha ofrecido oportunidades de enseñanza y aprendizaje flexibles y accesibles tanto para estudiantes como para profesores. Las aulas en línea ofrecen una libertad más personalizada con el tiempo y la ubicación, lo que las hace más atractivas para los estudiantes que manejan una variedad de compromisos y prioridades personales y profesionales. El aula en línea ofrece potencialmente una opor-

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tunidad de empleo inclusiva y de apoyo para los profesores que también están equilibrando las responsabilidades profesionales y las prioridades personales en competencia. En este estudio descriptivo, examinamos por qué los profesores buscan y permanecen en puestos de enseñanza en línea. Mediante una encuesta en línea, preguntamos a los profesores qué factores influyeron en su decisión de comenzar y permanecer en un puesto de profesores en línea a tiempo parcial o completo. Los desafíos geográficos y las responsabilidades de los cuidadores fueron los dos factores principales que contribuyeron a que los profesores eligieran trabajar en línea. Nuestros hallazgos sugieren que algunos miembros de la facultad eligen y prefieren puestos de enseñanza en línea debido a la flexibilidad para equilibrar los compromisos personales y profesionales.

Palabras clave: enseñanza en línea, profesores en línea, trabajo desde casa, equilibrio entre el trabajo y la vida

影响网络教师事业的专业因素和个人因素

摘要

网络课堂和大学数量的迅速增长，为学生和教师提供了灵活且可获取的学习机会和教学机会。网络课堂在时间和地点方面提供了更多的个性化自由，对那些试图完成一系列个人和专业承诺及重要事项的学习者而言更具有吸引力。网络课堂为那些争取平衡专业责任和个人事务的教师潜在提供了支持性和包容性的就业机会。在本描述性研究中，我们分析了为何教师寻求并保留网络教学职位。通过使用一项网络调查，我们询问教师有哪些因素在其选择从事并保留兼职或全职网络教学职位一事中发挥了作用。调查发现，地理位置方面的挑战和照顾家庭的责任是教师选择网络教学的两个主要因素。我们的研究发现暗示，一些教师选择并偏好网络教学职位的原因在于后者平衡个人和专业承诺的灵活性。

关键词：网络教学，网络教师，居家办公，工作–生活平衡

Distance education offers asynchronous, flexible learning opportunities for students and employment opportunities for faculty. According to Seaman and colleagues (2018), distance education enrollments have increased for fourteen years, growing by approximately 5% annually in recent years. The flexibility of online classrooms better supports students who have competing professional and personal priorities (Jaschik, 2009). This increasing need for distance education options for students has led to an increase in distance education faculty opportunities as well. Like today's students, faculty members also have significant and competing professional and personal priorities or challenges and online teaching positions may provide important employment opportunities for them.

Early in the shift to distance education, Parker (2003) conducted a literature review to examine faculty reasons for teaching distance education courses and reported that most articles on this topic identified self-satisfaction, flexible schedule, and wider audience as main factors. In a later study of online and face-to-face faculty, Lefebvre (2008) found that online faculty members typically were older and wanted geographic flexibility, desired teaching non-traditional students with unique experiences, and felt online teaching had a positive impact on their other professional priorities such as consulting or writing. Also examining differences in experience between face-to-face (F2F) and online faculty, Bedford (2009) found that only three faculty members (13.6%) reported personal reasons such as flexibility as their primary reason in pursuing full-time hours adjuncting at multiple institutions. Focusing specifically on online faculty across institutions, Starcher and Mandernach (2016) examined whether adjunct faculty at for-profit or non-profit institutions had different motivations for teaching online. At both institution types, faculty cited financial concerns, remaining active, giving back, and engaging in intellectual stimulation as their main reasons for teaching online (Starcher and Mandernach, 2016). These studies highlight that faculty have many different reasons for teaching online. Given the potential benefits of freedom and flexibility, as well as the challenge of most online courses requiring more teaching time (Cavanaugh, 2005; Stephens & Coryell, 2020), why do some faculty choose to begin and remain in an online teaching position?

Gender may be a key part of answering this question. At traditional institutions, about half of full-time faculty are women (Finkelstein et al., 2016) and the majority of non-tenure track faculty are women (AAUP, 2019). At online institutions, women represent a higher proportion of the faculty (e.g., University of Phoenix-Arizona, 78%, Western Governors University, 75%; Grand Canyon University, 73%, Southern New Hampshire, 59%) (2019 data taken from National Center for Education Statistics, 2021). At traditional institutions, women typically do not make up most of the faculty population, holding 38.6% of all faculty positions in 1993 to holding 49.2% of all faculty positions by 2013 (Finkelstein et al., 2013).

Women scholars disproportionately face major disparities in academic employment in higher education (Curtis, 2011; Savigny, 2014), even though women are the majority in completing undergraduate and graduate programs (Knapp et al., 2011). Researchers have referred to this as a leaky academic pipeline, where women leave, or "leak," from an academic career path, not being employed in tenure-track and academic leadership roles at the same rates as men (Ahmad, 2017; Finkelstein et al., 2016). The loss of women scholars early in their academic careers is often attributed to the family status of academic women (Mason, 2013a; Mason, 2013b; Mason et al., 2013; van Anders, 2004). Junior scholars, especially women, may have new or increased family caregiver responsibilities while they are earning a terminal degree or working in their early career positions such as post-docs or junior faculty. Exploring this issue, Van Anders (2004) found that both male and female academics expressed a desire to start a family with children, but sometimes female academics self-selected to leave their academic careers due to their perceptions that academia is an unsupportive environment. In a study of science and engineering faculty, Fox (2010) found that women faculty felt that work interfered with family more than men faculty, and more women faculty felt that family interfered with work. Mason's body of work on gender equity in academia (2013) found evidence that women pay a "baby price" for choosing to have children. Conversely, academic men with children had more opportunities for career development and tenure, while women who have children had fewer opportunities (Mason et al., 2013). Women faculty members who perceive traditional F2F academic positions as inflexible with personal priorities may find that online faculty positions provide an opportunity to remain in academia when they might otherwise leave the academy. In this survey study, we explored why online faculty, especially women faculty, initially sought and have stayed in online teaching positions

Methods

Using a descriptive, nonexperimental design, our online survey collected information about participant background, experiences with teaching, and personal priorities and responsibilities. The survey (See Appendix A) included 20 questions in three categories: Demographics (10 questions), Employment Information (3 questions), and Employment Perceptions and Experiences (7 questions, 4 of these were open response). We modeled our questions based on findings in previous literature examining online faculty experience (Lefebvre, 2008; Parker, 2003). The survey was published, and responses were collected for 30 days in February and March 2017.

Participants were recruited directly through email to the authors' professional networks. , or were indirectly recruited through snowball sampling, receiving the survey link from other colleagues. The survey was also shared in two Facebook groups, one for online faculty and one for academic mothers.

Inclusion criteria for participants were self-reporting having earned a graduate degree and online teaching experience at the college level.

This study was approved by the American Public University System Institutional Review Board and follows the ethical treatment of human subjects outlined by the American Psychological Association. All participants self-reported that they were over the age of 18 and had the option of opting out of the survey on the welcome page.

Results

A total of 154 participants provided data. One participant was excluded for not meeting the inclusion criteria (did not hold a graduate degree). The final sample was 153 participants.

Demographics

We first collected some demographic data on our participants (See Table 1). Participants (*N*=153) were faculty at higher education institutions with online teaching experience. Participants included men (24.2%), women (75.8%), and one participant who did not share their gender (<1%). Study participants ranged in age from: under age 30 (1.3%), ages 31-40 (29.4%), ages 41-55 (41.8%), and ages 56+ (27.5%). For highest degree earned, some held a master's degree (35.3%), and most held a doctoral degree (64.7%). Most participants identified as not Hispanic or Latino (94.1%) and as white (87.5%). Most study participants were partnered or married (76.5%) rather than single (unmarried, divorced, separated: 22.9%). Many participants reported being parents (77.1%).

Most study participants were affiliated with at least one online institution (92%) while a small proportion of participants teach online but were affiliated with only one or more F2F institutions (8%). About half of participants reported not changing their primary position type over time (54.6%). Of these participants who changed their primary position over time, 94.2% reported that they shifted from a F2F position to an online position.

Caregiver Responsibilities

We asked faculty participants if they had caretaking responsibilities, and if so, to estimate the percentage of caretaker responsibilities they hold in their families (<50%, ~50%, >50%). Caretaking responsibility was operationalized as caretaking or parenting children, grandchildren, a family member with special needs, and/or an elderly family member or attending to personal health issues.

We found an even split between participants who reported that they have significant caretaking responsibilities (*N*=77) compared with those who reported that they did not have significant caretaking responsibilities (*N*=76). While some participants estimated they provided more than half of the caregiver responsibilities in their family (30.7%), most estimated that they provided less than half the caregiver responsibilities (41.2%) or reported an even split

Table 1. Summary of participant demographics

	Survey options	% of participants
Gender	Woman	75.2
	Man	24.3
Age	<30	1.3
	31-40	29.4
	41-55	41.8
	56+	27.5
Highest degree earned	Masters	35.3
	Doctoral	64.7
Partner status	Single	22.9
	Partnered	76.5
Hispanic or Latino	Not Hispanic or Latino	94.7
	Hispanic or Latino	5.3
Race	American Indian or Alaska Native	3.3
	Asian	1.3
	Black or African American	7.2
	Native Hawaiian or Other Pacific Islander	0.7
	White	87.5

of caregiver responsibilities with their partner (20.3%).

Reasons Faculty Teach Online

To examine why online faculty members choose to teach online, one survey question asked participants to rate the degree to which race/ethnicity, self or family health issues, self or family disability status, caregiver responsibilities for children or elders, or geographic location affected their decision to teach online (See Table 2). The factors that contributed most to their decision to teach online were geographic location (61.2%) and caregiver responsibilities for children (41.7%).

Geographic Location

Geographic location was an important factor for faculty choosing to teach online for over half of our participants (61.2%). Participants said that geographic location very much (38.8%) or somewhat (22.4%) influenced their choice to teach online.

Open responses provide more context to these results. Several participants (n=7) shared that being both an academic and a military spouse played a role in their decision to teach online. These participants shared they did not have traditional faculty positions available to them in the areas where they were stationed or holding F2F academ-

Table 2. Representative participant responses about reasons for choosing to teach online

Reason for teaching online	n	Representative participant responses.
Caregiver responsibilities	31	My husband's health declined.
		During the period of my being online, I did take a leave of absence from F2F to homeschool an autistic son for 4 years.
		Youngest child born premature - health issues, required more flexible job.
Geographic location	21	Military reassignment.
		I married a military man and knew I would need to move often (averages less than two years at any one place).
		My husband is in the military, so online is the only way I can work.
		Geographic location (I live in a small town where academic teaching opportunities for me are not nearby).
		Very important as a military spouse with a husband that deployed frequently.
Flexibility, time freedom	6	F2F you have to commit to being in class at a specific time. Online I have more time management freedom. I can travel and still work.
Creative freedom	5	My motivation is job satisfaction coupled with creative freedom.
Disability	4	I am a 50% disabled veteran and sometimes I cannot stand for long periods of time as is required for F2F. Also, if I am not feeling well, I can work from my bedroom.
		I switched so I could take care of my elderly mother.
Professional opportunity, income	4	I moved online because I could only find adjunct work F2F. The pay was low and I could not pay my student loan bills and credit card bill (left over from Grad school).
		A position that closer aligned with my research interests.
Changes at F2F institutions	3	Reduction in F2F courses being offered.

Note. Participants who reported yes to changing their primary position over time from a F2F institution to an online institution had the option to provide personal narrative about what prompted the change.

ic positions was not possible due to the nature of moving every 2-3 years for military reassignments. One participant explained "my husband is an active-duty Marine. We move about every three years making it hard to achieve tenure with an organization." Another shared "as a military spouse I am geographically isolated and yet still need (and want) to work full time."

Participants also shared some other reasons, unrelated to family circumstances, for geographic location playing a role in their decision to teach online. For example, some participants shared that they live in rural areas where there is a lack of local universities and colleges. For others, local institutions lack courses in their discipline. A few participants noted that online positions free up time and resources compared with F2F jobs that have the cost of a commute. Another participant noted that retiring and being able to teach from an area without cold winters was important for choosing an online teaching position.

Caregiver Responsibilities - Children

Almost half of participants (41.7%) shared that caregiver responsibilities were very much (27.8%) or somewhat (13.9%) a factor for teaching online. Open responses added important context to this finding. Several participants shared that welcoming a first baby was what shifted them to online teaching. Some participants shared that caring for children has had a long-term effect on their career, with them planning to continue teaching online until their children reach school age. Others shared that they plan to teach online while caring for their young children and then return to F2F teaching when their children are more independent and in school full-time. Some participants shared other special circumstances such as caring for premature infants or welcoming twins. Others shared that online teaching fit well with family priorities such as homeschooling, with a parent being able to teach their children and balance online teaching as well.

Others described how the flexibility of online teaching gives them the opportunity to have more family time, be present for extracurricular activities, and overall, be available for the changing needs of children and teens. Online teaching typically allows faculty members to work asynchronously on their own timetable, around children's schedules and needs. A participant explained "my kids and my family are my first priority—I did not want to ever have to use childcare, so I needed to be home for them when they got home from school." Similarly, another participant shared that "online work affords me the ability to fully meet my children's health, educational, and extracurricular needs without juggling schedules or conflicts in schedules."

The flexibility of being employed and working from home while caring for children also comes with financial benefits. One participant mentioned that online teaching provided the opportunity to earn income at flexible times and not pay for childcare. As one participant shared, "childcare with both

school age and younger is not always easy and affordable with three children."

Caregiver Responsibilities- Elderly

Eldercare was not a significant factor for choosing to teach online. For the 18.9% of participants that eldercare was a major reason for teaching online, several shared detailed reasons. One participant shared that because of online teaching, it was possible to travel and be with an aging and ill parent without having to apply for Family Medical Leave (FML). Another participant shared that with online teaching, it was possible to move across the country to help care for an elderly centenarian parent. A participant shared that they and their partner "went through some tough times as 3 of our parents needed special care and eventually passed away."

Health

Almost a third of participants (30.3%) cited health as a factor in teaching online.). The experiences participants shared in the free response section were diverse. For example, one participant shared that working from home helped manage migraines, but noted it also meant missing out on social interactions with colleagues. Another participant shared how online teaching helps ease social anxiety in face-to-face settings, "I don't function well in meetings. I have meeting anxiety, and I panic and feel unprepared in things like staff meetings." One participant shared that online teaching "permits me to work on days when my autoimmune issues are flaring and significantly impact my mobility." These health issues described by participants showed a range of visible and invisible mental, emotional, and physical health challenges that have an impact on faculty decisions to teach online. Compared with less flexible in-person teaching or meetings, teaching online offers flexibility in preventing triggers or being responsive to acute health changes.

Some faculty members shared health challenges as their reason for teaching online. In some cases, this referred to the faculty member's own health challenges and in other cases this referred to the faculty member's role as primary caregiver for a loved one's health challenges. For example, one participant shared that they retired early and teach online to take care of parents and have time to arrange and attend medical appointments. Another shared that they adjusted their career direction based on having two children with special needs, and another shared that having a premature baby was a reason for moving to teaching online. Another participant said teaching allowed flexibility when a spouse was undergoing cancer treatment.

Disability

For some faculty members (15.9%), disability played a role in their decision to teach online. Participants shared that disabilities prevent them from working set hours, standing for long periods, and navigating other limitations that they would experience in a F2F work environment. Providing care for a loved one with a disability was also an issue for some participants. One participant

shared "Due to my husband's disability, I need flexibility in my work schedule."

Race/Ethnicity

Some faculty participants reported race or ethnicity as a reason for teaching online (4.6%). One respondent shared that teaching online helps with eliminating student issues with understanding their accent. Another shared about turning to online teaching after a difficult time with the traditional full-time faculty job market, "I believe that as a minority, I faced more discrimination and implicit bias in seeking a full-time position."

Other Reasons Faculty Teach Online

Respondents shared several unique reasons for teaching online. One wanted to increase earnings from a F2F environment but with a flexible time commitment. One participant shared, "Online teaching affords me the flexibility to work on outside projects like writing, volunteering and community activism." Another shared "I like the idea of being able to get up and go whenever/wherever I want, but still have a significant income. Teaching online provides a lot of freedom." The aspects of time and flexibility were threaded among responses.

Discussion

The online classroom is well established as providing flexibility and access for students balancing multiple time commitments and challenges- largely employment, caregiving, and geographic limitations. It makes sense that faculty members are in a similar position: they are also adults juggling similar professional and personal priorities like their students. Our study suggests that some academics purposefully choose online career paths because of the flexibility and freedom it offers them. Participants in this study reported that the two most important factors for beginning and staying in an online teaching career were geographic location and caregiving for children.

Online teaching provides an opportunity to be geographically flexible. Some participants reported that they were limited in employment options by their location. These geographic limitations tended to be family-based. For example, participants shared that by teaching online their family did not need to relocate regularly because of changing F2F positions, or their family was able to live near extended family. For other participants, they were able to have continuous employment in online settings during moves for family member military service or a partner's career or be employed remotely while their partner remained in a location-bound career.

Caregiver duties for children or elders was also a major reason for teaching online. Academic work lacks boundaries, creating difficulty in balancing work and life for many academics (Cook, 2004; Curtis, 2011; Kane, 2017). Lack of work-life boundaries in academic roles can be more challenging for women scholars because of the biological and gendered caregiver expectations of pregnancy, birth, childrearing, and household duties (Fox, 2010). Traditional academic careers are some-

times stereotyped as incompatible with the complex caregiver responsibilities of women (Mason et al., 2013). Participants in our study shared that caregiver duties play an important role in their decision to teach online, from flexibility during pregnancy and postpartum care to reducing the need and cost for childcare outside the home.

Limitations

One limitation of the study is that our sampling strategy may have introduced some bias because participants predominantly identified as women (75.2%). Though the percentage of women sampled in our study aligns well with data from the National Center for Education Statistics (2021) demonstrating that for some major online universities, the majority of online faculty are women. Women faculty members experience gender equity challenges (Finkelstein et al., 2016; AAUP, 2017) in the academy and have a higher need for workplace flexibility (Ahmad, 2017; Mason et al., 2013). Online teaching may be one career strategy that helps more women with advanced degrees continue working in academia and this may explain why at some online universities women comprise over half of the faculty. Future studies would benefit from exploring the reasons behind this trend. Examining online faculty position type (e.g., part-time, full-time; tenure track, no tenure system, etc.) and whether faculty members are temporarily or permanently teaching online would help with understanding the reasons they teach online and if those change over time with new circumstances.

Another limitation is the lack of racial and ethnic diversity in the participant sample. Our sample was predominantly white (87.5%), non-Hispanic (94.5%) faculty members. Few participants (4.6%) reported that their race or ethnicity played a role in their decision to teach online. While this is a small percentage of the total sample size, it represents a large proportion of the non-white and Hispanic faculty who were sampled. This finding should be examined in future studies, specifically focusing on the experiences of faculty members from racial and ethnic backgrounds that were underrepresented in our sample.

It is also important to note that our study reports on data collected before the COVID-19 pandemic, and the reasons faculty choose to teach online may be shaped much differently during and after COVID-19. Our study focused on faculty members who choose to teach online, which is quite different than the unexpected and emergency online teaching roles many found themselves in beginning early in 2020. This will be an interesting area to explore in the future.

Conclusion

Online teaching positions provide scholars an opportunity for a non-traditional, but viable and long-term, career path that has increased flexibility to balance professional responsibilities and personal

priorities. Our results suggest faculty purposefully choose online academic careers because of the flexibility provided, particularly related to locales, caregiver duties, and health and disability challenges. These challenges often disproportionately affect women faculty members, which may explain why women make up the majority of faculty at some online institutions. Online faculty positions create more flexible academic work opportunities. Offering fully or partially online faculty positions may be an important institutional strategy to attract and retain diverse faculty.

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Appendix A

Study Survey

Section 1: Demographic information

Gender

- Man
- Woman
- Choose not to answer

Sex

- Male
- Female
- Choose not to answer

Age

- Under 30
- 31-40
- 41-55
- 55+

Highest Degree conferred

- Bachelor's
- Master's
- Doctoral
- Other

Marital Status

- Single (unmarried, divorced, separated)
- Partnered (partnered, married)

Children (number, ages)

- Number of children under 5
- Number of children 6-11
- Number of children 12-17
- Number of children 18+

Race/Ethnicity

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Hispanic or Latino

- Two or more races

Life circumstances

- Identify your role as a caretaker
  - I do have significant care taking/parenting responsibilities
    - (for example- children or grandchildren, special needs family member, elderly family member, personal health)
  - I do not have significant care taking/parenting responsibilities
- Estimate your contribution to caregiver duties
  - <50%
  - 50%
  - >50%

Section 2: Employment information

Which best describes your current job role(s):

- I am a faculty member at one F2F institution
- I am a faculty member at more than one F2F institution
- I am a faculty member at one online institution
- I am a faculty member at more than one online institution
- I am a faculty member at least one F2F institution and at least one online institution
- I have been a faculty member at a F2F or online institution in the past and I am currently in an alternate career
- I have been a faculty member at a F2F or online institution in the past and I am currently not employed

Has your primary position changed over time?

- Yes, I shifted from a F2F institution to an online institution
- Yes, I shifted from an online institution to a F2F institution
- No, I have not changed my primary position
- If you have changed your primary position, what prompted that change? For example: health or disability concerns, caregiver responsibilities, geographic location, creative freedom, other.

Section 3: Employment perceptions and experiences

Rate the degree to which these factors play a role in your career path (1= not at all, 2= somewhat, 3=very much; textbox below each saying "optional narrative- how does this factor play a role in your career path?):

- Race or ethnicity:
- Health issues of self or immediate family member:
- Disability status of self of immediate family member:
- Caregiver responsibilities for children:
- Caregiver responsibilities for elderly family members:
- Geographic location:

Rate the degree to which the following factors play a role in your decision to start and continue in an online faculty position (1= not at all, 2= somewhat, 3=very much; textbox below each saying "optional narrative- how does this factor play a role in your decision to start and continue in an online faculty position?):

- Race or ethnicity:
- Health issues of self or immediate family member:
- Disability status of self of immediate family member:
- Caregiver responsibilities for children:
- Caregiver responsibilities for elderly family members:
- Geographic location:

Rate the degree to which the following factors play a role in your decision to pursue an alternative academic career, outside of a faculty role (1= not at all, 2= somewhat, 3=very much; textbox below each saying "optional narrative- how does this factor play a role in pursuing an alternative academic career?):

- Race or ethnicity:
- Health issues of self or immediate family member:
- Disability status of self of immediate family member:
- Caregiver responsibilities for children:
- Caregiver responsibilities for elderly family members:
- Geographic location:

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Challenges and Digital Solutions with STEM Learning

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Abstract

Encouraging active interest while building engagement in Science, Technology, Engineering, and Math (STEM) fields in secondary and higher education is challenging for many educators. Significant barriers that pose difficulties for high school and college students in STEM learning and proposed solutions to better support their achievement are included. A focus on digital solutions is provided that has implications for supporting both K-12 schools and universities that offer increased online and hybrid learning since the emergence of Coronavirus Disease 2019 (COVID-19).

Keywords: STEM, science, math, college, higher education, barriers, digital, online, disabilities, English Language Learners (ELLs), digital divide

Desafíos y soluciones digitales en el aprendizaje CTIM

Resumen

Fomentar el interés activo mientras se desarrolla el compromiso en los campos de Ciencias, Tecnología, Ingeniería y Matemáticas (CTIM) en la educación secundaria y superior es un desafío para muchos educadores. Se incluyen las barreras significativas que plantean dificultades para los estudiantes de secundaria y universitarios en el aprendizaje de CTIM y las soluciones propuestas para apoyar mejor su logro. Se proporciona un enfoque en soluciones digitales que tiene implicaciones para apoyar tanto a las escuelas K-12 como a las universidades que ofrecen un mayor aprendizaje en línea e híbrido desde la aparición de la enfermedad del coronavirus 2019 (COVID-19).

Palabras clave: CTIM, ciencias, matemáticas, universidad, educación superior, barreras, digital, en línea, discapacidades, estudiantes del idioma inglés (ELL), brecha digital

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STEM学习的挑战与数字解决方案

摘要

对许多从事中学和高等教育的教师而言，在鼓励活跃兴趣的同时还要促进参与科学、技术、工程和数学（STEM）领域一事是具有挑战性的。本文描述了为高中生和大学生的STEM学习带来困难的一系列显著障碍，并提出了更好地支持学生成绩的一系列解决方案。聚焦于数字解决方案，其对支持K-12学校和大学而言具有意义，这些机构自2019冠状病毒病（COVID-19）爆发以来提供了更多的网络学习和混合学习。

关键词：STEM，科学，数学，大学，高等教育，障碍，数字，网络，残疾，英语语言学习者（ELLs），数字鸿沟

Though Science, Technology, Engineering, and Math (STEM) continue to be at the forefront of many educational agendas, little progress has been made over the last couple of decades (De and Arguello, 2020) with including a wider variety or enough learners into programs. The National Academies of Sciences, Engineering, and Medicine (NASEM) (2016) wrote that the "very culture of STEM presents both barriers and opportunities for successful degree completion for all students" (p. 2). They point out there are many routes for students, but "institutional, state, and national education policies have not been developed to support the various pathways that students are now taking to earn a STEM degree" (p. 2). NASEM purports that students' degree progress is slowed as they are deterred from transferring due to articulation policies or lack of them. They explain that "diminishing funding from state and federal sources have led some universities to adopt the practice of charging differential tuition" (p. 2) and this may particularly affect females and underrepresented minorities. Prior to admission to two-year or four-year STEM programs, a variety of barriers exist for students and educators at a time with increased demand for STEM professionals to enter the workforce.

Trends and Needs

In their study, Ramsey, and Baethe (2013) explored aspects that promote future success in STEM careers and found that critical thinking through meaningful application of concepts determined success and continued interest of college science majors. Similarly, Arum, and Roksa (2011) studied 2,400 college students at 24 different universities over a four-year period and found that critical thinking and other skills

like writing were no longer progressing during college as compared to previous generations of students. The possible causation of these findings from secondary education might be attributed to an increase in high-stakes assessments, which may reduce students' need to apply critical thinking skills through meaningful application of content. David (2011) declared that "state tests tend to rely on easy-to-score questions that measure basic skills and recall instead of higher-order thinking" (para. 3). Diminishing meaningful opportunities for students to apply the content as result of the high-stakes movement in assessment may also affect motivation in STEM learning. Sheldon and Biddle (1998) found that when rewards and sanctions were attached to test performance, students became less intrinsically motivated to learn and less likely to engage in critical thinking. They went on to say that attaching a high-stakes nature to assessments also obstructs students' paths to becoming lifelong, self-directed learners. The Center for Energy Workforce Development (CEWD) (n.d.) presents problem-solving, creativity, inquiry, engineering design-thinking, critical thinking, and collaboration as some of the essential skills needed for STEM and explains that effective STEM learning requires a combination of critical thinking skills: analyzing information, evaluating designs, reflecting on thinking, synthesizing new ideas, and proposing creative solutions. CEWD emphasizes that all those skills are essential to becoming an independent, critical thinker. Skill development is clearly crucial. Hayes (2017) shared that:

> …results from ACT-tested students who graduated in 2016 indicate that among the students who expressed interest in pursuing a STEM major or field after high school, only about one-fourth (roughly 225,000) met the ACT STEM Benchmark"… [and thus] …approaches meant to widen the STEM pipeline by drawing in students not currently interested in STEM are rendered less effective due to levels of preparation, for postsecondary education generally and STEM majors more specifically, which are even lower than those of STEM-interested students. (p.1)

Hayes (2017) added that the onus is on policymakers to ensure schools and teachers are equipped with necessary resources for students choosing STEM trajectories to "have the precollege academic preparedness to succeed in their college coursework" (p. 2) as they are not adequately prepared for postsecondary courses "necessary to join the STEM workforce" (p. 2). In addition to lack of readiness, Hayes explained that U.S. STEM occupations grew by 10.5 percent from May 2009 to May 2015, which is more than twice the rate of growth of non-STEM occupations and that "the U.S. Bureau of Labor Statistics projects that computer occupations alone will create nearly 500,000 new jobs between 2014 and 2024" (p. 1). A recent report echoes the call for increasing students' interest and skills for STEM and STEM-related careers.

(ISC)2 (2019) highlighted job shortages exceeding 500,000 in the cybersecurity field.

Randazzo (2017) made similar points:

> …lack of STEM access is a critical equity issue in education, particularly for students in urban and rural communities, where access to high-level math and science courses is often out of reach. Soon, the impact of students living in STEM deserts will not only be reflected in those students' high school and college competition rates, but will also take a toll on the country's technological superiority, its economy and national security.

While the need to increase the number of individuals from underrepresented communities in technical careers has long been recognized, it can now be viewed as a needed component to strengthening the U.S.'s ability to protect itself as cyber-attacks continue to rise. Aside from more traditional STEM occupations, the need to raise inclusivity and diversity levels in technology could translate into strengthening the country's security posture. Iversen (2019) wrote "cybersecurity education could reinforce arguments casting STEM education as a benefit to students and country alike" (para. 3). The need for students to enter college with strong STEM skills and persist through degree programs is at a critical point.

Inclusivity, Diversity, and Access

Getting diverse learners into the STEM pipeline continues to be a challenge. Tate and Tripp (2007) discussed statistics related to lower participation of girls as compared to boys in upper-level math and science classes and the outperformance of boys over girls in standardized math and science tests and that in the early 2000s, "18 to 25 percent of all scientists and 10% of engineers were women" (p. 77). More recently, the National Science Foundation (2015) highlighted that people with disabilities along with women and racial minorities are still considered underrepresented groups in STEM. Funk and Parker (2018) reported increases as well as decreases in representation of women in STEM fields and continued lack of representation of minorities. Diversity challenges and access to STEM curriculum and careers continue and extend to factors beyond gender and disability to include cultural, linguistic, and more.

Cultural Diversity

In considering how the teaching of math and science affects student motivation and how students see themselves as being valid contributors to the field, it is worthwhile to note that students observe how content is presented in the way teachers emphasize the valid contributors to the field. This ultimately influences how students see themselves *fit* within the narrative of STEM.

In recent studies, Bauer-Wolf (2019) noted that Latinx and African

American students leave the STEM fields at far higher rates than their white peers. The White House Initiative on Educational Excellence for African Americans showed that in 2012 in the area of science and engineering, only 11.2% of bachelor's degrees, 8.2% of master's degrees, and 4.1% of doctorate degrees were awarded to women of color. While women received over half of the bachelor's degrees awarded in the biological sciences, they received far fewer in the areas of computer science (17.9%), engineering (19.3%), physical sciences (39%), and mathematics (43.1%). In exploring these statistical anomalies, what is it, within the infrastructure of STEM teaching that might be drawing underrepresented student populations out of these disciplines and into other careers? According to Gholston-Key (2010), cultural diversity in content presentation is the key to engaging students of color into STEM disciplines:

> Science curricula and science classrooms have been devoid of relevant cultural inclusion or multicultural education. Many science educators believe "science is pure" and thus escapes the influences of current pedagogy, trends, and especially cultural influences. Even though science processes are generic or "culture free," if students cannot and do not identify with information that are "processing," they may internalize the notion that they cannot perform science or are not expected to process scientific information. The process of validating and/or correcting perceived notions depends on one's culture. Multicultural science or culturally inclusive science is believed to be an enhancement for students of color. (p. 1)

Scott (2018) emphasized the ongoing practice of using outdated science textbooks that primarily showcase images of white, middle-aged men and recommended that educators "represent science and scientists in a way that all students can see themselves in the field" (p. 73). Photos, art, books, texts, online resources, and articles should show breadth of science contributors in terms of people, locales, and cultures across K-12 and higher education classrooms.

Linguistic Diversity

Inclusive education considers the strengths and needs of all diverse students and should provide opportunities for English Language Learners (ELLs) to access STEM curriculum. A joint study by Lancaster and Sheffield Universities found that language proficiency influences learners' abilities to answer scientific questions. Because ELLs are still developing proficiency in their second language, the learning of new terminology in the sciences as well as inclusion of next generation science standards further increases language demands placed upon them (Lancaster University, 2019). A focus on vocabulary building for all students, especially ELLs, should be a focus during science and STEM instruction in K-16+ settings.

Neurodiversity

Friedensen (2018) wrote that "more students with a range of disabilities from impairments in mobility, intellectual disabilities, and mental health conditions are enrolling in postsecondary education institutions" (para. 1) than in previous years. The National Center for Educational Statistics (n.d.) reported that in 2011–2012, students who met American with Disabilities Act of 1990 (ADA) requirements comprised 11% of those students enrolled; and in 2015-2016, that increased to 19%. Even as these numbers rise, fewer students in this category persist to graduation relative to their peers without disabilities, and even fewer graduate with degrees in STEM (Friedensen, 2018). Thus, it is important to explore the ways in which greater inclusivity is addressed in the curriculum to support students with disabilities and encourage their participation in STEM fields.

The Digital Divide

In exploring the reasons for a decline in participation and motivation in STEM fields, it is important to consider issues related to technological access and the digital divide among low-income households and school districts. According to Brown (2018), "lack of access to technology creates a technology divide that begins at the elementary educational level and impacts students' postsecondary educational careers. A relationship exists between the use of digital media and student academic achievement" (para. 2). A lack of access perpetuates this digital divide such that in 2013, 89% of college graduates compared with 37% of non-high school graduates had high-speed Internet access at home (Zickuhr & Smith, 2013), and the Pew Research Center shared that 98% of college graduates used the Internet in 2021 compared with 79% of non-high school graduates in 2019. Numbers are increasing as gaps continue.

Beyond Internet access are issues with the availability of technology programs, such as computer science and robotics to high-need school districts due to underfunding. With increased access to these programs, there is also a concern that teachers in these schools do not have the necessary training and needed skills to provide meaningful opportunities to engage their students in applied STEM environments (Herold, 2017). With shifts in enrollments during COVID-19, funding and resources have decreased for some universities and many college students in Gupta et al.'s (n.d.) study expressed concern about diminished learning experiences without in-person classes and network-building.

COVID-19

Persistence among science-interested college students has been compromised because of the COVID-19 pandemic. Gupta et al. (2021) found in their study that nearly 50% of college student participants declared "that their academic trajectory has been greatly or moderately affected by the pandemic" (para. 2). Various concerns were shared such as fears about performance in a remote learning setting, physical displacement (e.g., moving out of dorms), and loss of opportunities such as relationships,

networks, and internships. Gupta et al. (n.d.) explain their Summer 2020 alumni survey revealed that "more than 65% of program graduates were seeking or had secured internships and summer jobs in STEM fields… [and that] these employment opportunities had since been cancelled" (p. 4). College students need new pathways for connection and support to help them persist and complete their courses and programs successfully.

Proposed Solutions

As K-12 schools and higher education institutions continue to navigate offering in-person, virtual, and hybrid instruction, there are a variety of considerations for providing solutions to counter recent and emerging STEM learning barriers. These proposed solutions are applicable across different types of classrooms with a focus on online settings, and they address the skill development, resources, teaching approaches, diversity (e.g., cultural, linguistic, special needs), digital divide issues, and other college-specific challenges (e.g., networking, remote learning, etc.) for more successful STEM learning.

Skills

To provide more meaningful opportunities for students to engage higher-order critical thinking skills in STEM instruction, project-based and problem-based strategies are key. Including more relevant and authentic application activities for students to connect their learning to solving complicated scenarios across subjects is important. De and Arguella (2020) pointed out that "novel discoveries have become a cross-disciplinary process, and modern science is most active at the interface between disciplines, requiring individuals from multifaceted backgrounds with varied perspectives to solve complex problems" (p. 1). The National Science Teaching Association (NSTA) (2020) recommends interdisciplinary instruction and experiences that prompt long-term, sustained interest into adulthood" (para. 1) and drawing from A Framework for K–12 Science Education, it points out that decision making in the 21st century will require citizens to have abilities to "frame scientific questions pertinent to their interests; evaluate complex social, civic, economic, political, and personal issues; seek out relevant data and scientific argument; and communicate…understandings and arguments to others" (para. 1). This is a call for K-16+ educators to collaborate across disciplines: with other educators and experts from the community and field. Embedding STEM concepts and skills into authentic scenarios that interest students and require additional subject-area concepts and skills should better prepare them for college and beyond. Lessons should require students to collaborate and find solutions to societal problems, and example activities include creating animal habitats and homes to keep local pets warm, building strong bridge models to withstand severe climate, and planting community gardens to help with hunger challenges. These activities may then be scaled from desk-size to community-size. These problem-based

scenarios require skills in STEM as well as economics, sociology, and language arts, to name a few. When students are learning at a distance, teachers and professors may use virtual meeting rooms via Zoom, Mozilla Hubs, or Adobe Connect to foster collaboration and provide materials to students through mail or other means so that students have hands-on sessions. Students/student groups do not need to engage in the exact same activities as the focus should be on skills and concepts driven by interests.

Modeling prior to group project work should help with skill building. Modeling is an option synchronously through live sessions in virtual meeting rooms, or asynchronously through pre-recorded videos that students may view and then discuss at their own pace. Using shorter presentation structures as through PechaKucha, with multimedia slides that are 20 x 20, or 20 slides in length and 20 seconds per slide, should better engage students and allow them to focus on targeted skills and concepts due to the succinct format. This type of digital tool allows for educators to teach in an engaging way and prompt uncomplicated collaboration at a distance as students of any age may discuss, plan, contribute to, and present slides as well.

Encouraging students to think creatively and providing safe environments for them to take risks in their learning promotes the belief that failing is part of the learning process. This increases the knowledge that in STEM, part of achieving success is through the process of attempting problems through multiple iterations until a solution is devised to tackle complex issues. Multiple iterations are part of the engineering design process, which parallels the process that artists follow in that "engineers must make a plan, be creative, and attend to considerations, test, and improve their original plan" (Tate et al., 2018, p. 31). Helping students identify and discuss fields and jobs where creative problem-solving, improving, and redoing are required may help K-12 and college students embrace those skills.

Diversity

Educators should begin to view students through a growth-mindset (Heggart, 2015; Prothero, 2020), leaving behind deficit thinking in working with underrepresented and/or neurodiverse groups. The goal is to see them as capable of academic achievement, just as any other student, if given the proper accommodations that allow for their success. STEM teachers should consider the ramifications of the weed-out culture that has traditionally dominated the field and explore opportunities that provide students access to the curriculum through scaffolding and support. Thompson (2021) stated that, "we know…weed-out courses do not weed out students evenly (para. 4). Thompson (2021) found that first-year STEM grades accounted for 19% of the total difference in persistence rates (para. 9) and suggests that colleges rethink grading curves and offer pass/fail courses. At the classroom level, attempts should be made to use Universal Design for Learning principles in the teaching and development of STEM curriculum to provide students with multiple instructional

pathways, enabling them opportunities to both receive content and represent their learning through varied means.

To better engage students in STEM content, educators should consider ways to decolonize their syllabi. Though, Ahadi and Guerrero (2020) declared it is easier to implement syllabus decolonization within non-STEM disciplines. However, they support instructors ensuring STEM courses serve students better. Culturally inclusive science has the potential of integrating learners' cultures into the academic and social context of the science classroom aiding and supporting science learning (Baptiste & Key, 1996; Boisselle, 2016). One approach is to integrate the learning of the traditional science curriculum with the cultures of students represented in the classroom and beyond.

Student achievement is influenced by several factors including student attitudes, interests, motivation, type of curricula, relevancy of materials, and the culture of the students (Banks & Banks, 1995). The White House Initiative on Educational Excellence for African American Students (n.d.) encourages strategies that enable students of color to receive additional support through mentorship, academic support services, and growth-mindset strategies to develop resilience. Underrepresented K-12 students should be provided more meaningful opportunities to apply STEM learning through after-school programs and museum visits. Leveraging online museum visits and resources is applicable to K-16+ students and their instructors. Infusing multicultural literature, art, photography, poetry, and music to help students learn and engage in STEM skills and concepts is an exciting option for in-person, online, and hybrid classes.

English Language Learners

In developing lessons to better engage English Language Learner (ELL) populations, mindful language planning should be integrated for what students will be reading, writing, listening, and speaking about in their classroom processes and products. Teachers should survey their curricular resources to assess if any textual features might pose problems for ELLs in their classrooms. Wu et al. (2019) suggested that when bridging the gap for ELLs in science, "hybrid language affords the opportunity for students to communicate through various modes, including natural language, visual representations, mathematical expressions, and manual-technical operations" (p. 24). ELLs, various students with disabilities, and learners in general benefit from visuals —viewing and creating them—as well as interactive, hands-on lessons that include viewing key vocabulary before, during, and after a learning experience and socially constructing understandings through reading, writing, speaking, listening, journaling, dramatizing, and negotiating. "Studies have shown that language learners especially benefit from more active learning techniques (i.e., creating mental linkages of concepts) that enable them to organize information and retrieve new information they learn (Oxford, 1990)" as cited in Lee et al. (2020). For example, when studying erosion, Wu et al. (2019)

found that "students who connected their written claims with visual representations…tended to construct stronger arguments than those who did not make connections between text and visuals" (p. 24). STEM educators need to set the classroom stage for success by using effective pedagogical practices.

Lancaster University (2019) explained that the current underrepresentation of linguistically diverse learners in STEM postsecondary education needs to be addressed now and that one of the most challenging aspects is vocabulary. Insufficient vocabulary leads to lower assessment outcomes and possibly less self-esteem. Lee et al. (2020) recommend that instructors encourage ELLs to "participate in conversations, read articles, or listen to relevant media…[to help] them rehearse their language skills" (p. 29). These approaches to building vocabulary may be done independently or collaboratively in groups and set up at a distance.

Lee et al. (2020) suggest asking students to sort and organize vocabulary. They also recommend modeling the reading of texts/lab texts highlighting previously learned words while asking students to make connections, answer questions, summarize, and predict. Lee et al. (2020) explained that having students discuss lab reports prior to writing, providing models of lab reports, and allowing oral presentations in lieu of written reports are helpful approaches. They shared that assessment questions should include visuals such as illustrations and graphs. Allotting time for and using these approaches in traditional, online, and hybrid classrooms ideally yields more positive outcomes across STEM courses for ELLs and students in general who are struggling readers, less verbal-linguistic learners, or experiencing a learning disability.

Students with Special Needs

Friedensen (2018) pointed out that students with various disabilities have different outcomes when persisting in STEM fields. Referring to some research, she explained it has shown:

> …that students with autism spectrum disorder (ASD) persist in STEM fields at levels similar to peers without disabilities and may even possess some STEM-specific advantages arising from their unique cognitive processing. Similarly, the challenges presented by a classroom environment may be different for d/Deaf students or students with hearing impairments than they are for a student with a processing disability, physical disability, or ADHD. Some students have high-incident, non-apparent disabilities—that is, disabilities such as dyslexia and ADHD, which are common among college students and often cannot readily be discerned by untrained observers. (para. 5)

The implication is for higher education institutions to have supports in place for students with special needs, especially in STEM departments. Training educators is a first step in developing a strong support system. Friedensen (2018)

stated that instructors are sometimes "hostile or indifferent to providing requested accommodations" (para. 8). Helping faculty members understand laws, evidence-based strategies, and disability-specific theories and practice will likely better equip them to teach students with special needs. Friedensen explained that some faculty members reported a lack of guidance with STEM-appropriate accommodations from disability services departments. Professionals in such university departments would benefit from training as well. Advances with digital tools and assistive devices help virtual classrooms become more accessible to students with disabilities. Gomez (2021/2022) presented Kurzweil 3000, Echo Smartpen, and Dragon Naturally Speaking as useful assistive technology tools.

Students with Limited Internet Access

To mitigate the effects of the digital divide, state governments and policymakers should increase funding for low-income schools to enable them access to digital tools and frameworks and enhance technological training for teachers in those districts. These initiatives serve to better support students' learning and increase their interest in STEM fields. Further, they may provide more meaningful opportunities for students in marginalized neighborhoods to learn through computer science and robotics applications, increasing access to STEM careers. Grants tend to be more widely available through STEM-related organizations for K-12 and higher education to help with funding.

K-12 school districts are increasingly putting Wi-Fi into buses for students to use when traveling to and from school, especially since the onset of the pandemic. They have also placed parked buses with Wi-Fi into lower income neighborhoods for students to connect to virtual classes. In higher education, college students have more options to access the Internet through businesses and libraries that provide it for free. Initiatives intended to address the digital divide, help college students persevere in their studies. CollegeBuys' California Connects program helped with distributing 30,000 Chromebooks and 5,000 Internet hotspots to help address the community college digital access gap (Gomez, 2020). Universities that offer STEM degrees may consider packages and incentives for students to have pre-paid Internet access to engage in online and hybrid classes, virtual networks, and online research.

Conclusion

This is the time for policy makers to make shifts that are based on the needs of society and students. Schools, universities, educational leaders, and educators need to collect and analyze data about their STEM students and programs and implement effective approaches to include all learners in ways that will their build skills, knowledge, and successful college and career pathways. Leveraging digital tools and increased resources will help diverse students persevere and persist in STEM courses and programs, and eventually in the field.

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Dr. Mangahas has worked extensively with diversity, equity, and inclusivity initiatives and in support of faculty development efforts with organizations like Branch Alliance for Educator Diversity and received grants to develop diversity initiatives and programs. With her passion in education and her advocacy for student success, her goal is to prepare students for career-ready pathways and achievement of their academic and professional goals and to support faculty in their various functions.

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Three Questions for an Online Learning Leader

Featuring Jeremy Dickerson, Ed.D., *Assistant Provost, Office of Distance Education and eLearning, University of North Carolina (UNC) Wilmington, USA*

Dr. Jeremy Dickerson serves as the Assistant Provost for Distance Education and eLearning at UNC Wilmington, where he is also Associate Professor of Instructional Technology in the College of Education. Since 1999, Jeremy has been in faculty and leadership positions at three different universities, where his career has included managing educational technology, infrastructure and integration, designing, developing, and coordinating new online degree programs, and leading campus-wide online teaching efforts. Notably, in his current role at UNC Wilmington, his office has provided support in the "pivot" to remote teaching during multiple hurricanes and the pandemic. Aside from his leadership opportunities, Dickerson also enjoys teaching, writing, and mentoring graduate students seeking work in the field of educational technology and online learning.

Jeremy earned an AA at Coastal Carolina Community College, a BA and MEd at UNC Wilmington, and an EdD in Technology Education with a focus in Training and Development at North Carolina State University. He is presently working towards an MA in Educational Innovation, Technology, and Entrepreneurship at the University of North Carolina at Chapel Hill.

Tres preguntas para un líder de aprendizaje en línea

Jeremy Dickerson, Ed.D., *Assistant Provost, Office of Distance Education and eLearning, University of North Carolina (UNC) Wilmington, EE. UU.*

El Dr. Jeremy Dickerson se desempeña como Asistente del Rector de Educación a Distancia y eLearning en UNC Wilmington, donde también es Profesor Asociado de Tecnología Instruccional en la Facultad de Educación. Desde 1999, Jeremy ha ocupado cargos docentes y de liderazgo en tres universidades diferentes, donde su carrera ha incluido la gestión de la tecnología, la infraestructura y la integración educativas, el diseño, el desarrollo y la coordinación

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de nuevos programas de grado en línea y el liderazgo de los esfuerzos de enseñanza en línea en todo el campus. En particular, en su función actual en UNC Wilmington, su oficina ha brindado apoyo en el "pivote" de la enseñanza remota durante múltiples huracanes y la pandemia. Además de sus oportunidades de liderazgo, Dickerson también disfruta enseñar, escribir y asesorar a estudiantes graduados que buscan trabajo en el campo de la tecnología educativa y el aprendizaje en línea.

Jeremy obtuvo un AA en Coastal Carolina Community College, un BA y MEd en UNC Wilmington, y un EdD en Educación Tecnológica con un enfoque en Capacitación y Desarrollo en la Universidad Estatal de Carolina del Norte. Actualmente está trabajando para obtener una maestría en innovación educativa, tecnología y espíritu empresarial en la Universidad de Carolina del Norte en Chapel Hill.

对网络学习领导者的三个提问

受访者：Jeremy Dickerson，教育学博士，助理教务长，远程教育和电子学习办公室，北卡罗来纳大学威明顿分校，美国

Jeremy Dickerson博士是北卡罗来纳大学威明顿分校负责远程教育和电子学习的助理教务长，他也是该校教育学院的教学技术副教授。自1999年起，Jeremy在三所大学中担任院系及领导职位，工作范围包括：管理教育技术、基础设施和一体化，设计、开发并协调新的网络学位课程，以及领导校园网络教学。特别地，他目前在北卡罗来纳大学威明顿分校的办公室一直在数次飓风事件和新冠肺炎大流行时期为远程教育提供核心支持。除此之外，Dickerson还爱好教学、写作以及指导研究生寻找教育技术和网络学习领域的工作。

Jeremy在海岸卡罗来纳社区学院（Coastal Carolina Community College）获得文学副学士学位，在北卡罗来纳大学威明顿分校获得文学学士和教育学硕士学位，在北卡罗来纳州立大学获得教育学博士学位，研究方向为技术教育（聚焦培训和开发）。目前他在北卡罗来纳大学教堂山分校攻读名为"教育创新、技术和创业"的文学硕士学位。

1 What do you predict will be the biggest challenges in online learning in the next five years?

I predict that the biggest challenges in online learning will be at the university administration level and will focus on funding and planning. Many universities are receiving lower levels of funding from states, causing some administrators to look at online programs as a focus of new student enrollment and revenue. Administrators who lack the experience working with online programs think they are cheap to stand-up and will automatically make new profit silos. Leaders need to be knowledgeable and intentional with their planning processes and understand the upfront costs to compete in this market. Failure to properly plan and support new online programs will create low quality online experiences, inadequate marketing efforts, and sub-standard returns for all stakeholders. Big picture: leaders need the knowledge, experience, and proper perspective to plan and grow exemplary online programs. Online education is a longitudinal process, not a get-rich-quick scheme!

2 What do you look for in an enterprise-level technology when it is presented to you for adoption by your university?

Enterprise level technologies are very expensive and need to serve the community, not cater to a small group of individuals. The impact of enterprise level technologies should be clear and simple to explain. The technology needs to solve problems that are widely acknowledged, and the ROI should be easy to understand. I want to see a proven record of accomplishment of integration at other universities and I want to speak to the teams who have used the product. I dread committee work, but the process for adopting enterprise-level technologies is truly an example where you need a wide array of input from a large and vocal committee. Many voices, clear problem solving, and an articulate rollout plan are necessary.

3 What is your personal strategy when designing an online learning experience?

Instructional quality and student focus are key! At the university level, I strongly suggest that institutions create teaching support centers or teams with instructional designers, instructional technologists, and videographers. These professionals can support faculty and elevate online programs in truly amazing ways. As a senior leader, my strategy is to build a collaborative team of creative and productive designers, technologists, videographers, and faculty—then allow them to do what they do best.

A Review of *Mobile Learning and the Future of L&D*

Growth Engineering, Ltd. (2017). *Mobile learning and the future of L&D*. https://elearningindustry.com/free-ebooks/mobile-learning-future-of-learning-and-development

By Theresa Melenas

American Public University System, USA

Abstract

A review of *Mobile Learning and the Future of L&D* features an examination of mobile learning as an alternative to traditional eLearning as a corporate training tool and as a tool for higher education. Tips on using mobile learning for increased engagement, higher retention, and applications for teacher education are addressed.

Keywords: mobile learning, mLearning, eLearning, teacher education

Una reseña de *Mobile Learning and the Future of L&D*

Resumen

Una reseña de Mobile Learning and the Future of L&D presenta un examen del aprendizaje móvil como una alternativa al eLearning tradicional como herramienta de formación corporativa y como herramienta para la educación superior. Se abordan consejos sobre el uso del aprendizaje móvil para una mayor participación, una mayor retención y aplicaciones para la formación del profesorado.

Palabras clave: aprendizaje móvil, mLearning, eLearning, formación del profesorado

《移动学习和移动与开发的未来》述评

摘要

《移动学习和移动与开发的未来》（Mobile Learning and the Future of L&D）述评就移动学习作为传统电子学习的替

 doi: 10.18278/jolrap.8.2.5

代物、作为企业培训工具以及作为高等教育工具一事加以分析。就“使用移动学习以增加参与度、提升记忆力及教师教育应用”一事探讨了相关建议。
关键词：移动学习，mLearning，电子学习，教师教育

Mobile Learning and the Future of L&D promotes the use of mobile devices as an alternative to the traditional eLearning model that has been in place for the last 30 years. Higher education has used the eLearning model to educate students since 1982, when Western Behavioral Science Institute offered its first online college program (Ferber, 2019). This model became the standard for online and hybrid instruction in corporate training and secondary education. Growth Engineering Ltd. (2017) posits the benefits of mobile learning outweighs the limitations. The information, while geared toward corporate training, has definite implications for secondary and higher education. Teacher preparation courses at the graduate and undergraduate level should emphasize mobile learning as a viable option for educating students at the secondary level.

Benefits of Mobile Learning

The ebook clearly articulates the benefits of mobile learning (mLearning) in the 21st century, such as it appealing to learners with short attention spans. A study by Microsoft reports that the average attention span has dropped from 12 to 8 seconds due to the distracted nature of “heavy multi-screeners” (McSpadden, 2015). In response to this distracted nature, mLearning pushes out content that is designed to be consumed in short bursts of time, allowing the learner to enter and exit learning at their convenience. This flexibility is attractive to digital natives who want a more interactive learning experience. Mobile Learning provides these benefits through microlearning and gamification. Additionally, these applications may support increased retention by providing targeted bursts of content to learners repetitiously through multiple interactions while capturing informal learning opportunities.

Applications for Teacher Education Programs

Research suggests that teacher education programs integrate mobile learning through special courses and infusion of practicum (Baran, 2014). When content-specific teacher education courses require exploration of pedagogical benefits of mobile learning, the result may include shifts in perspectives toward mobile device integration (Baran, 2014). Growth Engineering Ltd. (2017) suggests that education benefits from increased student engagement, increased retention

of material, and a deeper learning as mLearning address Bloom's Taxonomy at all levels from knowledge to creation.

mLearning may increase student engagement if new learning is labeled as a game, challenge, or quest. Growth Engineering Ltd. (2017) suggests that instead of having learners engage in traditional methods of knowledge acquisition, educators should set challenges to acquire new knowledge. The rationale is that completing a challenge is more fun than meeting a learning objective in traditional ways, making the learner more likely to engage with the content. Using mobile features such as videos and photographs to capture the completion of the challenge may further increase engagement. The fluid nature of mLearning allows the learner to repeat challenges and interact with the content more than just once. Multiple engagements with the content help increase the retention of material. This platform also allows instructors to send push-notifications to students to create a sense of urgency for meeting specific benchmarks or completing challenges in a timely manner helping them to persist potentially.

Integration of technology is important when using eLearning or mLearning to increase student achievement. According to Jacob Hayes, "teachers need to integrate technology seamlessly into the curriculum instead of viewing it as an add-on, an afterthought, or an event" (as cited by Sastri, 2019, para. 1). Teacher education programs must prepare preservice and in-service teachers to integrate seamlessly the use of apps, podcasts, videos, and games into lesson planning to facilitate their students' meeting of learning goals.

Apps that Support Learning

Growth Engineering, Ltd. (2017) reviewed popular mobile learning apps that teacher candidates and practicing teachers could share, explore, and apply in the field during their respective teacher education program. Evernote is a research and note-taking app that keeps notes in one place and arranges them as deemed appropriate by the learner. Simplemind is a mind-mapping app that allows learners to make connections among concepts, thus increasing the retention of new material. Applications such as Quizlet and Quizup are highlighted as a way to engage learners in quiz-types of challenges with their peers. Learners create their own quizzes or flashcard-style reviews or engage in those that are assigned to them. Finally, Udemy is a user-led learning app that allows students the opportunity to take their learning beyond what is required by the teacher.

Conclusion

While the ebook focused on corporate training and development, it has implications for teacher education and other programs. Concerns such as lack of student engagement and lack of content retention are addressed and seemly solved by mLearning and mobile device applications. When striving for

increased student engagement and academic achievement, it is important to remember that "engagement does not equal learning when the use of technology is not supported by strong objectives and goals as the foundation of its use" (Rosenthal Tolisano, n.d., para. 6). A strong teacher education program should combine foundational pedagogy with integration of mobile learning applications to support students learning. Growth Engineering contributes to the body of knowledge on the effective use of mobile learning to support education through micro learning, mobile learning apps, and gamification. The ebook will provide graduate and undergraduate teacher educators viable suggestions to update traditional eLearning and technology integration, thus providing preservice and in-service teachers tools that encourage more innovative lesson design and student engagement.

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Dr. Theresa Melenas is a part-time faculty member in the Teaching program in the School of Arts, Humanities, and Education at American Public University. She has over 23 years of experience in both K-12 and higher education as a middle school teacher, instructional coach, principal, and instructor of graduate teacher education courses. She earned a BA in History and a post-baccalaureate degree in Secondary Education at the University of Arizona and an MA in Curriculum

and Instruction and EdD in Education Leadership at the University of Phoenix. Theresa continued with post-graduate studies at the University of North Carolina Wilmington.

Dr. Melenas is dedicated to supporting schools, teachers, and students in the journey for continuous improvement. She uses predictive analysis and data driven instruction to increase student achievement and positive student outcomes. This passion has led her to be a guest speaker for many professional organizations on a variety of related topics.

A Review of *Personalized Deeper Learning: Blueprints for Teaching Complex Cognitive, Social-Emotional, and Digital Skills*

Bellanca, J.A. (2020). *Personalized deeper learning: Blueprints for teaching complex cognitive, social-emotional, and digital skills*. Solution Tree Press.

By Ashley Gleiman
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Abstract

Engaging students in 21st century skills is a valuable teaching strategy for educators today. However, many are often confused or misguided in specific techniques that engage their students and help achieve deeper learning in the classroom. Bellanca (2021) offers recommendations and specific blueprints as tools for educators to teach content and promote deeper learning skills simultaneously.

Keywords: personalized learning, deeper-learning, self-directed learning, 21st century skills, preservice teachers, inservice teachers, teacher education, digital skills

Una reseña del aprendizaje más profundo personalizado: planos para la enseñanza de habilidades cognitivas, socioemocionales y digitales complejas

Resumen

Involucrar a los estudiantes en las habilidades del siglo XXI es una valiosa estrategia de enseñanza para los educadores de hoy. Sin embargo, muchos a menudo se confunden o se equivocan en técnicas específicas que involucran a sus estudiantes y ayudan a lograr un aprendizaje más profundo en el aula. Bellanca (2021) ofrece recomendaciones y planos específicos como herramientas para que los educadores enseñen contenido y promuevan habilidades de aprendizaje más profundas simultáneamente.

Palabras clave: aprendizaje personalizado, aprendizaje más pro-

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fundo, aprendizaje autodirigido, habilidades del siglo XXI, profesores en formación, profesores en activo, formación del profesorado, habilidades digitales

《个性化深度学习：关于教授复杂认知技能、社会-情感技能及数字技能的蓝图》述评

摘要

让学生参与使用21世纪技能是目前教育者的一项宝贵教学策略。不过，许多教师经常对一系列“让学生参与课堂并帮助实现深度学习（deeper-learning）”的具体技术感到困惑或被误导。Bellanca（2021）将一系列建议和具体蓝图作为工具提供给教育者，用于教授教学内容并加强深度学习技能。

关键词：个性化学习，深度学习（deeper-learning），自主学习，21世纪技能，师范生，在职教师，教师教育，数字技能

A guide to deeper learning for educators at every level, Bellanca (2020) provides specific strategies, lesson plans, and blueprints in *Personalized Deeper Learning: Blueprints for Teaching Complex Cognitive, Social-Emotional, and Digital Skills*. Deeper learning strategies and outcomes enrich instruction with the new competencies and skills today's learners need to be productive employees, compassionate citizens, and inspiring leaders. Students must develop their abilities to think critically, be creative, work collaboratively, and communicate to solve problems in a rapidly evolving world. However, fostering deeper learning and engagement in the classroom requires a skillset that often eludes the best of instructors. It is a combination of modeling, coaching, and mentoring by teachers who "see learning not as a reception of knowledge into empty containers of set capacity but rather see and foster learning as the construction of meaning by both thinking and feeling beings" (p. 2). The book focuses on equipping preservice and inservice teachers with approaches for K-12 learners; however, beyond implications for teacher education programs, there are wide applications for adult learners across a variety of instructional settings.

The first five chapters of the book introduce blueprints and topics related to personalized learning plans, engagement, outcome-driven instructional strategies, and learning transfer. The

next three chapters examine 21st century skill sets and reveal how they are most responsible for deeper learning outcomes. Each chapter builds upon the knowledge of the previous to provide the reader a holistic experience in developing strategies that fit their needs.

Paradigm for Professional Learning Communities

Interweaving specific skills throughout curriculum and personalized learning plans are not new concepts in education. However, the development of a teacher playbook that includes not just teaching strategies, but blueprints for how to incorporate social-emotional, complex cognitive, and digital skills through professional learning communities (PLCs) is a new concept that Bellanca posits is long overdue (p. 5). Bellanca breaks down this process by offering a series of chapters to help guide both new and experienced teachers on the process of personalized learning by highlighting sections that focus on theoretical concepts, evolutions in teaching, a student-centered focus, and evidence-based instructional practices.

The Four Cs

Bellanca prefaces all strategies in the book with framing and categorizing 21st century skills as the four Cs, which are "complex cognitive (including creative and critical thinking skills), social-emotional (including collaboration and communication) and digital skill sets" (p.7). Establishing these skill categories as prerequisites for students to learn becomes the gateway for deeper learning results to include self-directed learning as a skill for the future. In each subsequent chapter, Bellanca provides a series of questions asking the reader to define how concepts appear in their classroom, making it a personalized active experience. Bellanca then provides examples of evidence-based strategies and helpful tools (e.g., playbooks, lesson plans, rubrics) in each chapter prompting the reader to reflect on ways to move forward.

Final Thoughts

The book concludes with a section dedicated to how personalized deeper learning will continue over the course of a learner's lifetime. Technology, innovation, and global issues such as the coronavirus disease will greatly affect pathways and directions of learning in the future. Bellanca suggests that as technology in education advances, teaching will not be an obsolete profession and states, "in future years, educators will be engines of learning more than ever" (p.210). While machines and technologies are evolving and may someday provide better tools for supporting deeper learning, they are far from being prepared to replace the need for human interaction in education.

Conclusion

Overall, Bellanca provides a how-to book that offers practical approaches for educators

to incorporate into practice at any time and across contexts. While much of the book provides a K-12 focus, the lesson plans, reproducible templates in the appendix, and evidence-based practices offer ready-made suggestions that would benefit educators at every level.

Dr. Ashley Gleiman is an Academic Administrator with the U.S. Naval Community College and provides academic leadership, vision, and support in the development of their programs as a new institution. In her previous role, she was the Senior Project Coordinator of Alternative Learning with the Center for Professional and Continuing Education (CPCE) at American Public University System. Ashley earned a BS in Communication Studies at the University of Maryland Global Campus, an MS in Adult and Continuing Education at Kansas State University, a Graduate Certificate in Academic Advising through the Global Community for Academic Advising (NACADA), and a PhD in Adult and Continuing Occupational Education at Kansas State University.

Removing Barriers with Assistive Technology

Caroline R. Gomez, Ph.D., *Auburn, Alabama, USA*

Abstract

College students in the U.S. who report a sensory, physical, or cognitive disability are eligible to request and receive assistive technology (AT). There are hundreds of AT tools to assist with learning challenges, so determining the best AT tools may be daunting. To assist with AT, most colleges have offices dedicated to supporting students with disabilities (SWD). The offices play a vital role in providing AT and the training needed to use it. AT can promote educational, psychological, and social benefits for SWD. This review will highlight a few of the popular high-tech AT resources currently on the market.

Keywords: assistive technology, AT, students with disabilities, SWD, higher education, college

Eliminación de barreras con tecnología de asistencia

Resumen

Los estudiantes universitarios en los EE. UU. Que informan una discapacidad sensorial, física o cognitiva son elegibles para solicitar y recibir tecnología de asistencia (AT). Hay cientos de herramientas de TA para ayudar con los desafíos de aprendizaje, por lo que determinar las mejores herramientas de TA puede ser abrumador. Para ayudar con la AT, la mayoría de las universidades tienen oficinas dedicadas a apoyar a los estudiantes con discapacidades (SWD). Las oficinas juegan un papel vital en la provisión de TA y la capacitación necesaria para usarla. La TA puede promover beneficios educativos, psicológicos y sociales para los SWD. Esta revisión destacará algunos de los recursos de AT de alta tecnología más populares que se encuentran actualmente en el mercado.

Palabras clave: tecnología de asistencia, AT, estudiantes con discapacidades, SWD, educación superior, universidad

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利用辅助技术消除障碍

摘要

报告存在感官、身体或认知障碍的美国大学生有资格要求获得辅助技术（AT）支持。辅助学习的AT工具成百上千，因此确定最佳的AT工具可能是极困难的。为完成AT支持，大多数院校都设有致力帮助残障学生（SWD）的办公室。这类办公室在提供AT和AT使用所需的培训一事中发挥关键作用。AT能为残障学生提供教育利益、心理利益和社会利益。本篇述评将强调目前市场上流行的一些高科技AT资源。

关键词：辅助技术，AT，残障学生，SWD，高等教育，大学

Approximately 20 percent of undergraduate college students in the U.S. have reported disabilities (NCES, 2019). With the growth of assistive technology (AT), a college education is now a realized dream for many students with disabilities (SWD). Any college student in the U.S. who reports a sensory, physical, or cognitive disability is eligible to request and receive assistive technology (Newman & Madus, 2014). This is important for educators and administrators to understand.

Assistive technology is defined as, "any product whose primary purpose is to improve an individual's functioning and independence and thereby promote their wellbeing" (Khasnabis et al., 2015, p. 9). Despite what some may assume about the word "technology," not all AT tools are high-tech. Low-tech AT includes tools such as highlighters and organizers. This review is specific to high-tech AT, which is now available for a variety of platforms including desktops, laptops, and mobile devices. There are hundreds of AT tools to assist with learning challenges and determining the best AT tools may be overwhelming.

McNicholl et al. (2019) reported that AT promotes educational, psychological, and social benefits for SWD adding that, "Harnessing the potential of mainstream devices as AT for all students will facilitate inclusion and reduce stigma" (p.1). This review will highlight a few popular high-tech AT resources and related considerations.

Institutional Support

To assist with AT, most colleges have offices dedicated to supporting students with disabilities. The offices play a vital role in providing AT and the training needed to use it. The use of AT contributes to stu-

dent success, but only if the AT is specific to the need and training is provided on how to use it (Guyer & Uzeta, 2009). Institutions should prioritize remaining current with assistive technology tools and consider them when budgeting and planning.

Assistive Technology Tools

Assistive technology resources are often categorized into support for (a) reading/literacy/writing; (b) note-taking/study; (c) dictation/speech-to-text/speech recognition; (d) screen readers/magnification software; (e) organization/time management; (f) research; and more. The following is a review of tools for reading/literacy/writing, note-taking/study, and dictation/speech-to-text/speech recognition.

Reading/Literacy/Writing

Kurzweil 3000 integrates useful tools including text-to-speech, text highlighters, sticky notes, and word prediction. Also included is a talking spell checker, a graphic organizer, text-based writing templates, a language translator, and access to a cloud-based library with no storage limitations. The customizable program allows users to adjust reading speed, change tab displays, and create new tabs.

The program is easy to use with an intuitive interface. In addition, the program reads Web text aloud. Kurzweil 3000 is a comprehensive literacy support system that has earned high scores for its ability to make content accessible. A single year subscription gives students access to three applications, each with a number of literacy tools. It is the priciest of the technologies reviewed.

Note-taking/Study

The Echo Smartpen is a tool that allows a student to record everything heard, said, or written. It can link the audio recordings to notes and has a voice-to-text capability. The software allows the student to save, organize, and play back interactive notes from the computer or directly from the pen. In addition, educators may use the tool to create tutorials about course content for students.

The Smartpen is an effective tool for taking notes. The Smartpen is easy to use with clear instructions. While the Echo Smartpen is a relatively single purpose device, it has great potential to help with challenges with note taking.

Dictation/Speech-to-Text/ Speech Recognition

Dragon Naturally Speaking

https://www.nuance.com/dragon.html

Dragon Naturally Speaking is a dictation product designed to increase productivity, alleviate the stress of typing, and ease a number of other problems associated with controlling a computer by hands. The program allows one to dictate documents and emails, navigate computers, and control other functions such as web browsing with one's voice.

The program is reported to be accurate the first time used, but it improves over time because it learns lan-

guage patterns and commonly used words. There are some drawbacks with Dragon Naturally Speaking. It takes time to learn how to use it and it is costly given that Windows operating system has some dictation features built into it. Dragon Naturally Speaking Home version is the least expensive of the tools reviewed.

Barriers

Students with disabilities encounter various challenges when approaching university courses in terms of reading, writing, listening, speaking, retaining information, and more. Use and cost of some assistive technologies may be additional barriers. Further, faculty may contribute to barriers. McNicholl et al. (2019) noted that inadequate AT training of higher education staff is a significant barrier to educational engagement for SWD. The researchers reported that the unavailability of appropriate AT support staff also makes it difficult for some SWD to engage in academic tasks using AT. A concern is whether or not inadequate AT training and the unavailability of AT support staff is contributing to the low graduation rate of 34% of SWD from college (Newman et al., 2011). It is critical to have qualified staff in place for decision-making, support, and barrier removal to help with student success and persistence.

Conclusion

With the substantive increase of assistive technology (AT), a college education is now a realized dream for many students with disabilities. There are hundreds of AT tools to assist with learning challenges, and so determining the best AT tools may be daunting. To assist with AT, most colleges have offices dedicated to supporting students with disabilities. The offices play a vital role in providing AT and the training needed to use it. Importantly, the use of AT contributes to student success, but only if the AT is specific to the need and training is provided on how to use it. Learning about new AT may help colleges make informed decisions about available software and offer better tutorials for staff and students on how to make use of various features.

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Caroline R. Gomez, PhD., born in Miami, Florida, received a PhD in Rehabilitation and Special Education with specialization in autism spectrum disorder (ASD) from Auburn University in 2003, and has been working with the ASD community for over 35 years. In addition to being a part-time faculty member in the Teaching program at American Public University (APU), Dr. Gomez provides diagnostic, consultation, and training services to the ASD community. She serves on the first cohort of the Competency-Based Education Network's (C-BEN) Quality Assurance Review Team, reviewing college and university special education programs.

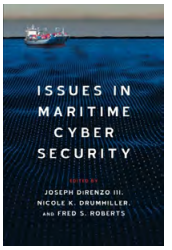
During her tenure as Alabama's first state autism coordinator, Dr. Gomez led the Alabama Interagency Autism Coordinating Council toward a statewide system of care for the ASD community. Caroline facilitated the opening of and then directed the Autism Hope Center in Columbus, Georgia and the Auburn University Autism Center in Auburn, Alabama; directed Emory University's model autism program research replication site; and evaluated and taught children with ASD in the U.S. and Japan.

Caroline has published articles in *Focus on Autism and Other Developmental Disabilities*, *Young Exceptional Children Monographs*, and *Teaching Exceptional Children*. In addition, she has been an invited speaker at a number of national and regional conferences including the National Autism Association Conference, the

Bi-Annual Conference on Research Innovation in Early Intervention, and the Centers for Disease Control and Prevention (CDC) Act Early Learn the Signs Regional Summit.

Dr. Gomez currently serves as president on the Board of Directors for the Autism Society of Alabama. Her latest honors include Resolution Honoring Professional Achievement presented by the Alabama State Senate, President's Award presented by the Autism Society of Alabama, and Alabama Today's Woman of Influence.

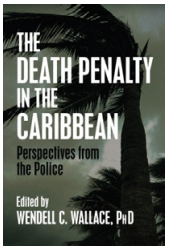
Featured Titles from Westphalia Press



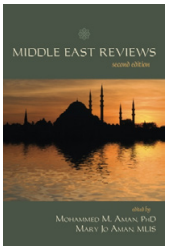
Issues in Maritime Cyber Security Edited by Nicole K. Drumhiller, Fred S. Roberts, Joseph DiRenzo III and Fred S. Roberts

While there is literature about the maritime transportation system, and about cyber security, to date there is very little literature on this converging area. This pioneering book is beneficial to a variety of audiences looking at risk analysis, national security, cyber threats, or maritime policy.

The Death Penalty in the Caribbean: Perspectives from the Police Edited by Wendell C. Wallace PhD



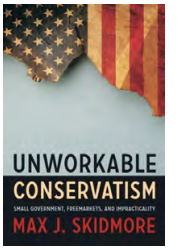
Two controversial topics, policing and the death penalty, are skillfully interwoven into one book in order to respond to this lacuna in the region. The book carries you through a disparate range of emotions, thoughts, frustrations, successes and views as espoused by police leaders throughout the Caribbean



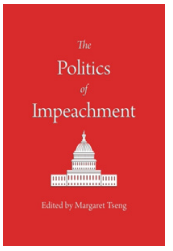
Middle East Reviews: Second Edition
Edited by Mohammed M. Aman PhD and Mary Jo Aman MLIS

The book brings together reviews of books published on the Middle East and North Africa. It is a valuable addition to Middle East literature, and will provide an informative read for experts and non-experts on the MENA countries.

Unworkable Conservatism: Small Government, Freemarkets, and Impracticality by Max J. Skidmore



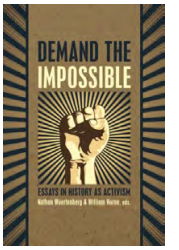
Unworkable Conservatism looks at what passes these days for "conservative" principles—small government, low taxes, minimal regulation—and demonstrates that they are not feasible under modern conditions.



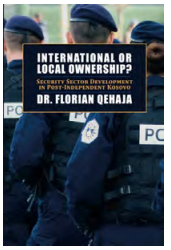
The Politics of Impeachment
Edited by Margaret Tseng

This edited volume addresses the increased political nature of impeachment. It is meant to be a wide overview of impeachment on the federal and state level, including: the politics of bringing impeachment articles forward, the politicized impeachment proceedings, the political nature of how one conducts oneself during the proceedings and the political fallout afterwards.

Demand the Impossible: Essays in History as Activism
Edited by Nathan Wuertenberg and William Horne



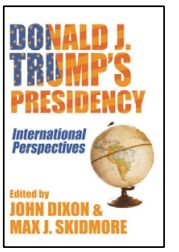
Demand the Impossible asks scholars what they can do to help solve present-day crises. The twelve essays in this volume draw inspiration from present-day activists. They examine the role of history in shaping ongoing debates over monuments, racism, clean energy, health care, poverty, and the Democratic Party.



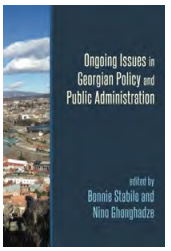
International or Local Ownership?: Security Sector Development in Post-Independent Kosovo by Dr. Florian Qehaja

International or Local Ownership? contributes to the debate on the concept of local ownership in post-conflict settings, and discussions on international relations, peacebuilding, security and development studies.

Donald J. Trump's Presidency: International Perspectives
Edited by John Dixon and Max J. Skidmore



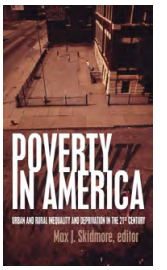
President Donald J. Trump's foreign policy rhetoric and actions become more understandable by reference to his personality traits, his worldview, and his view of the world. As such, his foreign policy emphasis was on American isolationism and economic nationalism.



Ongoing Issues in Georgian Policy and Public Administration
Edited by Bonnie Stabile and Nino Ghonghadze

Thriving democracy and representative government depend upon a well functioning civil service, rich civic life and economic success. Georgia has been considered a top performer among countries in South Eastern Europe seeking to establish themselves in the post-Soviet era.

Poverty in America: Urban and Rural Inequality and Deprivation in the 21st Century
Edited by Max J. Skidmore



Poverty in America too often goes unnoticed, and disregarded. This perhaps results from America's general level of prosperity along with a fairly widespread notion that conditions inevitably are better in the USA than elsewhere. Political rhetoric frequently enforces such an erroneous notion.

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