The AdvanceKentucky Influencer Model: Transforming Additive Manufacturing Education in the K-16 Classroom

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Abstract: The rise of social media has elevated influencers into prominent roles, with academia joining this trend by producing "academic influencers" who make specialized knowledge more accessible. One such field, additive manufacturing (AM), commonly known as 3D printing, has transitioned from niche industrial use to a widespread educational tool. The AdvanceKentucky Influencer Model, developed by Somerset Community College (SCC) and Kentucky Science and Technology Corporation (KSTC) in partnership with Tennessee Technological University (TTU), has successfully trained educators to integrate AM into classrooms, empowering teachers as community influencers. Originally funded by a National Science Foundation (NSF) Advanced Technological Education (ATE) grant, the model uses low-cost 3D printers, open-source software, and an easily implemented curriculum to make AM education accessible to diverse learners, including those in rural and underserved areas.

Through online professional development and subsequent student engagement, Kentucky K-16 teachers have leveraged advanced knowledge of additive manufacturing (AM) to showcase the economic and technological potential of 3D printing in their communities. Evaluation data shows notable AM skill improvements, including understanding engineering mechanics, mastering CAD software, and troubleshooting 3D printers. By blending online courses, in-person workshops, and scalable materials, this model overcomes logistical barriers and promotes widespread adoption.

Looking forward, the program offers a scalable template for introducing AM education nationwide. It prepares students for 21st-century careers while fostering local economic growth. Future efforts aim to expand dual-credit enrollment, refine instructional materials, and align education with industry demands. With its practical, accessible approach, the AdvanceKentucky Influencer Model positions itself as a leader in transforming STEM education through additive manufacturing.

Keywords: additive manufacturing, academic influencer, 3D printing, professional development

Introduction

Since the rise of social media platforms such as YouTube, Instagram, and TikTok, with content creators generating thousands and sometimes millions of followers, the term “influencer” has become more mainstream. Social media influencers often generate engagement around lifestyle choices, branding, and sales of their endorsed products. Similarly, academic influencers can leverage their expertise, professional reputations, collaboration, and networking to foster engagement in students, fellow academics, educational leaders, and even leaders of industry to bring topics once only discussed in traditional research and application settings outside academic circles to a more accessible and broader audience. Academic influencers have bridged the gap between academia and the public as well as the private sector, producing a more equitable environment for topics previously considered out of reach. Additive manufacturing (AM) is one of those topics.

Since its inception in the 1980s, additive manufacturing (AM), also known as 3D printing, has become a key innovation driver in the manufacturing industry [1]. AM gained significant attention during the COVID-19 pandemic due to supply chain disruptions and the shortage of Personal Protective Equipment (PPE) in medical environments, highlighting its advantages and making it particularly appealing to K-16 STEM educators [2]. Many higher education programs now incorporate AM into their curriculum through rapid prototyping, beta testing, tactile learning, visualization, and research [3], and introductory AM design and post-processing techniques are being introduced to students as young as elementary school. Academic institutions, especially those with a Career and Technical Education (CTE) focus, have diversified their AM courses by offering online, in-person, and hybrid formats to prepare students for the post-COVID, 21st-century job market with skills in AM product development, analysis, and testing.

Despite the growing need to prepare the current and future workforce with skills in AM design, maintenance, post-processing, and materials, resources for training engineers and technicians in these new and complex technologies remain limited. While some models, such as the NSF ATE-funded Rapid Tech Center at the University of California, provide hands-on training in AM and rapid prototyping for undergraduate and graduate students [4], there are few comparable training models for community college, secondary students, or educators. One project at Mohawk Valley Community College, based in Utica, New York, featured a remote AM lab-sharing model with coursework for high school and college students [5]. However, teacher training in 3D printing has primarily focused on webinars, one-day training, and summer programs [6, 7, 8], with no known professional development programs to date offering long-term college training and opportunities for industry certification. The development of an AM-literate workforce is a priority for several funding agencies [9, 10], and various funded projects have focused on creating AM-related curricular materials, Massive Open Online Courses (MOOCs), and training workshops [11]. Additionally, many design and manufacturing courses have integrated AM-specific modules into their instruction [12].

Innovations in the educational delivery of AM have been practiced in several ways, like train-the-trainer workshops, studios, remotely accessible laboratories, and mobile learning platforms. Compared to traditional learning paradigms, learning AM in these new ways has provided several benefits to rural and underserved area students, teachers, and industrial practitioners [13]; however, the delivery of instruction to rural and underserved students has produced additional logistical and cultural challenges including 1) time and distance to travel to training locations, 2) the cost of AM equipment and materials needed for training, 3) the lack of local industry partnerships to provide student internships and real-world application, and 4) the need for more rural teachers who have an understanding of AM and 3D printing applications.

To address the rural and underserved AM education challenges, Somerset Community College (SCC), one of sixteen public learning institutions in the Kentucky Community and Technical College System, acquired NSF Advanced Technological Education grant funding in 2019 (NSF DUE #1902437**)** in partnership with Tennessee Technological University (TTU) to develop a mobile additive manufacturing program (Mobile AMP). The grant provided funding to equip a trailer with 3D printers and other tools to travel to schools to demonstrate 3D printing technology through educational events across Kentucky and Tennessee (See Figure 1).

When COVID-19 closed in-person access to educational institutions, the Mobile AMP project was forced to shift focus to take what had been face-to-face training and develop a methodology for providing completely online training. Since one of the cultural challenges was the need for more rural teachers to have exposure to AM and 3D printing, the program focused on professional development for teachers. To garner access to a network of K-16 teachers, SCC partnered with AdvanceKentucky, an initiative of Kentucky Science and Technology Corporation, utilizing its connections to K-16 teachers and support from the Kentucky Department of Education to create the CS+Additive Manufacturing Initiative. AdvanceKentucky then recruited educators to take a Digital Printing Technology course (DPT 100). At the end of the semester, teachers who took the course requested more instruction, leading to AdvanceKentucky recruiting a second cohort of DPT 100 participants and SCC offering DPT 150 Introduction to Engineering Mechanics for 3D Printing to the first cohort. The process continued and became coined as the AdvanceKentucky Influencer Model. The goal of the model was to make AM education more accessible to K-16 students statewide through the training of AM educator "influencers" in their home communities.

Fig. 1. The Mobile AMP trailer featured with faculty and administration from Somerset Community College and Tennessee Technological University

After several teachers had been trained, Tennessee Technological University (TTU) offered an in-person workshop to groups of teachers from both Kentucky and Tennessee to provide more advanced technician programming and resources.

This original paper reports the practices and findings of the NSF and Kentucky Department of Education-funded programs implemented in Kentucky and Tennessee. The authors will highlight the practices they conducted and present the evaluation results they collected from the participants

Key Program Elements

One of the key elements of the AdvanceKentucky Influencer Model has been the role of the community in the dissemination of AM opportunities and applications. Through creating very specific assignments and lecture materials that are part of the curriculum given to the teachers, the teachers and the students have become community influencers and advocates for 3D printing. By requiring students to design and 3D print products similar to those found in modern-day automotive, aerospace, and industrial fields and then encouraging the students and/or teachers to post pictures of those designs and products, the assignments themselves have become marketing materials. Once family or adult friends, being those who work in or own the local manufacturing industries, see these designs and products, they not only recognize them but also become curious as to how the students are making them. This leads to conversations with the students and teachers, who also have been trained through the curriculum about the value of AM technology and its future, including the economics of it. This, in turn, has spurred the family or adult friends to see the technology's economic potential or, at the very least, want to learn more. Eventually, these community members reach out to the teacher who will then connect them to those responsible for potential workforce training, and the community begins to embrace the technology and benefit from it economically.

A second key element of the model is its ease of scalability. To increase the likelihood of success and sustainability, attention was given to elements of the model that would negatively impact scalability, particularly the costs of 3D printing hardware and related software, the difficulty in delivering the curriculum across a variety of learning management systems (LMS), and the amount of time and effort necessary for a teacher to replicate the curriculum in their own classroom. These factors were evaluated for minimization as much as possible.

To address cost, the management team provided participants with a 3D printer that was approximately $500 or less, as this represented a cost that could likely be tolerated by most educational budgets for the purchase of additional machines for a lab. To address curriculum delivery and time needed for implementation, all software used in the curriculum was made open-source or free for students and teachers. For this model, the curriculum was hosted on a cloud server so any teacher could simply use a single hyperlink from within their school's particular LMS access and deliver it to students. Most importantly, though, the curriculum, including all lessons, quizzes, assignments, grading keys, etc., was fully packaged, free, and fairly easy for the teachers to implement in their classrooms. Otherwise, many teachers simply would not have the time and resources to begin teaching the courses. The daily educational challenges and responsibilities would eventually overcome the teacher's resolve, and like many educational initiatives, it would be forgotten.

Methods

The methods used to summarize the data in this paper are a combination of quantitative descriptive statistics and qualitative responses from surveys. Descriptive statistics included cumulative totals of DPT teacher participants, DPT enrollment across all KCTCS institutions, disaggregated by type of institution employed, and demographics including sex, race, ethnicity, and socioeconomic status as indicated by Pell eligibility.

Instruments

The evaluation of the DPT 100 and DPT 150 courses, and the workshops used retrospective pretest surveys to assess participants' attitudes, opinions, and perceptions of knowledge gained. The instruments were designed to capture both quantitative and qualitative data. The surveys measured self-reported improvements in awareness, understanding, and abilities in 3D printing technology, engineering mechanics, and related software. Both the courses and workshops focused on practical skills and knowledge in additive manufacturing, with Likert-scale and open-ended questions to gather more detailed feedback. The project evaluator developed the instruments in consultation with the project team.

Data Collection

Data were collected via the online Qualtrics platform to ensure accessibility and flexibility for participants. For the DPT 100 and DPT 150 courses, students completed retrospective pretest surveys at the end of the semester to assess their knowledge and skills before and after the courses. For the workshops, participants completed similar surveys immediately after the sessions. The evaluator also attended several in-person sessions to conduct unstructured interviews and observations, providing additional insights into participant engagement and instructional effectiveness. Unstructured interviews with Principal Investigators (PIs) were conducted to further contextualize the survey data.

Data Analysis

Data from the courses and workshops were analyzed using quantitative and qualitative methods. Quantitative data were analyzed through descriptive statistics, and Net Promoter Scores (NPS) were calculated to evaluate participant satisfaction and the likelihood of recommending the courses or workshops. Qualitative data, including open-ended survey responses, field observations, and PI interviews, were analyzed using thematic and inductive coding to identify key themes and patterns. By integrating these analyses, the evaluation comprehensively assessed the courses and workshops' impact on participants' knowledge, skills, and satisfaction.

Results and Discussion

The results of the program are broken down into two categories and time frames. For Kentucky AM, training spanned from Fall 2020 to Spring 2024. Participants included 201 educators. Summary statistics also included the number of students across all KCTCS institutions in the same time frame to demonstrate how teacher training of "influencers" jumpstarted dual-credit enrollment and community college credit-seeking enrollment for AM students across all KCTCS institutions.

For Tennessee, summary statistics and survey results were included for participants of an in-person workshop at TTU in June 2024. In addition to educators from Tennessee, some of the workshop participants included Kentucky DPT teachers.

Kentucky AM Participants

For the Kentucky component of the program, teachers recruited by AdvanceKentucky initially participated in an asynchronous DPT 100 course through Somerset Community College. Specific demographic information of participants was not collected outside of the type of school where the teacher was employed. The number and totals of participants per type of educational institution are summarized in Table 1.

Table 1. Number of participants in the SCC DPT 100 course by semester disaggregated by grade band and type of educational institution where employed (*N* = 201)

Semester	Total Participants	ELEM	MS	HS	ATC	CC	Other
Fall 2020	18	1	5	5	3	0	4
Spring 2021	22	3	3	7	2	0	7
Summer 2021	25	8	5	4	4	0	4
Fall 2021	12	2	1	5	4	0	0
Spring 2022	20	1	7	7	5	0	0
Fall 2022	25	0	6	16	1	0	2
Spring 2023	20	0	2	10	8	0	0
Summer 2023	18	7	5	2	2	0	2
Fall 2023	13	2	1	10	0	0	0
Spring 2024	28	1	10	11	4	2	0
Category Totals	201	25	45	77	33	2	19

After taking the DPT 100 course, each teacher-participant received a 3D printer with supplies to use in their classroom, and those teaching at the high school, ATC, or community college level had the opportunity to 1) offer the course as a dual-credit course to their students in partnership with a participating KCTCS institution and 2) take additional DPT courses, including DPT 150 and DPT 280, the AM program's capstone course. Teachers who completed the three-course sequence and had at least two technical electives and a business course requirement had the option to apply to Somerset Community College as a certificate-only student to receive a 3D Printing Technician Level 1 industry certificate. By May 2024, a total of 15 Kentucky teachers had obtained the technician certificate, and 2,105 students had enrolled in DPT courses as AdvanceKentucky participants, credit-seeking, high school dual-credit, and other non-degree students across thirteen of sixteen total KCTCS institutions. Demographics for the 2020-2024 enrollments are shown in Table 2.

Table 2. DPT enrollment across KCTCS institutions from Fall 2020 to Spring 2024 Classification

College	Cred-Seeking	High School	Other Non-Degree	For-Credit Workforce	Totals	% Female Students	% URM Students	% Pell Eligible
Ashland	242	21	2	*	265	13.6	6.4	54.7
Big Sandy	13	79	*	*	92	21.7	13.0	5.4
Bluegrass	*	75	*	*	75	20.0	16.0	*
Elizabethtown	52	23	2	*	77	16.9	18.2	28.6
Gateway	40	2	*	*	42	21.4	11.9	42.9
Hazard	13	56	*	*	69	10.1	7.3	15.9
Hopkinsville	122	3	*	*	125	15.2	25.6	53.6
Jefferson	98	297	*	1	396	27.0	49.9	8.6
Madisonville	42	80	*	*	122	12.3	19.8	13.1
Owensboro	31	1	1	*	33	6.1	12.1	45.5.
Somerset	278	245	10	217	750	25.3	13.2	21.2
Southcentral	10	*	*	*	10	0.0	40.0	50.0
Southeast	10	38	1	*	49	20.4	4.1	12.2
Totals	951	920	16	218	2105			

*Note: * indicates no students in those sections or numbers not reported by the institution*

By Spring 2024, a total of 201 K-16 Kentucky educators had participated in the DPT 100 course over ten semesters. The impact across the state is illustrated in Figure 2.

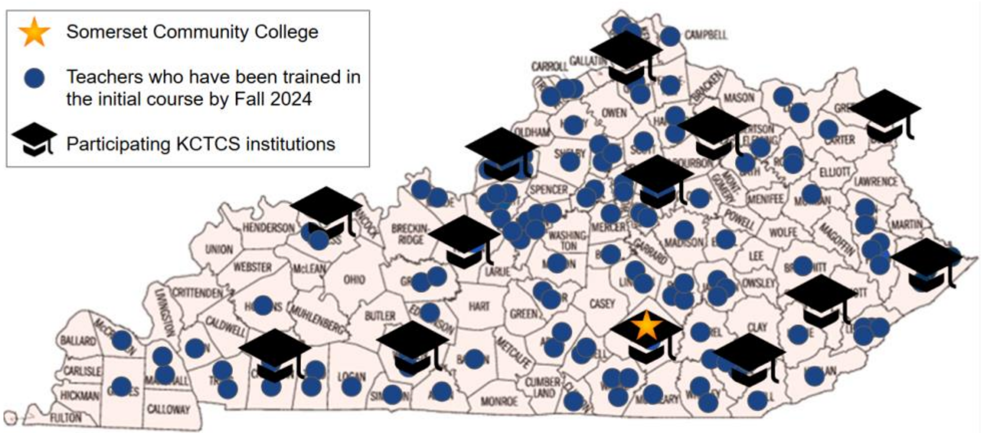

Fig. 2. Counties in Kentucky where K-16 teachers have taken at least one AM course

At the end of each semester of teacher training, participants also had the option to attend an in-person workshop at Somerset Community College to receive more advanced CAD design instruction along with slicing, troubleshooting, and maintenance instruction for their 3D printers, the type of training that industry professionals often refer to as "dialing-in." Fifty of the 201 participants attended in-person workshops from Fall 2020 to Spring 2024 (See Figure 3).

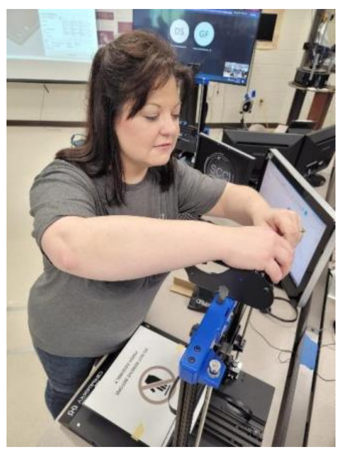

Fig. 3. Teacher participant during an in-person workshop at Somerset Community College

Findings From the Courses and Workshops

The evaluation employed a retrospective pretest approach for all surveys, as the focus was on participants' perceived understanding, knowledge, and skills gained rather than objective performance measures. The retrospective approach provides a more accurate picture of self-reported learning outcomes as it minimizes response shift bias. Thus, the findings presented here summarize the pretest-posttest differences in participants' self-assessments, capturing their perceived growth in AM competencies over the course of the training.

DPT 100 Courses

Participants in the DPT 100 courses reported significant improvements in their awareness, knowledge, and abilities related to 3D printing technology. The net promoter scores for the DPT 100 course ranged from 57% to 100%, suggesting variability in participant satisfaction across different cohorts. This range indicates that while some participants exhibited moderate enthusiasm, others reported highly positive experiences, which may reflect differences in instructional delivery, course content alignment with expectations, or participant engagement levels. Across all cohorts, participants reported enhanced three-dimensional visualization skills, understanding of 3D printing software applications, operating systems, and using 3D printers in various sectors and settings, including business, education, and home. Additionally, participants developed an increased awareness of software distribution, cloud computing, and available online resources for troubleshooting and support. The teachers noted considerable gains in their conceptual understanding, particularly in relation to 3D printing materials, terminology, and the ethical considerations associated with additive manufacturing. In the words of one teacher, *"This course provided invaluable insights into the selection of appropriate 3D printing materials, which I can now confidently apply in my own classroom."*

In terms of practical skills, participants reported increased competence in tasks such as managing 3D printing files, utilizing CAD tools for model manipulation, and conducting basic printer maintenance. These skills were frequently identified as having immediate applicability in educational and professional contexts. One participant remarked, *"Mastering Fusion 360 has given me the confidence to create and troubleshoot 3D models from the ground up—something I never imagined being able to do."*

DPT 150 Courses

Participants in the DPT 150 courses reported improvements in their comprehension of engineering mechanics and its applications to 3D printing. The net promoter scores for the DPT 150 course were consistently 80% across course offerings, indicating a stable level of participant satisfaction across different cohorts. Many participants indicated that their understanding of foundational mechanical principles—such as force, stress, and deformation—was substantially enhanced. These principles were identified as critical for designing structurally sound 3D-printed objects. The courses also facilitated notable skill development in the use of software for design and failure analysis, as well as in the application of industry-standard techniques to optimize design performance. It additionally included training in the use of highly advanced Artificial Intelligence (AI) applications nearly five years before the ChatGPT explosion. Participants expressed confidence in their ability to make custom modifications to improve the functionality of 3D-printed objects. One participant stated, *"The ability to analyze my designs for structural integrity before printing has already proven invaluable in my work."* Participants praised the depth of the course material covered, particularly in relation to advanced techniques such as topology optimization and the use of lattice structures. As one participant observed, *"Generative design has opened up new possibilities for creating innovative and efficient solutions in my engineering projects."* Another participant expressed enthusiasm about using these skills in their teaching, stating, *"This course has equipped me with the knowledge to introduce my students to the real-world applications of 3D printing in engineering and manufacturing."*

Workshops

Participants in the 3D printing workshops reported notable improvements in their understanding, practical skills, and confidence in the application of 3D printing technologies. The net promoter scores for workshops averaged around 80%, indicating a high level of participant satisfaction and a strong likelihood of positive word-of-mouth recommendations. Most participants reported entering the workshops with limited prior experience and developing a significantly enhanced understanding of the key concepts covered, including 3D printing terminology, relevant software tools, and basic hardware troubleshooting techniques. One participant remarked, *"I now feel adequately prepared to incorporate 3D printing in my classroom, particularly for creating instructional materials like prototypes."* This shift in knowledge was observed across multiple workshops as participants progressed from foundational knowledge to more advanced comprehension.

Participants expressed increased confidence in applying the skills acquired through the workshops, particularly in designing educational projects that integrate 3D printing. Many educators indicated a strong intention to incorporate 3D printing technologies into their curricula, aiming to foster student engagement through real-world problem-solving activities. One educator noted, *"I anticipate using 3D printing to encourage my students to explore creative solutions to real-world engineering challenges."*

The practical, hands-on nature of the workshops was highly valued. Participants reported meaningful improvements in key skills, such as managing 3D models using CAD software, addressing hardware issues like bed adhesion, and utilizing slicing software to optimize print quality. As one participant reflected, *"The hands-on activities were instrumental in helping me overcome significant challenges, such as troubleshooting and maintaining the printer."* These skills were viewed as directly applicable to both instructional and professional environments, with participants indicating their readiness to implement them in practice.

While participants anticipated that the knowledge and skills gained from the workshops would benefit their students, estimates of student impact were generally moderate. Despite the overwhelmingly positive feedback, some participants suggested that extending the duration of the workshops would allow for a more comprehensive exploration of advanced topics, including 3D modeling, advanced slicing techniques, and hardware upgrades. Overall, the workshops were praised for their practical orientation, with one participant stating, *"This was an enriching professional development experience, and I am already applying what I have learned to enhance my instructional practices."*

Conclusion

Findings from the AdvanceKentucky Influencer Model program evaluation revealed a positive impact on educators, enhancing their knowledge, skills, and confidence in integrating 3D printing technologies into their teaching. Participants reported notable improvements in their understanding of 3D printing concepts, software tools, and troubleshooting techniques compared to their pre-training abilities. Moreover, the hands-on, industry-relevant training enabled educators to create engaging and practical STEM experiences for students, bridging theoretical learning with real-world applications.

The program’s implications for future work are profound, positioning educators to introduce advanced additive manufacturing (AM) concepts and transfer this knowledge to students as early as elementary school. Its scalability is particularly promising, with the potential for broader adoption through institutional collaboration, teacher-to-industry networking, and additional skill training. Furthermore, participants expressed a strong interest in extended workshops and more advanced AM topics, emphasizing the need for ongoing professional development to deepen expertise and sustain long-term impact. The model shows promise to be especially effective in states similar to Kentucky, where centralized community college structures support rapid program deployment and dual enrollment opportunities, making it a template for similar educational systems nationwide.

Additionally, teachers learning AM skills and integrating them into their day-to-day delivery of instruction become AM “influencers” in their schools and communities by actively modeling enthusiasm, integrating hands-on learning, and sharing success stories through social media, newsletters, and local events. They can also influence others by providing training for fellow educators through peer workshops, professional development sessions, and mentorship programs or engaging the community by hosting innovation nights, partnering with local businesses, and involving parents. Connecting with broader networks, presenting at conferences, and collaborating with industry professionals can further establish their AM credibility and expand their impact. By taking these steps, teachers have the opportunity to inspire change and drive innovation in education, reinforcing AM as a crucial skill for the future workforce.

Looking ahead, the model offers immense potential for scaling new educational initiatives across diverse socioeconomic and geographic contexts. In Kentucky, the program is approaching critical mass, with exponential growth in student dual-credit enrollment on the horizon. Future enhancements will likely involve refining instructional materials to better align with community workforce, and AM industry needs and further solidifying the model's role in preparing students for technological job demands while fostering local economic and educational development through longitudinal analysis of the data.

This growing network of AM-trained educators strengthens STEM education and cultivates a culture of innovation that extends beyond the classroom, equipping students with the skills and mindset needed for the evolving workforce. By continuing to expand access, foster industry connections, and refine instructional strategies, the AdvanceKentucky Influencer Model has the potential to serve as a national benchmark for integrating AM into K-12 education. With sustained investment and collaboration, this initiative will empower the next generation of educators and students, ensuring they are prepared to thrive in an increasingly technology-driven world.

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Disclosures
The authors declare no conflicts of interest.

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