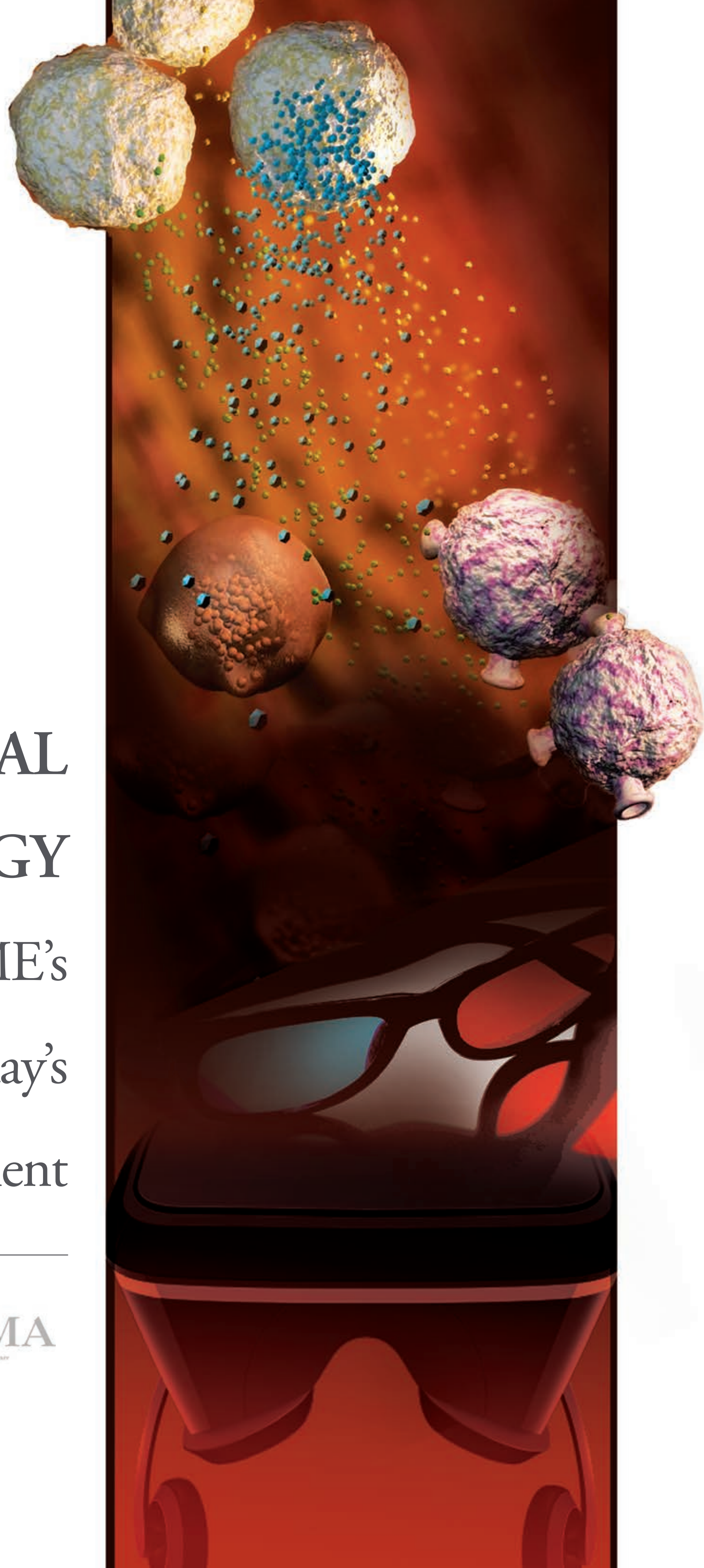
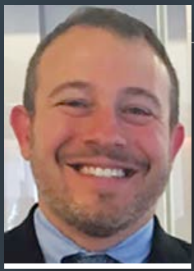
Using VIRTUAL TECHNOLOGY *to* Advance CME's Role *in* Today's Healthcare Environment



Med Learning Group | UMA

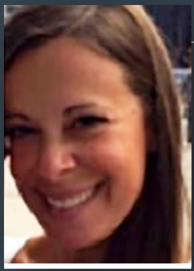
A DIVISION OF ULTIMATE MEDICAL ACADEMY

Matthew Frese, *General Manager & Vice President*



Matthew Frese, General Manager for Med Learning Group, is responsible for the development and implementation of the vision and mission of MLG's continuing medical education programming. Matthew has more than 12 years of experience in the Continuing Medical Education arena. Matthew specializes in the development of innovative approaches to continuing education programming and the development of unique partnerships with academic health institutions, scientific associations, patient advocacy groups and large healthcare systems to provide continuing education and data solutions. Matthew has also served as a volunteer Site Surveyor for the past 7 years on behalf of the Accreditation Council for Continuing Medical Education. This professional background provides Matthew with a well-rounded perspective on the Continuing Medical Education enterprise, from innovative program development and accreditation to program implementation and outcomes. Matthew holds a B.A. in Psychology from Quinnipiac University and an M.B.A from Quinnipiac University School of Business.

Christina Gallo, CHCP, *Senior Vice President, Educational Development*



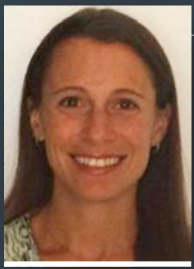
Christina Hosmer-Gallo, CHCP is the Senior Vice President of Educational Development at Med Learning Group. She has over 17 years' experience in the medical education arena, specifically in the educational development and implementation of national and global programming. Christina is responsible for a team of program managers, project coordinators and recruitment solution architects, who are charged with implementing and delivering our educational activities. Christina's deep understanding of the adult learning principles, upon which our programs are based, allows her to ensure that all projects are realized with the appropriate spirit and vision.

Andrew Grzybowski, *Sr. Vice President Educational Partnerships*

Andrew leads the partnerships and collaborations department at Med Learning Group. Within this role he is responsible for external contact with numerous groups including, granting organizations, patient advocacy groups, medical societies, technology providers and government agencies. Andrew has a great understanding of the value of partnerships and collaborations in the CME space which allows for our education to reach more practitioners and be more impactful in improving patient care.

Andrew has over 8 years' experience as a medical professional, previously working at Quintiles Medical Education where he was Director of Medical Educational and Grants. Having experience in numerous arms of clinical development and medical affairs has allowed Andrew to bring unique and impactful perspectives on MLG's current and developing educational initiatives.

Lauren Welch, *Vice President of Outcomes and Accreditation*



Lauren leads Med Learning Group's departments focused on educational outcomes analysis and accreditation policies and implementation. She is responsible for developing and reporting on the outcomes of our educational activities, analyzing impact on knowledge, practice, an collaboration with patients and their care teams. Reviewing outcomes across the life of our programs, Lauren provides input to our program management team to ensure our content and learning formats are meeting our learning objectives, addressing system-based needs, and ultimately helping physicians improve patient care. Lauren also maintains Med Learning Group's accreditation department, ensuring all activities are compliant with ACCME requirements and are conducted within the spirit of the guidelines with a focus on improving patient care.

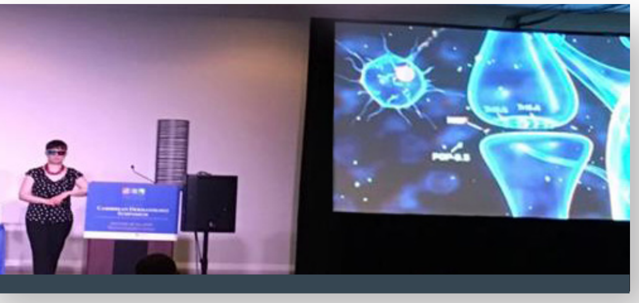
Before joining Med Learning Group, Lauren worked with the Department of State for eight years. Lauren contributed to the development of the annual U.S foreign assistance budget, with a particular focus on programs in health and education. While in South Asia, Lauren helped implement healthcare support in countries across the region, and justified budget requests for international health programs to the U.S. Congress. Lauren holds a MA in International Development Studies.

Mazi Rasulnia, Ph.D.

Mazi has over 10 years experience in strategic planning, quality improvement, and outcomes and performance assessment. Mazi consults with various healthcare organizations including pharmaceutical companies in developing practical approaches to measuring impact and effectiveness of communication and adherence programs. Mazi also serves as adjunct faculty of the University of Alabama, Birmingham, School of Public Health. Mazi graduated with a bachelor of science in Biology from the College of William and Mary and he holds a MPH, MBA, and PhD from the University of Alabama, Birmingham. He was also a fellow at the Center for Outcomes and Effectiveness Research and Education (COERE).

INTRODUCTION

The continuing medical education (CME) industry constantly faces the challenge of engaging learners in a manner that facilitates recall and advances practice change. There are new and innovative uses of technologies that provide a more diverse and immersive learning experience, which has the potential to improve CME outcomes. As Dr. Lila Davachi and her colleagues point out, dopamine is an important neurochemical in terms of capturing an individual's attention, and "varying learning techniques provides additional novelty that can help raise dopamine levels to keep the learner's attention in the learning environment."1 In particular, by projecting participants inside a patient's body and forcing learners to use a variety of senses at once, virtual technologies can better hold their attention, improve their comprehension, and facilitate their recall compared with strictly didactic lessons.[1]



Some of these technologies include virtual reality (VR). VR is "an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one's actions partially determine what happens in the environment."[2] VR is currently applied in a variety of ways in the healthcare industry, such as helping surgeons visualize a surgery, aiding chronic patients in relaxation, allowing long-term patients to participate in outside activities, supporting rehabilitation of traumatized nervous systems, making repetitive motion exercised more fun, to name a few uses.[3] Specific examples of current VR use in the healthcare industry include[4–6]:

- The University of Texas use of VR training in equipment and surgical scrub protocols;
- Use of VR to support veterans' recovery from post-traumatic stress disorder by having them view virtual recreations of their experiences in war in a safe environment;
- Cleveland Clinic's use of innovative hospital systems towards replacing cadavers with virtual bodies; and
- University of Southern California's Center for Body Computing's discovery of ways for using virtual healthcare providers (HCPs) that can provide patients with answers to their questions in a judgement-free environment, on their own time, and in their own space.

Albert "Skip" Rizzo, PhD, is a psychologist at the University of Southern California's Institute for Creative Technologies in Los Angeles who is leading the VR treatment for PTSD effort. "We're not just talking about skill learning," he said. "We're talking about creating virtual experiences that may be well-matched to the needs of certain clinical applications."[4] While these may be examples of organizations at the forefront of this innovative approach to healthcare and training, the demand is only expected to grow, with global industry analysts projecting that the worldwide market for VR in healthcare will reach $3.8 billion by 2020.[4]

This growing demand and the continued demonstration of progress through innovative technology have motivated Med Learning Group (MLG) to incorporate this technology into the CME industry. One of MLG's key objectives is to integrate innovations in the adult-learning and healthcare-training settings into our overall mission to improve the quality of care delivered by HCPs and, ultimately, patient outcomes. As more HCPs utilize VR in training and their practices, their awareness of its impact on learning and practice can lead to greater expectations for immersive education.

With this in mind, MLG conducted extensive research on the impact of immersive technologies like VR in our medical education. Through our literature reviews on the value of virtual technologies, we have found that such technologies can 1) improve engagement, 2) enhance recall, and 3) facilitate greater comprehension. Based on these findings, MLG incorporated these technologies into its CME and quality- improvement initiatives. Over the past three years, we have designed and implemented 14 programs incorporating three-dimensional (3D) technology and 12 programs incorporating VR using Oculus headsets. In each program, scripted 3D or VR animations that align with each particular program's learning objectives are interspersed among didactic lecture and case-based question and answer (Q&A) sessions. To this point, our animations have focused on disease pathophysiology, treatment targets, therapeutic agents, disease comorbidities, and understanding the molecular features of relapses.

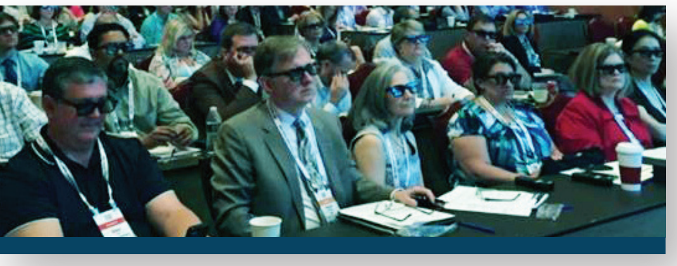
Of particular note, MLG has developed CME targeted towards person-centeredness and patient engagement. As the National Quality Strategy states, "When patients' needs, experiences, perspectives, and preferences are taken into account—and when they get the clear and understandable information and support they need to actively participate in their own care—outcomes and patient satisfaction can improve."[7] 3D and VR modeling can support this goal. Given that "human brains are wired to understand models in the way VR presents them," VR "removes levels of abstraction and helps people communicate directly about the same thing."[8] Mary Spio, CEO of Next Galaxy, commented that VR "is going to be instrumental in the training and education of not just health care workers and medical professionals, but also patient education" by helping them visual what procedures and treatments will do for them, which can substantially increasing buy-in and adherence.[9]

MLG has also designed its 3D and VR animations to be systemic in nature, seeking not only to address individual physician needs but to also improve care coordination and HCP-patient dialogue by providing our virtual animations via downloadable toolkits that can be used in the practice setting. Participants who download a 3D or VR scripted animation receive 3D glasses or Google Cardboard VR glasses, respectively, to share with their patients. Patients and their HCPs view the toolkits, which have been developed with new scripts directed toward patients in order to help activate awareness about their disease and treatment options and help spark more dialogue.

We have recently conducted an analysis of outcomes across these innovative programs to determine their impact on learning and practice. We have also looked at how these outcomes compare with the results of some of our more traditional, passive programs—composed largely of didactic lecture with case-based Q&A—to measure the extent to which these animations can improve the advancement of translating knowledge into practice and, in particular, can support the collaborative relationships between HCPs and their colleagues and patients.

This white paper provides an overview and comparative analysis of the research highlighting the potential impacts virtual technologies can have on education and then examines the extent to which our 3D and VR programs achieved these enhancements in our education, particularly in terms of the virtual tools provided to participants for use in their practices and their direct impact on quality of care. We hope this white paper serves as a call to action to CME stakeholders to continually strive to incorporate innovation into CME activities and develop unique learning tools that can be used in practice, which will further substantiate CME's pivotal role in achieving the triple aims of the National Quality Strategy.

WHY USE VIRTUAL TECHNOLOGIES TO EDUCATE?



Our literature review on virtual technologies—3D and VR animations, in particular—found that these technologies provide a unique learning opportunity for HCPs to interact with content and personalize their educational experience. 3D and VR are innovations that can play a role in CME to enhance knowledge, skills, and practices of HCPs. These technologies enhance the learning experience by maintaining learner engagement, facilitating recall, and improving comprehension.

Greater Learner Engagement

The first primary goal of integrating 3D and VR animations into CME programs to enhance CME effectiveness is audience engagement. Research indicates that use of these visual technologies in education grabs learners' attention, while personalizing the learning experience. As Jusko of AVRover pointed out, "the more of our senses engaged in a particular activity, the more neural a ctivity, the more learners remember and retain."[10] Given that approximately 80% of our sensory input comes from our visual system[11] and that we see the world multi-dimensionally, it makes sense that viewing and "playing with" an object in 3D or VR would enhance our learning of how it works.[12] Furthermore, in Bamford's 2011 study of 3D education in classrooms across seven European countries, teachers consistently reported higher attention spans and greater motivation to participate and engage in lessons involving 3D animations.[13]

Enhanced Understanding

The second primary goal is the simplification of complex information to increase comprehension. Research suggests that 3D and VR animations can facilitate learning and comprehension by presenting information in the most economical manner possible, thereby simplifying large amounts of complex facts and complicated and abstract ideas. Visual learning allows participants to see the whole of something, leading to a better understanding of its functionality.[13] Bertoline and his colleagues pointed out that details in VR models (eg, contours, colors, and shadings) contribute to making a subject easier to understand.[11]

Several studies have concluded that 3D and VR technologies increase understanding in the medical field. For example, the health-sciences faculty at Linkoping University in Sweden conducted a study in which they used high-resolution computed tomography and magnetic resonance images from clinical research to incorporate high-quality 3D visualizations into healthcare curricula. The investigators found that the 3D images stimulated students to better understand biological variations among organs. They concluded that "3D visualizations based on authentic, viable material provide a new dimension for learning material in anatomy, physiology, and very probably, pathophysiology."[14] Interestingly, some studies are showing the degree of immersion can also correlate to the impact on comprehension. For example, in a study with medical students at the University of New Mexico, one group used a fully immersed VR environment employing a head-mounted display (HMD) and another group used a partially immersed (computer screen) VR environment. The study found an overall positive effect of VR simulation on learning as reflected by improvements in knowledge structure; however, using an HMD in full-immersion learning had an enhanced effect versus a screen-based VR system.[15]

Improved Retention

The third goal is education retention. As Jusko explained, "when objects are perceived to be within our haptic envelope, that is, the immediate space around us where we feel we can reach out and touch any given object, these neurons are activated, thus engaging more of our neural pathways and resulting in a stronger memory."[10] By providing participants with what Bettex describes as a glimpse at an entire concept, 3D animations provide all the information needed at once. Considering that human cognition includes a limited working memory when taking in new information, this immediate rendering of the whole picture improves the ability of learners to store information effectively in their long-term memory.12 Similarly, studies have also shown that VR can improve recall of what has been learned. For example, Andersen and colleagues conducted a study on retention of mastoidectomy skills with participants who took part in VR-simulation training. Of the 39 participants, 36 largely retained the skills gained via VR after three months. The authors concluded that "Complex psychomotor skills should be regularly reinforced to consolidate both motor and cognitive aspects, and virtual reality simulation training provides the opportunity for such repeated training and should be integrated into training curricula."[16]

ADDRESSING CHALLENGES OF 3D/VR INCORPORATION INTO MEDICAL EDUCATION

While highlighting the potential benefits of incorporating visual technology into education, it is also important to identify its challenges. For instance, sole dependence on this technology may actually make instruction more complex if it is new to users and they must learn how to manipulate it on their own, while simultaneously trying to achieve their original educational objective. In addition, reliance on virtual technology for education does not prove beneficial if it is not a component of a larger program. Research indicates that the impact of 3D and VR technology in medical education depends on the extent to which it is used to complement a planned curriculum or agenda.

After studying several 3D educational experiments, Bettex of GE Healthcare found that only those 3D models that are simple a nd well-conceived can enhance learning.[6] When not used appropriately, 3D technology can turn a reasonably simple task into a frustrating experience. Bettex emphasizes that 3D technology fulfills its purpose only if it has an ancillary role in education, providing additional information and is not used simply for its own sake.[6] In the Linkoping University study, making 3D images an accessible part of the existing curriculum was given a high priority, allowing them to contribute to students' knowledge and comprehension in conjunction with lectures and textbooks.[14] Bettex emphasized the importance of using 3D animation to provide additional information.[12]

Other challenges in using VR as a CME tool are choosing the right platform of VR technology for your learning objectives and consideration of your faculty's and learners' understanding of how to incorporate such technology into overall education. These issues need to be considered and addressed before embarking on VR education. As Aziz and colleagues wrote, "the novelty of the use of virtual worlds for education brings with it the challenge of developing pedagogical understandings around the relationship between the use of synthetic experiences and the educational context."[17] If VR is not incorporated as an ancillary component of an educational initiative and if participants' comfort and capabilities with the VR tools are not considered, the positive impact that the technology can have on learner engagement, understanding, and retention can easily be lost.

We considered these challenges and took several actions to overcome them in our programs that incorporate 3D and VR animations. First, our scientific staff collaborated with the faculty on the 3D and VR images from the very beginning. Experts in the various medical specialties identified what images made the most sense to produce in 3D and VR, given the therapeutic area and learning objectives. Faculty wrote their own scripts to accompany the 3D and VR animations and ensure for seamless incorporation of the 3D and VR display into the lecture. Failing to include faculty in the design of 3D and VR interventions could well have diminished the images' influence on comprehension. Collaboration with faculty is essential to ensuring that animations have the desired impact on the effectiveness of CME.

Second, MLG also emphasized such integration in its own CME programs. For both the online and live programming, 3D and VR animations were introduced to complement the faculty's lecture. In the psoriasis programs, for example, 3D and VR animations of how current and emerging therapies function inside the body played out in sync with an audio recording of the faculty. Without that timed voiceover, learners would likely not have understood the images. In addition, just as the learners indicated high levels of satisfaction with the 3D and VR effects, they also gave high ratings to the programs' case studies and associated Q&A. They indicated that practice in making treatment decisions based on sample patient scenarios helped them understand how to apply the education to their practice. In this sense, the components of our learning format—didactic lecture with slides, case-based presentations, and 3D/VR animations—all worked together to reach the desired educational outcomes. Therefore, it is critical to view 3D and VR animations as another tool that, when integrated into existing learning methods, can greatly enhance CME.

Of note, once animations are created, they serve a variety of purposes and can be used repeatedly for far-reaching impact. They can also be modified to address the latest updates in clinical evidence. Well-planned and executed 3D and VR animations offer CME providers an engaging means by which to connect with their learners in a way that improves medical practice and ultimately leads to better patient outcomes.

The first step was to recognize the opportunities that virtual technologies offer for improving the educational experience and outcomes. Second, it was important to identify ways to overcome the challenges of their integration. Once these steps were completed, in 2013 MLG began integrating 3D and then VR into its CME programs.

IMPACT OF 3D AND VIRTUAL REALITY ON CME

Methodology

MLG analyzed the outcomes of 14 3D and 12 VR live and online educational programs conducted between 2014 and 2016 across a variety of disease types to determine whether the incorporation of 3D and VR animations did indeed have the impact on learning suggested by our literature review, ie, enhancing learner engagement, facilitating recall, and improving comprehension.

3D AND VR PROGRAMS	
Programs analyzed (number)	14 3D (9 live, 5 online) and 12 VR (live)
Therapeutic areas	Gastric cancer, lung cancer, breast cancer, multiple sclerosis, diabetes, dyslipidemia, multiple myeloma, Alzheimer's disease,psoriasis, rheumatoid arthritis
Learners (number)	15,726
3D and VR toolkits downloaded (number)	3743

To assess outcomes from these activities, MLG conducted pre/posttests containing knowledge- and case-based questions and evaluations to assess participant satisfaction and encourage commitments to changes in practice. Behavior-modification surveys were also sent out 60 and 90 days post-activity to assess self-reported actual practice change and motivate participants to reflect on any barriers to change. Finally, post-activity surveys and interviews were also conducted via phone with participants who downloaded the 3D or VR animations and used them in practice to engage patients in treatment planning. The interviewers asked how the 3D and VR animations had been used in practice (eg, to review information, to educate patients on treatment options, etc.) and how patients reacted to the animations.

Finally, MLG compared the average change in knowledge and competence and behavior change in people who completed programs including 3D and VR animations and downloadable toolkits with a sample of our more traditional programs, composed of didactic lecture and case-based Q&A.

TRADITIONAL CME PROGRAMS	
Programs analyzed (number)	21 live and 5 online
Therapeutic areas	Gastric cancer, lung cancer, breast cancer, multiple sclerosis, diabetes multiple myeloma, Alzheimer's disease, psoriasis, rheumatoid arthritis
Learners (number)	14,893

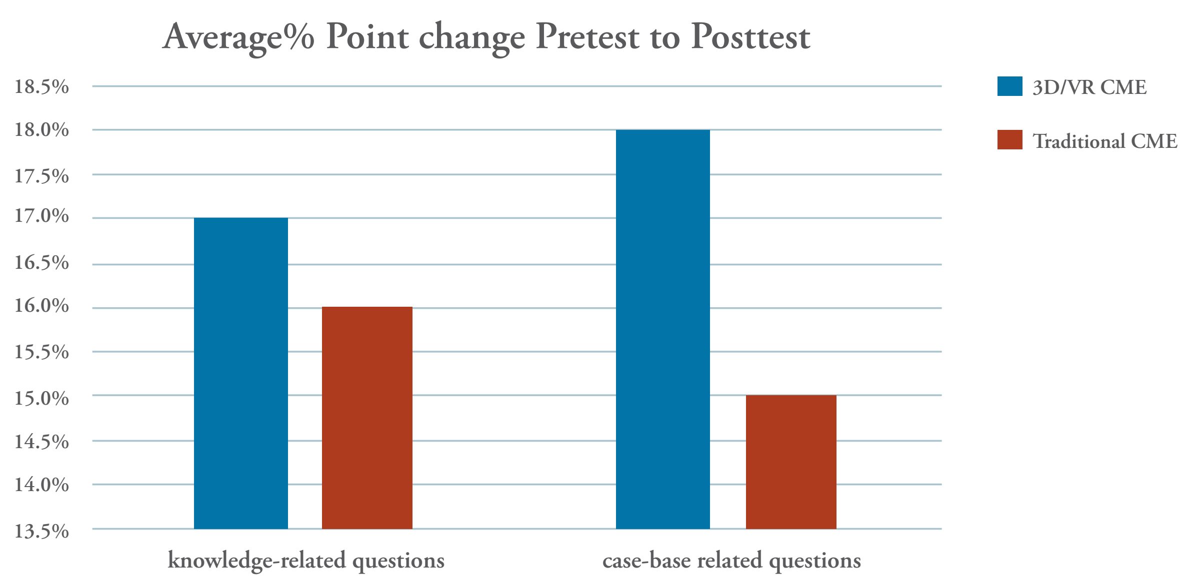
These two types of programs were conducted in the same time frame and in the same therapeutic areas to see how outcomes might differ with the inclusion of 3D and VR animations. Tools used for outcomes assessment in both groups included pre/posttests, evaluations, and behavior-modification surveys conducted 60 and 90 days post-activity.

Findings: Expanding Engagement, Awareness, and the Conversion of Knowledge into Practice

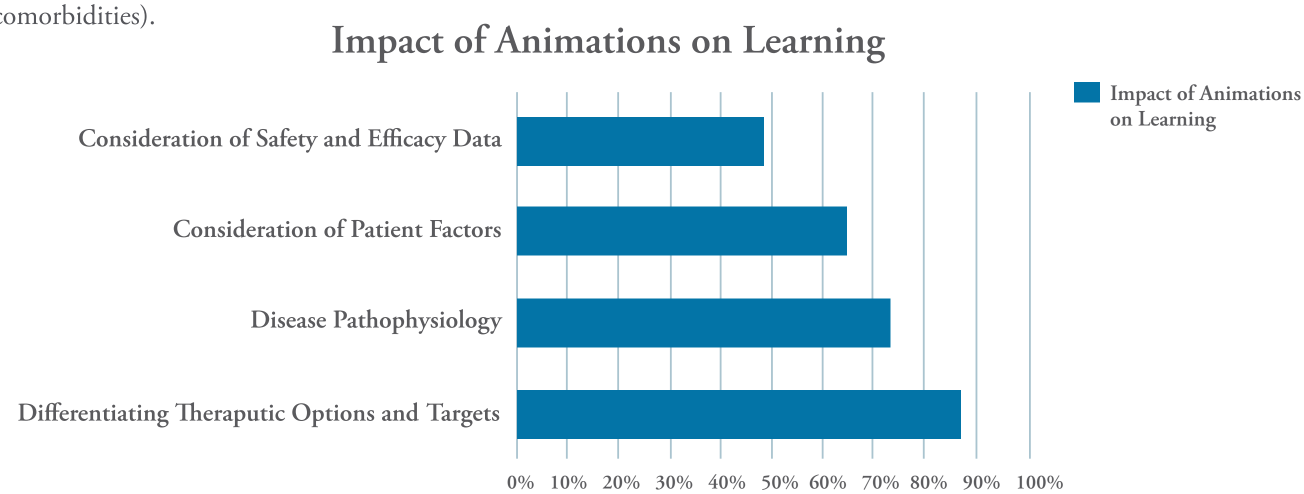
Overall, the pre/posttests and self-reported feedback received in the program evaluations and the behavior modification surveys sent out 60 and 90 days post-activity indicate that the programs achieved what had been identified as the three key effects of 3D and VR technology in education.

In response to a yes/no question asking if the 3D or VR technology enhanced their learning experience, 95% replied "yes." As to audience engagement, when asked if they found the program to be interactive and engaging, an average of 71% of respondents "strongly agreed" and 26% "agreed." In terms of comprehension, across our 3D and VR programming, we have found participants' knowledge and comprehension improved, as measured by our pre/posttest results. On average, correct answers increased by 17% (from 66% at baseline to 83% on the posttest) in knowledge-related questions ($P<0.005$) and by 18%, (from 62% at baseline to 81% on the posttest) in case-based questions ($P<0.005$). In comparison, the percentage of participants attending traditional programs who answered knowledge-related questions correctly increased by 16% (from 64% at baseline to 71% on the posttest) in knowledge-related questions ($P<0.005$) and 15% (from 60% to 75% on the posttest) in case-based questions.

Therefore, while the difference between innovative versus traditional programs in terms of improvement in answering knowledge-based questions was not substantial, the difference in competence gained based on results of the case-based questions does show a 3% higher gain in the innovative group of CME programs compared with the more traditional group of CME programs analyzed.



Participants were also asked targeted questions about the impact of the 3D and VR on their educational experience in the evaluations that were filled out immediately following an activity. Results indicate that 3D and VR animations contribute to improved understanding and learning of complex information in the CME setting. Participants were asked multiple-choice, "check all that apply" questions to identify specific educational effects of the 3D or VR technology. In particular, 84% of respondents indicated that the technology enhanced disease-specific clinical pearls, eg, understanding disease pathophysiology, differentiating therapeutic options and targets, enriching understanding of evidence from the latest clinical trials, and considering different patient factors (eg, comorbidities).



These results suggest that the use of 3D and VR in these CME programs had the greatest impact in terms of our scientific objectives by improving respondents' understanding of disease processes in the body and how different therapies interact to prevent disease progression. Our findings about the simplification of complex information are best described by the following comments from participant evaluations.

ENGAGEMENT

"The 3D images make the lecture come alive."

"Game changing. That was really, really fun!"

"It is shocking what the experience is like…awe inspiring."

"Can't wait to tell my kids about this. Please keep me posted on future events"

COMPREHENSION

"The 3D image of therapies targeting the molecule pathway told 1,000 words."

"The 3D technology allowed me to comprehend the MOAs of therapies in a concise and effective manner"

"No better way to press the point about CV risk than putting you inside the heart!"

"Talk about immersive!"

"I am a very visual person and seeing the education in this format is very helpful in understanding the different molecules involved and how the new disease-modifying agents work."

RECALL

'The images of molecules coming at me and how its inhibitors reduce inflammation will definitely stick with me."

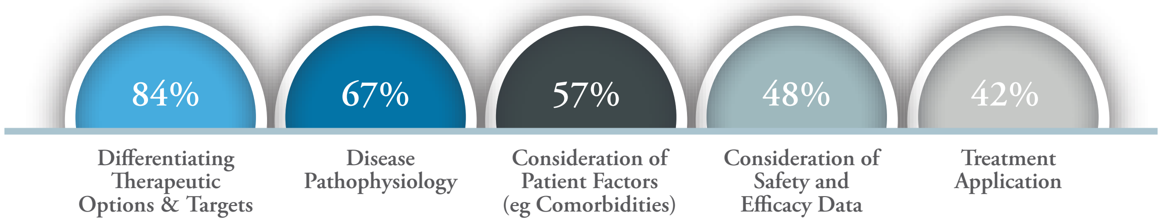
"I will recall the 3D animation whenever I read more studies on the latest news in psoriasis"

"Recall of the 3D animations describing what MM does will help me help patients to visualize what is happening in their bone marrow and what therapies can do about it. "

"I will remember to monitor for cardiotoxicity when using proteasome inhibitors."

"I will definitely remember the info on pathophysiology of MS thanks to the VR."

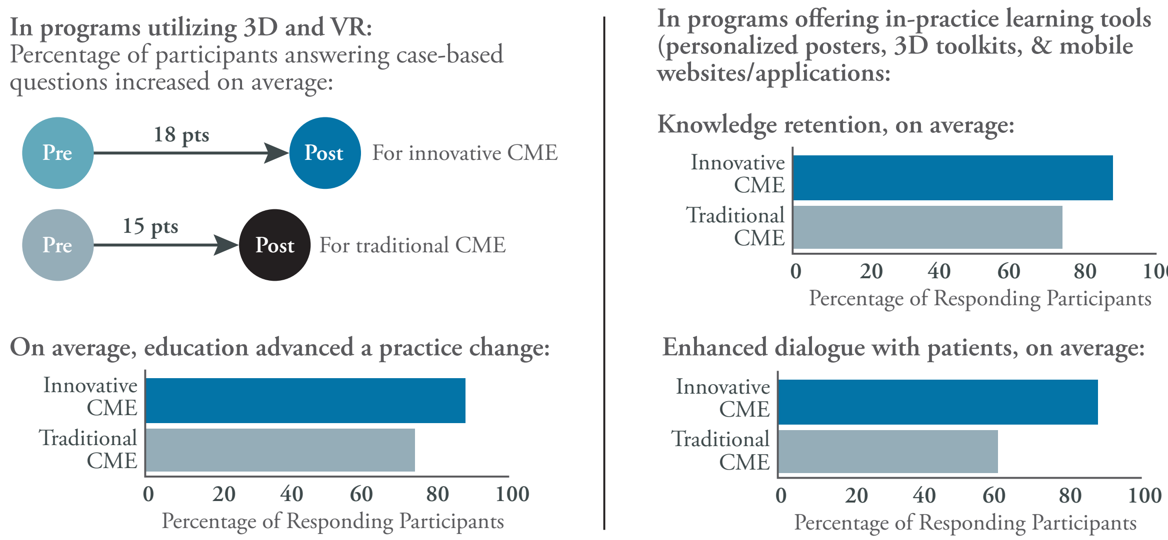
In addition, participants were asked about areas in which they found the 3D and VR animations to be most beneficial. Results demonstrate the impact the technology has across educational objectives.



Finally, in terms of knowledge retention, 88% of respondents to the post-activity behavior-modification surveys in the 3D/VR CME group reported implementing changes to their practice based on lessons learned in the educational programming, compared with 76% in the traditional CME group. When asked again about the impact of 3D or VR learning, 90% of survey respondents replied that it facilitated recall of lessons learned, and 82% indicated that such recall facilitated changes in behavior. In particular, respondents found they are more likely to consider different treatment methods and to discuss treatment options with patients. In comparison, 78% of participants in the more traditional CME programs indicated retention of key clinical pearls in behavior-modification surveys conducted 60 and 90 days post-activity.

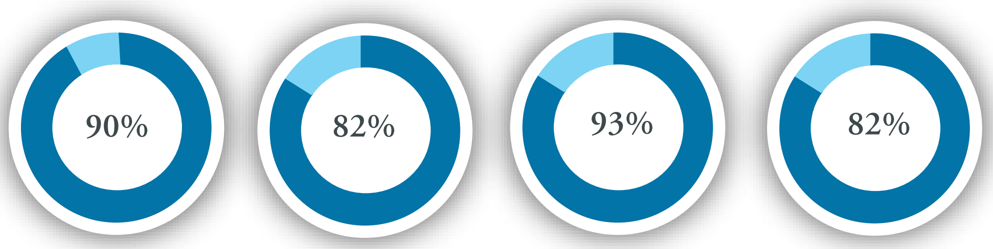
The following graphic summarizes the overall changes in terms of knowledge and competence gained, knowledge retention, and practice change between our 3D/VR CME grouping and our traditional CME grouping.

Educational Gains and Innovation



Enriching Collaborations in Care

Of particular interest, MLG also reviewed the feedback from 42 follow-up surveys and 21 interviews conducted with participants who downloaded the 3D and VR animations and used them in discussions with patients about their diagnosis and treatment plans. While limited data were available in the public domain on the utility of 3D and VR technology for this purpose, MLG's findings suggest that bringing animations into the practice setting is indeed advantageous when seeking to enhance the patient's role in care and overall HCP-patient collaboration. Approximately 90% of respondents said the animations facilitated conversations with their patients and 86% said the animations facilitated conversation with their colleagues. In particular, 93% respondents indicated that the animations facilitated conversations with patients regarding disease pathology, 82% indicated that the animations were beneficial for discussing treatment options, and 69% replied that the animations engaged patients in making treatment decisions. Finally, when asked if patient engagement via 3D and VR animations could also lead to improved adherence, 77% replied positively.



Overall, 88% of respondents to our surveys and interviews indicated that the technology led to greater engagement of patients in their own care. Anecdotally, during interviews and in open-ended survey questions, MLG received the following feedback from HCPs using these animations in practice, which speak strongly to how this technology can enhance patient engagement in their care.

> ***"My patients' eyes light up when I bring out the 3D glasses and show the animations. They seem really appreciative of this extra effort and like feeling involved."***
>
> ***"The videos prompt my patients to ask questions that I did not realize they had."***
>
> ***"After viewing the videos, several of my patients have enthusiastically told me they have a better idea of what is happening inside their bodies."***
>
> ***"One of my patients watched what the treatment would do to her cancer and said 'I want to try that.' It was the first time she seemed to grasp the impact therapy could have. And that hope is crucial on the path to recovery."***
>
> ***"Sharing the videos with my patients helps them understand their disease and focus on what can be done."***

We have also received some examples of the impact these technologies can have on individual patients via our follow-up interviews with participants who download the animations for use in practice. While each story may represent only one patient, they are very telling about how the incorporation of 3D and VR technologies can have a direct impact on patient outcomes and satisfaction with their care. For example, an oncologist in Phoenix who participated in our 3D Breast Cancer Summit told MLG "I recently shared the 3D video with one of my advanced breast cancer patients whom I expected to resist treatment. By helping her visualize what the therapy would do, this video helped encourage her to receive treatment."

Likewise, a participant in our MS VR Summit in Philadelphia shared the following information. "I recently used the cardboard Google glasses to show a patient with relapsing MS what relapsing actually meant, what was actually happening inside her body. She was fascinated and started asking questions I never would have gotten from her otherwise. She walked away with a better understanding of what symptoms to expect and why sticking to her treatment plan was so important."

These physician-patient experiences are powerful examples of how innovative CME can contribute to improved HCP-patient relationships in ways that improve care delivery and patient outcomes.

CONCLUSION

These findings support the view that 3D and VR technology have a strategic and valuable role to play in medical education. They open new avenues by allowing what Mantovani describes as the observation and examination of areas and events unavailable by other means, including traveling inside the human body.[18] The outcomes of and participant feedback on MLG's innovative CME activities also demonstrate that the incorporation of 3D and VR technology successfully engages learners. Comparative results also suggest the technology also enhances comprehension and retention.

While our results to date support much of the research previously done on the impact of 3D and VR on learner engagement, comprehension, and recall, it is important to emphasize the way this technology was incorporated into our programming and how that may have affected results. As Bettex's research suggests, this technology may have a successful educational impact only if the images are not overly complex and they are used for targeted purposes.[6] Given the strong reaction from participants about the role of 3D and VR animations in in our programming, further examination of our programming format and how and when we relied on the technology for educational purposes may be useful.

Moreover, the results of programs that brought 3D and VR tools to the clinic indicate that animations can facilitate HCP-patient engagement about diagnosis and treatment options and also can help motivate patients to initiate treatment. These findings highlight the value of 3D and VR technology as tools in the effort to make CME more patient-centric and help provide effective care, focusing not only on the HCP's use of the latest evidence-based treatment approaches but also on HCP-patient collaboration towards improved patient outcomes.

MLG continues to support and expand the use of innovative technology in CME activities. As virtual technologies continue to gain traction and show positive impacts in both the education and healthcare arenas, with HCPs and patients using virtual technologies to engage in and improve their performance, it is important for CME to be flexible and able to change with the times in order to adapt to technological advances that can improve the educational experience and, ultimately, outcomes for both HCPs and patients. Using innovative technologies in CME will also further align CME missions to the National Quality Strategy, which calls for us to "foster innovation in health care quality improvement, and facilitate rapid adoption within and across organizations and communities."[18]

MLG makes the following specific recommendations for the use of virtual technology in CME.

1) **Develop scripted virtual animations**, with expert faculty playing a leading role in design and integration into live and online CME programs.
2) Integrate technologies into CME interventions that aim to address **systematic** gaps in coordination of care and patient engagement in particular.
3) **Widen your audience** beyond the physician and use innovative CME to directly impact care coordination, patient-centric care, and shared decision- making.
4) **Create a space via CME for different stakeholders in the healthcare system** to learn from each other through partnerships with HCPs, patients, patient-advocacy groups, health systems, government bodies, information technology (IT) and Tech companies, etc.
5) Tie outcomes of innovative CME to movement across the **quality target metrics**, which are tied to $$$ via the Affordable Care Act. For example, consider providing instructional VR videos that align with quality care benchmarks tied to reimbursements.

Moving forward, MLG is working to partner with systems of care interested in 3D and VR HCP-patient communication toolkits in 2017 to further this effort. We will make it a priority to take steps to motivate participants to use these toolkits by developing endpoints that ultimately tie to improved quality and cost savings.

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