

## Converged learning: the spectrum of technology-mediated learning

### Aprendizagem convergente: o espectro da aprendizagem mediada por tecnologia

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#### James Lipuma

M.Ed. Ph.D. in Environmental Science  
New Jersey Institute of Technology. University Heights, Newark, 07102  
New Jersey. U.S.A  
E-mail: lipuma@njit.edu

#### Cristo Leon

M.B.A., Ph.D. (candidate) in Business Administration  
New Jersey Institute of Technology. University Heights, Newark, 07102 New Jersey, U.S.A  
New Jersey. U.S.A  
E-mail: leonc@njit.edu

#### ABSTRACT

New Jersey Institute of Technology (NJIT), a four-year polytechnic research university in the United States, utilized a participatory strategic planning process to implement an innovative approach to the delivery modes between face-to-face and online instruction. NJIT defines the spectrum of online and on-ground instruction integration as Converged Education. This spectrum allows students to participate face-to-face, join remotely through real-time video conferencing technology (synchronously), or watch classroom instruction asynchronously. The article opens with a general background of NJIT's approach to the new idea of converged instructional delivery. Then, the process of defining and clarifying the terms and conceptions of the various modes to be adopted is presented. Finally, the resulting implementation of the new policy and its reflection on course offerings is shown and discussed.

**Keywords:** digital learning, converged, hyflex, course development, instructional design, strategic planning

#### RESUMO

O New Jersey Institute of Technology (NJIT), uma universidade politécnica de pesquisa com duração de quatro anos dos Estados Unidos, utilizou um processo de planejamento estratégico participativo para implementar uma abordagem inovadora para os modos de entrega entre instrução presencial e on-line. A NJIT define o espectro da integração do ensino on-line e presencial como Educação Convergente. Esse espectro permite que os alunos participem presencialmente, participem remotamente por meio de tecnologia de videoconferência em tempo real (de forma síncrona) ou assistam ao ensino presencial de forma assíncrona. O artigo começa com um histórico geral da abordagem do NJIT à nova ideia de fornecimento de instrução convergente. Em seguida, é apresentado o processo de definição e esclarecimento dos termos e concepções dos vários modos a serem adotados. Por fim, a implementação resultante da nova política e seu reflexo na oferta de cursos são mostrados e discutidos.

**Palavras-chave:** aprendizagem digital, convergente, hyflex, desenvolvimento de cursos, design instrucional, planejamento estratégico

## RESUMEN

El New Jersey Institute of Technology (NJIT), una universidad politécnica de investigación de cuatro años de Estados Unidos, utilizó un proceso participativo de planificación estratégica para implantar un enfoque innovador de los modos de impartición entre la enseñanza presencial y la enseñanza en línea. NJIT define el espectro de la integración de la instrucción en línea y presencial como Educación Convergente. Este espectro permite a los estudiantes participar cara a cara, unirse a distancia a través de la tecnología de videoconferencia en tiempo real (sincrónicamente), o ver la instrucción en el aula de forma asincrónica. El artículo comienza con una descripción general del enfoque del NJIT sobre la nueva idea de la enseñanza convergente. A continuación, se presenta el proceso de definición y clarificación de los términos y concepciones de las distintas modalidades que se adoptarán. Por último, se muestra y discute la aplicación resultante de la nueva política y su reflejo en la oferta de cursos.

**Palabras clave:** aprendizaje digital, convergente, hyflex, desarrollo de cursos, diseño instruccional, planificación estratégica

## 1 INTRODUCTION

The iGeneration does not consider their world as the separate spheres of 'face-to-face (F.T.F.),' 'online,' or 'blended,' but rather as a single, seamlessly interconnected world (Rosen, 2010). Michael Moore has also stated the importance of changing the way education is delivered based on the direction technology is heading:

"The experience of learning would be greatly improved in both quality and cost if we would substitute face-to-face interaction with other communication methods when they can do the job as well and divert resources to pay for improved face-to-face teaching in a far more widely distributed geography when it was really needed to accomplish defined learning outcomes" (Moore, 2016).

According to the New Jersey Institute of Technology's (NJIT) "Convergence: A Vision and Framework for Leadership in Digital Learning: Serving the iGeneration requires breaking down barriers between the physical campus and the virtual campus to create a fully digital learning environment without a distinction between F.T.F. and online learning" (NJIT, 2013). This spectrum of conceiving course delivery has been termed 'convergence' by Dr. Fadi P. Deek, Provost and Senior Executive Vice President. Institutions of higher Learning are in the process of rethinking how they can deliver their curricula through the use of digital technology to reach more students, reduce costs, and improve effectiveness. Consistent with long-established practices, efforts have focused on classroom technologies such as adaptive Learning and Massive Open Online Courses (MOOCs) that retain the distinction between online and F.T.F. NJIT's "Vision 2020 Strategic Plan" (NJIT, 2015) seeks to transcend this by setting the goal of establishing modes of delivery that end this distinction by the year 2020.

NJIT, a four-year polytechnic research university in the United States, utilized a participatory strategic planning process to implement an innovative approach to the delivery modes for instruction between face-to-face and online instruction. NJIT defines these new modes of integration of online and

on-ground instruction as Converged Education that allows students to participate face-to-face, join remotely through real-time video conferencing technology (synchronously), or watch classroom instruction asynchronously. In addition, these different modes were designed to allow students to choose their mode of consumption throughout the semester rather than at the time of registration as typically done.

The article opens with a general background of NJIT's approach to the new idea of converged instructional delivery. Then, the process of defining and clarifying the terms and conceptions of the various modes to be adopted is presented. Finally, the resulting implementation of the new policy and its reflection on course offerings is shown and discussed.

### 1.1 OBJECTIVES

This exploratory study aimed to examine the participatory strategic planning process to implement an innovative approach to the modes of instruction termed Converged Education. The study sought to review data gathered from committee meetings, pilot tests, and institutional research sources to offer an understanding of the new policy and its impact. The research worked to understand the collaborative process undertaken with a committee of 20 Faculty, Administrators, Students, and Staff members of the university, followed by an exploratory phase with forty pilot classes and the formal adoption of the four new modes of instructional delivery by the university.

### 1.2 SUMMARY OF KEY FINDINGS

The results identify that participatory planning positively impacts the design of new modalities. The resulting implementation of the new policy and its reflection on course offerings is shown and discussed. The study shows the process resulted in a successful policy with four new modes of instruction. During the fall semester of 2020, 820 classes implemented the Convergence model, demonstrating the success of the planning process. Another relevant finding is related to the creation and implementation of educational technologies (especially when informed by pedagogy and classroom practice) strongly correlated to technological innovations' development. The resulting plan was more successful thanks to the additional time and collaboration amongst the faculty and technology support departments.

### 1.3 STRATEGIC PLANNING

Converged Learning was first discussed at NJIT during strategic planning committee meetings. As NJIT entered its participatory process, the concept of the converged learning mode of instruction was discussed with the community at large:

"The 2020 Vision emerged through an open, participatory process. In early December 2013, members of the NJIT community were invited, in the spirit of shared governance, to participate in strategic

planning. Over 200 faculty, administrators, students, alums, and board members joined five committees and numerous sub-committees to design the objectives and strategies. Out of these committees emerged specific reports for five areas: students, Learning, scholarly research, community, and investment" (NJIT, 2020b).

The converged learning working group was charged with defining 'converged Learning' and decided that pilot tests were needed to understand this innovation's technological and pedagogical challenges and nuances.

## 2 CONVERGED LEARNING

As NJIT's move towards this model was undertaken, the Converged Learning working group met and reviewed Technology-based learning (TBL) and HyFlex learning from EDUCAUSE (Brown et al., 2020) along with NJIT's convergence white paper "Convergence: A Vision and Framework for Leadership in Digital Learning" (NJIT, 2013) which was used to explain and promote this idea for NJIT's 2020 strategic plan. Converged Learning is a prime example of technology-based learning (TBL), which incorporates several delivery modes, such as asynchronous, synchronous, or F.T.F., and various online tools. It became clear that no single mode of instruction would fit between the existing conceptions of F.T.F. and online instruction. Instead a variety of different modes of instruction that leveraged technology and pedagogical strengths to offer flexibility would be more appropriate. Some allowed for flexibility in location while others offered the flexibility of time and access. One key factor that characterized the innovation sought by convergence was the idea that faculty and students could be freed from the choice of mode at registration often months prior to the first class and determined by an administration unfamiliar with how best to deliver the content effectively.

### 2.1 COURSES FOR PILOT AND SUPPORT

In the fall of 2014, a pilot was run to test different technologies and supports. In the spring of 2016 (4th semester), a much larger integrated group of undergraduates was studied to identify scaling issues in a senior seminar class with 105 regular and honors students. Additional tests and scaling were conducted in subsequent semesters as the policy on the modes of instruction was developed and approved by the university faculty, administration, and board of trustees. In the 2019 academic year, NJIT offered courses in all six modes of instruction at scale for the first time. They will be described below.

A team of NJIT technology support personnel, instructional designers, and computer support technicians were involved to help support faculty and student needs as new procedures were developed and tested. NJIT staff oversaw student workers who acted as co-pilots and technicians for early implementation tests. The co-pilot/technician handled troubleshooting in the classroom, acting as level 1 support for any student issues. The time devoted to the course by additional personnel was reduced each

semester. This was due to more classes in the converged model and the reduced need for support. The transition also had an impact on the roles and responsibilities of the co-pilot. During the converge pilot, the 'co-pilot/technician' was assigned to assist the professor in managing the technology interface. As equipment and training increased, the amount and types of support were reduced and shifted to less personnel-intensive activities.

## 2.2 DELIVERY MODES AT NJIT

First, it was necessary to define the two existing modes of instruction at NJIT clearly:

- Face To Face: "All course meetings are held at a given time and place with the instructor and learner in the same space."
- Distance Education is "Education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction" (NCES & IPEDS, 2019).

Based upon this, the NJIT groups working on digital Learning identified a continuum that went from fully in-class to fully online independent studies (no synchronous contact time). Converged classes were along this continuum such that students had the option for a fully F.T.F. classroom experience, a fully online asynchronous experience, or an option that allows students to be synchronous but remote. The critical nature of the converged classroom is that students can choose how and where to consume course content. This poses many pedagogical and logistical issues for faculty planning and designing the course. Most faculty would not typically allow for this wide range of options to occur at all times in all classes. However, it was deemed necessary to explore how different elements might work together and what was needed to make convergence happen.

NJIT's administration officially published its "6 Modes of Instructional Delivery at NJIT", including four blended modes:

"Synchronous Online: Delivery of instruction takes place on the day and time noted, independent of location. All course activity is completed online through the learning management system. There are no face-to-face sessions, but remote attendance is expected.

Converged Learning: Delivery of instruction is independent of place, merging the physical and virtual classrooms. Attendance is expected, and students can attend class face-to-face or use real-time synchronous video conferencing technology. Some instructors may require occasional proctored exams (sometimes called a synchronous distributed course).

Hybrid: Delivery of instruction in which some traditional face-to-face contact hours are replaced with required synchronous or asynchronous online instruction (frequently through the learning management system). The instructor sets the amount of online activity, which varies by course. No Hybrid course should be more than 50% online.

HyFlex: Delivery of instruction is independent of time and place, allowing students to choose to attend class in any of three modes: Face-to-face, Synchronous Online, and Synchronous Online.

Based upon these definitions, the comparison table below shows how the different modes utilize the various attributes to provide students and faculty with more options" (NJIT, 2019).

Table 1. Delivery mode comparison.

Dimensions of Delivery Modes	Time		Location		Choice of modes		
	Synchronous	Asynchronous	On-ground	Online	Registrar	Faculty	Student
Converged	X		X	X			X
Face-to-Face	X		X		X		
Hybrid	X	X	X	X		X	
HyFlex	X	X	X	X			X
Online		X		X	X		
Synchronous Online	X			X	X		

NJIT pioneered distance education development and pedagogical approaches for digital Learning. Currently, some undergraduate courses and complete masters-level programs are delivered online. Many courses delivered on campus are also offered hybrid, combining the elements of F.T.F. and online instruction. NJIT's Vision 2020 Strategic Plan states, "Digital learning will be an integral part of every student's experience, with instructors engaging students through 'converged' pedagogies where the boundaries between online and F.T.F. instruction fade. Students will be given more opportunities to learn at their own pace and to explore their path to achieve their learning goals" (NJIT, 2015). Additional research will be needed to determine the effectiveness of each mode and its implementation in the different types of courses.

### 3 RESULTS

The Strategic planning aided in understanding and troubleshooting the technological demands of this new teaching model and how it interfaces with NJIT's current technological infrastructure. NJIT requires students to come to class with a minimum level of computing technology supported by software licenses, allowing them to download copies of various programs. In addition, NJIT completed a program that expanded bandwidth and redesigned learning spaces to allow for increased connectivity and power needs.

The number of professors attempting converged classes has increased each semester and represented a wide range of subjects and disciplines at both the undergraduate and graduate levels; all consulted the ongoing findings of the pilots. The technology used for convergence was more than adequate, but workarounds often had to be found for many first-time issues. Once identified, these workarounds were documented and added to a set of best practices, or more permanent solutions were found. Technicians became better at managing classes, handling student questions and troubleshooting issues, and directing students to appropriate support materials and personnel. The details of these specific actions are not shared since each will vary with institutional variables in infrastructure, technology, support software and services, level of sophistication with the technology of both students and faculty, and other factors related to size, student body, and geographic locations. However, logging all issues, finding solutions, and building a support and training materials database were vital to successful development. Also, bringing the early adopters together with the larger faculty community to discuss teaching in this mode was very helpful.

Thanks to the strategic planning process, NJIT was more prepared for the shift to online delivery resulting from COVID-19. The table below shows this significant shift to converged modes for Fall 2020 course offerings.

Table 2. Course offering mode 2014 to 2020.

Term	F2F	Distance Learning	Convergence	Total
AY 2014	2793	242	0	3035
AY 2015	2927	281	2	3210
AY 2016	2926	299	1	3226
AY 2017	3020	324	20	3364
AY 2018	3061	330	3	3394
AY 2019	3128	357	0	3485
2020 Fall	1663	203	820	2686

Some structural elements tested proved effective in how the course was run. The room allowed students to work in groups well and share. The converged model also worked well for groups of remotely located students and experts brought together at a standard time. This configuration was termed nodes so that groups could work independently on tasks, discussions, or projects in their own spaces, wherever they might be. Then, during the reporting phase, each group could share a computer screen with other groups and the master room, where the teacher would discuss the results. This successfully emulated roundtable discussions that promoted effective collaboration. One drawback was that the single faculty member could not visit each group locally and had to rely on the computer interface. Visits from guest speakers and

external experts were facilitated by allowing them to avoid travel and host meetings at their local institution. Guest reported the benefit of watching the classroom interactions while students were learning and working in groups.

Course design is an area that provides results. First, students must clearly understand the requirements and penalties for course attendance and scheduling. There is a clear, unspoken understanding of what students think a course should be in the F.T.F. or online. Allowing freedom is seen as a benefit, but at the same time, students need to have a clear structure and an outline of expectations of their role and responsibility from the professor. One danger is that students with poor time management might skip class, assuming they will go back to watch the video but never do so. Similarly, some students watch live but remotely without paying attention to class but feel they have attended. The difference is that contacting distracted or absent students in the converged setting is more challenging since they may participate asynchronously.

A clear plan for what materials are to be delivered and what, if any, class interaction is expected is critical. Many students did not want to communicate via the online chat, while others had muted audio, making it difficult for them to participate in class discussions. Converged Learning worked best for one-way lectures and had the most difficulty when mixed groups of online and on-ground students tried to work collaboratively and had to share drawn or written work. If some students felt most comfortable working on paper, sharing it became challenging. One group even resorted to holding documents on a laptop used as a collaboration station. This complex pedagogical challenge led to the recommendation of a range of modes for adoption as the final policy.

Convergence, when appropriately planned, could emulate all aspects of a regular F.T.F. class while offering students flexibility and a record of what happened in the class. As with any technology, there was a time for student adoption of the technology, and this seemed to be longer than with other courses, but this may have been an artifact of attention paid to these types of issues. Having the technical support staff was crucial, and allowing class time to deal with and onboard students was an effective way to overcome problems and help students feel more comfortable. Since portions of the class were moved to online materials, this was not as major an issue for time and task completion. In the end, better instruments to gain feedback and formative assessments of the students' progress are crucial and must be developed. In converged classes, it is sometimes difficult to determine if the student is having problems with the course content due to the content itself, the technology interface, or the student's engagement with the technology-mediated experience.

A dedicated, independent side channel was beneficial. In several cases, students could not access one or more aspects of the class but could text and (or) email the technician to ask for assistance or at least inform the faculty member of the issue. Similarly, this side-channel proved helpful in private messaging between outside experts and the lead faculty. However, it could lead to information overload if a single



faculty member has to manage all channels simultaneously while teaching and managing the class. Assigning a co-pilot or technician as the coordinator and moderator proved helpful as faculty members are new to using teleconferencing balanced teaching with this new form of classroom management.

Table 3. Considering Convergence.

Key questions.
What is our technological infrastructure to support converged Learning?
Do we have sufficient devices to support converged Learning?
Will the faculty and technical staff require training?
Do the course offerings and instructional staff fit the desired mode?
Are instructors willing and able to teach in the selected mode?
What is the level of student engagement?

## 4 DISCUSSION

The global pandemic of COVID-19 has introduced a disruptive innovation for universities. Thanks to the pilot and implementation of 'converge learning,' NJIT was better prepared for the crisis. Nevertheless, as new technologies are emerging and the Web is moving far beyond Web 2.0:

"For the development and implementation of effective pedagogy in Web 5.0 environments, teachers need to become active and critical Web 5.0 users and develop their own skills and strategies for selecting and managing Web 5.0 materials and emotions. Teachers need to select or develop high-quality Web 5.0 resources and use the resources through well-prepared strategic management activities" (Benito-Osorio et al., 2013).

Beyond this is Web 6.0 (translational), which will allow full integration of the previous webs.

The pace of innovation and expansion of the Web is not to be ignored or accommodated. Each new generation of learners will expect the norms of their everyday life to be reflected in these secondary and post-secondary classrooms. As the pace of innovation and disruption grows, so must the response of the educational system and the educators within it. We realize that NJIT is a polytechnic institution, and so broader liberal arts institutions may face different challenges. Our investigation did not explore the issues of student preferences, academic integrity, and assessment delivery, which will be examined in future research.

### 4.1 PARTICIPATORY PLANNING

A participatory approach is invaluable in bringing together stakeholders from the community to discuss their needs and wants. The authors considered strategic planning an ongoing process that will give a clearer vision of the organization's future by "building a strong foundation" (NJIT, 2020a). Information

and communication technology will be a crucial foundation for achieving an innovative educational system in this new strategic plan.

Lastly, to achieve a change of culture, it is essential to be aware of the climate and needs of the community. Kurt Lewin expressed: "Culture change requires the Change of leadership forms in every walk of life. At the start, particularly important is leadership in those social areas which are fundamental from the point of view of power" (Burnes, 2004).

## 5 CONCLUSION

From NJIT's experience thus far, it is clear that convergence is a way to evolve the digital learning offerings for undergraduate and graduate students. In addition, as technology advances and devices and connectivity become more ubiquitous, offering courses will become more attractive and necessary. One of the most important outcomes is the realization that convergence is on an ever-expanding continuum of technology-based Learning and must be customized to the critical factors of teaching style, limitations of technology, educator and student level of technology sophistication, and most importantly, educational content demands for delivery, assessment, and dissemination of content. Finally, one clear outcome of this initial pilot was identifying a need for new evaluation tools that fit this new converged model of delivery along with new support and training structures for faculty and students. As these new delivery modes become more common and offered to students earlier in their academic careers, they will become more effective. With the introduction, adoption, and integration of any new technology into education, its persistence, and use are tied to its effectiveness, availability, and usefulness. In the opinions of the authors, the combination offered by convergence, when tailored to content, students, and educators correctly, has great potential to improve outcomes and positively influence student learning, engagement, and successful completion of the course. Furthermore, leadership styles such as knowledge management and the participatory planning model are relevant to achieving better design and implementation levels of emerging educational modalities.

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