Remote Exam Proctoring

Current State of the Market for Voice Proctoring, Facial Recognition, and Other New Technologies

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EDUVENTURES

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- Eli Adler, Director of Marketing – Voice Proctor
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- Michael P. Lambert, Executive Director Emeritus – Distance Education Training Council
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ABSTRACT

Remote exam proctoring is a relatively young industry that is growing in importance as postsecondary online enrollments and course offerings continue to grow. As ninety-five percent of online exams are taken by the honor system, and the pressure on students to get good grades is greater than ever, the prevalence of cheating has become more widespread.   Accreditors are becoming increasingly concerned with the integrity of the test taking process and schools are being pressured by public and private constituencies to validate the quality of the education they provide. Remote proctoring technology, or the ability to use technology to help validate the exam management process, is one way to help provide this assurance – there is a growing market of vendors that intends to fill this void through the creation of new remote proctoring technologies for use in low-stakes testing environments. Today, most exam proctoring is done by a combination of webcam monitoring, keyboard lockdowns, and student authentication. New proctoring technologies that focus on physical characteristics like facial recognition and voice analysis are in various stages of development and may provide even more secure and scalable options for educators interested in growing their online program options in the future. In this white paper, Eduventures will identify some of the fundamentals driving this market and how it can provide value for the educational community. Eduventures will also provide an overview of the vendor community and the current technologies in use, and how they are expected to evolve in the future.

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INTRODUCTION

Background

Remote exam proctoring, also known as online exam proctoring, typically entails the use of technology like webcams, voice or keystroke recognition, and keyboard lockdowns to accommodate the scale enabled through online education. Broadly defined, remote exam proctoring is when a third party monitors an exam that is taken outside of a physical classroom. Remote proctoring has its roots in the traditional correspondence school model where lessons and exams were mailed to students; the exams were "remotely proctored" by an agreed-upon intermediary, usually a public figure like a police officer, minister or notary public, and then mailed back to the school for grading. The effect of online learning and the efficacy of technology are rapidly evolving the meaning of that definition.

Distance education today is remarkably similar to the correspondence model. The primary difference is that the internet has enabled coursework to be delivered online instead of through the post office. The scale that online learning offers has dramatically increased the number of students that have the ability to pursue distance education. Enabling technologies have sprouted up in support on online education and have effectively re-defined traditionally accepted academic processes – remote exam proctoring is just one example. While webcams and keyboard lockdown technologies currently dominate vendor offerings, biometric recognition technologies are starting to play a greater role in the development of this market. It is these technologies that this paper is concerned with – we will see that this is a young industry that is developing to meet the diverse needs of today's educational institutions and their course delivery models.

This project is based on primary and secondary research, including interviews with experts in the field. As little has been written about this industry to date, our goal is to provide a foundational and objective description of the fundamentals driving industry growth, a description of some of the technologies and vendors that currently exist, an understanding of how they define the market and serve the needs of the educational community, and a prediction of how they may develop in the future.

High-Stakes vs. Low-Stakes Testing

Understanding the difference between high-stakes and low-stakes exams is critical because it is the proliferation of low-stakes exams in the postsecondary online market that is creating the conditions necessary to drive demand in this industry. Put plainly, high-stakes exams *really* mean something. Low-stakes exams are used to evaluate progress and are often considered milestones that indicate proficiency – they sometimes even culminate with the ability to take a high-stakes exam.

Most college courses include multiple low-stakes exams ranging from short multiple choice tests to more lengthy qualitative essay format exams. A typical college course might include several tests with a final exam at the end of the semester – all are considered low-stakes exams. A college student's final

grade point average (GPA) is simply the average of multiple low-stakes exams that have been created, monitored and graded in any number of ways. Low-stakes testing is not limited to college – it is also relevant to secondary education, adult education, and corporate learning.
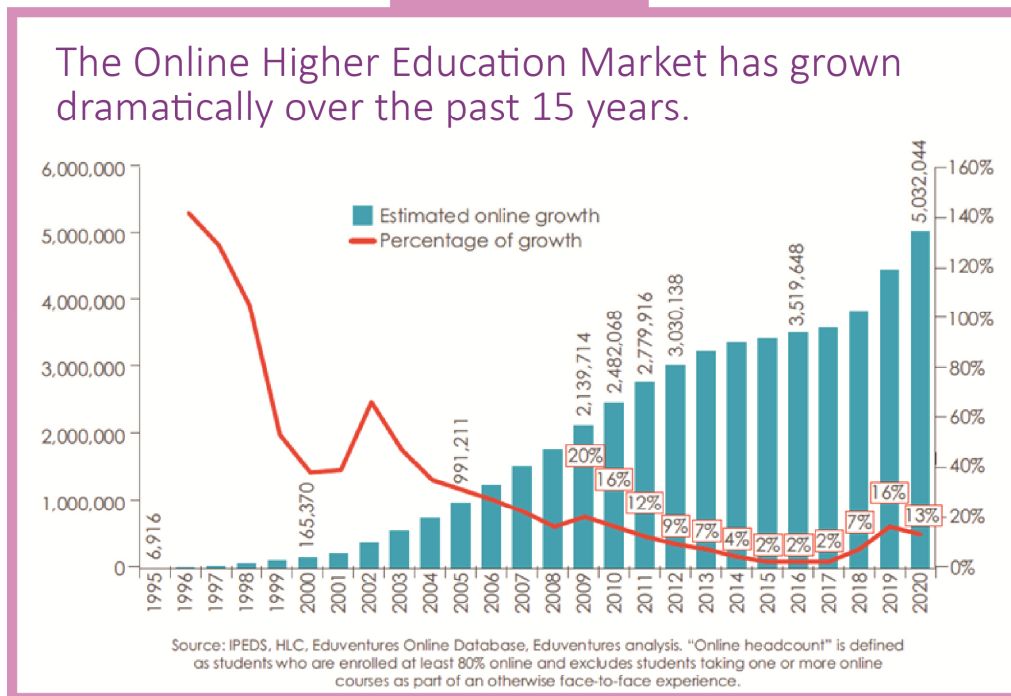
To the contrary, high-stakes exams are created based on detailed criteria established by industry experts and regulatory bodies, are monitored under strict supervision in controlled environments through the use of human proctors or their technological equivalents, and are rigidly graded in a non-subjective manner. High-stakes exams are typically used to test an individual's knowledge in a certain subject area and result in some type of professional certification, license, or other measure of assessment. Examples of high-stakes tests include the Certified Public Accountant (CPA) license exam, the National Council Licensure Exam (NCLEX) for nurses, and state driver's license tests.

REMOTE TESTING MARKET

Market Context

While remote proctoring is not explicitly limited to online education, the primary driver of the market for low-stakes remote proctoring systems is the growth in postsecondary online education. As Exhibit 1 shows, the online market has grown dramatically over the past 15 years. Remote exam proctoring systems for online learning have been slow to catch up with this growth curve; they have yet to enter the mainstream and many technologies for low-stakes exams are still under development.

Exhibit 1.

The Online Higher Education Market has grown dramatically over the past 15 years.

Source: IPEDS, HLC, Eduventures Online Database, Eduventures analysis. "Online headcount" is defined as students who are enrolled at least 80% online and excludes students taking one or more online courses as part of an otherwise face-to-face experience.
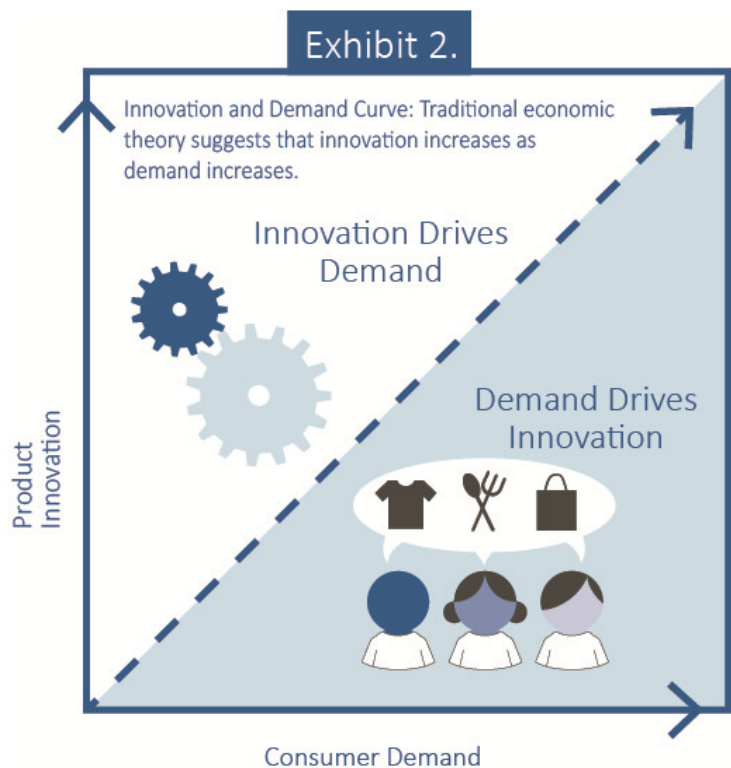
As typically happens when industries go through this type of supply / demand imbalance, some companies evolve along with the changes whereas others are replaced with new upstarts. In the case of low-stakes remote exam proctoring, the increase in demand has outstripped the ability of traditional proctors to monitor the plethora of distance education options. While traditional remote proctors and proctoring centers still exist, and are expected to exist well into the future, their numbers will decrease proportionally as the number of remote proctoring vendors increases. Many schools want to continue including remote proctors as an option to accommodate blended learning offerings, student preferences, or their own pedagogical / programmatic models.

> *"We provide 100% online education – we give our students three options for exam proctoring – they can use webcam proctoring through our 3rd party provider, they can go to an approved testing center, or they can employ a pre-approved proctor [like a librarian]."*
>
> *–Jerome Alley, President, William Howard Taft University.*

As Mr. Alley suggests, it is important to provide students with options, but there is an inherent cost in doing so. Live proctors are more expensive and have limited scalability – and driving to centrally-located testing centers is inconsistent with some of the benefits of online learning.

These dynamics suggest that remote proctoring is an industry where "needs are driving innovation" as opposed to "innovation driving needs". This is an important distinction to make for an emerging technology market because it confirms that demand for a product exists; this is a good place to be if you are a vendor. It also heightens public attention and helps to drive support for vendors from financial backers. On the contrary, when innovation drives customer needs, market demand could be years away thus casting uncertainty upon the innovation in the first place (or it could be intentional strategic market positioning on behalf of a deep-pocketed technology vendor).

Exhibit 2.

Innovation and Demand Curve: Traditional economic theory suggests that innovation increases as demand increases.

Innovation Drives Demand

Demand Drives Innovation

Product Innovation

Consumer Demand

> *Case Example. The market for 3G technology vs. the market for mobile handsets.*
>
> *Several years ago, the proliferation of mobile phones drove demand for value-added ancillary items like chargers, handsets, and other gadgets that make cell phones a more integral part of life. This was an example of demand driving innovation. The advent of 3G technologies is an example of innovation driving demand. Mobile telecommunications technology vendors foresaw the demand for streaming video applications and mobile internet access. However, at that time, most handsets were not yet fully capable of streaming video, and service providers were unable to handle the additional bandwidth this would require. Today, fortunately for the telecommunications vendors, product and service innovations finally caught up with the technology as more and more people are now using streaming video and internet applications on their mobile handsets.*

Market Drivers

As discussed, the growth in online learning and the subsequent increase in low-stakes online exams are creating an ideal condition for the development of new remote proctoring technologies. Two factors are fueling this demand: student authentication and cheating. While cheating is sometimes cited as the primary driver for remote proctoring technologies, as most individuals affirmed through the course of this research, student authentication should be considered of equal if not greater importance. Additionally, regulatory oversight from accreditors was deemed to be highly influential in guiding schools' decisions around educational practices. Interpreting the factors that are driving the growth of low-stakes remote proctoring solutions requires a more detailed look at some of the key stakeholders as well as some of the circumstances around test taking.

Cheating

Academics, administrators, accreditors, and education industry experts have long been concerned with cheating. In order to help gauge the impact of cheating and understand how to segment the higher education market for remote exam proctoring services, schools need to consider the likelihood of cheating within the context of their own specific circumstances. Vendors need to conduct a more elaborate exercise in market segmentation to understand which sectors and subsectors of the education market to target. Furthermore, both vendors and schools need to consider the nature and prevalence of cheating as well as the close relationship between i) the structure of the learning environment, ii) course design, and iii) student demographics.

There have been numerous studies over the years suggesting that the prevalence of cheating is high; it is routinely understood that "where there is a will to cheat, an enterprising student will find a way". The International Center for Academic Integrity, a noted organization that takes strong positions on cheating and plagiarism in higher education, conducted a 2005 study that determined 70% of college students admitted to cheating and 60% admitted to some form of plagiarism. Michael P. Lambert, Executive Director

> *"The utility of a proctoring system is dependent on the instructional model, the business model, the student body, and the overall mission of the institution."*
>
> *–Dr. Leslie Gargiulo, Chief Learning Officer, Ashworth College*

Emeritus of the Distance Education Training Council (DETC), an influential accreditor for distance and online learning programs, suggests this number is closer to 33% on the average. A recent US News poll even suggested that 20% of adults believe that there is nothing wrong with them completing their children's homework for them. A more optimistic perspective comes from a recent survey conducted by the Josephson Institute of Ethics suggesting that students cheat *less* today because of stronger parental and educational focus on honesty and character. Further muddying the picture is that, given the ability for students to readily use the internet for homework, and the pressure on getting good grades, the definition of what is considered cheating in the first place has become blurred.

As indicated above, student demographics have perhaps the largest influence on cheating – Mr. Lambert believes that adult learners have less of an incentive to cheat than 18 – 22 year old students given the lack of pressure related to getting into, and doing well, in college. The goals of many adult learners are related to career or personal interests – cheating makes less sense in these cases. Course design also has an impact on the prevalence of cheating. James Lang, associate professor of English at Assumption College, concludes that courses designed with a higher frequency of exams tend to experience less cheating than courses with only one final exam.[1] Punishment, or the fear of getting caught, can be a strong disincentive to cheat. Lang also suggests that learning environments like class size, type of course / program, type of school, and level of student / teacher interaction all play a role in the likelihood of cheating.[2] Schools and vendors need to consider these factors when selecting remote proctoring services and segmenting the market, respectively.

Student Authentication

While clearly of concern to schools, student authentication is also of concern to accreditors as well as public and private constituencies like state education boards, professional associations, employers, and even philanthropic organizations. When asked about the primary drivers and value proposition for remote exam proctoring services, the primary response from academics and accreditors was "student

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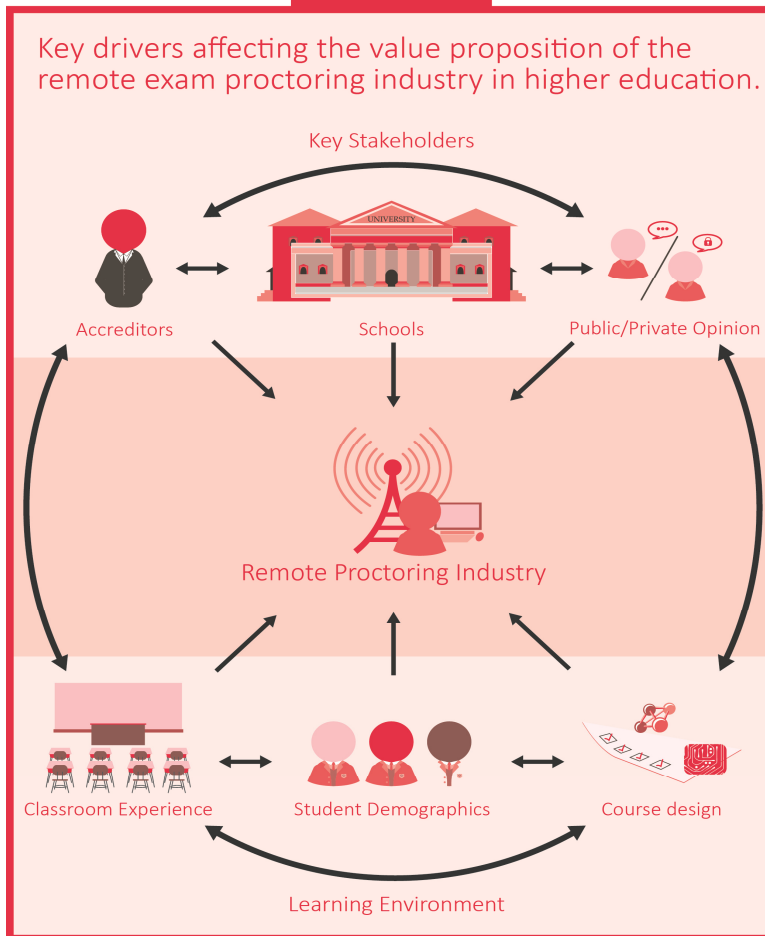1 James M. Lang, "Cheating Lessons, Part 2", The Chronicle of Higher Education, July 8, 2013. (http://chronicle.com/article/Cheating-Lessons-Part-1/139453/)
2 James M. Lang, "Cheating Lessons, Part 1", The Chronicle of Higher Education, May 28, 2013. (http://chronicle.com/article/Cheating-Lessons-Part-1/139453/)

validation and affirmation". It was also stated that student authentication also addresses cheating – if a student passes all the coursework but then fails the final exam, this is evidence that someone else has taken the test, and vice versa.

Public opinion has a relatively strong influence on the education sector given the level of accountability demanded from educators and accreditors – while online education has been a catalyst in the case of low-stakes remote exam proctoring; public scrutiny extends to all types of postsecondary education. As a gateway to our children's future, and as one of the largest expenditures many will make in a lifetime, public opinion related to the quality of education and the industries that support it (or sell into it) should not be underestimated. While remote proctoring might have limited effect on actual student learning or pedagogy, it is a technology that can help affirm the value derived from the system – and "every little bit helps," as every stakeholder will attest.

Exhibit 3.

Key drivers affecting the value proposition of the remote exam proctoring industry in higher education.

Key Stakeholders

Accreditors — Schools — Public/Private Opinion

Remote Proctoring Industry

Classroom Experience — Student Demographics — Course design

Learning Environment

Federal regulators – namely the US Department of Education (USDOE) – play a primary role in setting educational policies and governing accreditation agencies. While the USDOE requires that accrediting agencies need to have a standard for schools that they examine student identification, they only require password protection for this purpose. This sets a low bar from the government's perspective and leaves it up to the accreditation agencies to determine how far to go with this requirement. As will be seen, accreditation agencies' positions on remote proctoring depend on the focus of their regulatory authority.

There is also political pressure directed at online education – public and private opinion of for-profit education, much of which is online, is increasingly negative given the some politicians' and the media's portrayal of misleading marketing practices, disproportionate levels of financial aid, low graduation and persistence rates, and difficulties in students finding employment. While the point of this paper is not to debate the value of online or for-profit education, anything that can be done to allay this perception is

welcome – low-stakes remote exam proctoring can help bring a higher standard to all forms of online education.

Accreditor Concern

All this political and public scrutiny adds pressure to accreditation agencies; there has been an increasing expectation on them over the past 10 years to require that schools verify student identity. Similar to the USDOE, regional accrediting agencies like the New England Association of Schools and Colleges (NEASC), the Higher Learning Commission of the North Central Association of Colleges and Schools (HLC), and others take a broad approach to remote exam proctoring. They do not have specific proctoring requirements and only expect that schools provide a legitimate exam process. As a relatively large percentage of schools accredited by these regional accreditors are traditional campus-based schools, remote proctoring is not as great of an issue to them at this point. Public and political pressure may eventually change this as more and more traditionally campus-based schools explore online or hybrid course and program delivery options.

Career-related accrediting agencies like the DETC take a different approach. Given that a relatively high percentage of students are focused on career goals, and a primary form of educational delivery is online (where convenience in course delivery is a key benefit), some of these agencies have stricter requirements for the schools they accredit. For example, the DETC stipulated in the late 1980s (when

> *"Regional accreditation agencies do not have proctoring requirements but I wouldn't be surprised if they started asking questions about how schools verify the quality of online education. As accreditors come under more pressure for student outcomes, part of how they assure the public could be substantiated through the use of remote proctoring."*
>
> *–Audrey Kaplan, Commissioner, Accrediting Council for Independent Schools and Colleges (ACICS)*

online education did not exist) that there must be strict proctoring standards for distance education. These standards now apply to online education and while they do not dictate what type of proctoring is required, the DETC is perhaps one of the strongest proponents of remote proctoring. Consequently, schools accredited by the DETC and potentially others like them should be interested in remote exam proctoring services – not only because the accreditors are interested, but because employers, and consequently students are too.

Last but not least, schools themselves are not merely reactive to the suasion placed on them by regional accreditors, or the even the more explicit requirements of the DETC. As stated, they have a clear role in the public eye to validate the integrity of their educational process and, as one might expect, are considered thought leaders when it comes to quality of education. The professional integrity of maintaining high quality and control over academic practices is paramount to the educational community – proctoring can even be directly or indirectly linked to broader issues of great interest like

student retention, graduation rates and career preparedness. In short, schools are perhaps the most eager of all stakeholders to help shape public opinion and educational policies; the usage of low-stakes remote proctoring technologies is one way they can do this.

> *"The key benefit of remote proctoring solutions is the salability and acceptability of student credentials to employers. Ninety-nine percent of adult students who take online or distance education courses do not cheat – there is no incentive for them to cheat and they might even be offended if it were suggested. Students embrace this technology because it allows them to validate their degrees by saying to an employer 'my exams were proctored by a third party."*
>
> *–Michael P. Lambert, Executive Director Emeritus, Distance Education and Training Council*

Market Definition and Size

By now it has become clear that remote proctoring is most applicable to distance learning which, today, largely means online learning in the postsecondary education market. Market size is driven by the growth of online enrollments which is expected to continue (please refer back to Exhibit 1). A key benefit of online education is that it gives institutions the ability to serve new students – adults, international students, and the military are examples. These are areas where vendors of innovative remote proctoring solutions are concentrating their efforts, but they should by no means exclude campus-based learning, secondary education, or other forms of education in the long term.

While accreditors play a large role in influencing schools on adopting remote proctoring technologies, they (and we) will not take a position on which technology or which product or service will work best for any particular school. The risk is that implementing the wrong solution could undermine the institution's educational delivery model.   For that reason, it is only fair to generalize on the applicability of remote proctoring solutions to specific subsectors of the higher education market. For example, industry specific vocational programs that can be taught online (like medical billing or insurance claims processing) may *not* be good candidates for remote proctoring because there is little incentive to cheat or misrepresent one's identity – on-the-job success or failure can be easily determined in an interview. However, when employers (like hospitals or insurance companies) require this assurance, then remote proctoring makes sense regardless of student demographic or discipline. Lastly, a remote proctoring solution that rates high on security, but low on scalability would not be a good option for online schools with large class sizes (or MOOCs). As Dr. Gargiulo from Ashworth College points out, *"understanding the range of options will help schools identify the pros and cons of each technology as it relates to each institution's organization and mission."*

TECHNOLOGY

Overview

The primary goals of remote proctoring technologies are to overcome the security weaknesses and scale limitations of traditional proctoring. Security weaknesses allow both students and proctors to exploit the system for their own benefits. As premised in the classic 1980s movie *War Games*, taking the "men out of the loop" (or women) removes the ability for human error, either intentional or unintentional. The ability and potential to use such non-biased and accurate technology at scale may indeed support the growth of online education, and may even help substantiate alternative educational models like MOOCs.

There are several technologies attempting to solve this puzzle ranging from established technologies like cameras and video to more progressive biometric methods like facial, voice, and fingerprint recognition technologies; it is likely that no one technology will provide the right answer on its own, but that some combination will provide the appropriate functionality depending on customer needs. As of now, most remote proctoring technologies involve some level of human intervention thereby putting limitations on scale. Following is a non-exhaustive and brief overview of these technologies, many of which are currently integrated with one or several others available in the market. Consistent with the goals of this research, and given that the following technologies can be specifically aligned with one or several vendors, a more detailed pro and con analysis has been withheld in favor of objectivity.

- **Computer lockdowns** are when a test taker is prevented from "surfing the internet" while taking a test. Lockdown technology is typically used in testing centers and for high-stakes tests but can also be installed directly on students' computers for low-stakes tests. Lockdown technologies differ in the extent to which they actually "lock down" or "take over" students' computers and there is a variety of vendors offering this type of software. Remote exam proctoring vendors either create these lockdown capabilities internally, or they outsource it from third parties.

- **Electronic signatures** function in a manner similar to e-signatures and hand-written signatures except they are digitally analyzed for conformity to the original in the interest of affirming identity. Electronic signatures, also called biosignatures, are in use in some high-stakes testing environments but are not yet commonly used in low-stakes environments.

- **Keystroke dynamics** recognize typing patterns based on rhythm, pressure, and style – this is then analyzed for conformity to the original in the interest of affirming identity. While there are some commercial software products that use keystroke dynamics to authenticate users, a limited number of remote proctoring vendors are currently using this technology.

- **Recognition technologies** are used to authenticate a student based on a prior examination of some physical feature. They are typically built upon a before / during / after analysis to verify that the same student who initially registered for the course was actually the same student who took the exam. Commonly-known recognition technologies include:

  - Facial
  - Fingerprint
  - Palm
  - Voice

  Facial, fingerprint, and voice recognition technologies are all currently represented in the remote proctoring industry and are in various stages of technology development (please refer to the following section, Vendor Landscape). These technologies are expected to be more prevalent in the medium term future of remote exam proctoring. It is likely that recognition technologies will be most effective when used with some combination of other technologies available.

- **Webcams** are one of the original technologies used to replace a live proctor and are present in most remote exam proctoring solutions on the market. They vary in abilities depending on the type of camera used and can record videos or still images. They can record individual students when the camera is part of the computer, or groups when the camera is placed in a classroom. Webcam technologies often require significant storage capabilities so that video records can be reviewed if necessary.

A more technical needs analysis is required for an educational institution to make the right decision on which vendor to choose. Webcam technologies and keyboard lockdown software are readily available and there is a range of quality options for the former. Electronic signatures and other recognition technologies are not as readily available; many such as facial, voice, and fingerprint technologies are available but are still being developed and refined in the interest of mainstream application and affordability. Other technical attributes that should be assessed in the context of each institution's individual needs are scalability, speed,

Exhibit 4.

Checklists can be used to identify needs (as shown here) and evaluate vendors.

Remote Proctoring Needs Analysis

	Level of Importance (1=low, 5=high)	Comments
Technical Attributes		
Scalability		
Speed		
Compatibility		
Storage Capacity		
Etc.		
Practical Attributes		
User-Friendliness		
Staffing/Maintainence Requirements		
Ease of Implementation		
Affordability		
Etc.		
Business Attributes		
Vendor Location		
Years in Business		
Support		
Ability to Customize		
Etc.		

compatibility, and format and storage capacity. Practical and vendor-specific attributes that should be assessed include internal integrity, user-friendliness, support and staffing requirements, and affordability. Schools should consider creating checklists and rating each of these attributes to help inform their analysis.

Vendor Landscape

The landscape of today's remote exam proctoring industry includes roughly 8 – 10 vendors, some of which focus on both high- and low-stakes testing. They range from independently-owned companies like Kryterion, Software Secure, and ProctorU to larger companies like Tegrity, a division of McGraw Hill that offers remote proctoring services as part of a larger educational product offering. Most of these companies use webcam technology as the centerpiece of their proctoring solutions, and offer a range of different product versions and features to accommodate different market sectors or client needs.

As demand continues to drive new technology developments, greater options will become available to the educational community. More companies will move from offering higher stakes and higher margin products, to offering more scalable and affordable low-stakes solutions designed specifically for today's online educational community. Companies will also differentiate themselves by adding new features or other improvements to their core products – these new products and features will be either internally developed or purchased through acquisitions.

Kryterion, based in Phoenix, AZ and considered one of the "veterans" of the exam management industry, offers a wide range of proctoring options – it is one of the first vendors to offer facial recognition technology in its effort to complement its existing student authentication options (like passwords and other identifiers such as social security numbers, etc.). Another provider, Software Secure, of Newton, MA, is one of the first vendors to use fingerprint technology. Both firms use different technologies and have different growth strategies. While part of Kryterion's business strategy is likely to maintain its existing network of testing centers while targeting new market sectors, Software Secure is focused on providing scalable and affordable remote proctoring solutions for the low-stakes online exam environment in both postsecondary and K – 12 education.

A new market entrant, Voice Proctor, also based in Phoenix, AZ, is one of the first to focus exclusively on voice technologies for the postsecondary market – it was created only after a thorough scan of the market determined that voice technologies might provide a more effective alternative to those currently available for use in low-stakes testing environments. Voice Proctor believes that voice technologies are less intrusive and more accurate than some of the other technologies available in the market at a similar price point. Again, in order for schools to make informed decisions about which vendor or technology to choose, they should weigh the options to determine which solution is best for their individual needs and circumstances.

Costs

> *"It's all about price point – there is not a lot of margin for this type of extra cost unless you can validate that it will work well. Schools need to question if it will increase their quality and reputation, and result in greater enrollments."*
>
> *–John Padgett, Vice President of Institutional Advancement, City College, Fort Lauderdale, FL*

As Mr. Padgett points out – schools need to ask themselves *"Do we really need it, how big of a problem is it, and how can one validate it?"* These are the types of questions schools need to ask themselves, and vendors need to answer. Decision-makers will require answers to these questions prior to committing to any new technology that involves adjustments to their core instructional models.

While the cost of low-stakes remote proctoring services is considered an "additional cost" in course delivery, live proctors and testing centers are much more expensive. Cost sensitivity is something that will define the rate of product adoption in this industry – especially considering the multitude of additional costs layered on schools by other vendors in the educational technology value chain. Schools (and vendors) will also need to discern if these are costs can be passed on to students directly or if they can be absorbed – schools will be most unlikely to use it as a justification to increase tuition. One place to start is to conduct a Return on Investment (ROI) analysis – the ROI of low-stakes remote exam processing will largely be a subjective analysis based on imperfect data at this point in the industry's life cycle.

Pricing models for low-stakes remote exam processing are still under determination. Most of the products available today are calculated on a per-student, per-exam, or per-course basis; however, there is uncertainty regarding the pricing of implementation, consulting, and support. Pricing for high-stakes testing is typically more than low-stakes given the need for enhanced security and process. Low-stakes exams have to be more affordable given the frequency with which they are used in the exam process. In addition to consulting and implementation costs, which increasingly make up larger and larger shares of vendors' revenues, integration with existing technology systems is both a cost and a compatibility issue.

Integration

When evaluating low-stakes remote proctoring systems, schools must consider i) integration with the school's existing Learning Management System (LMS) and ii) integration with its exam management or assessment system. The ability for a remote proctoring system to easily "bolt on" to an existing LMS is extremely important considering the rate of change in technology today – it is expected that the market will continue moving towards multiple independent solutions because no one company can be expected to house all the necessary expertise and technology. It *can* be expected that large LMS providers will be

interested in purchasing stellar technology that is outside of their areas of expertise in order to solidify or enhance market positions.

Similarly, most schools already have some type of exam management system in place. While LMS platforms are most often outsourced to third party providers, exam management systems can be more easily created and managed in-house. Many schools prefer this because they are not beholden to generic vendor-provided solutions that are oftentimes consuming and expensive to customize. Some more entrepreneurial schools may even choose to commercialize their homegrown systems. However, many realize that creating software programs or technology is outside their areas of expertise and not considered a core academic process. The case for whether to buy a remote exam proctoring system that is integrated with an exam management system or not is a tricky one. Some portion of the market will prefer outsourcing remote proctoring systems that are integrated with an exam management system so they do not have to build their own (Voice Proctor provides an integrated solution); others will prefer integrating a stand-alone remote proctoring system to their in-house or previously outsourced exam management system (Software Secure and ProctorU offer stand-alone proctoring products while other vendors like Kryterion offer multiple assessment and remote proctoring alternatives). Again, selecting an integrated or a standalone system depends on each school's individual circumstance. Either way, user-friendliness and transparency of systems are almost always a requirement.

THE FUTURE

Initial Market Development and Saturation

Low-stakes remote exam proctoring will continue to be aligned with the growth of online learning in the coming years. There will be plenty of "catch-up" as remote proctoring technologies become more widespread in the postsecondary market – within five years, both current and new remote proctoring products like webcams, voice, and facial recognition systems will become standard components of online courses that enable greater validation of student authentication and prevention of cheating. Current technology challenges like the potential for webcams to be considered invasive, or large storage requirements, will find answers – or they will be supplanted by other technologies. Future challenges like privacy concerns related to biometric recognition technologies may emerge (as the Transportation Security Administration (TSA) learned after implementing, and then removing, full body scan X-ray technologies from major US airports). New proctoring solutions entering the market will make it more competitive – some vendors will focus on providing higher quality solutions to the sectors of the market that demand it. This will fuel continuous product development and innovation. Other vendors will simply be interested in accumulating market share by offering low cost solutions for schools that are not as particular – they will be more focused on volume and corporate valuation (their own). As of now, this market is largely undeveloped meaning that there should be a place for most vendors and technologies in the near term.

The vendor market will initially move from 8 – 10 vendors to at least twice that as new technologies and companies respond to the favorable demand conditions. That is happening now with some of the vendors and technologies referenced in this report. Some companies' product offerings will be strengthened through partnerships and through internal research and development. Firms with the largest market share or the best technology will become acquisition targets. Likely buyers will be other educational technology vendors like LMS providers, vendors of student information systems, and others that are interested in differentiating their own products, or growing their revenue base by offering a more horizontal suite of products. Large publishers will likely play a similar role given their extensive distribution channels and their interests in digitizing their product portfolios (not to mention their vast financial resources). As mentioned, McGraw Hill is already represented in this market. Pearson's VUE subsidiary is well-known for its high-stakes testing centers but has not overtly moved into low-stakes remote proctoring – given the aggressiveness with which Pearson enters new markets, it could retrofit its high-stakes testing technology, develop new technology, or simply buy an existing vendor.

The ultimate size of this market depends on many things including cost, scalability, and user-friendliness. Most remote proctoring technologies today rely on some level of human involvement outside of system implementation and support costs. Vendors of the future will offer turnkey proctoring solutions completely based on technology that is nearly transparent to the user. While this technology is a long way off (schools are not advised to wait), this could be the silver bullet that can accommodate a more broad range of educational models at an affordable cost given the inherent scalability. Technology-based solutions are generally seen as less intrusive, more reliable, and ultimately more affordable than those where humans are involved. Upon being presented with persuasive evidence that remote proctoring technology creates enough value or cost savings, more schools might be willing to outsource it – this will be crucial to market sizing and growth.

Market Expansion and New Product Applications

As the postsecondary market embraces low-stakes remote proctoring solutions, some of these technologies will be refined to meet the needs of other education market sectors. Virtual high schools and online corporate training are likely candidates because they face some of the same issues as the postsecondary market sector. There are also scenarios where remote proctoring may become important to on-campus classroom environments such as attendance verification for industry licensure or federal aid purposes, or outsourcing test taking time to reserve more time for classroom learning.
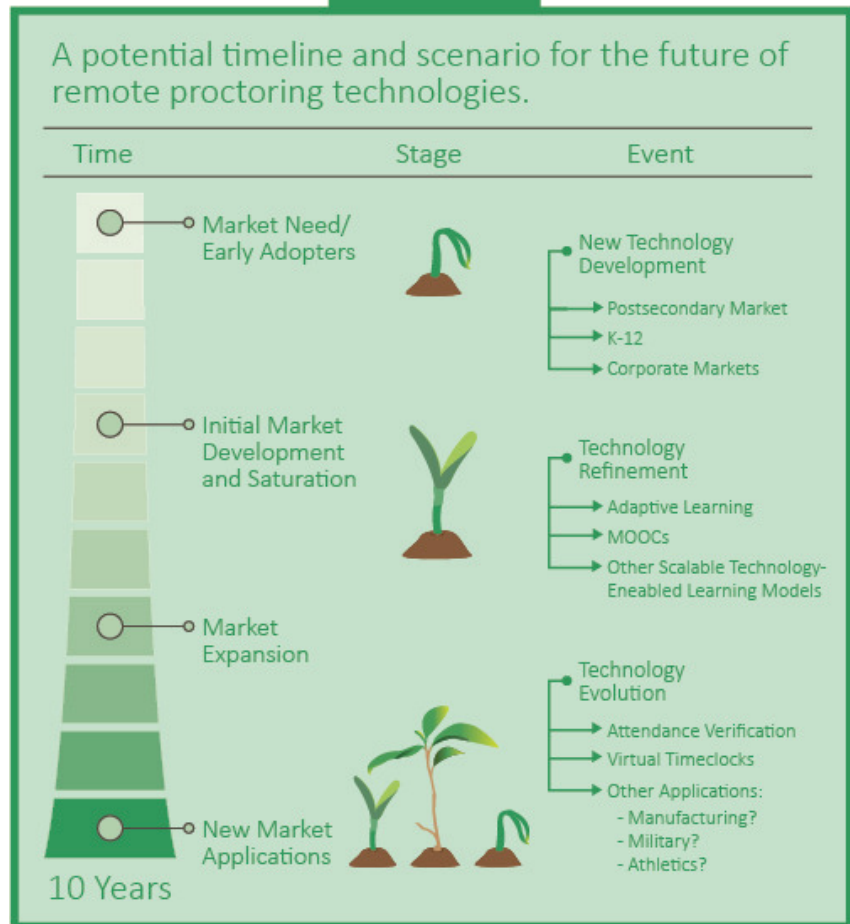
Low-stakes remote exam proctoring technology may also evolve to help substantiate and validate alternative learning models in higher education – namely adaptive learning and MOOCs. Both are still considered unproven business models, but both have the potential for significant growth (the continued influx of venture capital and private equity money is evidence of this optimism). MOOCs will be more focused on scale – technology that can accommodate large numbers of students and exams. Adaptive learning technologies will also focus on scale but at a more intimate level as these models focus on constant assessment during the learning process. These different customer needs suggest that a remote

proctoring technology that works for one market sector may not work for another, or that significant technology refinements will be needed to adjust to the specific needs of each business model or industry sector.

Finally, remote proctoring technologies may evolve to accommodate demand in other industries, and may even become reliant on technology that is *not* reliant on online internet access. Future developments could include virtual time clocks for remote employees, verification of attendance for employee training or compliance purposes, and others. More advanced biometrics like iris scanning, DNA, and other physiological characteristics

Exhibit 5.

A potential timeline and scenario for the future of remote proctoring technologies.

Time	Stage	Event
	Market Need/ Early Adopters	New Technology Development ► Postsecondary Market ► K-12 ► Corporate Markets
	Initial Market Development and Saturation	Technology Refinement ► Adaptive Learning ► MOOCs ► Other Scalable Technology-Eneabled Learning Models
	Market Expansion	Technology Evolution ► Attendance Verification ► Virtual Timeclocks ► Other Applications: - Manufacturing? - Military? - Athletics?
10 Years	New Market Applications	

may eventually play a role in the future of remote proctoring – given that many biometric technologies have been developed *outside* of education, this could prove disruptive to the existing remote proctoring industry as developers move from say, military or national security applications, to higher education. However, this is a longer term projection and plenty will happen between now and then. The future for low-stakes remote exam proctoring is bright and will be exciting to watch – there is a void to fill and it is within schools' and vendors' mutual interests to fill it.

About Eduventures

Eduventures is the industry leader in research, data, consulting, and advisory services for the higher education community. For 20 years, college and university leaders and education industry providers have looked to Eduventures for innovative and forward-looking ideas, for insights into best practices, and for help with making the strategic and operational decisions vital to their success. More about Eduventures can be found at www.eduventures.com.

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Voice Proctor is a complete online assessment platform that includes integrated proctoring, content management, and exam creation. This platform enables educators to effectively manage their organization's online assessment process using feature-rich exam creation tools. Students can easily take their proctored exams online using just a telephone and the Voice Proctor website without any additional hardware or software. Located in Phoenix, AZ, Voice Proctor, Inc. is an independent corporation owned by the founders and principals of National Paralegal College. For more information, please refer to their website at www.voiceproctor.com or call (480) 448-1378.