Seven Critical Strategies and Features for **Application Performance Management in Higher and Further Education**

eG Innovations

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Educators and educational institutions are continually embracing digital change to offer new services and deliver better experiences and outcomes for students. Modernizing curriculum delivery and services, student support services, finance and research operations of colleges and universities has led to the widespread adoption of several key application platforms and frameworks, including:

○ LMS (Learning Management Systems) and curriculum frameworks such as Moodle, Blackboard and Canvas.

○ Applications to support HR, administration, research, finance, and student information system (SIS) software such as Polus' Fibi - Electronic Research Administration Suite, Kuali, PeopleSoft Campus Solutions and OnCore.

○ Content and learning creation tools and applications such as MyKnowledgeMap.

○ Cloud platforms and services on Microsoft Azure, Amazon AWS (Amazon Web Service) and others.

○ Virtualizing and streaming faculty specific applications often for remote access via SaaS (Software as a Service), VDI (Virtual Desktop Infrastructure), DaaS (Desktop as a Service) and technologies from vendors such as Citrix, VMware, and others.

Adoption of application platforms and frameworks has benefited educators and students alike but reliance upon third-party functionality comes with increased demands on IT operations teams to implement, configure and ensure performance and availability. When issues arise the IT administrators may need to isolate the problem and rely on the response of third-party support services and if implementing open-source solutions they will need the tools and skills to identify and resolve issues in-house.

Whilst cloud platforms offer SLAs (Service Level Agreements) for their infrastructure it is the campus administrator's responsibility to ensure the applications and services deployed in Cloud are available to students and staff, often 24x7.

In this white paper we will cover the key features needed for a proactive APM (Application Performance Monitoring) strategy and benefits of adopting such a strategy, to help you construct a business case for your institution and quantify the value and cover key features APM products should possess to support specific educational application platforms and frameworks such as Blackboard, Moodle, PeopleSoft Campus Solutions, and others.

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Use cases for APM in higher education

Good APM observability platforms and monitoring tools help to ensure the smooth operation of key student-facing functions such as course registration, grade checks, financial aid disbursement, exam scheduling and graduation application.

Important demand driven use cases may include:

Students Checking Their Grades
During the end of term, students will likely check their grades frequently, which can cause a spike in traffic on the application.

Course Registration
During the registration period, students will be trying to access the application to select their classes, which can cause a spike in traffic.

Financial Aid Disbursement
When financial aid is disbursed, students will access the application to check their balances and make sure their aid has been applied correctly.

Exam Scheduling
When scheduling for exams, students will access the application to check their schedule and make sure they have not conflicting exams.

Graduation Applications
During the graduation application period, students will access the application to submit their application and check their status, this can cause a spike in traffic.

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The business case for implementing APM in higher education

Increased student satisfaction

Many students are now essentially customers and evaluate their choice of institution carefully. Institutions that have invested in good services and modernized their teaching delivery to meet students' expectations are naturally more appealing in the competitive education sector. Institutions that have modernized their IT infrastructure can cost-effectively offer a wider range of courses remotely and at more appealing times with increased accessibility and appeal.

Enabling institutions to grow

Digitizing teaching, research and administration applications frees universities from many of the constraints of physical infrastructure and physical campuses. Institutions can grow beyond historical downtown campus labs and even expand to provide revenue-generating remote e-learning courses and facilitate satellite campuses in other cities or countries. Students value the ability to work from anywhere at any time and avoid inconvenient commutes and to access resources around paid work, childcare, and visits to family in overseas home countries. When educators and researchers have fast and reliable access to these powerful education platforms, they can manage teaching content, curricula, and delivery more efficiently and to a higher quality with greater transparency.

Free IT teams from troubleshooting

Proactively monitoring applications and infrastructures for signs of issues before they become significant and before real students and staff encounter them and raise help desk tickets, reduces the time admins must spend verifying and processing support cases leaving them time to focus on long term and strategic IT projects.

Adopting automated root-cause diagnosis technologies that can identify in which tier or application stack the source of issues has arisen avoids the need for manual and time-consuming investigations and removes the inefficiencies of investigating the wrong tier.

Right-size and capacity plan to reduce costs

Good application and infrastructure monitoring and management will collect sufficient information to enable IT departments to optimize their costs and beyond this demonstrate the value they add, future capacity expansion needs, and the costs that failing to modernize legacy systems are accruing can be used to justify budgets. Enabling an overall view of the impacts and values of application delivery linked to comprehensive data, highlights to finance and management authorities the value and importance of IT.

Improved security and governance

Proactive monitoring of applications and user access is key to protecting student and research data and to meeting regulatory compliance standards, as well as ensuring educational institutions are protected from disruptive malicious cyber security breaches and attacks.

Comprehensive live and historical reporting can automate auditing activities and feed into KPIs for educational governance and quality reporting.

Data driven IT management reports allow institutions to demonstrate their success at delivering on their promises to students.

Seven Key Features needed for APM in higher education

Universities and further education establishments are rapidly evolving IT environments, subject to continual and frequent changes. As curricula evolve, The applications required for coursework change and students access content and services in new ways with elevated expectations.

Educational IT teams are required to deploy an extremely broad range of applications and services ranging from core finance, research, and HR functionality to demanding 3D CAD applications. Often IT teams support delivery to a wide range of locations with infrastructures of varying quality such as student halls of residence and dormitories, faculty libraries, satellite campuses and to students and staff working from home or even from abroad. The term/semester structures and highly seasonal nature of academic years, mean peaks in demands around admissions, exam and teaching cycles. Different applications may be used during long vacations, when research and administration activities may dominate over teaching.

With numerous applications built around technologies such as Java, .NET, Node.js and PHP and delivered on application servers such as Apache Tomcat, IBM WebSphere, Oracle WebLogic and JBoss, the IT administrator responsible for these applications needs continual insight into their performance but in a simple to use, intuitive way that does not require developer tools, coding experience and is highly automated to alert on issues and automatically identify the root-cause of issues.

Any observability tool or platform adopted must offer key features:

1. Easy to install, maintain and use
2. Real User Monitoring
3. Deep Insight into Business Transactions
4. Converged Application and Infrastructure Monitoring
5. Synthetic testing and availability monitoring
6. Cost effective licensing
7. Secure and Scalable

01 Easy to install, maintain and use

eG Enterprise is simple and easy to install using best practice auto-discovery and topology mapping to understand and deploy across application and infrastructure architectures. Moreover, it is designed to automatically adjust to change and auto-scaling, that may occur in environments like Kubernetes or VDI where additional containers, VMs (Virtual Machines) or application servers may be spun-up automatically.

By using a Universal Agent, there is no need for different agents for different technologies and it is simple to integrate with IaC (Infrastructure as Code) workflows and container platforms. Auto-discovery means you spend less time setting up the monitoring system and have fast rollout and can focus on how to respond to alerts. The eG Universal Monitor enables the unified IT monitoring of 250+ applications, 10+ operating systems, 10+ virtualization platforms and 20+ storage devices. Based on embedded domain expertise, the eG Universal Monitor provides

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performance monitoring insights into end-user experience, business transactions, applications, and the supporting infrastructure (physical, virtual and cloud). Administrators have the flexibility to choose between agent-based and agentless monitoring options. Deployment is easy - eG Enterprise can be loaded in a gold image and configured on-the-fly to monitor different applications or servers.
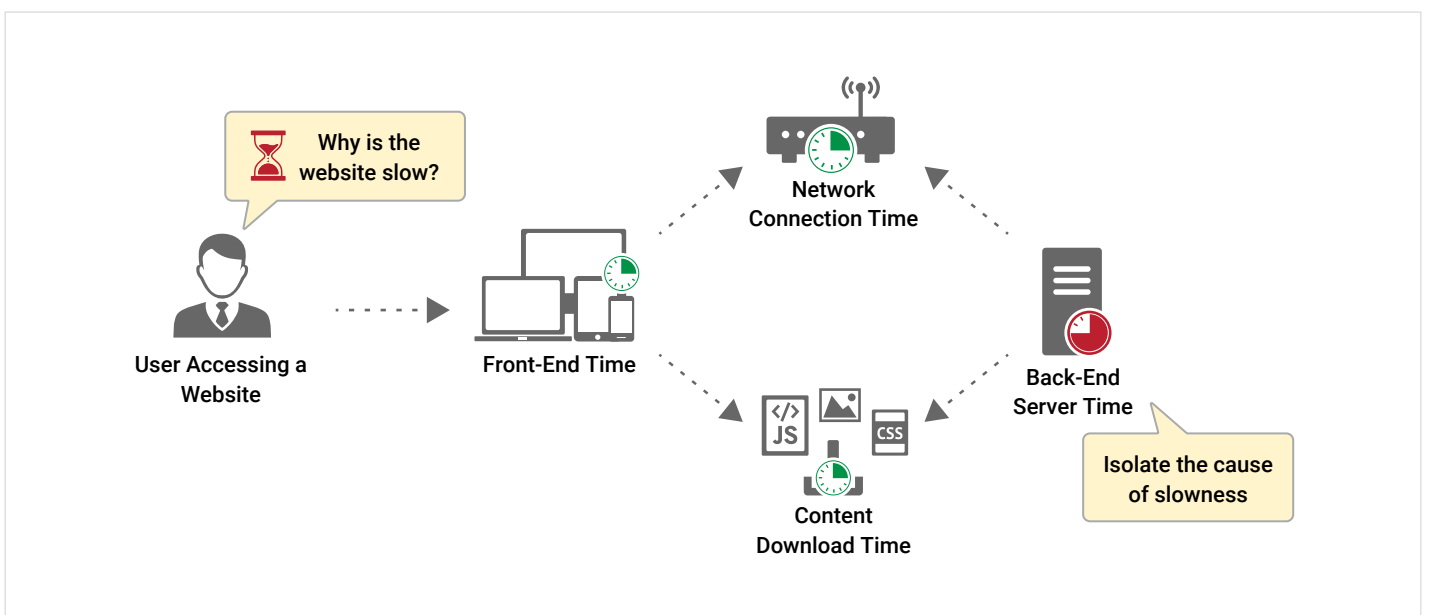
A single universal agent that has all the monitoring capabilities you need for operating systems, application logs, processes, JVMs (Java Virtual Machines), web containers, transactions etc. Many other solutions require a separate "machine" agent for the OS and an "application" agent for each application instance.

Once deployed eG Enterprise is designed to be simple and intuitive to use by a non-domain expert without the need to resort to other tools. You can leverage RBAC (Role Based Access Control) and role-based dashboards in eG to provide persona-driven unified visualization that enables distinct roles in an IT organization such as DevOps, Helpdesk, IT Ops and so on.

02) Real User Monitoring

Real User Monitoring (RUM) is a passive monitoring technology that analyzes all user interaction with a website or client interacting with a server or cloud-based application. Monitoring actual user interaction with a website or an application is important to operators to determine if users are being served quickly and without errors and, if not, which part of a business process is failing. Real user monitoring can be implemented in diverse ways:

○ Many applications capture and report user experience (for example, with Citrix access, ICA latency is captured for each user session).

○ User experience can also be monitored by deploying agents on user terminals.

○ Network taps/probes can also be used to watch user interactions and report user experience.

○ For web applications, a common way of tracking user experience is using JavaScript injection.

Why is the website slow?

User Accessing a Website

Front-End Time

Network Connection Time

Content Download Time

Back-End Server Time

Isolate the cause of slowness

What is JavaScript Injection?

A small JavaScript code snippet is introduced in application web pages being served to clients. When each client downloads the application content, it also downloads and executes the JavaScript code snippet. This snippet reports details about the client (IP address, location, browser version etc.), the page being accessed (URL, query string, etc.) and the performance seen by the client (page load time, JavaScript errors, etc.).

The ideal approach for an institution depends on the degree of control that you have on the end points, the network, the application, etc. For instance, if you are the application owner, it may be difficult for you to tap into the network or have agents on all the end points. JavaScript injection may be the ideal approach for you.

eG Enterprise captures the real-user experience of students and staff accessing applications allowing IT operations to identify long-term slowdowns, trends and problems affecting groups of users or specific applications. Beyond this though, a range of features allow deep drilldown into individual users to enable the delivery of help desk services e.g., when an engineering student complains they cannot access AutoCAD from their dormitory and so on. Collecting this data proactively ensures that complaints and issues raised with help desk can be retrospectively investigated with meaningful data, an important capability as students and staff are often unable to access IT support immediately if they are in the middle of a class or laboratory practical.

03 Deep Insight into Business Transactions

Business transaction monitoring (BTM) is the approach commonly used by APM tools to identify and diagnose server-side processing slowness in websites, eCommerce sites and web applications. A transaction is a user-instigated action with a desired outcome. In the context of education this could be a student registering for a class within Moodle or an employee requesting annual leave within PeopleSoft. Thresholds and KPIs (Key Performance Indicators) can be associated with transactions especially around response times e.g., the annual leave request should take less than 2 seconds to process.

Using bytecode instrumentation and tag-and-follow techniques, business transaction tracing highlights the time spent at each of the application tiers by following each request as it is processed through the application front end, middleware, and back end. Using this information, IT operations teams and web application managers can identify problems such as:

○ Badly designed business logic in the application code that can take up excessive time to process.

○ Poorly written database queries that require a lot of time to execute.

○ Web service calls to third-party, external components that are taking time.

Business transaction tracing is one of the critical dimensions of application performance monitoring (APM). With no application code changes, business transaction tracing provides insights that help an IT Ops staff to identify where the problem lies. Web developers can identify which portion of their Java or .NET code they need to optimize. They can also analyze to see which

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queries need to be tuned for faster response (for example, by making better use of database table indexes). A good APM product will facilitate a common language between IT administrators and application developers focused on the transaction and outcome for users rather than code modules and function calls.

Our many education customers use eG Enterprise to apply transaction monitoring and analysis for:

○ Blackboard application software modules that run either in a Java Virtual Machine (JVM) or .NET CLR environment.

○ Code-level visibility into the performance of PHP applications built on the Moodle framework with the ability to trace transactions across heterogeneous application environments and to correlate PHP calls to downstream Java/.NET/PHP/Node.js tiers.

Of course, within this context of potentially millions of user transactions from staff and students the automation and scaling capabilities of any APM tool need careful evaluation. It is simply impractical for administrators to manually define and refine alerting thresholds, especially in the context of seasonality and chronological user patterns. The application usage patterns of students will be quite different on a busy term time weekday morning compared to 3am on a Sunday in the middle of the summer vacation. This is where eG Enterprise's patented AIOPs (Artificial Intelligence for Operations) capabilities built around machine learning exceed the capabilities of many APM tools. Capable of processing and correlating millions of data points from metrics, events, logs, and traces, eG Enterprise intelligently learns about your applications and auto-baselines performance adjusting out-of-the-box pre-set alert thresholds dynamically.

04) Converged Application and Infrastructure Monitoring

BTM features alone though are insufficient in the modern university whilst real user experience and transaction monitoring will identify in which tier a problem causing slowdowns and issues lies, they do not identify the true root cause which could be a full storage disk supporting a database or a faulty network switch or a remote student's ISP (Internet Service Provider) or Wi-Fi router.

Most APM tools offer user experience monitoring and transaction tracing capabilities. But, when there is infrastructure slowness affecting the application, these APM tools cannot always pinpoint the root cause of problems. This is where unified infrastructure monitoring comes in. To be able to truly diagnose the root cause of application slowness, IT operations teams need:

○ Visibility into the availability, performance, and usage of every tier of the infrastructure – virtualization, cloud (Microsoft Azure, Amazon AWS), storage, networking, Active Directory, databases etc.

○ Analysis of metrics from each tier to be able to see performance abnormalities proactively.

○ Correlation of metrics across the different tiers, to be able to determine the exact cause of slowness.

Some examples of infrastructure problems that can affect application performance include:

○ Network connectivity issues.

○ Failure in a SAN array slowing down all I/O accesses.

○ Backup jobs running on a database server, causing slowness for all applications.

- Resource contention at the virtualization tier, affecting applications hosted on a virtual infrastructure.

- Database-specific problems like index fragmentation, redo log contention, etc.

- Problems on users' endpoints particularly when institutions have adopted BYOD (Bring Your Own Device) strategies.

IT organizations should consider using application performance monitoring tools that provide converged performance visibility of applications and the infrastructure. Without forcing you to toggle between separate management consoles for each part of the infrastructure, your APM tool should provide correlated visibility across user experience, business transactions, applications, databases, and the supporting infrastructure tiers such as network, storage, virtualization, cloud, containers, etc. This is true "full-stack" application performance monitoring.

To summarize, business transaction monitoring is a key piece of the application performance monitoring framework, but not the solution in and of itself for root cause diagnosis and problem resolution. IT teams need deeper, far-reaching, infrastructure-wide correlated visibility for accurate problem diagnosis and faster resolution to effectively support today's digital business.

05 Synthetic Testing and Monitoring

Student and staff satisfaction and productivity are the ultimate measures of application performance. By continuously monitoring the end-user experience, IT managers can be alerted to times when users experience deficient performance, slowdowns, or outages.

Many modern applications have built-in instrumentation to track and report key performance metrics which combined with business transaction and real user monitoring detect and analyze real problems users are encountering. This passive monitoring approach alone is not effective when users are not actively using the applications or when instrumentation is not available (for example, legacy applications and custom applications). Therefore, a synthetic monitoring approach is needed to test business transactions actively and continuously and preemptively identify problems.

eG Enterprise includes a full suite of synthetic monitoring tools that enable administrators to probe and test their application delivery continually automatically. In educational settings it is common for our customers to simulate students accessing Moodle or Blackboard early in the morning before the main rush to campus and

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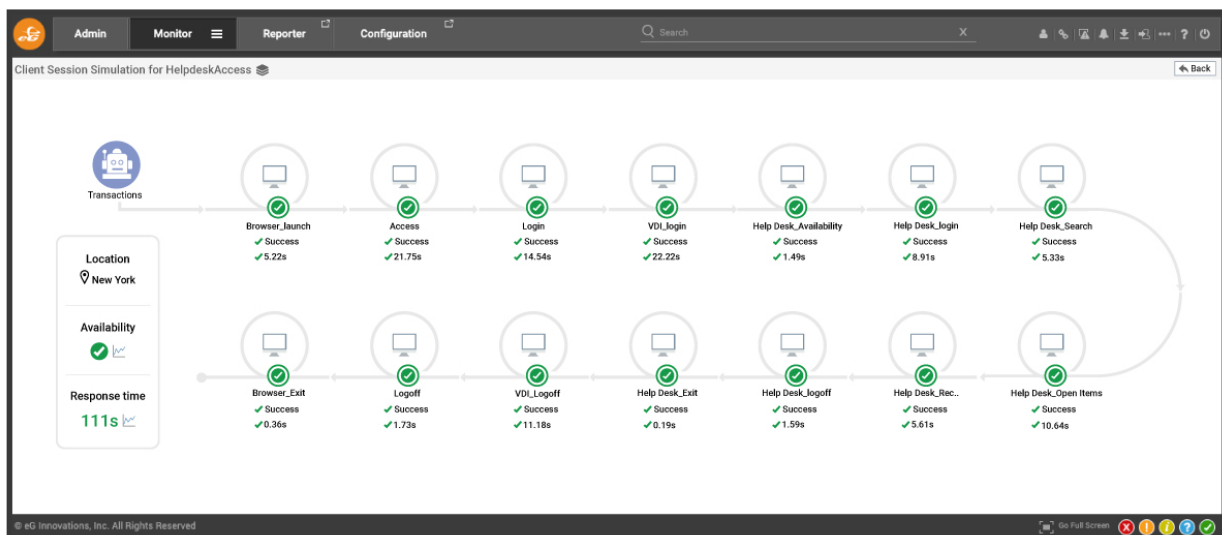
class - if problems are discovered they can usually be resolved before students or staff are impacted and teaching disrupted.

Synthetic testing is also leveraged when IT or software changes are made to ensure that applications and services are available and performant before they go live and into production.

06 Cost-Effective Licensing

eG Enterprise licenses are transferable between over 250+ technologies to allow the administrator to avoid shelf ware and reallocate licenses to reflect the demands of individual terms and courses. eG Enterprise can be licensed by server, users, or concurrent users as appropriate.

Many APM solutions are prohibitively expensive for education as they are licensed by JVM instances – so if you had 5 JVMs on a system, you would need 5 licenses. eG Enterprise is licensed by operating systems monitored, not by number of JVMs to be monitored. This makes our solution highly cost competitive in an educational setting where there is a responsibility to ensure costs are minimized and expenditure is focused on educational services and outcomes. The cost-effective price point allows administrators to cover more applications rather than prioritizing a few key services above others.

07 Secure and Scalable

As a solution eG Enterprise is designed to scale securely for even the largest multi-campus institutions and the volumes and surges in demands that their applications need to handle.

When choosing any APM solution for higher education, the evaluation process should consider features that ensure observability at scale:

○ **Scalability:** The APM solution should have the ability to handle high volumes of data and traffic (since students might check their scores at the same time resulting in traffic spikes).

○ **Alerting and Notifications:** Out-of-the-box, configurable alerts and notifications for specific events, such as performance thresholds or errors, so that you can quickly respond to issues. AIOps powered anomaly detection and event correlation technologies will avoid alert storms.

○ **Customizable and one-click dashboards:** The ability to customize dashboards and reports to fit the specific needs of your organization. In larger institutions ensuring that simple rapid overviews are available is essential to scale.

○ **Integrations with other tools:** DevOps tools, ITSM ticket and help desk tools such as PagerDuty, Autotask, ServiceNow etc. Ensuring that automation and workflows handle issues by process at scale.

○ **Multi-cloud support:** The ability to monitor applications and infrastructure across multiple cloud platforms, such as Amazon AWS and Microsoft Azure.

○ **Security features:** 2FA / MFA, encryption, user and administrator audit trail features and so on should be standard features in enterprise grade solutions.

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Summary

Proactively managing the performance and availability of key applications such as Moodle, Fibi, Blackboard and Peoplesoft within higher and further education is a strategic choice that long term leads to efficiencies and improved student and staff satisfaction and better educational outcomes. Educational establishments that can modernize and digitize have a competitive advantage to attract the best staff, students, and researchers. When evaluating APM tools remember to check for and evaluate:

○ AIOps (Artificial Intelligence for Operations) capabilities

○ Real User Monitoring (RUM) capabilities

○ Deep Business Transaction Monitoring (BTM)

○ Synthetic monitoring and testing capabilities

○ Converged Application and Infrastructure Monitoring

○ Education friendly licensing

○ Secure scalability

Read more about eG Enterprise for education at IT Performance Monitoring for Education and Universities (https://www.eginnovations.com/industry/education-it-management)

About eG Enterprise

eG Innovations provides the world's leading enterprise-class performance management solution that enables organizations to reliably deliver mission-critical business and customer services across complex cloud, virtual, and physical IT environments. Where traditional monitoring tools often fail to provide insight into the performance drivers of business services and user experience, eG Innovations provides total performance visibility across every layer and every tier of the IT infrastructure that supports the business service chain. From desktops to applications, from servers to network and storage, eG Innovations helps companies proactively discover, instantly diagnose, and rapidly resolve even the most challenging performance and user experience issues.

eG Innovations' award-winning solutions are trusted by the world's most demanding organizations and companies to ensure end user productivity, deliver return on transformational IT investments, and keep business services up and running. Customers include Anthem, Humana, Staples, T-Mobile, Cox Communications, eBay, Denver Health, AXA, Aviva, Southern California Edison, Samsung, and many more.

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