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Universities' data readiness in the era of data-driven digital technologies

Gotowość uniwersytetów do przetwarzania danych w erze technologii cyfrowych opartych na danych

Słowa kluczowe*:* badania stosowane, edukacja akademicka, experience API (xAPI), generatywna sztuczna inteligencja (Gen AI), gotowość do przetwarzania danych, konwergencja.

Streszczenie: Artykuł podkreśla znaczenie gotowości uniwersytetów do zarządzania danymi w erze technologii cyfrowych opartych na danych. Autorzy wprowadzają koncepcję „gotowości do przetwarzania danych" i omawiają kluczowe kwestie z tym związane. W artykule zbadano konwergencję dwóch głębokich technologii cyfrowych opartych na danych, experience API (xAPI) i generatywnej sztucznej inteligencji (Gen AI), w celu poprawy edukacji akademickiej. Ponadto w artykule przedstawiono raport z badań stosowanych xAPI przeprowadzonych w środowisku akademickim w celu wykazania krytycznej potrzeby i znaczenia gotowości danych.

Key words: academic education, applied research, convergence, data-readiness, deep tech digital technologies, experience API (xAPI), Generative Artificial Intelligence (Gen AI).

Abstract: The article emphasizes the importance of universities being ready to manage data in the age of data-driven digital technologies. It introduces the concept of 'data readiness' and discusses its key issues. The article investigates the convergence of two deep tech data-driven digital technologies, experience API (xAPI) and Generative Artificial Intelligence (Gen AI), to enhance academic education. Additionally, the article presents a report on xAPI applied research conducted in the academic setting to demonstrate the critical need and significance of data readiness.

Universities' Data Readiness – Understanding Its Importance and Challenges

Data readiness is an essential concept in today's data-driven world, where data is often compared to vital resources like oil or even oxygen. Just as organizations need continuous access to quality and secure data, they must ensure their data is

ready for practical use. Data readiness encompasses several critical aspects, such as availability, quality, and diversity of data. At universities, the goal is to support data-driven specifications, such as xAPI or Gen AI technological advancements, by providing data that is not only plentiful but also accurate, complete, and clean. Data readiness is crucial for digital success but has significant challenges and opportunities[1].

One of the main challenges of data readiness is unifying, storing, analyzing, and applying data at scale. Universities can struggle with data quality and accessibility issues, hindering the effectiveness of Gen AI-enhanced agents. Data lakes and ETL (Extract, Transform, Load) processes are commonly used to address these challenges, but many universities still need mature platforms for data organization[2]. The need for large volumes of diverse data for training Gen AI models adds another layer of complexity. This is particularly true for creating models that require extensive, varied datasets to ensure robust training and reliable outputs[3].

Data readiness also involves navigating the legal and ethical landscape of data use. Data privacy, security, and governance are paramount, especially when dealing with sensitive information like personally identifiable information (PII)[4]. Universities must ensure that their data management practices comply with relevant regulations and are designed to protect against unauthorized access and breaches. Using cloud-based solutions, such as AI as a Service (AIMaaS), which allows the integration of AI technologies into operations without the need for extensive infrastructure or expertise, can help manage data securely[5]. Nonetheless, universities must remain careful about how data is handled and stored.

Data readiness presents substantial opportunities. Universities can unlock significant value from digital initiatives by effectively managing and preparing data. For example, data readiness enables faster and more accurate data analysis, which can drive insights and educational decision-making. Universities can also leverage Gen AI processes, predict trends, and gain a competitive edge in the demanding educational market. Achieving this requires a strategic approach to data-driven

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1 Computerworld: *Data and Gen AI: A Primer for the Fundamentals of AI Success,* https://us.resources.computerworld.com/resources/data-and-genai-a-primer-for-the-fundamentals-of-ai-success-6/ [Access: 07.06.2024].

2 IBM: *Driving data lake success with automated governance, storage options, and enterprise readiness,* https://www.ibm.com/blog/driving-data-lake-success-with-automated-governance-storage-options-and-enterprise-readiness/, Access [07.06.2024].

3 BusinessTech Weekly: *Data Readiness: Establishing a Roadmap to a Business Success,* https://www.businesstechweekly.com/operational-efficiency/data-management/data-readiness/ #google_vignette [Access: 07.06.2024].

4 RSI Security, *PII Compliance Checklist 2023,* https://blog.rsisecurity.com/pii-compliance-checklist-2023/, [Access: 07.06.2024].

5 Simplilearn: *AIMaaS: Revolutionizing Business with AI Technology,* https://www.simplilearn.com/aimaas-article, [Access: 07.06.2024].

digital technologies, including adopting educational notions and best practices[6] – described in the consecutive parts of this article.

xAPI and Gen AI Convergence in Academic Education

Among the digital technologies that are significantly shaping today's academic education landscape (e.g., Cloud Computing, Virtual Reality, and Distance Education through various LMS services and MOOCs), two especially require data readiness: xAPI and Gen AI. Both technologies belong to deep tech, rooted in significant scientific or engineering advancements. Deep tech often spans multiple scientific and engineering disciplines, requiring collaboration across various fields of expertise to achieve breakthroughs[7]. It can include IT specialists collaborating with experts in academic education. xAPI and Gen AI are data-driven technologies rooted deeply in Big Data (BD), a vast resource used to analyze patterns and make predictions. BD in education may constitute a foundation for new trends in teaching and learning and future innovation values[8].

xAPI and Gen AI have a foundational and transformative impact on data management and academic education. xAPI is a robust specification that collects, stores, and analyzes detailed data about learning experiences. It captures interactions from various devices and services, comprehensively understanding educational processes. The detailed insights and reports xAPI produces on learner engagement and performance are crucial for refining educational strategies and outcomes. Gen AI uses advanced machine learning models to generate new, contextually relevant content. It leverages large datasets to create text, images, audio, and code across domains.

When xAPI and Gen AI are integrated into an academic setting, they play a pivotal role in tailoring educational content to individual learners' needs, thus enhancing personalized learning experiences. This integration not only streamlines administrative tasks and improves communication within educational institutions but also drives significant advancements in the efficiency and effectiveness of academic operations. By harnessing the power of xAPI and Gen AI, universities can foster innovation and maintain a competitive edge in the evolving education landscape.

Therefore, the article is a trial to showcase how data gathered by xAPI can enrich Gen AI-enhanced tools in academic surroundings. To maintain consistency in this article, and as xAPI (Experience API) has been widely described by professionals in different Learning and development (L&D) resources[9], let us point out here only the most

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6 JISC: *Digital Transformation In Higher Education,* https://www.jisc.ac.uk/guides/digital-transformation-in-higher-education [Access: 07. 06.2024].

7 TechCrunch: *What do we mean when we talk about deep tech?,* https://techcrunch.com/2020/03/11/what-do-we-mean-when-we-talk-about-deep-tech/ [Access: 07.06.2024].

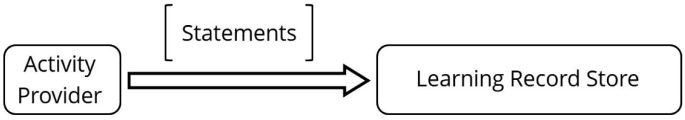
8 K. Cukier, V. Mayer-Schoenberger, F. de Vericourt: Framers: *Make Better Decisions In The Age of Big Data, Random House UK Ltd, London 2022.*

9 xAPI: xAPI *(Experience API) Overview,* https://xapi.com/overview/, [Access: 07.06.2024].

essential facts about this data-driven digital technology. xAPI is a specification for collecting and storing data about learning experiences. It enables the analysis and reporting of this data, which can then be used to improve educational processes.

xAPI architecture enables collecting information about a user or group of users in modules called Learning Record Store (LRS). Each LRS accepts data from Activity Providers (APs), i.e., (mobile) devices or different services incorporated into the system. These devices or services are coupled with xAPI through their APIs. APs can be temporarily disconnected from the Internet. Then, data is sent to the LRS when they reconnect to the Network. xAPI communicates (sends) the 'learning experiences' from AP to LRS in the form of statements in the format (Pict. 1):

Actor: Who? The user of the system, i.e., a student or an academic teacher.
Verb: Did what?
Object: Concerning or in connection with what?



Picture 1. xAPI Fundamental: Activity Provider to Learning Record Store Flow

Source: own elaboration based on [Głębocki, 2024][10].

xAPI is an analytically flexible and powerful solution for communicating learners' and teachers' activities regarding the educational processes they are experiencing. At the same time, the specification does not 'lock' the users into a single tool zone, e.g., a particular LMS or another information silo. It expands the observation area to include places where formal and informal learning occurs. A coherent info system is created – a learning environment in the digital world.

Although xAPI technology is valuable for learning analytics and understanding end-users engagement with learning content or applications, it is not considered 'intelligent.' No wonder it is not, as xAPI (formerly known as Tin Can) is not a 'newbie' in the educational world. It originated from 2012-2015[11] and aimed to replace its predecessors, such as SCORM. Educators assign verbs to specific actions, which are then sent in statements to a database for later analysis. Nonetheless, this data-driven specification has undoubtedly lived up to its expectations. For example, xAPI data can be used to generate insightful reports on learning experiences[12].

The advent of wide usage of Generative Artificial Intelligence (Gen AI) in learning environments could lead to a renaissance for xAPI. Namely, xAPI can enhance

[10] R. Głębocki, *Multimedia: Understanding xAPI,* https://bit.ly/colours-xapi**,** [Access: 07.06.2024].
[11] xAPI: *Project Tin Can Evolution,* https://xapi.com/tin-can-evolution/, [Access: 07.06.2024].
[12] A. Berg, M. Scheffel, H. Drachsler, S. Ternier, *The Dutch xAPI Experience,* https://www.researchgate.net/publication/301591282_The_dutch_xAPI_experience, [Access: 07.06.2024].

another data-driven technology, Gen AI, by providing robust, valuable, context-specific, and personalized data that aligns with a particular educational setting, e.g., learning and teaching processes at university. Many L&D specialists are presently focusing their attention on Gen AI. Thus, let us introduce it in a nutshell: in the scenario of how xAPI and Gen AI can converge to create the next–generation learning environment supported by a digital data ecosystem.

Gen AI is an advanced branch of AI that focuses on creating new content by learning from existing data patterns and structures. Using the Large Language Model (LLM), Gen AI generates original outputs such as text, images, audio, and code. Transformer architecture is a significant development in AI, especially in natural language processing. Transformers allow models to process entire data sequences simultaneously, capturing the context of the data within these sequences. This capability is crucial for models like GPT (Generative Pre-trained Transformers), which have been trained on large datasets containing publicly available text from the Internet.

The applications of Gen AI are wide-ranging and diverse. It impacts various domains by automating complex tasks and nurturing innovation and creativity. In the field of education, Gen AI has the potential to enhance learning by creating personalized educational content. When it comes to data analysis, Gen AI plays a crucial role by generating insights from large datasets and offering data-driven recommendations. Its ability to handle different data types and produce high-quality outputs makes Gen AI a transformative technology[13].

The article *Navigating the AI era: University communication strategies and perspectives on generative AI tools*[14] explores the potential impact of Gen AI on university communication. It discusses the current applications of Gen AI in universities, such as translation, text correction, and text generation, to improve operational efficiency. The article emphasizes the importance of adopting strategic and integrated approaches to using Gen AI tools, considering the ongoing advancements in data-driven technologies and the necessity for universities to adapt and innovate their communication strategies accordingly.

Regarding the abovementioned article, we sketched how xAPI can be integrated with Gen AI in the following framework scenario. It, of course, would need solid technological analysis and consecutive technical implementation. Nevertheless, the presented synergy would be very beneficial because xAPI gathers in-depth information about learning experiences, creating a comprehensive dataset that Gen AI can use to create customized educational content. By using the context-specific and accurate data provided by xAPI, Gen AI models can generate more relevant and effective educational materials tailored to the specific needs of each

[13] IBM: *What is Generative AI,* https://www.ibm.com/topics/generative-ai, [Access: 06.07.2024].

[14] J. Henke: *Navigating the AI era: University communication strategies and perspectives on generative AI tools,* https://jcom.sissa.it/article/pubid/JCOM_2303_2024_A05/, [Access; 07.06.2024].

learner. This improves the learning experience and enables educators to provide more impactful instruction.

Moreover, by integrating xAPI and Gen AI, academic institutions can significantly enhance communication. Gen AI, fueled by extensive data from xAPI, can automate generating personalized reports, feedback, and educational materials. This can streamline administrative duties, enabling educators to dedicate more time to teaching and less to routine documentation. The collaboration of these technologies can result in more efficient and adaptable educational settings, ultimately improving the overall effectiveness of academic operations.

However, universities must ensure that the data collected and utilized by these technologies is managed securely and complies with relevant regulations. Universities can address these concerns by developing their systems and maintaining control over their IT xAPI and Gen AI infrastructure while fully leveraging the benefits of these advanced technologies. This strategic and ethical approach will be essential in creating a balanced and effective integration of xAPI and Gen AI, fostering innovation while safeguarding data integrity and privacy[15].

Research Report on xAPI Implementation Expectations

Applied research on insider target groups, such as academy specialists, can provide insight into data readiness. Professionals from universities in the COLOURS Alliance[16], united under the Erasmus+ European Universities Initiative, were invited to complete a series of surveys on xAPI implementation expectations. The research, conducted from February to May 2024, involved specialists from eight universities. It regarded the non-technical aspects of a comprehensive analysis before introducing the xAPI to the COLOURS Alliance.

Research Methodology

The research comprised four surveys based on the Value vs. Complexity (or Effort) Matrix[17]. This methodology was chosen because it could significantly enhance the consecutive decision-making processes regarding xAPI implementation, ensuring that resources are allocated efficiently and that high-impact initiatives are prioritized. This method featured a two-layered approach to xAPI. The first concerned enhancing day-to-day education. The other regarded future needs, such as incorporating Gen AI into educational processes enriched by the xAPI-gathered

[15] B. Melissa, K. Hassan, M. De Laat: *A meta systematic review of artificial intelligence in higher education: a call for increased ethics, collaboration, and rigor.* https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-023-00436-z [Access: 07.06.2024].

[16] COLOURS Alliance: *COLOURS Alliance,* https://colours-alliance.eu/ [Access: 07.06.2024].

[17] V. Rohit: *Exploring the Value vs. Complexity Matrix: Alternative to RICE Model Complexity Matrix: Alternative to RICE Mode,* https://www.linkedin.com/pulse/exploring-value-vs-complexity-matrix-alternative--rohit-verma--gicuc/ [Access: 07.06.2024].

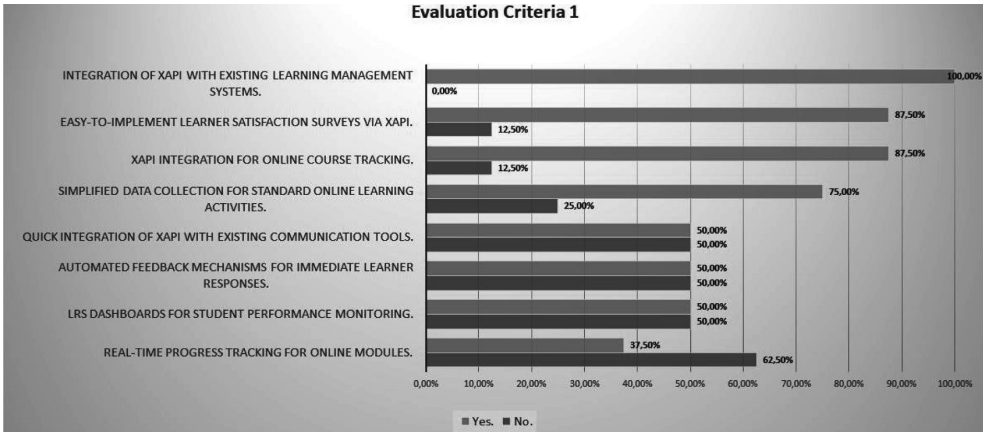
data. Therefore, the research procedure can be viewed as forward-looking as it focuses on implementing data-driven technology for current and prospective use.

Each of the four surveys consisted of three sections:
- In Section 1, specialists were requested to select the university they came from.
- Section 2 – referred to a particular part of the Value vs. Complexity (or Effort) Matrix.
- In Section 3, the specialists could provide open comments and feedback.

Researchers asked the respondents what COLOURS xAPI feature they would consider a 'Must have' – Survey 1 (Pict. 2), 'Should have' – Survey 2 (Pict. 3), 'Could have' – Survey 3 (Pict. 4), and 'Might have' – Survey 4 (Pict. 5). The research outcomes can serve as indicators for the implementation team regarding what to prioritize in meeting the end-users' expectations and allocating resources efficiently. The outcomes can also support training on COLOURS xAPI, e.g., by providing detailed real-life case studies, Q&As, or example scenarios on implementation areas that end-users perceive as important[18].

The Research Outcomes[19]

The research respondents communicated the following additional comments:
- Feasibility analysis: A more precise feasibility analysis would need to objectively determine whether new systems are necessary or if additional functions to existing systems will be sufficient.



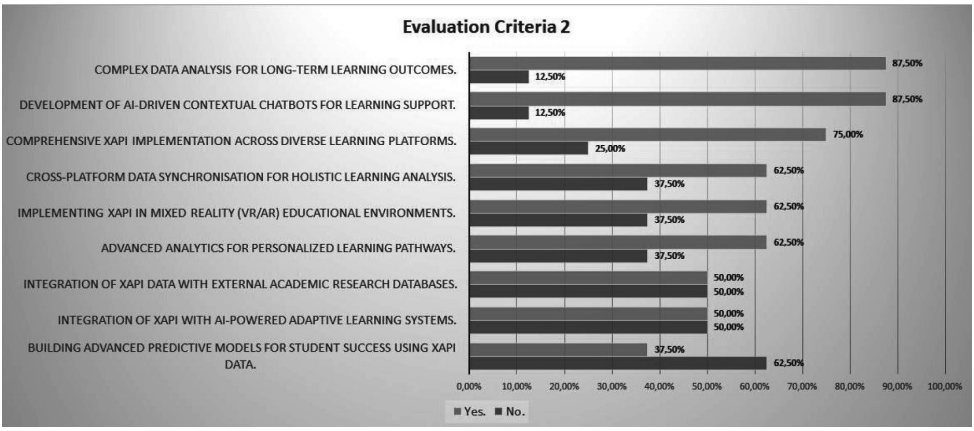
Picture 2.

Survey 1. Evaluation Criteria 1. Value vs. Complexity (or Effort) Matrix – High Value, Low Complexity (Quick Wins). It shows what the respondents consider a 'must have' feature for the COLOURS xAPI.

[18] This article was written when the COLOURS xAPI training material was developed to support the COLOURS Alliance's data readiness for introducing xAPI into educational processes.

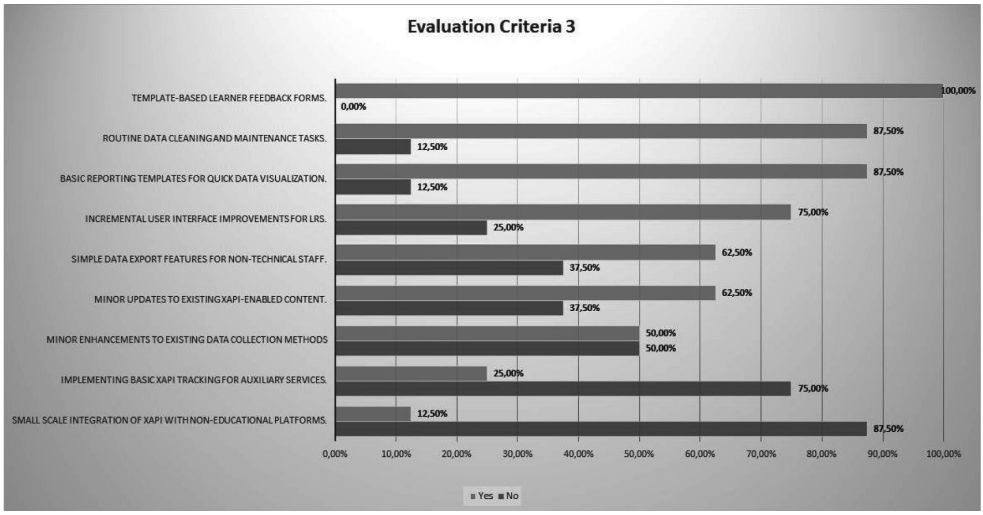
[19] Elaborated on by L&D researchers: R. Głębocki, A. Kozerska, A. Gil, Jan Dlugosz University in Czestochowa, Poland.

- Data handling: The assumption is that personal data is being handled correctly and in compliance with the Personal Data Act and GDPR.
- Target group identification: The development of various xAPI requires clear identification of target groups to ensure they can be easily directed to the appropriate audience, such as teachers, researchers, administrative staff, or students.



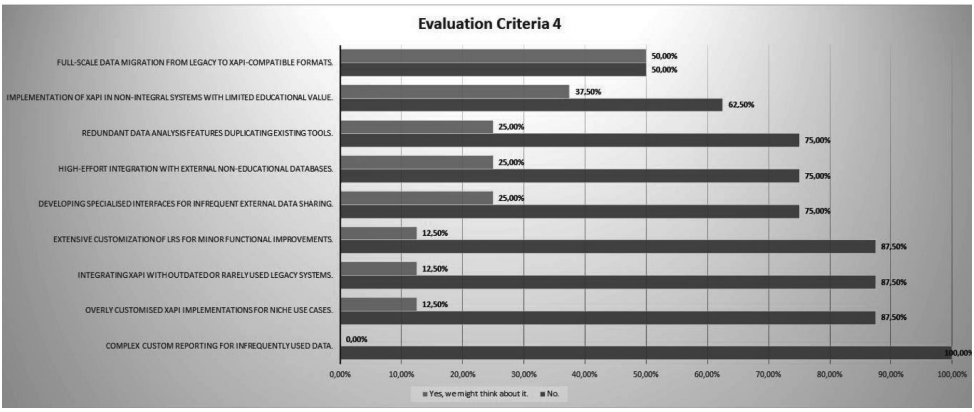
Picture 3.

Survey 2. Evaluation Criteria 2. Value vs. Complexity (or Effort) Matrix – High Value, High Complexity (Major Projects). It shows what the respondents consider a 'should have' feature for the COLOURS xAPI.



Picture 4.

Survey 3. Evaluation Criteria 3. Value vs. Complexity (or Effort) Matrix – Low Value, Low Complexity (Fill-Ins). It shows what the respondents consider a 'could have' feature for the COLOURS xAPI.



Picture 5.

Survey 4. Evaluation Criteria 4. Value vs. Complexity (or Effort) Matrix – Low Value, High Complexity (Thankless Tasks). It shows what the respondents consider a 'might have' feature for the COLOURS xAPI. In this case, answering 'No' indicates a 'WILL NOT have' criterion, and answering 'Yes' means – we might think about it.

Research Discussion

It is worth pointing out that the initial analysis was conducted at an early stage, and further proceedings may be required. For example, a different analytical methodology may be chosen, other aspects may be considered, or used terms can be defined. Nonetheless, during the xAPI design and development stages, it is essential to remember the learning/feedback and teaching purposes the system will serve. Iterative development and continuous improvement benefit data-driven educational solutions, which require adapting to fast-changing user needs and emerging technological opportunities.

Summary

The article provides a detailed analysis of the importance of universities' data readiness, particularly in integrating advanced deep tech data-driven digital technologies such as xAPI and Gen AI. It illustrates how xAPI can enhance Gen AI's capabilities in academic settings by providing robust and context-specific data and how this integration can significantly improve Gen AI's effectiveness in creating educational content and supporting communication processes. The article also emphasizes the importance of addressing data management's legal, ethical, and strategic aspects.

Moreover, including a research report on xAPI implementation expectations adds a practical dimension to the article by offering valuable insights into the current state of readiness among a group of universities and identifying key areas that require attention. Consequently, this article can be a valuable resource for educators, researchers, administrative staff, and technologists who want to use data-driven digital technologies to improve educational outcomes.

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