An Exercise in Institutional Reflection:
The Learning Analytics Readiness Instrument (LARI)

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ABSTRACT

While the landscape of learning analytics is relatively well defined, the extent to which institutions are ready to embark on an analytics implementation is less known. Further, while work has been done on measuring the maturity of an institution's implementation, this work fails to investigate how an institution that has not implemented analytics to date might become mature over time. To that end, the authors developed and piloted a survey, the Learning Analytics Readiness Instrument (LARI), in an attempt to help institutions successfully prepare themselves for a successfully analytics implementation. The LARI is comprised of 90 items encompassing five factors related to a learning analytics implementation: (1) Ability, (2) Data, (3) Culture and Process, (4) Governance and Infrastructure, and, (5) Overall Readiness Perception. Each of the five factors has a high internal consistency, as does the overall tool. This paper discusses the need for a survey such as the LARI, the tool's psychometric properties, the authors' broad interpretations of the findings, and next steps for the LARI and the research in this field.

Categories and Subject Descriptors

J.1 **[Administrative Data Processing]** Education; K.3 **[Computer Uses in Education]** - General

General Terms

Measurement, Reliability, Experimentation, Standardization.

Keywords

Learning Analytics, Readiness, Survey Design, Higher Education.

1. INTRODUCTION

Learning analytics (LA) continues to attract significant attention in the educational sector. As the field matures and more research emerges demonstrating the significant teaching and learning benefits of the practice, a growing number of learning organizations are considering adopting LA initiatives. Whether these plans emerge from a research team's findings, a strategic plan, or a mandate from leadership, one thing is certain: learning

analytics is not a fad likely to fade away. In fact, The New Media Consortium has listed learning analytics in the past three Horizon Reports suggesting that the potential for LA to significantly impact education has reached the mainstream [1]. However, assuming all institutions have the same probability of success in carrying out an LA initiative is a costly mistake. Typically, LA projects require significant investment, and, like any investment, should not be undertaken without thoughtful and deliberate consideration of factors that may contribute to success.

The literature offers would-be practitioners a solid base of theory, process, and research. To be sure, these sources provide an invaluable source of knowledge for those looking to make an initial foray into the LA field. However, most literature to date does not address the concept of institutional readiness in more than a cursory fashion. Many landscape works exist [2, 3, 4], the EDUCAUSE Center for Applied Research developed *The Analytics Maturity Index* [5], and Drachsler and Greller have examined stakeholder perceptions and expectations of LA [6], but there has been little concerted effort focused on the fundamental question of *whether an institution is ready to undertake a learning analytics initiative.* The authors of the present study argue that before embarking on a LA journey, institutions need to have a realistic understanding of how "ready" they are so that they are better positioned for success. The logistics of starting a LA initiative can seem daunting in a diverse and still evolving space.

2. THE NEED FOR REFLECTION

As discussed earlier, it is imperative that institutions considering learning analytics reflect upon their readiness to do so. This exercise in institutional-reflection must be thorough so that a comprehensive understanding from which decisions can be informed can be created. To achieve an accurate understanding of an institution's readiness, multiple perspectives much be taken into account. Successful LA projects often have cross-disciplinary teams on them, demonstrating that the expertise and skills necessary to implement a project are diverse [4]. It only stands to reason, then, that looking at a single perspective before deciding to undertake an initiative could lead to a less than successful endeavor. We posit that gathering readiness feedback from administrators and faculty, various departments, and multiple levels of an institution is imperative to minimize bias individual lenses may inadvertently interject. Collecting feedback from multiple levels of an institution also will provide a more realistic understanding of skills and expertise that can be accessed in support of an LA project, since simply having the resources somewhere on a campus is not sufficient; a project must have ready access to the requisite resources [7, 8].

3. THE LEARNING ANALYTICS READINESS INSTRUMENT

The authors put forth the Learning Analytics Readiness Instrument (LARI) for consideration. The LARI is a survey instrument designed to be completed by multiple people within an institution as they deliberate the merits of engaging with an LA project. Conceptually, the LARI could be used in the formative stages of planning to undertake a LA initiative. While still in an iterative state, it will ultimately provide an institutional profile with readiness indicators on several key elements necessary for LA success. The LARI has been designed to serve the purpose of a prescriptive diagnostic, meaning the instrument can be used to help determine strengths as well as potential foci that may need additional attention before a large-scale initiative is undertaken.

3.1 Framework for Creation

When creating the framework for the LARI, the authors wanted to ensure it was fully situated in the existing learning analytics space. While this space is not yet comprehensively defined, many definitions have been proffered by scholars and institutions.

- The Society of Learning Analytics Research defines learning analytics as the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs [9].
- The EDUCAUSE Learning Initiative posits that LA evaluate[s] large data sets to provide decision makers with information that can help determine the best course of action for an organization, with a specific goal of improving learning outcomes, which could be measured by grades, retention, or completion; further, it specifically mention the use of "digital breadcrumbs" and peer comparison [10].
- van Barneveld, Arnold and Campbell argue that LA is the use of analytic techniques to help target instructional, curricular, and support resources to support the achievement of specific learning goals [11].
- Cooper states that analytics is the process of developing actionable insights through problem definition and the application of statistical models and analysis against existing and/or simulated future data [12].
- Krumm, Waddington, Lonn, and Teasley claim that learning analytics uses data to inform decision-making; leverages data to identify students in need of academic support; and allows for direct user interaction with a tool to engage in some form of sensemaking that supports a subsequent action [13].

While these are not the only definitions present in the literature, the context of learning analytics can be broadly formed using these five definitions. The LARI is framed using clearly delineated assumptions rather than a precise definition. Drawing from the definitions above, the following principles were incorporated as a definition and broad consideration for the LARI: Institutions should examine 1) rich, learning-related data sets, 2) as they are exposed to various analytics techniques, 3) in an effort to support teachers and/or learners, 4) as those populations move toward intervention, action, and increased success. By adopting this framework for practice, the LARI was created to firmly seat LA at the intersection of "big data" and student success.

3.2 Readiness Components

As originally designed, the LARI consisted of five readiness components: governance/infrastructure, ability, data, culture, and process. The optimal environment for learning analytics success would include sufficient readiness on each of the five components. Composite institutional scores, created by combining multiple individual's scores from a single institution, serve as a catalyst for intense reflection on each component.

3.2.1 Governance and Infrastructure

The governance and infrastructure component exists to encourage reflection of foundational aspects of learning analytics. Elements included in this category include technical infrastructure, institutional governance, policies and oversight.

3.2.2 Ability

To achieve success in any learning analytics initiative, proper abilities must be accessible. A wide range of skills will be utilized at different points during an implementation, ranging from technical expertise and analytic proficiency to strategic leadership and student support skills. The ability component encourages exploration of all these requisite skills, along with realistic expectations of unfettered access to said skills.

3.2.3 Data

Data is an essential component of success in learning analytics. This component focuses on helping individuals and institutions reflect on their readiness status by investigating what types of data are present within the institution, how valid and reliable those sources are, how the data is stored and accessed, and what data ownership, distribution, and utilization paradigms exist.

3.2.4 Culture

The fourth component examined in the LARI is culture. Institutional change requires cultural acceptance to reach its greatest potential. The cultural domain, then, is vitally important in helping an institution reflect on the level of readiness for LA. This component examines the awareness and acceptance of data-driven decision making, the existence of stakeholder support, and the presence of shared vision for support of student success.

3.2.5 Process

The process of implementing LA is the final component in the LARI. This element includes the examination of stakeholders and the extent to which they're involved in the process. This element also contains pragmatic concerns, such as sustainability and project/process management needed to move an idea from goal to reality.

4. METHODOLOGY

4.1 Procedure

Once developed and framed within the current LA literature, the authors sought to pilot the instrument in an effort to gather feedback regarding the LARI and perform item reduction through the use of both the feedback and an exploratory factor analysis. Because of the nature of the survey, the authors sought out those associated with institutions and/or familiar with successful implementations of LA who were largely associated with a consortium of research institutions in the American Midwest. Additionally, individuals associated with other institutions were targeted based on their experience and knowledge. Participants were emailed multiple times over the course of six weeks to request them to complete the instrument, which was deployed via an online survey tool. After a sufficient number of responses were obtained, data were downloaded and analyses conducted.

4.2 Participants

A convenience sample of persons familiar with successful implementations of LA completed the instrument. In all, thirty-

three respondents from nine different institutions participated in the pilot survey; of the nine institutions, one was Canadian, while the remaining were from the United States. All respondents were faculty or staff at their respective institutions with roles that were related to learning analytics, data analysis, and/or research related to educational technologies. The nine institutions are all large research universities with high undergraduate enrollments.

5. RESULTS

5.1 Factor Analysis

An exploratory factor analysis was conducted using the 139 quantitative measures from the pilot survey instrument in order to A) intelligently reduce the length of the survey by eliminating questions that did not fit logically with other items on the survey and B) confirm and/or redefine the five readiness components described in Section 3.2.

Five factors were extracted in an initial factor analysis using varimax rotation with Kaiser normalization. Using the conventional exclusion criteria of |.30| [14], as well as removing items that did not load well on any factor or seemed incongruous with the factor onto which they loaded, 42 survey items were eliminated from the extracted factors. A second factor analysis, also extracting five factors, eliminated an additional 7 survey items. The final 90 survey items with factor loadings unique to each of the five factors, explained 55.7% of the variation. The 90-item the LARI had a Chronbach's alpha of .946, indicating a high level of internal consistency.

Since each factor includes survey items that have different ordinal and interval scales, regression factor scores were used for investigation of the extracted factors. In this case, a score of 0 indicates a respondent's ratings are close to the average whereas a negative or positive score indicates lower or higher ratings compared to the average, respectively [15]. Descriptive statistics are presented in Table 1. The skewness and kurtosis indicated that all factors had a negatively skewed distribution. Also, the Cronbach's alpha statistics indicated that all factors had a relatively high internal consistency.

Table 1. Descriptive Statistics for Five Learning Analytics Readiness Factors

Factor	# of Items	Median	Skewness	Kurtosis	α
Ability	19	-.038	-.401	-.640	.940
Data	22	.228	-1.157	.686	.945
Culture & Process	23	.146	-.420	.073	.898
Governance & Infrastructure	15	.164	-1.299	2.131	.896
Overall Readiness Perceptions	11	.006	-.734	1.421	.841

5.1.1 Factor 1: Ability

The first factor, "Ability" (Eigenvalue = 20.32), measures respondents' perceptions regarding professional staff at the institution who possess skills and experience in areas critical for successfully implementing learning analytics. For example, *"My institution has professionals with mathematical / statistical experience in deriving and validating statistically sound algorithms (e.g., simulations, cross validation)"* (5-point Likert scale from Strongly Disagree – Strongly Agree).

5.1.2 Factor 2: Data

The second factor, "Data" (Eigenvalue = 9.57), measures respondents' perceptions regarding the extent to which different types of data are collected at the institution and the person(s)/group(s) responsible for storing and maintaining that data. For example, *"The extent to which my institution currently collects Admissions data (e.g., prospect demographics, interests, application evaluation, DescriptorPlus)"* (7-point Likert scale from Does not currently collect – My institution collects all / nearly all of this data).

5.1.3 Factor 3: Culture & Process

The third factor, "Culture & Process" (Eigenvalue = 9.23), measures respondents' perceptions regarding institutional norms concerning data use, sharing, security, and how data is utilized in reports and decision making. For example, *"My institution has a culture that accepts the use of data to make decisions"* (5-point Likert scale from Strongly Disagree – Strongly Agree).

5.1.4 Factor 4: Governance & Infrastructure

The fourth factor, "Governance & Infrastructure" (Eigenvalue = 6.14), measures respondents' perceptions regarding the institution's investment in learning analytics and professional staff who possess skills and experience related to data management, training, and documentation. For example, *"My institution has professionals with knowledge and expertise in manipulating data from multiple sources and platforms to conform to institutional specifications"* (5-point Likert scale from Strongly Disagree – Strongly Agree).

5.1.5 Factor 5: Overall Readiness Perceptions

The fifth factor, "Overall Readiness Perceptions" (Eigenvalue = 4.87), measures respondents' perceptions regarding a variety of areas including institutional resources, IRB, the faculty's acceptance of learning analytics, and professional specializations. For example, *"My institution's faculty largely accept the use of analytics for improving teaching and learning"* (5-point Likert scale from Strongly Disagree – Strongly Agree).

5.2 Institutional Differences

Mean factor scores were calculated for each institution with at least two participants (see Table 2). There was a significant difference between means for the Ability factor ($F(6, 24) = 2.755, p = .035$) and for the Overall Readiness Perceptions factor ($F(6, 24) = 3.574, p = .011$). Most institutions rated the Ability and Culture & Process factors lower than the calculated overall average while the Data and Governance & Infrastructure factors were typically rated higher than the calculated average. Results for the Overall Readiness Perceptions factor were mixed, reinforcing the fact that analytics readiness is highly variable across institutions and that LA is not as widespread or as competently applied as many may think. This also underscores the need for institutional reflection, given how institutions can make wildly different yet equally effective changes to their policies, practices, and approaches to student success through analytics.

Institution	A Mean (SD)	B Mean (SD)	C Mean (SD)	E Mean (SD)	F Mean (SD)	G Mean (SD)	I Mean (SD)	Mean Square
Ability	-0.264 (0.65)	-0.068 (1.018)	-0.901 (0.301)	-0.671 (1.172)	-0.83 (1.084)	0.162 (0.652)	1.036 (0.383)	2.034*
Data	0.417 (1.075)	-0.156 (0.46)	0.756 (0.559)	-0.133 (1.697)	0.47 (0.161)	0.007 (0.62)	-0.679 (1.432)	0.916
Culture & Process	0.784 (0.474)	-0.372 (0.677)	-0.949 (0.27)	0.275 (0.277)	-0.17 (1.851)	-0.118 (1.885)	-0.053 (0.86)	0.967
Governance & Infrastructure	0.313 (0.24)	-0.239 (1.214)	0.17 (0.008)	0.107 (0.989)	0.353 (1.082)	-1.379 (1.099)	0.452 (0.802)	1.385
Overall Readiness Perceptions	-1.285 (0.598)	0.700 (0.767)	0.459 (0.402)	-0.444 (0.506)	0.413 (0.734)	-0.838 (1.965)	-0.017 (0.462)	2.468*

*$p < .05$, **$p < .01$, ***$p < .001$

6. DISCUSSION
6.1 Unpacking the LARI Factors
The purpose of this study was twofold: create a practical, more parsimonious version of the Learning Analytics Readiness Instrument and ensure that the factors within the revised LARI were internally consistent and contained mutually exclusive items. As demonstrated in the previous section, these two ends were achieved; over 40 items were removed from the original instrument, and the current version has five factors with high Chronbach's alpha scores and low collinearity with each another.

Most of the literature regarding learning analytics within institutions has focused either on successful implementations or the extent to which an institution has matured in its use of analytics to positively affect student success; the current study works to fill the void in the literature regarding how an institution can proactively work to successfully implement learning analytics by understanding its own strengths and weaknesses with regard to the five aforementioned factors.

The LARI was reduced from 139 to 90 items while maintaining high internal consistency for the overall measure and the five subscales. The presence of marker variables within the factors suggests a robust solution and clearly define the constituent factors, despite there being a relatively small sample size [16, 17].

The factors resulting from the analysis were slightly different than those originally conceived by the authors. Where the authors conceived culture and process as being distinct constructs, data indicated that the items were very much intertwined; as such, one factor was created in the revised LARI where two were envisioned at the start. Additionally, the authors believed that the concept of overall readiness for analytics would arise from simply completing the survey, but upon analysis, it became apparent that the overarching notion of readiness cleanly fit within the survey.

The Culture and Process factor is comprised of items that formerly made up the original two factors of culture and process, but also several from original categories of data and governance/infrastructure. To us, this means that many of the components related to data do not involve procuring or analyzing the data as much as the rules, policies, paradigms, and practices that surround the use of data on campus. Further, items in the new factor relate also to the extent to which an institution has specific goals or objectives spelled out, as well as internal processes that will allow for analytics to be implemented.

As noted earlier, all respondents were affiliated with large, research-intensive universities. As such, data procurement or analysis did not seem to be areas of concern. Rather, these respondents, both within an institution and across the broader data set, noted that the concepts of ability and broad institutional readiness were of greatest concern. The ability factor, while an area of concern for the respondents, is not a surprising finding. Bischel [4] noted that many institutions have concerns with being able to "direct existing resources to analytics," continuing that many staff members are "too busy … to think about analytics" and that future calls and actions for greater accountability could further distance institutions from starting LA projects (p. 14).

Readiness as a factor in and of itself, rather than an outcome measure of the LARI overall, is something that bears more discussion here. Many institutions want to apply analytics because it is something their peers are doing, or because they've seen strong, positive results emerge from other institutions' implementations. While emulating peers in a manner that results in an institution bettering itself is admirable, the notion of being ready to actually do that work is an important one. Norris and Baer [2] indicate that institutions should start with a strategic question and from there determine the best means of approaching it. The items that comprise the overall readiness perceptions, to some extent, revolve around knowledge of analytics on campus, and, perhaps more importantly, the extent to which institutional will exists to move LA projects forward.

Powell and MacNeil [18] have one of the few publications in the analytics frame discussing readiness, and with it governance and practice. However, while much of their writing is applicable in any educational environment, feedback to the authors on the LARI indicated distinct governance and infrastructure differences among different countries' systems of higher education. This distinction is important, and one of the limitations discussed in the next section.

6.2 The LARI's Utility for the Field
Broadly, the LARI is a tool that is an important contribution to the field of learning analytics, particularly as it is applied to an institution looking to positively affect student success. Where little to no guidance currently exists for institutions to consult as they begin to implement analytics, the LARI, when fully completed, will bring not only an understanding of where an institution currently excels, but also where it has deficiencies – and will provide specific actions an institution can take to help mitigate or remediate those areas to ensure the broadest chances of success for the project.

7. LIMITATIONS
The biggest limitation associated with this study is the small sample size. Ideally, a much larger sample encompassing a broader range of institutions would have been employed in this

study, and future studies will ensure that will occur. Secondly, in interacting with others based in non-American institutions, it became apparent that while many of the challenges involved with an analytics implementation are common across national boundaries, those associated with governance, infrastructure, and culture are not as ubiquitous. As such, further research will need to be conducted to better understand how different systems of higher education are governed, and how those practices affect the application of data to improve student success.

8. NEXT STEPS

From here, additional research will be conducted using the more parsimonious version of the LARI. Multiple institution types will be sought out to ensure that the instrument holds its psychometric properties – and potential usefulness – across institution types. Additionally, work will be done to determine which persons at which levels of an institution should be involved in completing the LARI so that appropriate guidance may be given to those wishing to employ this tool. Third, the tool will be built into an automated website for delivery and feedback.

Finally, as referenced in the discussion section, this tool is not meant to serve solely as a diagnostic. While simply knowing where on a scale one lies is useful, the authors believe that additional guidance is necessary so as to appreciate the meaning behind a given score. For example, knowing that an institution has a low score in ability is necessary, but nowhere near nuanced enough to help remedy that institution remedy the problem. As such, the researchers will work to develop automated yet specific, actionable feedback that will indicate where energies may be focused to increase the chance of a successful LA implementation, as well as suggested steps, evidenced by their peer institutions to take towards that end.

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