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Enabling Context-based Learning with KPortal Webspace Technology

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Abstract

Recognizing the importance of context-based learning and the general lack of technology applications in the design and development of the ideal and formal curricula, this paper describes an experimental system at a large public university. The authors describe the creation of a contextual environment for introducing concepts related to information security to undergraduate business students using the KPortal (Knowledge Portals) webspace technology that supports dynamic content gathered from various sources automatically. The KPortal webspace rated highly on the various attributes of effective contexts and the characteristics of technologies that enable context-based learning. The flexibility provided by the webspace permitted the authors to develop adaptable environments in which the students could connect well with rather abstract concepts. The overall intervention was designed to examine if a limited portion of the course could be supported by technology and next phases of the research will broaden its use to semester-length curriculum.

Keywords: Context-based learning, KPortal, webspace.

The last decade has seen a tremendous interest across college campuses on a teaching method broadly termed as “active learning” or “flipped learning (or flipped classrooms)” (Faust & Paulson, 1998). The term “active learning” is often used to explain varied class room experiences which are more than straight lecture and listening but engage learners in the analysis, synthesis, and evaluation of material (Ishiyama, 2010). The benefits cited are that students learn and retain knowledge more and develop higher levels skills such as creativity, teamwork, and collaborative skills. Active engagement and learning are often considered to be the most significant predictors of student success and retention.

The recognition of active learning as beneficial to student success has prompted significant research to understand the techniques to engage students, class room layout, and technologies to support student engagement (e.g., Bonwell & Eison, 1991; Yaron & Ruth, 2015). Active learning techniques are quite varied and range from simulations to

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case studies with an emphasis on the role of the faculty member in the design of experiences which engage students both in and out of the class room.

Active learning has its theoretical roots in Context Based Learning (CBL) which has been used extensively to develop curriculum in chemistry, physics, and the general science (Hunter, 2015). This approach is best exemplified by the Salters' approach in the field of chemistry (Campbell, Lazonby, Nicholson, Ramsden, & Waddington, 1994). What is unique to this approach is the creation of a real-life or fictitious environment to enable learning. The "context" can also be created by field visits and any activity which forces the learner to use class room concepts within the real-life contexts.

This paper reports on our experiment to create a contextual environment using a webspace called Knowledge Portals (KPortals) where we aggregate news links, Twitter feeds, and varied social media content and connected this material to a mobile app so that the learning experience is embedded, continuous and ongoing. We further use KPortals to build various active learning exercises so that students in undergraduate and graduate business classes are able to explore a diversity of topics. We report below the process which we used and efforts which resulted in creating these activities with the hope that broader and longer duration experiments will reveal if the use of such technologies does produce the benefits theorized from CBL.

Context-based Learning

The use of "contexts" to create curriculum and bring the teaching of course material closer to students by linking key concepts to their environment (personal, societal, and work) has influenced education research in the sciences since the 1900s. Gilbert (2006) provides a detailed background and explanation of models, attributes, criteria, and usefulness of contexts in education. While this explanation is specifically related to chemistry education, the principles are applicable more generally. As he notes, the origin of the word is from the Latin language "contexere" or "weave together" and is used generally to describe "circumstances which give meaning to words, phrases, and sentences" (p. 960). Thus, a context is the external environment which places the concept under study within a broader perspective. In so doing, the student first connects with a specific experience, problem, issues, or circumstance which either he/she is familiar or can relate easily to before being led into an inquiry-based examination of specific concepts meaningful to that context. This is very different from a teaching philosophy of learning a series of concepts with possible application of some in a hypothetical example or through an explanation provided by a faculty member from their life experiences.

As noted by Pilot and Bulte (2006a), the approach has resulted in the development of curriculum such as *Chemistry in Context* in the United States, *Salters Advanced Chemistry* in the United Kingdom, *Industrial Chemistry* in Israel, *Chemie im Kontext* in Germany, and a *Context-based Approach* in the Netherlands. Within the field of chemistry education, each of the above approaches has been shown to be quite beneficial to students, well accepted by faculty, and promoted by government policy as "relevant education." What is common to each of the above approaches is that they connect well-researched curriculum concepts to a broader context. The context is chosen and prepared so that it is meaningful to the student, thereby, giving each concept a visible connectedness which facilitates both teaching and learning.

Contexts in Curriculum Design and Development

Pilot and Bulte (2006b) anchor context-based learning in the curriculum models of Goodland (1979) and Van den Akker (1998) using the concepts of the *ideal curriculum* (the original vision), the *formal curriculum* (the elaboration of the original vision), the *perceived curriculum* (how teachers understand it), the *operational curriculum* (how the curriculum is presented in the class), the *experienced curriculum* (the actual learning processes), and the *attained curriculum* (the learning outcomes achieved).

The *ideal curriculum* delineates how the study of concepts will be associated with one or multiple contexts. An example is provided in the details of the chemistry curriculum developed in Israel (Hofstein & Kesner, 2006) where the primary context of the education is based on industrial chemistry in Israel, its importance to the Israeli society, the technological, economic, and environmental factors of the chemical industry, specific problems and the dynamic nature of the chemical industry. The *formal curriculum* sets out details of the contexts and the details of each element of the curriculum. Continuing with the Israeli example, two case studies were specifically constructed to teach chemistry concepts. In addition, the development of case studies reflected broader issues of how the chemical industry had changed in Israel through regulation, competition, and advances in science which enveloped chemistry education in socio-technical and cultural components of Israeli society. In order to help the *perceived curriculum*, educators must be familiar with the context developed. In the above example, teachers would have to know the nature and details of the chemical industry in Israel so that they could develop a narrative in the classroom to connect the environment to chemistry concepts. The developers of the curriculum assisted in the transfer of knowledge by creating small group sessions and workshops to bring the right background information to them.

The *operational curriculum* is the process of implementing what the teachers perceive and in the example above was facilitated by lab exercises, case study questions, mini-projects, and classroom debates. The intent was to use specific narratives to reveal and discuss key chemistry concepts even as the broader discussion of the Israeli chemical industry takes place. Finally, the *experienced* and *attained* curriculum is the process of assessment—both formative and summative with a goal to understand if the formal curriculum was operationalized correctly. The context of the curriculum is not as important in these phases. Rather, the emphasis is on the learning, effectiveness, and attainment of knowledge which can be transferred to different problem sets.

Duranti and Goodwin (1992) propose educational contexts to have four attributes (p. 6/8) for effective learning:

(a) **Setting**: A setting, a social, spatial, and temporal framework within which mental encounters with focal events are situated;

(b) **Environment**: A behavioral environment of the encounters, as the way that the task(s) are related to the focal event;
(c) **Language**: The use of specific language, as the talk associated with the focal event that takes place; and
(d) **Relationship**: A relationship to extra-situational background knowledge.

The "focal event" referred to above is the discourse which takes place within the context – it is the event that gets attention and from which relevant discussion of concepts ensues.

Context-based learning approaches help address several challenges in the design and development of curriculum (Pilot & Bulte, 2006a) such as curriculum overload, isolated facts, transfer, relevance, and emphasis.

(a) **Curriculum Overload**: Contexts are considered useful because of their ability to identify classroom content using the "need-to-know' principle. Rather than approach curriculum as exhaustive, a context-based approach would apply a selection criterion based on the environment (context) and help to bring only those concepts to the class room applicable to the selected contexts. In so doing, the emphasis shifts from teaching the entire curriculum to teaching the "relevant" curriculum and avoiding overload.
(b) **Isolated Facts**: Another challenge is attributed to the curriculum being treated as a collection of isolated facts, which risks students not knowing how these fit together. By developing contexts, the curriculum resembles a spider web—in which the concepts are connected in a visual form—which can help students to develop a mental schema of the course material. The designers of existing context-based courses focus on how one spider-web leads to the next and using this analogy, various higher level concepts are introduced to the student.
(c) **Lack of transfer**: Students can be encouraged to see the concept as a way to understand many different phenomena or solve not just the problem given to them but other problems as well. This transfer of knowledge is known to happen explicitly in context-based curriculum development.
(d) **Lack of relevance**: Developing a relevance to education could be the strongest contribution of context-based learning. Contexts explicitly develop an environment to which students can connect and then explains concepts related to that environment. This is not the same as chapters in a book which exhaustively detail each concept. Instead, the context is the primary mode of bringing a learning experience to students.
(e) **Inadequate emphasis**: Many courses taught today are thought to bring a "solid foundation" to education—the emphasis is on pedagogical completeness and not on usefulness or relevance to the student. The Industrial Chemistry in Israel emphasizes the technological, environment, economic, societal, and political issues to which the study of chemistry is relevant. The emphasis on practice in this particular case was deliberately chosen to broaden the aims of a specific educational experience by bringing a balanced emphasis to it.

Technology-enabled Context-based Learning Framework

Recognizing the importance of context-based learning in higher education, it useful to explore how technology might be able to best support it. A preliminary framework is proposed below.

The development of the framework begins with recognizing different phases of curriculum development with the context-based approach, salient process associated with each phase, and the technologies which could support each phase. See Table 1 for an overview.

Table 1. Technology Support in Curriculum Development Phases.

Curriculum Phase	Salient Processes	Technology Support
Ideal Curriculum	Develop the original vision, basic philosophy, rationale and underlying mission, and also a model of context use	n/a
Formal Curriculum	Elaborate on the curriculum and design context(s)	n/a
Perceived Curriculum	Determine how teachers understand and plan to use the curriculum	n/a
Operational Curriculum	Develop the nature and content of the interactions between teachers, students and resource material	LMS, online content and information sharing systems
Experienced Curriculum	Articulate the actual learning processes undertaken by the students	LMS, online systems such as Facebook, blogs, wikis
Attained Curriculum	The learning outcomes achieved by the students	LMS, online systems such as Qualtrics

The primary task in developing the *ideal curriculum* is an agreement on what type of context is relevant to the curriculum. Secondary tasks involve the relationship of the selected context(s) to specific concepts around which learning should concentrate. Contexts have sometimes been based on a broad view of society and the environment and implemented either generally while describing issues such as "global warming" or detailed case studies. There has been no reference to any use of technology while creating contexts. Similar observations can be made for the *formal curriculum* in which details of context attributes are established and the focus is on the "use of contexts." It is also possible that the primary context line could be spliced into focused illustrations or subcontexts to allow manageable segments of study to emerge. The research is limited in how technology can support this phase of curriculum development. *Perceived curriculum* is a personal experience of a teacher interpreting the *ideal curriculum* based on his/her beliefs, attributes, and experiences. The scope of the use of technology during this phase has been rather limited as well.

A teacher's interpretation of curriculum is transformed into narratives (lectures, discussions, questions, labs, exercises) as part of the *operational curriculum* development. If the context(s) is chosen with care, the development of narratives can more effective. Generally, teaching support material such as study guides are the tools chosen by faculty as support tools and may include web sites established by the curriculum developers and/or publishers. Examples of technology in this phase are learning management systems (LMS) and information sharing sites of textbook or content publishers. Currently, the *experienced curriculum* and *attained curriculum* phases seem to enjoy technology support to a greater degree than other phases. LMS excel at the distribution of syllabi, slide decks, reading materials, discussion threads, and provide consistent support to students. To some extent, such capabilities are also available through disparate systems such as Facebook, blogs and wikis. The formalization of quizzes, tests, and assessment material to measure the success of the attained syllabus are core strengths of LMS and well developed with such systems.

The above analysis suggests that based on activities which comprise the different phases of curriculum development, there are only limited opportunities at the *operational*, *experienced*, and *attained* curriculum phases. Sharing of information amongst faculty, restricted web sites developed by publishers, faculty teaching material and its sharing could be the only support needed in these phases. However, the development of contexts at the *ideal, formal*, and *perceived* curriculum phases does represent an interesting possibility for technology use. The paper proposes that any technology application which can support context development at the initial phases of curriculum development should enable the following characteristics of contexts:

(a) **Malleability**: Following the logic presented by Whalley (1993), contexts need to be malleable, i.e., they should have the capability of changing over time and the capability to offer multiple perspectives on a particular domain. It should be possible to use the application to present and then represent ideas in ways which are difficult to achieve in print (p. 12).
(b) **Cognition**: Context-based education strives to embed learning in realistic and relevant settings, and cognition is at the core of such an experience, i.e., the choice of the environment determines what is taught and how it is taught (e.g., Brown, Collins, & Duguid, 1989). A technology application should be able to develop a cognitive context that provides stimuli for sense-making.
(c) **Dialog**: Contexts need discussion and a social dialog which allows their meanings to emerge, referred to as the zone of proximal development (Vygotsky 1978). Rather than the teacher bringing concepts to class, the contexts facilitate a flexible narrative which naturally allows concepts to emerge and be clarified; hence, the notion of student ownership and a joint learning process.
(d) **Mutimodal**: To bring a context to life, it must be more than logocentric (Cunningham, Duffy, & Knuth, et al. 1993). As noted by Cunningham et al. (1993), "It

is all too easy to fall into the trap of endless talk about issues and little consideration of all alternative representation" (p. 27). Consistent with the ideas presented by Gardner (1983), contexts must take advantage of multimodal representation of information.

(e) **Reflexivity**: A uniqueness of contexts is that they can encourage reflexivity in the classroom, which encourages self-awareness and an examination of the individual's own internal processes, beliefs, and thinking (Thomas & Thomas 1928).

Case Study: KPortal Webspace Technology for Information Security Context

Two authors of the current study teach an undergraduate course in management information systems (MIS); a course which shares several characteristics of context-based courses in chemistry and the general sciences. Like chemistry courses reviewed previously, it is an introductory class for business majors (mostly juniors) with few students with any intention of being in the information systems field or MIS majors. While all students may interact with technology concepts over their careers; most are not enamored with details of hardware, software, programing, information systems architecture, telecommunications, large systems or information security. It is also, perhaps, one of the last opportunities to introduce the students to the power of technology to change society, organizations, and lives.

As in most such classes, there is an exhaustive *ideal* and *formal curriculum* which describes detailed concepts to ensure that all parts of information systems design, development, use, and implementation are discussed in class. Both authors realized that this particular area of education faces challenges of overload; isolated facts; lack of transfer, lack of relevance, and inadequate emphasis. Technology changes rapidly and places a pressure on textbooks to add/update content; much of it is included in new additions without as much attention to how it fits into a broader perspective technology relevance to students. Textbooks sometimes deal with overload and new concepts by moving extensive details to appendices without much forethought.

The authors proposed that to address some of the challenges of teaching this course, they would adopt a specific context but only for a small portion of the course as an experiment to examine the broader applicability of this approach. A rather difficult portion of the course describes issues of information security and ethics, with each concept described in hardware and software terms. In assessing this specific area, the authors also realized that the area could be connected in a spider web to interesting ideas beyond the field of information security. An initial draw-out of this spider-web is shown in Figure 1 and is modeled on Schwartz (2006).

To operationalize a context in information security[2], we looked for ways that the topic could be taught within a natural environment such that the spider-web of Figure 1 could

[2] "Information security" and "cybersecurity" are used synonymously since much the news media does so and to include news items which could be captured by the term "cyber" rather than "information".

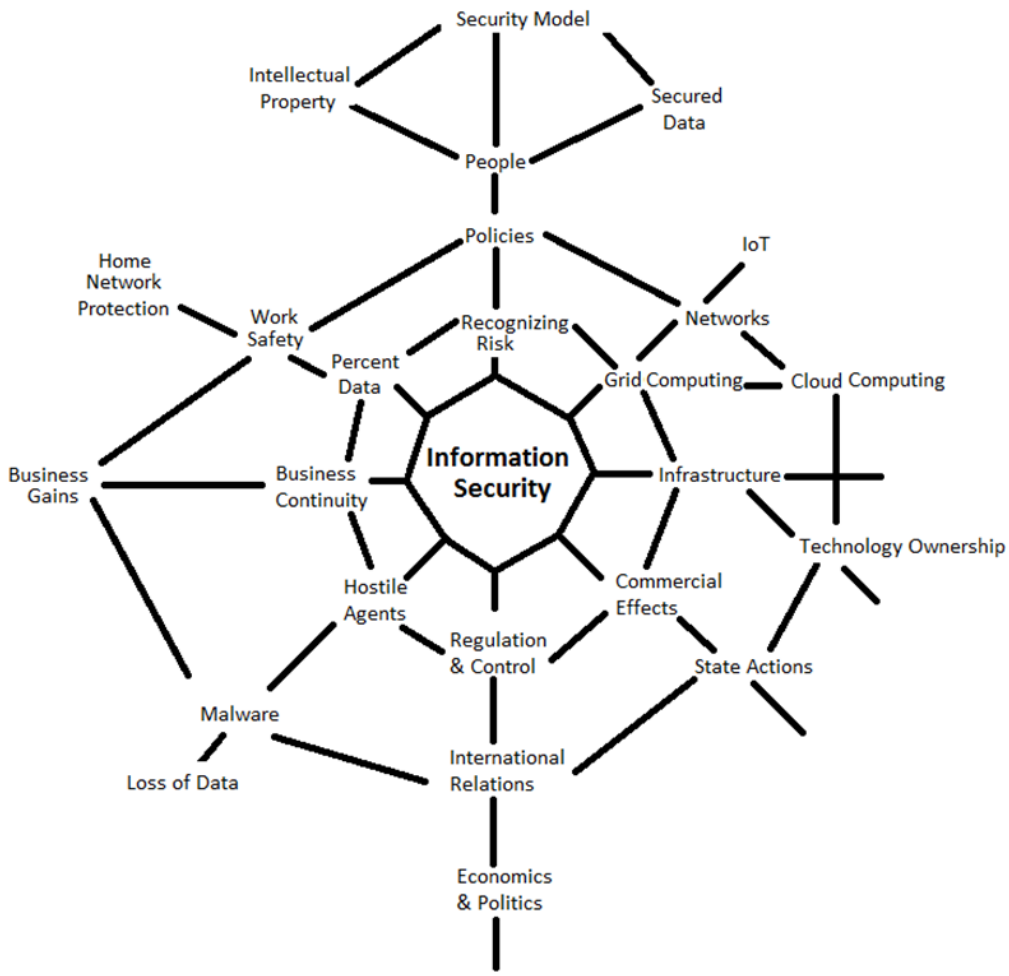

Figure 1. Spider-web draw-out for Information Security.

emerge naturally and begin to excite and engage the students. After a review of various technology tools, an educational version of a unique webspace called KPortals was licensed from a commercial company for use in the MIS class. A complimentary educational license permitted the use of a KPortal webspace called Cyberbriefs (www.cyberbriefs.org) to be custom designed for the course and allowed the dynamic aggregation of content from various sources such as news, social media, video, books, and articles, quite unlike the typical LMS. A view of the website is provided in the Appendix. The webspace is accompanied by a mobile app to push content to the students.

The structure of the webspace is as follows:

- **Main Story:** Any news item/announcement which the faculty deemed to be highlighted.

- **News Links:** News links of interest to the course. For the class project, these links were selected by two authors from everyday news. Frequent updates were made during days of interesting news in the field; sometimes as often as 15 minutes.
- **Twitter feeds:** Keywords specified to pull twitter feeds included cyber security, cybersecurity, cyber defense, cyber war, data breach, and cyber-attack. Included with the webspace is a sentiment analysis tool which classified each tweet into positive, negative, and neutral sentiments. Finally, an index value shows the general sentiments across tweets of the public-at-large.
- **YouTube videos:** Using a background keyword search, the webspace pulled in latest videos posted on YouTube related to the keywords above.
- **Amazon books:** Keywords as provided also retrieve recent books on those topics available at Amazon.com
- An extensive list of **blogs, websites, and magazines** is available in the webspace.
- A daily account of **number of visitors** is displayed on the web site along with the number-of- times a particular link was accessed.
- Finally, students subscribe to a daily **newsletter** on the main news items in the field of cybersecurity.

As can be seen from the Appendix, the webspace places a student squarely in the middle of current events in the field of cybersecurity, including latest news culled by faculty, updated twitter feeds on cybersecurity, latest video updates and books. There are opportunities to explore related sites and information links; the webspace helps the students to acquire a better understanding of the environment around them.

For the *ideal curriculum*, the webspace serves to create a context “which enhances students’ appreciation of how information security serves to keep us safe and lead somewhat private lives by helping us understand our digital environment and its risks.” Detailing the above context led to development of a *formal curriculum* based on several narratives which emerged naturally from the webspace. For the *perceived curriculum*, the webspace enables the faculty to learn and determine the background scope relevant for the context. Some examples are described below.

- **Example #1:** The webspace continuously displays a cybersecurity risk index which changes monthly. What is the status of the risk index? – is an effective cue to a discussion related to perceived risks by cyber experts. Relating the index to news items, tweets and sentiment index is an exercise which can happen every day.
- **Example #2:** The webspace also displays a cybersecurity portfolio which displays in real time an index of stock prices of cybersecurity firms (delayed 15 minutes). Since all students in the class are business majors, interpreting stock prices and returns is a natural environment for them. However, in this case, a discussion often begins with “Why is the index where it is today relative to yesterday? Last week? Last month?” Often, the answers are difficult but relating them to the content of the news items is informative and perhaps more informative is looking at the stock prices which make up the portfolio and displayed in the

screen in different categories. Understanding individuals stock and outlooks is generally very helpful in interpreting the portfolio.

- **Example #3:** Because the news items in the webspace are current, it is easy to begin a discussion with "What is the main story today (this week)?" and why is it important? Taking a longer term horizon (a week) is sometimes better because the students now have to make a choice of selecting among multiple main stories (which change every twice a day minimally). During one week of the Fall 2016 semester, news links were dominated by the hacking of the DNC (Democratic National Convention)[3]. Interestingly, some undergraduate students were unaware of this event but soon realized the extent to which cybersecurity was dominating national news.
- **Example #4:** Following up on the previous example, student groups are assigned to "Determine the top five/six cyber events over the last 12 months." The archives of the webspace are replete with examples and a quick search reveals a rather dominant list. Interestingly, some students opt to search externally and generally take longer because within cyberbriefs.org, incidents are flagged to provide cues of major events.

The examples above underline to the flexibility to create narratives and the variety of possible directions based on the selected context enabled by a technology application. Examples #1 and #2 may be viewed as interpretive applications in that there is not a single correct answer and the discussion can emerge. Examples #3 and #4 may be considered as deterministic applications in that there is generally a correct answer that may be identified through the learning process.

Discussion

In assessing the extent to which the Cyberbriefs webspace exhibited the characteristics for effective curriculum development, the following are noticeable.

(a) Malleability: The capability of change over time is embedded into the webspace. Since the site collects news links of events, twitter feeds, videos, and recently released books; there is little risk of the cyber context appearing dated. The site engine provides suggested news items which are sent to the faculty, who can then select and post relevant ones to the webspace.

(b) Cognition: Information security and cyber concepts tend to be highly technical. While most faculty may recognize their importance, most undergraduate students do not appear to grasp its relevance. By changing the nature of the discussion to everyday events which affects their lives, this context embeds learning in realistic and relevant settings. During the Fall 2016 semester, there was a day of massive internet outage in the United States[4] because of a DDoS (Distributed Denial of Service) attack at Dyn. There was a personal recognition of this event by several

[3] Here's What We Know About Russia and the DNC Hack, https://www.wired.com/2016/07/heres-know-russia-dnc-hack/

[4] What We Know About Friday's Massive East Coast Internet Outage, https://www.wired.com/2016/10/internet-outage-ddos-dns-dyn/

students because of disruption to their work and intermittency of internet connections. The event served to change perceptions of rather difficult concepts by making them immediately personal.

(c) Dialog: Cyberbriefs.org contexts allow intense discussions and narratives encourage social dialog. Following the example above, a narrative was created to brainstorm business losses and impacts as a consequence of the outage; the motives of the perpetrators, and actions which organizations could take related to business continuity. Referring to the nomological spider-web, it was quite effective in exploring several strands such as data backup strategies, disaster recovery plans, and failsafe strategies (See shaded areas in Figure 2 on the various concepts which were discussed).

(d) Mutimodal: Research conducted at PEW Research (Purcell et al., 2012) identified relevant modalities of representing information for undergraduate students as texts, video, and tools such as Google, YouTube, Twitter, and similar tools. By providing access to these tools, the webspace encourages students to assemble information from different information representations.

(e) Reflexivity: As noted previously, reflexivity encourages self-awareness and an examination of the individual's own internal processes, beliefs, and thinking. Using the context created through cyberbriefs.org and the example above, a narrative created for the class was "What is your personal data recovery strategy; how do you personally protect your work – at work, at schools?" Numerous times in the semester, such individual questions were posed so that students could understand their own beliefs, behaviors and attitudes.

In assessing the extent to which the Cyberbriefs webspace demonstrated the attributes of an effective context, the following can be discerned. In an introductory course in MIS, the desire was to teach information security (the focal event). The "setting" was a cyberattack which occurred recently[5], the havoc that this event caused, and the discussion of the possible motivation(s) of the perpetrator of the attack. The "environment" was the type of attack vector used in the attack, the methods of gaining access to computer systems and the attack footprint; as well as most likely attack paths in the event. The "language" relates to the technical language associated with the focal event, the need for cyber security, and the use of specific resistive methods which could stop such events. The "relationship" outlined the background and history of cyber events and the need for cyber vigilance culminating in a fuller articulation of cybersecurity concepts[6]. Informal comments provided by students indicated that the webspace enabled them to gain an overall understanding of information security, the need for proactive monitoring, and the extent to which it impacts society. The two authors who adopted the webspace technology in their courses, upon reflection, determined that the context allowed the emergent themes of various inter-related aspects of the focal context that they had not been able to achieve in previous offerings of the course that did not employ the webspace technology but followed a typical textbook-driven topic-based class sessions. The emergent themes

[5] In our specific class, we used the example of WikiLeaks hacking the DNC during October, 2016.

[6] The specific example was created by the authors during the Fall, 2016, term for use in four classes of undergraduate students and replaced a traditional lecture of cybersecurity concepts taught as linear concepts such as "What is a firewall?" and "How does DDoS attack work?".

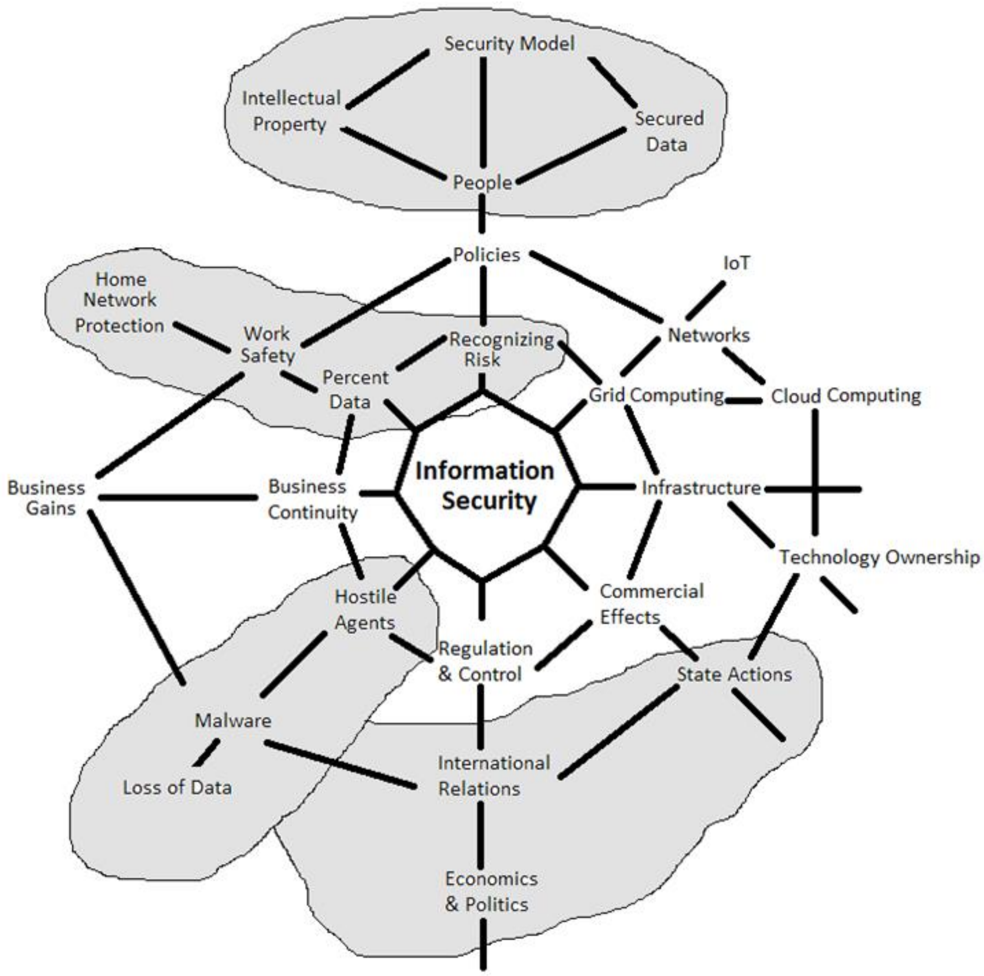

Figure 2. Emergent Concepts on Information Security in Dialog.

were driven jointly by both the faculty members and the students since the webspace technology provided new information, the discussion for which could not be planned for ahead of time.

The cybersecurity.org webspace shows promise as a general tool to create a context-based curriculum. The social, spatial, and temporal framework it placed before the students allowed a uniqueness to the educational experience. The webspace helps identify the focal events in multiple ways—graphically, using hyperlinks, analyzing tweet data, and building an environment from which students can explore the broad nature of the field. Previous examples of curriculum rely mostly on fixed state or *static* contexts, which, once written, inform the teaching of that specific curriculum for a period of time. In our study, the context is *dynamic*, i.e., the webspace is populated with news items and other content constantly. The dynamic nature of the content is quite powerful in addressing behaviors related to a chosen event. A simple game of team reading among students, for example, can identify actions taken to reduce threats. Actions will often be classified into people, processes, and technology and will encompass several strands of the spiderweb in Figure 1. Some of the language needed in using the webspace is *fixed* in that it seeks to explain presented information such as risk index levels. Other language is *flexible* based on student comments and discussions. Always having a starting point to begin the conversation was found to be quite useful for class purposes. Finally, the manner of easing a class from the environment to a group of concepts appeared seamless for our classes. Using the context as a frame of references also allows for an automatic selection of an "interesting hook" to begin a class discussion. The evolving nature of the cybersecurity environment and daily events provide the interesting hooks immediately.

Based on our experience with the webspace technology, it is possible to offer some guidelines and best practices for others who may strive to adopt similar strategies in class.

a) **Developing an acceptance of transitional context and concept**: There is a fundamental difference in the context-based experience due to the directionality of the "concept" and its "context." Traditionally, a set of concepts is posited in a curriculum and presented as theory that can scaffold to knowledge. The scaffolding often requires an illustrative anchor and thus the notion of "how is this used in practice" drives examples and case studies. A reversal of this tradition becomes obvious in the transition between context and concept when using a formal context-based approach. A familiarity with a context comes first, followed by an internal thought process as to the different concepts which interplay within that context. In our specific case, many concepts (e.g., malware and international relations) illustrated in the module would not be taught together during the same class session in a traditional offering, but became standard practice in context-based offering of the same course.
b) **Developing a nomological network for the study module**: The spider web, originally referred to as "clumpers" (Schwartz 2006), developed in Figure 1 has driven the study of concepts, their relationships, and directionality since the early 1990s. Cronbach & Meehl (1955) in describing a nomological network presented a coherent way to describe concepts and their linkages deterministically. We found this approach to be useful in our approach to context-based learning. It reinforces the logical relationships and cumulative information which arises from individual concepts. More importantly, it permitted us to examine proximal and distal relationships – those concepts which immediately support the primary theme and those which were not as well connected. For example, in our spiderweb in Figure 1, we identified the standard textbook concepts which are generally presented together and show them in the inner ring of the spider web and we then worked our way outwards by examining other chapters and concepts relevant to the theme of the information security. The spiderweb then represents a binder of ideas to present for a particular theme while parsing levels of dominance between the spiderweb circles.
c) **Developing an acceptance of the emerging themes in the context**: The acceptance of the emerging themes of context is critical. Often, our discussions in classes have led to rules and policies and policy making and other similar events

> due to class dynamics. The speed at which this can happen often speaks to the absorptive capacity of the class and instead of trying to bring the group "back to the point," allowing the discussion to cross conceptual boundaries can make the experience richer and longer lasting. Such an approach allows for the emergence of the themes in Figure 2 to happen rather quickly and it is important for the faculty member to let this happen while mentally recording the elegance of emergence. It should be noted that such emergence of themes is the result of a joint process – it is neither led by the faculty nor by the students. It may be difficult to assume that the emergent themes will be identical across various offerings of the course but it is reasonable to expect similar themes and allow for some outliers due to the nature of subjective discourses of facts as presented in the webspace technology.

Often, we have asked if we could provide the same experience without the webspace technology. While it might be possible, we believe it would be rather difficult to duplicate the experience of the ease of brining the context to the lives of students in a multi-channel format; making it a part of their extended classroom using mobile apps and giving them an active place in the discourse by encouraging active participation rather than passive listening.

Conclusion

An important feature which the use of technology afforded was the extension of the context beyond the classroom. The webspace is always available and the content of the webspace was pushed via a mobile app. Constant updates reminded the students of changes to the environment and created a habit endorsing process of keeping up with cyber news which, we believe, engages each student in subconscious manner by keeping the context alive at all times instead of simply being a class room activity.

Future extensions are planned to include more curriculum portions under the context-based approach. As noted, only a small component of the curriculum (related to information security) was taught using the context created by cyberbriefs.org. The context was, however, was discovered to be useful in including several other parts of the curriculum such as information infrastructure, ITIL (Information Technology Infrastructure Library) and related standards, and HR (Human Resources) development. The webspace does show promise in its capability to expand beyond the current focus and future studies will explore this issue both from a pedagogical and technical standpoint.

We also intend to develop future studies which could examine the effectiveness of the *attained curriculum* due to the use of the webspace. While we are encouraged by informal and anecdotal evidence from classes, it is our intention to collect detailed assessment data to understand the effectiveness of the IT-enabled approach adopted for this class.

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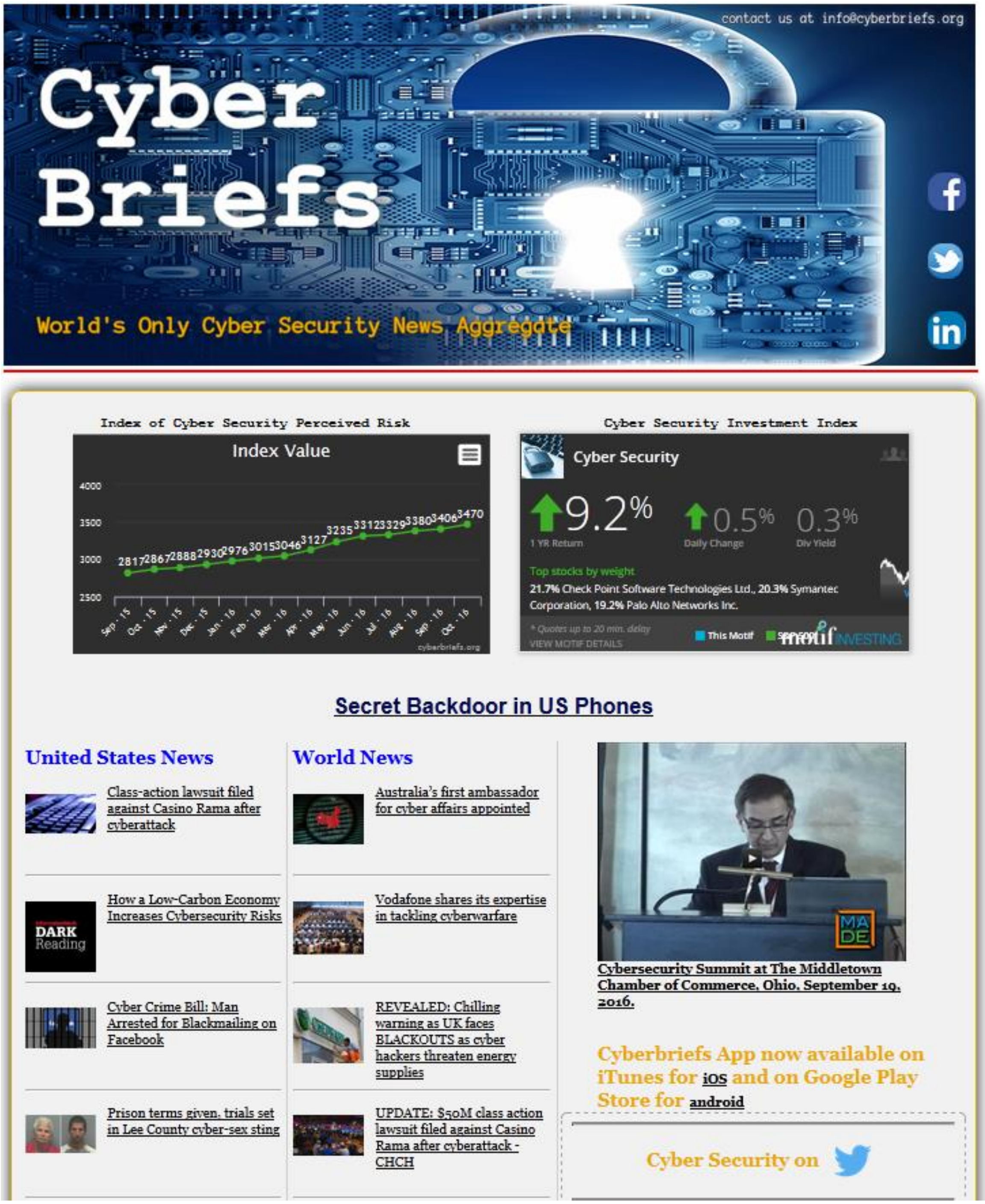

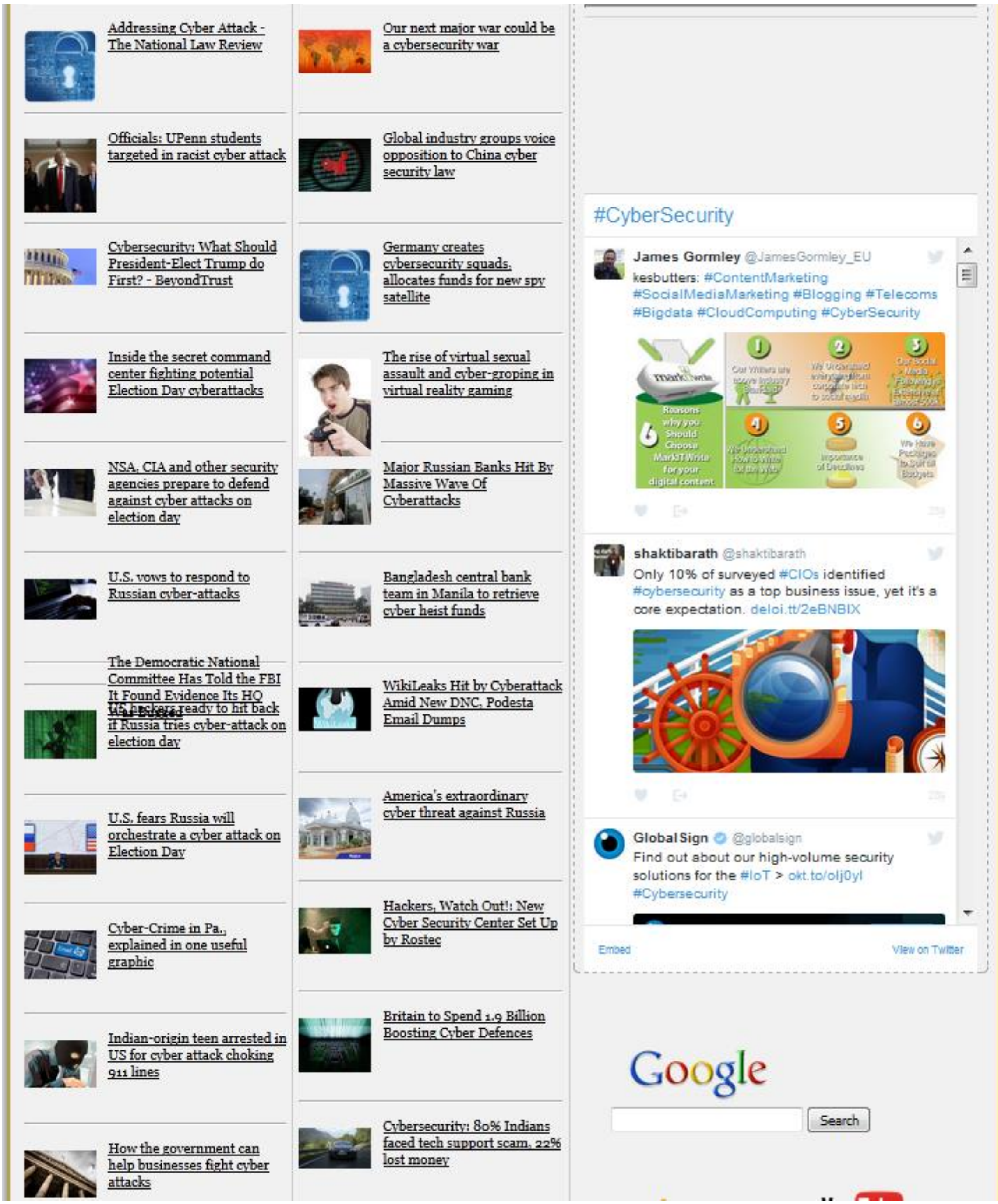
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RDWR	$13.09	-0.12	-0.91%
ZIXI	$4.77	++0.01	++0.21%
SYMC	$24.55	-0.08	-0.32%
AVG	$25.05	+0.00	+0.00%
FEYE	$14.25	++0.17	++1.21%
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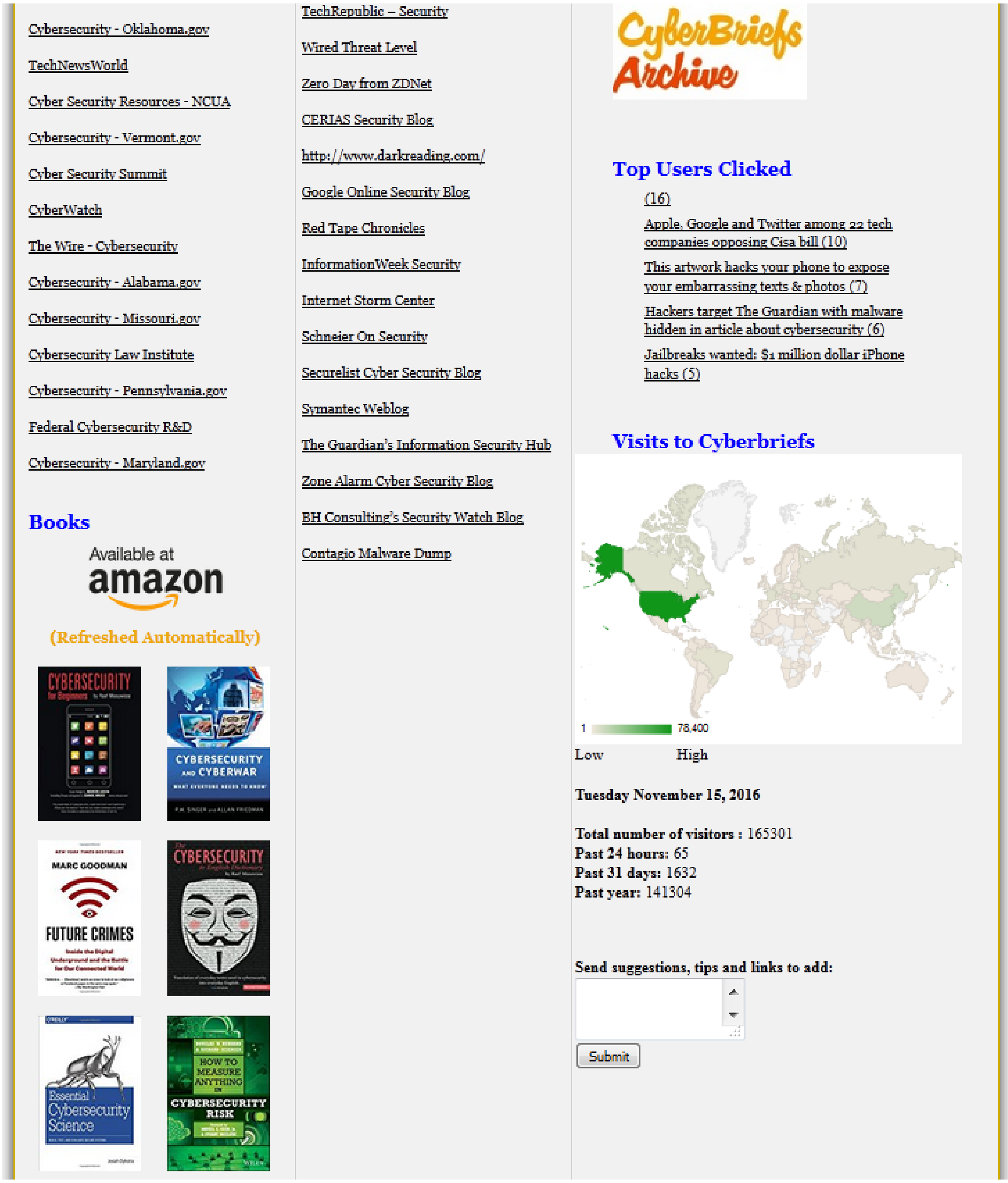

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