TechTrends (2017) 61:494–506
DOI 10.1007/s11528-017-0210-4

ORIGINAL PAPER

# Knowledge Based Artificial Augmentation Intelligence Technology: Next Step in Academic Instructional Tools for Distance Learning

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Published online: 4 July 2017


**Abstract** With augmented intelligence/knowledge based system (KBS) it is now possible to develop distance learning applications to support both curriculum and administrative tasks. Instructional designers and information technology (IT) professionals are now moving from the programmable systems era that started in the 1950s to the cognitive computing era. In cognitive computing or KBS a machine understands natural language, adapts, learns, and generates and evaluates hypotheses. A KBS system can manage data and assist instructional designers in creating tools and curricula that generate meaningful applications. As a proof of the concept, the authors conducted an exploratory case study with the input of twenty subject-matter experts (programmers, instructional designers, and content experts) for development of a proto-type KBS scholarly writing software (SWS) application that can be used for distance/online learning. Philosophical differences between the artificial intelligence and augmented intelligence approaches are also discussed. The role of instructional designers in the development and use of augmented intelligence with IBM's Watson is also a significant part of the discussion.

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**Keywords** Artificial augmentation · Artificial intelligence · Cognitive computing, knowledge based systems · Machine learning · Natural language processing · Distance learning and artificial augmentation applications · IBM Watson and distance learning tools

## Introduction

While there have been various minor advancements in applications of augmented intelligence in distance learning, there is still some resistance among educators, information technology professionals, and instructional designers to adopt augmented intelligence applications. This resistance has developed in part due to confusion between the concept of augmented intelligence and artificial intelligence. The philosophical conflict between these two concepts has continued for more than half a century (Lavenda 2016). Augmented intelligence refers to increasing the capability of human being to solve complex problems and gain better and faster comprehension of the situation (Engelbart 1962). Augmented intelligence is related to the concept of intelligence amplifier that was first used by Ashby (1960, 1956). Human intelligence is amplified by organizing intellectual capabilities into higher levels of synergistic structuring with assistant of technology (Engelbart 1962). In opposition, artificial intelligence refers to the capability of a machine to imitate intelligent human behavior (Artificial Intelligence 2017). John McCarthy was credited with devising the term artificial intelligence in 1956. Artificial intelligence is in distinct contrast with augmented intelligence. Augmented intelligence seeks to empower and amplify human capability to solve complex problems. It is used as a supplemental tool to support human beings. The purpose of artificial intelligence is to reproduce human intelligence, function autonomously, and replace human intelligence with computer system.

Artificial intelligence has been successful to simulate autonomous applications, such as IBM Deep Blue computer, which beat a chess grandmaster in 1997 (IBM At 100 2011). This has been supplemented in some respect by augmented intelligence in 2011with IBM's Watson. As impressive as this may sound, it should be noted that it is not possible at this juncture to fully replicate the entire human intelligence. Artificial intelligence is great as a mathematical modeling machine for processing information, and human intelligence is great at processing information, intuition, interpretation of context, as well as tolerance of ambiguity. When artificial intelligence conceptually reaches these limitations an augmented intelligence approach would be useful for developing instructional and administrative applications for distance learning.

Artificial intelligence, with its highlighted feature of replacing human beings, has overshadowed augmented intelligence and created trepidation among some experts including theoretical physicist Stephen Hawking, Microsoft Founder Bill Gates, and others (Gates and Hawking 2015). Some distance learning educators have developed resistance for adopting artificial intelligence applications that are perceived to take away the educators' jobs and act autonomously against educators' plans. Shifting educators' perspectives from artificial intelligence to augmented intelligence by instructional designers may reduce resistant and enhance adoption of applications related to augmented intelligence. Augmented intelligence is grounded in human computer interaction that requires significant instructional design expertise. The goal is harnessing computers' best strengths while keeping human agents at the forefront, not removing human and replacing with computers. Such a view has been shared by a number of organizations and resulted in developing applications with augmented intelligence approach.

## Background

Distance learning is becoming increasingly prevalent in both higher education and K-12. But is the technology of 2017 keeping pace with the increasing demands and tools for this mode of instruction? Knowledge based artificial augmentation intelligence may provide a partial resolution to this question. With knowledge based systems (KBS), and a team comprised of instructional designers, subject matter experts, and programmers, it is entirely possible to develop applications and tools for education (including distance learning) to support virtually any curriculum area. According to Bates et al. (2016), p.6), "Typically, students in online [distance learning] classes miss a higher percentage of course material like assignments and assessments because of lack of consistent communication and various computer and technology issues, often outside the control of the instructor". Knowledge based applications and or tools may be one method to minimize this issue by providing virtually instantaneous feedback for most online curriculum areas, and can be programed with assignment instructions and even real-time tutoring and assistance.

**Eras of Computing** According to Kelly (2015) there are three eras in computing. Tabulating Systems Era (1900s-1940); Programmable Systems Era (1950s–Present); Cognitive Computing Era (2011-????). Cognitive Computing Era made its debut in 2011when IBM's Watson (Watson) augmented intelligence/KBS system beat the greatest champions from the game show Jeopardy. Since 2011, IBM, developers have been working actively in the field of augmented/KBS intelligence to further enhance this technology.

Augmented intelligence/KBS may assist humans to better analyze, visualize, and comprehend big data (Olshannikova et al. 2015). In addition, Google Knowledge Vault, Wolfram Alpha, Microsoft Minecraft (AIX) Facebook (FAIR Team), and others are working to bring a similar technology to education. It may be time for instructional designers, information technology (IT) professionals, and subject matter experts (SME) to take distance learning to a new level by incorporating what knowledge based systems have to offer in the way of administrative, tutoring, feedback and research support.

**Knowledge Based Systems and Big Data** The use of knowledge based systems is predicated on cognitive computing that understands natural language processing, adapts, learns, generates and evaluates hypotheses. This technology can be utilized in distance learning to assist instructors and students to make better decisions by penetrating the complexity of big data. This cannot be understated. According to researchers at IBM, 90% of the data in the world has been created in the past two years! (Rometty 2016). That equates to 1.7 MB of data is created for every person on the planet. In 2000 it was estimated that 500,000 people participated in online purchasing. In 2016 that number rose to an estimated 20–25 million purchases. According to projections by International Data Corporation (IDC 2014) the digital world will reach 40 zettabytes (ZB) by 2020. To put this number into perspective, consider that 40 ZB is equal to 57 times the amount of all the grains of sand on all the beaches on earth. This makes managing big data virtually unmanageable across distance learning to keep up with the growing volume and velocity of information available.

**Dark Data** There is also the issue of what has been termed as "Dark Data". It is unstructured or unorganized data that is out there in cyber-space. According to IBM CEO Ginni Rometty, 80% of the data in 2016 is dark (Rometty 2016). It is estimated by 2020 this number will increase to 90%. From a Librarian's perspective, Heidorn (2008, p. 280) stated, "…presently dark data is not carefully indexed and stored so it becomes nearly invisible to scientists and other potential users [distance learning students and faculty] and is more likely to remain underutilized and eventually lost". Dark data should also be of concern to instructional designers. For example, when designing a project dark data may contain undiscovered and important acumens. This may result in lost content opportunities. Legal and security issues may arise, if dark data is not handled well in the development of distance learning curriculum/projects.

### Managing Big and Dark Data with KBS in the Cloud

Knowledge based systems are one way to try and manage big and dark data by creating tools that generate meaningful data. For example, using the cloud based IBM Watson platform, all known articles, texts, papers, presentations, research studies on cancer have been deciphered from big and dark data and stored in Watson (Kohn et al. 2014). Physicians and other health care professionals can have access to these materials in less than two seconds with a potential diagnosis and recommendations for treatment. Figure 1 uses health care as a model, demonstrating that it is entirely possible to port Watson's Core Services to other areas including distance learning and education in general.

By incorporating the use of Watson, tools and curriculum can be developed by instructional designers, in conjunction with information system professionals. This will assist distant learning teachers, faculty, and students in the areas of discovery, deep learning, large-scale math, fact checking, etc. In addition, time management is a common issue for many online distance learners and faculty that developers must take into account. Tools developed through Watson can provide real time feedback to teachers, faculty, and students to help mitigate time management issues; coupled with other issues and complexities surrounding distance learning including obtaining accurate research materials.

### Cognitive Computing and Knowledge Based Systems

Cognitive computing systems, including augmented intelligence/KBS, primarily work by interacting and learning in a natural way with people to extend what both humans and computing can do on their own. Knowledge based computing is not thought of as artificial intelligence per se. While it has many of AI's attributes, KBS relies primarily upon augmented intelligence. This form of augmented intelligence helps instructional designers make better decisions by penetrating the complexity of big data (Kelly 2015). In the world of distance education this can be accomplished by enhancing the cognitive process of distance learning by instructional designers and subject matter experts. According to IBM Institute for Business Value (2015), there is already a belief among subject matter experts [including instructional designers] that current computer architectures and programming paradigms must advance to take cognitive computing to the next level; including natural language processing that is a part of knowledge based/artificial augmentation systems.

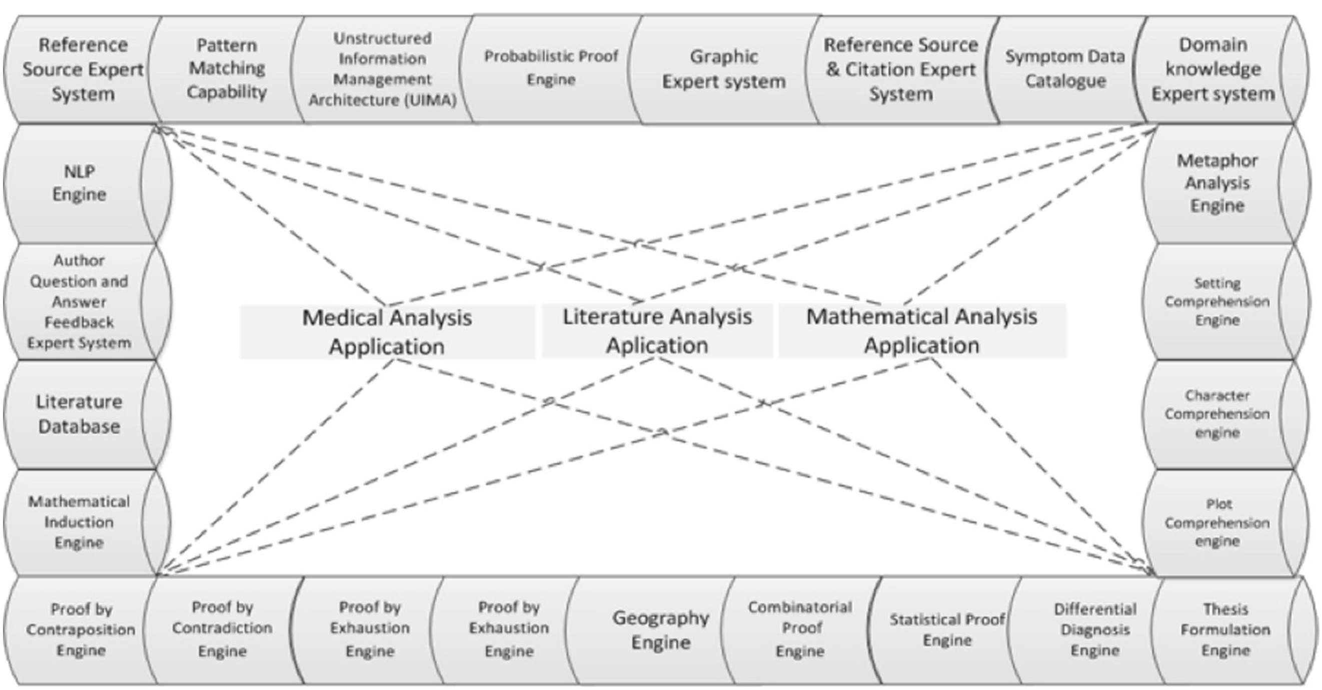


**Fig. 1** High-Level Architecture of IBM Watson Core Services for use in multiple applications including distance learning

**Natural Language Processing**

Assimilating and searching for vast amounts of information that is published by academia and others is a daunting task for students and faculty. This is even more central in the remoteness of distance learning/online environments. Using sources such as online libraries, Google Scholar, and other Web based sources can be challenging. Natural Language Processing (NLP) uses natural language to mitigate many of these issues. Using Watson as an example, this form of NLP was developed to understand natural language. One drawback is that presently it is only useable in English. Given the rapid advancements in augmented intelligence, that may soon change.

According to Ferrucci et al. (2012), NLP/Watson does not plot the inquiry to a database of questions and simply search for the answer. NLP/Watson is form of machine learning architecture for analyzing natural language content in both questions and knowledge sources. NLP/Watson assesses probable responses, tallies evidence for those responses; discovers and evaluates potential answers and gathers and scores evidence for those answers in amorphous sources. NL is defined as a human written or spoken language as opposed to a computer language (Natural language 2017). Sources include natural language (NL) documents and systematized sources, such as relational databases and knowledge bases.

## Application of Augmented Intelligence

**Intelligent Tutor Systems** One of the applications of augmented intelligence that can be developed for distance education is an intelligent tutor system. This refers to a computer system that includes interactive applications with some intelligence that facilitates teaching and learning processes (Rodrigues et al. 2010). Intelligent tutor systems encompass the major components of one-to-one interaction between the instructor and learners, customized instructions based on learners' needs, and individual feedback for the learners. Intelligent tutor systems have been developed by various organizations within the last half a century. A recent meta-analysis conducted by Kulik and Fletcher (2016) from 50 controlled evaluations of Intelligent Tutor Systems indicated that use of intelligent tutor systems raised students' performance well beyond the level achieved by students taught with conventional human tutoring or other form of computer tutoring. One of the recent successful intelligent tutor system is Intelligent Tutoring for Lifelong Learning (I-TUTOR), which is a multi-agent-based intelligent system to support online teachers, trainers, instructional designers, and tutors. It is supported by the European Commission and can be used in open source learning environments. In collaboration with Pearson Learning, IBM's Watson will be used as an intelligent tutor in online as well as traditional classrooms in the not too distant future (IBM Pearson 2016).

**Processing of Vast Amounts of Information** Watson Discovery Advisor is a cloud-based analytical arm of the computer system to help with scientific and educational research. Its purpose is to process vast amounts of information. For example, Discovery News primarily includes English language news sources that is updated continuously, with over 300,000 new articles and blogs added daily, sourced from more than 100,000 sources (IBM Developer 2017). Watson's role could be crucial in the medical field, due to the amount of documented medical knowledge that doubles every few years. According to Densen (2011) "by 2020, changes in medical education projects will double every 73 days" (p. 49). Teachers and instructors, especially those teaching distance learning classes, face a similar challenge in translating that knowledge into lessons. In addition, Watson could benefit distance learning teachers/instructors by expanding its role as a search engine, returning not only the best answer to a question, but also the logic for how that conclusion was reached.

**Growth of Distance Learning and KBS** Data from the United States Department of Education National Center for Education Statistics (NCES) reported that in the fall of 2013, there were 5,522,194 students enrolled in distance-education courses at degree-granting postsecondary institutions (NCES 2014). By comparison NCES reported that K-12 high school distance education enrollment was over 1.3 million from the period of 2009–2010. This represents an increase of over 1 million from 2004 to 2005 when the enrollment was approximately 300,000 (NCES 2012). According to a report published by the Babson Survey Research Group 2015, in partnership with, Online Learning Consortium, Pearson, WECT, StudyPortals, and Tyton Partners, found more than one in four college students take at least one distance learning course (total of 5,828,826) students, a year-to year increase of 217,275.

With this substantial influx of distance learners comes the challenge in developing and disseminating quality distance learning curriculum and associated support tools. According to He et al. (2011), a majority of distance learning programs are unable to meet the emerging demand and requirements for both students and instructors. There are also challenges to cognitive/knowledge based computing. A key challenge for the advancement of cognitive/knowledge based computing concerns the availability of skilled humans as instructional designers and subject matter experts to further the development of cognitive/knowledge based computing. Advancing cognitive computing capabilities and implementing cognitive systems require unique skill sets, such as those of instructional designers with a background in understanding the nature of artificial augmented intelligence, machine learning and natural language processing in order to support scientists and IT professionals (Intel 2016). These skills are in high demand and limited supply now and the foreseeable future (Kelly 2015).

**Knowledge Based System -IBM Watson for Education** Knowledge based technologies development is at the cusp of emerging in education and distance learning. Building on Watson's health care model, IBM is turning to provide its cloud-based services to education. In late 2016 IBM released the mobile product *IBM Watson Element for Education*. Using Watson, the mobile application provides educators with insights on their students from a consolidated 360-degree view from a range of data sources (IBM Education 2016). This application uses a variety of data sources, including demographic, academic, attendance, assessment, social and other data. Embracing these data sources can support the instructional designer in developing and enhancing knowledge based solutions.

In 2016, IBM released IBM Enlight For Educators that consists of two components. First, IBM Watson Education Analytics "‥ . uses a single data representation of each student to provide the educator with a comprehensive profile" (IBM Education 2016). This is accomplished by gathering data from numerous sources. These include demographic, academic history, student interests, behavior, academic strengths/weaknesses, etc. The second component is the IBM Watson Education Library. Learning content is consolidated to provide educators with a "simpler, rich source" of materials (IBM Education 2016). With this component, knowledge based/cognitive computing can provide analysis that is in alignment with curriculum and other resources including academic standards and customized instruction for the individual student (IBM Education 2016).

Both IBM Watson Element for Education and IBM Watson Education Library can be a potential benefit for designing distance learning courses. One issue for many distance learning designers and educators is time. Tools developed by IBM, and others may help with the demands of time management. A second benefit using IBM Watson/KBS is managing and organization of courses, especially in the development phase. Distance learning involves virtual instruction both synchronously and asynchronously. This creates a set of challenges for instructional designers when developing, delivering, managing, and organizing distance learning programs and applications.

**Knowledge Based System and Microsoft®** Microsoft has entered the distance learning education arena with the online game Minecraft™. Popular with ages ranging from elementary school to adults, Minecraft™ is an example of where augmented intelligence in conjunction with other technologies are emerging. Microsoft Corporation® saw the benefit for a future cognitive programs by purchasing Minecraft™ in 2014 for $2.5 billion dollars. In November 2016 Minecraft launched Minecraft: Education Edition. In the Minecraft: Education rollout, company executives disclosed what the platform has to offer, including lesson plans, starter worlds (AI/Virtual) and a place for instructional designers and educators to collaborate and develop additional uses for the software. In addition, a mentors program has been established by Microsoft to aid in this venture (Minecraft: Education Edition 2017, https://education.minecraft.net/). Minecraft™ mentor program connects instructional designers and educators with others experienced in teaching with Minecraft™. This allows designers and educators to explore ideas and lesson plans created by educators, covering topics from storytelling and poetry to city planning, sustainable living and geometry.

## IBM's Watson for Development of Tools to Support Distance Learning

Although there is an emergence of cognitive learning platforms by various developers (e.g. Microsoft, Google, Facebook, etc.) Watson may be one of the best solutions to facilitate the creation of a myriad of curriculum and administrative tools for distance learning. One question that is often asked by instructional designers is whether Watson can be classified as an expert system? Those knowledgeable in the field believe that it is a form of an expert system but goes far beyond (Murdock 2012).

**What is an Expert System?** An expert system has a two-part structure consisting of an inference engine and a knowledge base. The inference engine operates analogously to human reasoning by using the facts presented to it by the knowledge base (e.g. Watson) to infer the logical results of a proposition initiated by the user. It acts on the data by applying "if-then" type rules to it. Every if-then rule has multiple conditions and multiple actions from which to choose. Specific conditions must also be true for Watson to initiate specific actions. Relationships between the data presented and the actions initiated by Watson are deduced by interpreting the first-order logic based rules against the knowledge in the knowledge base (Ferrucci et al. 2010).

**Watson and Ontological Consistency** A knowledge base is a database that is structured into an ontologically consistent format and is analogous to a highly complex interactive encyclopedia. Ontological consistency of the knowledge base allows Watson's inference engine to make deductions that are valid and consistent within the particular domain of instruction that is required. The knowledge base contains two types of knowledge: expert and general. When a user queries Watson, the inference engine applies rules to the information contained in the knowledge base and new information is created. After the Watson system verifies and validates the new knowledge, it is stored in the knowledge base with the same ontological constancy with which the original knowledge was stored. This is how expert systems and quasi expert systems like Watson learn and continue to grow to be increasingly more useful over time.

**Constructing Knowledge Based System Applications for Distance Learning** Watson's Application Programing Interface (API) is used for building a software application that draws upon established application libraries that have known inputs, outputs and behaviors using a procedural language. Procedural language is one that requires the instructional designer, programmers, and subject matter experts to construct a series of well-formed and precisely described increments or steps. It requires a defined and well-controlled vector or flow through the program. Modern society is based upon this type of programming because it is useful in performing tasks repeatedly given certain inputs; the computerized optimization of an internal combustion engine for maximum performance is a relevant example of this concept.

Creating a useful ontology and successfully extending the cognitive/knowledge based computing capabilities of Watson is not unconnected from procedural programming. Functional programing takes procedural programs and contains them in functions, as the name implies. Functions can be used to build data structures that are used to control the flow, input and output of data. Procedures contained in functions are required to ensure that ontologies perform in predictable ways in KBS created and used in distance learning (see Fig. 2).

**Precedence for Instructional Design in Web Programming** Creating distance learning tools and applications has precedence in Web programming. The term is associated with creating Internet based web sites and Internet based applications. Web programming has changed the way we live and work in the 21st century. Whole industries have been created because of the capabilities of the Web paradigm. According to Hanus and Koschnickek (2014) Web programming developed relatively quickly to become a driver of distance learning, corporations, health care, recreation and social networking.

**Knowledge Based System Applications Beyond Web Programming** Development of tools required to construct knowledge based solutions for distance learning may have an equal or greater effect on society, as did the development of Web programming. Development of augmented intelligence may be one of the biggest events in technology history in comparison with the development of the Internet and Internet browser. The use of such a technology for distance learning applications will not only enhance education in general but may allow individuals the opportunity to learn and keep current in almost any type of profession with just an Internet or Wi-Fi connection. It may also enable individuals to obtain knowledge and understanding far more quickly and at a younger age than has been possible in the past.

## Feasibility Study: Artificial Augmented Intelligence/Knowledge Based System for Distance Learning

A qualitative exploratory single case study was conducted in order to provide a comprehensive evaluation and critical review of existing academic writing software tools by investigating strengths and weaknesses of each; coupled with the practicality of migrating these existing tools to an artificial augmented intelligence knowledge based system platform (AAI/

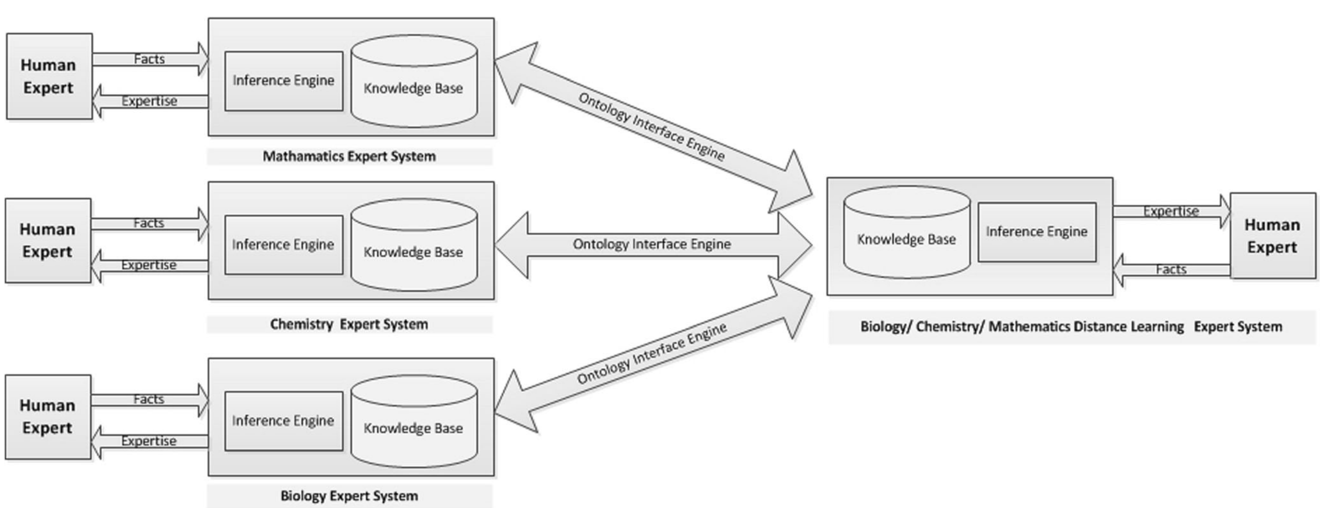


**Fig. 2** Watson's knowledge bases interfaced scalability to multiple distance learning and curriculum applications

KBS). A second goal was to determine whether a conceptual framework exists in current academic scholarly writing programs that may be incorporated into a development plan/model that can then be migrated to a prototype and future AAI/KBS scholarly writing solution. The third and final goal was to develop a working scholarly writing prototype.

Twenty instructional technology and computer science subject matter experts were individually interviewed as part of a study in an effort to investigate whether developing a knowledge based scholarly writing application was feasible for use in distance learning. This was based on the use of a Watson Cloud augmented intelligence based solution that resulted in a beta version of a scholarly writing software (SWS) application.

### Data Analysis

Data analysis consisted of documentation from the individual interviews, journal articles, white papers, and corporate/developer websites as part of the triangulation process. In addition, participants were asked to member check their responses. For the individual interviews, using an inductive approach, the data was then analyzed for categories/nodes, themes and similarities. NVivo Version 11 software was used to transcribe the individual interviews, field notes, and member checking that were manipulated and analyzed. NVivo software was also used to assist in identifying categories/nodes representing common themes that participants expressed.

**Design Framework** After determining in the initial exploration that current academic scholarly writing tools and/or knowledge based systems embody, a conceptual framework(s) using Jabareen's (2009) procedure for planned critical review was deemed to be relevant. Steps ("phases") in the qualitative critical review and development plan/model were used including:

- Design Framework Phase 1: Mapping the Selected Data Sources.
- Design Framework Phase 2: Extensive Reading and Categorizing of the Selected Data.
- Design Framework Phase 3: Identifying and Naming Concepts.
- Design Framework Phase 4: Deconstructing and Categorizing the Concepts.
- Design Framework Phase 5: Integrating Concepts/Themes/Categories.
- Design Framework Phase 6: Synthesis, Resynsthesis, and Making Sense of the Results.
- Design Framework Phase 7: Validating the Conceptual Framework.
- It is hoped that successful development of the prototype SWS may lead to other knowledge based systems being developed for both higher education and K-12 schools.

**Horizontalization** Initial interviews were transcribed into Microsoft Word™ then exported NVivo. Interview documents were also exported into a Microsoft Excel™ spreadsheet and grouped with their corresponding research question to further engage and deconstruct the transcripts. Individual transcripts were deconstructed into statements that were carefully reviewed. Common categories (Nodes) were then created to develop the clusters, followed by a query through NVivo, to establish preliminary units of meaning or themes. Textural and structural descriptions further describe the participants' knowledge and expertise in the areas of artificial intelligence augmentation systems and whether the technology is sufficiently viable to produce a prototype scholarly writing software program. Several interview questions were consolidated in order to construct more accurate themes. Individual interview and cluster statements and meaning units emerged from the data.

## Results

Four research questions were presented to twenty subject matter experts/participants. Several nodes emerged in which themes and categories were developed. From this analysis, statement clusters/exploratory meanings were formulated. For the purposes of this article the statement clusters and exploratory meanings were annotated.

### Research Question 1

What are the strengths and weaknesses of current academic writing software? A comprehensive review of existing scholarly writing tools was conducted to ascertain potential differences between a potential knowledge-based scholarly writing software and current APA and grammar-checking software including Grammarly, Turnitin, White Smoke, RFW, Perrla, Format Ease, and others. Primary differences between the software packages reviewed, and what a knowledge based solution may accomplish, is that it can be augmented to Microsoft Word™ (or another word processor program) and then evaluates the content of what was written both semantically and syntactically. In addition to semantic and syntactic recognition, an AAI/KBS solution would able to recognize if a user answered a question as required or addressed the topic under discussion in a meaningful manner. It may be also be able to recognize if the text was aligned throughout the document, followed directions, and checked for content. The software may be able to check for patterns in writing and content.

**Table 1** Individual respondents' strengths and weaknesses of current academic writing software

| Statement clusters | Exploratory meaning |
|---|---|
| "Current Academic writing software only helps with some aspects of scholarly writing. There is no full spectrum package for scholarly writing." | Understands the current capabilities and limitations of current software writing tools. |
| "The software is not built to teach but instead only corrects certain mistakes." | Does not provide in depth assistance in an interactive way. |
| "Academic writing software does help with correcting certain aspects of scholarly writing but does not teach you how to actually perform the task of scholarly writing." | Does not provide knowledge based assistance (Artificial Intelligence/Augmentation) |

Another benefit is that an AAI/KBS scholarly writing application may provide guidance on alignment and style. It may make suggestions about altering content to match citations or to change citations all together. It can possibly alert the user if they answered a question completely or only partially. An AAI/KBS scholarly writing program should be able to discern whether the question(s) were answered and responded to citation issues in a limited (scripted) fashion. Although some software applications reviewed may give the appearance of containing full artificial intelligence (AI) capabilities they fall short of the next iteration of computer/human interface/personality traits AAI/KBS software. The statement clusters/exploratory meaning for research question 1 can be found in Table 1.

### Research Question 2

What are some unique challenges facing instructional designers, information technology programmers and subject matter experts in producing knowledge based scholarly writing software? The statement clusters/exploratory meanings for research question 2 can be found in Table 2.

**Feasibility and Development of KBS for use in Distance Learning** Feasibility and development of knowledge based applications for use in distance learning is directly affected by the tools available for use in extending the cognitive computing capabilities of Watson. Watson has come a long way since it was used in the Jeopardy contest in 2011. In that contest a cluster of 90 standalone servers was used while in 2017 it is possible for a development team (including instructional designers) to purchase time on the IBM Watson Developer Cloud without the added expense of owning servers (IBM Developer 2017). Creating the necessary tools required for the development of knowledge based applications for distance learning is the first step. Educating programmers, instructional designers, subject matter experts to use the tools needed to develop a technology for distance learning is a necessary requirement. With augmented intelligence application development the human factor is present and needed.

**Role of Instructional Designers in Watson Knowledge Based System Development** In the typical instructional design structure it is normal to create an abstract bullet list or items the distance learning student is expected to know. This is applied to a situation and followed by single or multiple repetitions in a typical distance learning course. The student is usually given an illustration (one or two) that supports the curriculum. This scenario would generally not be enough to develop pattern recognition or to create an internal construct of how to deal with a particular situation that Watson would require.

In a characteristic Watson project development, the illustration described above would not be practical. Instead of abstractions, concepts, lists of rules, etc., instructional

**Table 2** Individual Respondents' Contributing factors and unique challenges for developing successful AAI knowledge-based scholarly writing software

| Statement clusters | Exploratory meaning |
|---|---|
| "A professional team of software engineers, instructional designers, and subject matter experts needs to understand all aspects of scholarly writing, computer programing and AI [AAI] approaches to scholarly writing software." | Team effort. Expertise by professionals in several different fields involved in the development process. |
| "You would need a team of professionals who understand instructional design for both ground based and distance learning course development, coupled with a programming knowledge base of AI [AAI] and scholarly writing." | Experts versed instructional design and distance learning requirements, AAI/AI and scholarly writing. |

**Table 3** Individual respondents' word processors and text editors that address the issue of prolixity (Prolixity - excessive wordiness in speech or writing)

| Statement clusters | Exploratory meaning |
|---|---|
| "Besides using some sort of word count, prolixity is beyond the abilities of most computers." | Present thinking precludes current software programs with addressing prolixity. |
| "Only humans can deal with the issue of prolixity." | Current technologies may not be able to solve the issue of prolixity. |
| "I don't know that there is actually a software package that helps with prolixity." | Unknown whether that there is an existing software program that deals with prolixity. |

designers in the Watson design team must provide numerous examples (could be in the hundreds) to the programmers for input into the Watson system. Watson requires this information in order to discern the highest probability for the correct response. In addition, subject matter experts must be included in the process to identify potential ambiguities in the examples developed by the instructional designer that would "confuse" Watson and/or create a false positive. Instructional designers should keep in mind that Watson is still a type of machine learning and works on probabilities. What Watson is capable of is providing answer/response/problem solving in as little as a nano-second. According to Kapp (2011), in addition to numerous examples, instructional designers can produce "…learning experiences using case studies, simulations, etc. to immerse the learner in dozens of similar (but not exactly the same) situations so the learner can recognize situations, not-by-rules, but by experience." The need for instructional designers that can adapt to this new paradigm is growing. A job description from IBM Watson Health demonstrates some of the unique requirements:

> **Instructional Designer Job Description**
> The Instructional Designer will apply principals of instructional design and adult learning to the creation and maintenance of instructional material and online courses. This individual will work as part of the education and training team while collaborating with Subject Matter Experts (SMEs) and Product Management to develop materials and courses.

- Essential Functions:
- Designs and develops instructional material for client and employee training sessions
- Develops web-based training sessions using learning management system
- Researches technical content to drive education sessions and learning outcomes in collaboration with SMEs
- Uses learning technologies and standards to create web-based education sessions
- Uses standard replicable techniques to evaluate the effectiveness of education sessions Knowledge, Skills, and Abilities Required
- Proven experience in learning technologies and adult learning
- Proven ability to research, analyze and synthesize complex technical information
- Proven visual and verbal communication skills* Able to work collaboratively and consultatively with SMEs
- Able to juggle multiple priorities and adapt to changing circumstances

**Table 4** Individual respondents' required components (technical, conceptual, etc.) for a knowledge-based application that can perform syntactic and semantic recognition. Commercially available artificial intelligence system that runs on a distributed computing platform

| Statement clusters | Exploratory meaning |
|---|---|
| "The components of a knowledge based application that can perform syntactic and semantic recognition are the same as those of an expert system such as a knowledge base, Inference engine and a sophisticated user interface capable of advanced speech and text recognition." | Understands the requirements to develop a prototype. |
| "The computer that can perform syntactic and semantic recognition is one that would require advanced Neural Net hardware" | Nineteen of the participants believe an AAI system is Feasible. |
| "Probably IBM's Watson, Kurzweil's AI tools or Google's AI tools has all the needed components to build a program that can act as an artificial scholarly writing instructor." | Several applications, other than Watson could be used to develop scholarly writing software. |

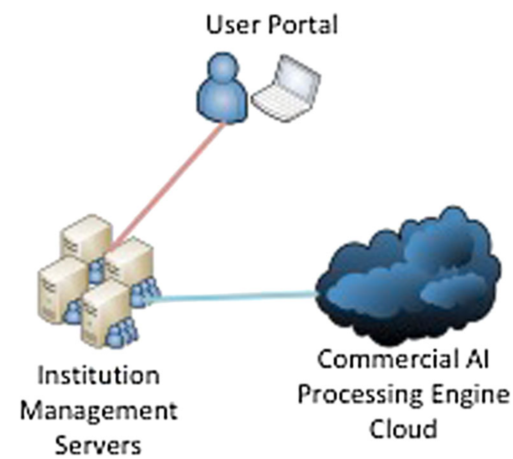


**Fig. 3** Scholarly writing software main components

- Able to manage projects from brainstorming through to completion and delivery
- Able to work effectively as part of a team and to manage own work independently with minimal supervision

Although many of the duties are generic to most instructional designers' positions, there are some differences. The one that stands out is the proven ability to research, analyze and synthesize complex technical information. With Watson, this would include at least an understanding of knowledge based system using augmented artificial intelligence so that the instructional designer can effectively communicate with the information systems programmer in conjunction with subject matter experts.

### Research Question 3

What are the issues surrounding prolixity (excessive wordiness in speech or writing) that instructional designers and programmers need to confront? The statement clusters/exploratory meaning for research question 3 can be found in Table 3.

Research Question 4: What are the required components (technical, conceptual, etc.) for knowledge based system applications that can identify syntactic and semantic recognition?

The statement clusters/exploratory meaning for research question 3 can be found in Table 4.

Technical, conceptual, and other components will be covered in the subsequent Scholarly Writing Software Prototype Development section.

### Summary of Research Questions Results

As a result of the responses to the research questions by the twenty subject matter experts, a rudementary software prototype using Watson's cloud based application was determined to be feasible. It should be noted that although the focus of the prototype was scholarly writing software, it is also possible to develop other distance learning technologies for use as tools as well as curriculum applications. One of the participant/experts took it one step further by stating that it is not beyond the realm of possibility to incorporate "Neural Net hardware" into a Watson distance education delivery system. Neural network hardware is patterned after the process of neurons in the human brain to promote "deep learning" in artificial augmented intelligence. One version that IBM uses for neural network exploration is known as "True North" (Hsu 2016). The incorporation of Watson into True North technologies may emerge in the not too distant future.

## Scholarly Writing Software Prototype Development

Scholarly writing software (SWS) is a prototype program that works inside of the word processing (e.g. Microsoft Word™) application. The purpose is to aid a user with the task of scholarly writing, and the concept is to go beyond the current abilities of the Microsoft's Word application and other software writing add-ons. A potential goal of the SWS is to analyze the content of what the individual

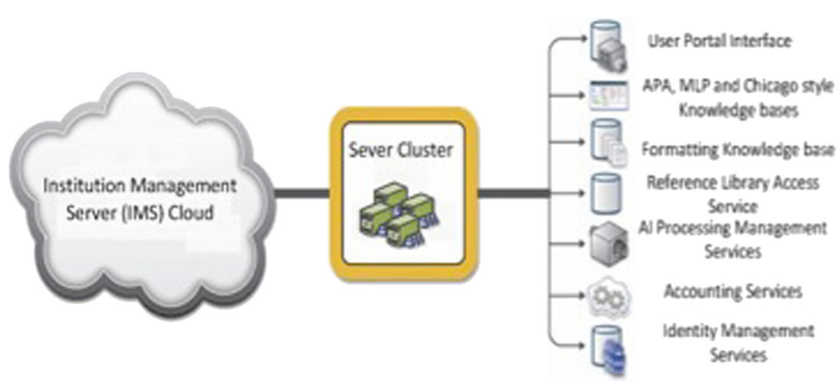


**Fig. 4** Cloud based institutional management system

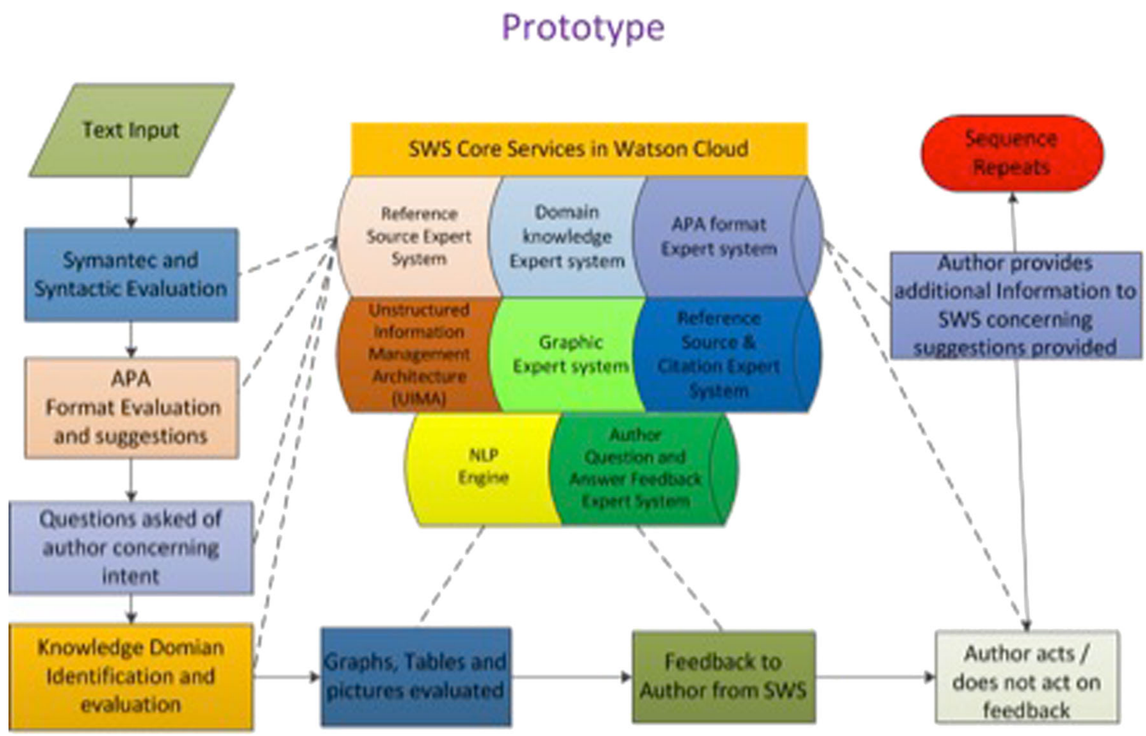


**Fig. 5** Scholarly writing software prototype using IBM Watson's cloud based service

is writing so that suggestions about improving the text can be made and acted upon in real time. Recent breakthroughs in symbolic and sub-symbolic AAI/KBS are encapsulated in subscription-based services make understanding a document on the semantic and syntactic level possible. An SWS consists of three main components: (a) institution management servers, and/or (b) a commercial AAI processing engine cloud, abbreviated CAPEC (Fig. 3), and (c) user portal.

## Institution Management Servers (IMS)

IMS consists of a group of servers that control access to the functions of the SWS from the User Portal (UP). The IMS will contain user identity management services, style knowledge bases and all records of user queries and other usage data. It may be possible for APA style (or other styles) to be programmed into a knowledge base that can be added to the corrections and issues that Microsoft Word™ can manage and correct. IMS can be

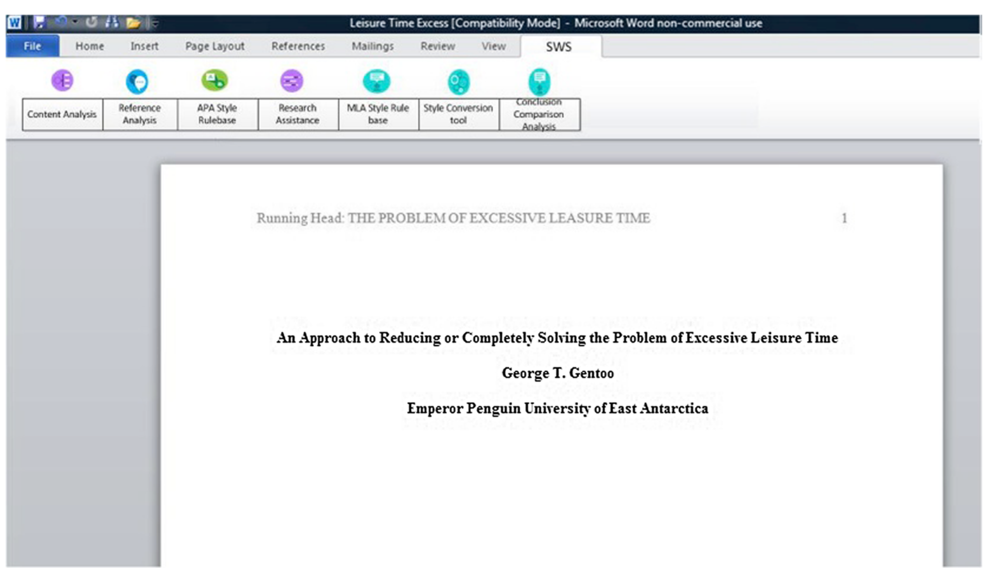


**Fig. 6** Scholarly writing software tool bar

hosted on a dedicated group of servers or on infrastructure as a service cloud computer. IMS can keep track of all costs associated with user queries to the Commercial AAI Processing Engine Cloud, see Fig. 4. IMS is the core of the SWS system because it controls all aspects of system usage. Software is updated, tested on the IMS and users down load the Microsoft Word add-ons form the IMS servers.

IMS may provide metrics that instructors can use to evaluate the progress of their students. IMS can also be used to compare the progress of all who use the SWS in an unbiased and impartial manner, allowing for direct comparisons of student progress in scholarly writing. Potential unlimited scalability of the IMS means that there may not be any technical limits to the number of users that could potentially be using the system simultaneously.

### Commercial AAI Processing Engine Cloud(CAPEC)

The CAPEC is a reference to a fee-for-service engine (e.g. IBM Watson). It is anticipated that more developers, due to costs, will use CAPEC. For the purposes of the SWS prototype, Watson's API (CAPWC) was used rather than the costly alternative of institution management servers. It was also decided to use cloud based services to avoid intellectual property concerns. One tool utilized for the prototype was IBM Watson Discovery™ (IBM Discovery Cloud, 2017). This "service" provides the possibility to quickly construct cognitive, cloud based exploration applications. Using "Discovery" provides insights to unstructured (dark) data. Further, data can come from numerous sources including proprietary, public, and third party (IBM Developer 2017). Fig. 5 provides a model of the SWS prototype development.

### User Portal

The user portal made use of Microsoft Word™ as the point of origin for all text analysis. Like other non-AI applications, such as Endnote, Grammarly, Refworks, the Scholarly Writing System incorporated an "add on" tool bar that may allow a user to initiate action, see Fig. 6. While the researchers included a radio button for Modern Language Association (MLA) style only American Psychological Association (APA) style was active in the prototype.

When the SWS tool buttons are activated (clicked) on the UP tool bar a "request" is made to a program that is running in the background on the user's computer. This will in turn call analysis functions into production via the Internet to the Watson Cloud. The background program executes the required function on the user's text and displays the results in a second instantiation of Microsoft Word™. At this juncture, the user has the ability to immediately insert the altered text into the original text at the click of a button or reject the changes suggested by the SWS. A background program monitors the SWS actions that were taken for a particular document, and allow the user to access them in a Microsoft Word™ for Windows™. User portal functions will not be accessible if the user is offline and no longer has a valid subscription to the SWS service. As a note, Microsoft Word for Mac™ was not used in the prototype study.

### Conclusion

Organizations are expected to continue focusing on harnessing augmented intelligence/knowledge based applications to support educators in distance learning. IBM for one has plans to further learn about human intelligence and how people learn to assist educators in improving the teaching and learning process using augmented intelligence applications. The aspiration for IBM developers is to "fundamentally bring the element of discovery, surprise and exploration back into the classroom, and in the process, deeply engage the learner." (Smith 2014, p.1).

Instructional designers play major roles for adopting augmented intelligence applications for both distance as well as traditional ground based learning. With the emergence of augmented intelligence systems, instructional designers help to identify the appropriate solutions, inform distance learning educators and administrators about the potential of augmented intelligence. Because of the complexity of these distance learning technologies, instructional designers should have multiple roles as researcher, innovator, and informer. Perhaps instructional designers' may take on part of the responsibility to shift the perspectives of educators from the philosophical concept of artificial intelligence to knowledge based system augmented intelligence in order to reduce educators' fear and hesitation of adopting augmented intelligence/knowledge based system applications. In addition, instructional designers should inform educators about the limitations and strengths of augmented intelligence and the relation with what is feasible to enhance the distance learning experience and process. Finally, by developing a prototype of a rudimentary scholarly writing software it is possible to not only take this technology to the next level but to also create new ideas and applications using knowledge based augmented artificial intelligence for online distance learning .

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