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Advances in Information Systems Development

Designing Digitalization

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Editors

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Designing Digitalization

 Springer

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Preface

The **International Conference on Information Systems Development (ISD)** is an academic conference where researchers and practitioners share their knowledge and expertise in the field of information systems development. As an Affiliated Conference of the Association for Information Systems (AIS), the ISD conference complements the international network of general IS conferences (ICIS, ECIS, AMCIS, PACIS, HICSS). The ISD conference continues the tradition started with the first Polish-Scandinavian Seminar on Current Trends in Information Systems Development Methodologies, held in Gdansk, Poland, in 1988. This seminar has evolved into the International Conference on Information Systems Development.

Throughout its history, the conference has focused on different aspects, ranging from methodological, infrastructural, and educational challenges in the ISD field to bridging the gaps between industry, academia, and society. Advancements in information systems foster technological developments. The deployment of the resulting technologies in all areas of society, including public and private sector, the community, and in the home is greatly beneficial. ISD has always promoted a close interaction between theory and practice that has set a human-centered agenda focused on advancing the methods, tools, and management of IS.

This volume is a selection of papers from ISD2018, the 27th Information Systems Development conference hosted by the Department of Informatics, School of Economics and Management, Lund University, Sweden, and held in Lund, Sweden, on August 22–24, 2018. All presented papers have been published in the AIS eLibrary, which is accessible at <http://aisel.aisnet.org/isd2014/proceedings2018>. This volume contains extended versions of the best papers, as selected by the ISD2018 Proceedings Editors.

The theme of the conference was Designing Digitalization. It focused on mutual influences between information systems and organizational structures, processes, and people to promote research of methodological issues and ways in which IS designers and developers are transforming organizations and society through information systems. The conference provided a forum for discussing research and developments in this field. The ISD2018 conference attracted contributions in the general area of information systems development, as well as in more specialized

topics including Transforming Society with ISD, ISD Education, Human-Computer Interaction, e-Health, Information Systems Methodology and Modelling, Managing ISD, and Topics in ISD. ISD2018 focused on these and associated topics in order to promote research into theoretical and methodological issues and ways in which these advances enable better synergies between theory and practice. We believe that the innovative papers assembled in these lecture notes will inform the reader of important contributions in this regard.

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Advancing ISD Education Research with Bioecological Systems Theory



Niamh O. Riordan and Simon Warren

Abstract The Information Systems (IS) community designs and delivers IS curricula in higher education and faces pedagogical challenges in teaching some complex and technical material. Many of us are involved in the design, implementation, evaluation, adoption, and use of IS to support education and training in academia and in industry. Yet IS research on education is often based on technologically deterministic assumptions about the impact of technology on education outcomes and involves narrowly focused studies on the use and impact of technology in education. In this paper, we introduce IS to Bioecological Theory (BET), whose insights have had a transformative effect in the field of developmental psychology but not well known in IS. We use BET to map existing literature on IS and Higher Education and also outline how this theory can be used in IS to inform the design of technological artifacts to support students' learning processes.

Keywords ISD education · Bioecological theory · Systematic literature review

1 Introduction

The Information Systems (IS) community has had a sustained interest in education for many years. IS scholars have written about in the design and delivery of IS curricula (e.g. [11, 18, 63]). IS scholars have investigated some of the specific challenges in teaching some of the complex and technical material that comes under the umbrella of IS (e.g. [20, 43, 61]). IS scholars have engaged in quite a reflexive manner on the role

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of Information and Communication Technologies (ICTs) in higher education (e.g. [7, 66]). Finally, IS scholars are involved in the design, implementation, evaluation, adoption, and use of IS to support education and training both in academia and in industry (e.g. [69, 72, 74]).

The IS community's research often borrows from established learning theories in education and related disciplines. These include the objectivist model, the constructivist model, the cooperative model, the cognitive information processing model, and the sociocultural model of learning (see [68]). For example, scholars often recognize that different learning models lead to different sorts of learning outcomes and account for some of the inconsistencies observed across IS education studies [37]. However, the IS community's main focus is usually on the technologies that can support different types of learning rather than on the pedagogical theories in themselves. For example, IS scholars have investigated the potential of the Internet and World Wide Web (WWW) to support asynchronous learning (e.g. [2]) via web-based virtual learning environments (e.g. [37]). Later, IS scholars investigated the usefulness of group support systems in collaborative learning (e.g. [15, 22, 23]) as well as virtual worlds for immersive education (e.g. [13]). More recently, IS scholars have studied the usefulness of gamification (e.g. [42]) and learning analytics (e.g. [3]) in technology-mediated training and education. As we illustrate in this paper, IS education research often overlooks many of the contextual factors that have been shown to influence academic performance.

Against this backdrop, we advocate for IS education research to be undertaken using Bioecological Theory (BET). BET explains how students develop their own abilities and skills via 'proximal processes' and has been used to explain why students' engagement in these proximal processes does not always directly correlate with students' ultimate achievements in education. Over the years, a large body of empirical research supported Bronfenbrenner's propositions about the kinds of ecological factors that affect students' academic performance. Its potential value in IS stems from the fact that it encourages scholars to take account of both the complex, reciprocal and subtle interactions among each individual's biological and personal characteristics and the significant social and ecological contexts that influence development [71]. We use BET to map existing IS education research and to confirm that IS education research has paid scant attention to many factors that are known to impact upon students' academic performance through BET. IS scholars can use BET to examine the impact of features of the broader ecological systems within which our students are embedded on their academic performance.

2 Introduction

2.1 *Introducing Bioecological Theory*

Urie Bronfenbrenner is regarded as a pioneer who has made outstanding contributions in the study of the ecology of human development [64]. Bronfenbrenner was among the first theoreticians to underscore the need to take into account both the complex, reciprocal and subtle interactions among each individual's biological and personal characteristics and the significant social and ecological contexts that influence development [71]. His Bioecological Theory (BET) altered the trajectory of research in field of developmental psychology; and it led to the conduct of ecological studies of human development in various disciplines including biology, psychology, anthropology, sociology, geography and education [73]. His works have been cited more than 75,000 times according to Google Scholar.

BET holds that individuals develop and actualise their potential by engaging in their environments in what are known as proximal processes (see [56, 57, 59]; see also [52]). Bronfenbrenner emphasizes the intentional and goal directed nature of an individual's interacting with and acting upon their environment as they move toward their currently adopted goal. He defines these processes as progressively more complex reciprocal interaction between an active, evolving biopsychological human organism and the persons, objects, and symbols in its immediate external environment. Bronfenbrenner explains that each individual proximal process requires "space and time and resources; it involves certain enabling structures and disabling structures; and it will require more or less effort depending on the process stage and the individual" [57].

Bronfenbrenner [53, 54] argues that a person's development is not solely a function of their own individual traits but is the product of a constellation of psychological, cultural, social, economic and political forces. His initial work concentrated on developing a better understanding of the environment itself and he later turned his attention to the role a person plays in his or her own development. He argued that to understand an individual's development, one must examine the entire ecological system within which growth occurs and one must do so using a systems perspective [53–55]. Using the analogy of the *matrioshka* (Russian doll), Bronfenbrenner argued that the environment consists of a set of nested structures, each inside the next: microsystem, mesosystem, exosystem, macrosystem and chronosystem. By examining this nested structure, researchers could better understand not only the proximal (direct) effects of the immediate social and physical environment but also the distal (indirect) processes that affect the individual's development [73].

According to Bronfenbrenner [54]:

- The *microsystem* is an immediate setting containing the learner (e.g., home, day care centre, classroom, etc.) A setting is defined as a place in which the occupants engage in particular activities and in particular roles (e.g., parent, teacher, pupil,

etc.) for particular periods of time. The factors of place, time, activity, and role constitute the elements of a setting.

- The *mesosystem* comprises the interrelations among the major settings containing the learner at a point in his or her life. The mesosystem is the system of micro-systems.
- The *exosystem* is an extension of a mesosystem embracing the concrete social structures, both formal and informal, that impinge upon or encompass the immediate settings containing the learner and, thereby, influence and even determine or delimit what goes on there. These structures include the major institutions of the society, both deliberately structured and spontaneously evolving, as they operate at the local community level.
- The *macrosystem* is the overarching institution of the culture or subculture, such as the economic, social, educational, legal and political systems, of which local micro-, meso-, and exo-systems are the concrete manifestations. Such macro-systems are conceived and examined not only in structural terms but as carriers of information and ideology that, both explicitly and implicitly, endow meaning and motivation to particular agencies, social networks, roles, activities, and their interrelations.
- Finally, the *chronosystem* (see [56]) encompasses change or consistency over time not only in the characteristics of the person but also of the environment in which the person lives (e.g. changes over the life course in family structure, socioeconomic status, employment, place of residence, or the degree of hecticness and ability in everyday life). The nature of the dynamic relation between the organism and its environment is such that over time, the external becomes internal and becomes transformed in the process [59]. However, because from the very beginning the organism begins to change its environment, the internal becomes external and becomes transformed in the process. Thus, he believed that it is critical for research designs that permit analysis of the dynamic relation between the process of change over time within the person and the process of change in the environment [55].

The original contribution of BET was its conception of the developing person, of the environment, and especially of the dynamic interaction between the two [54, p. 3]. BET inherited from biology at a time when more mainstream theories of human development inherit the experimental and reductionist models of the physical sciences [73]. More specifically, it originated in Kurt Lewin's field theory, which asserts that an individual's behaviour is a function of the person and their environment; it is also influenced by Gestalt Psychology more generally [58, pp. 41–49]. In this view, the individual as a whole person is different from the sum of their parts, and these individual parts are interdependent and interact in a dynamic fashion; this means that looking at individual elements separately from each other and separate from the person's perceptual or psychological environment produces a misleading view of the causes of human behaviour and how it can be changed [60]. It also was, as its name implies, an ecological theory. This means that it explicitly recognized organism-environment interrelatedness and that human development occurs in the midst of a vibrant, complex environment [56]. This family of theories further recognized that

our everyday experience involve, and are influenced by, constant, dynamic, mutually influential interactions between different conditions and between the person and the world [70].

2.2 *The Potential Value of BET in IS*

BET is potentially useful in IS. First, Bronfenbrenner's conceptualization of proximal processes offers some explanation of how individuals engage in particular tasks and can provide guidance as to how IS designers might design educational tasks for individual learners. Bronfenbrenner's work underscores the progressive nature of proximal processes, (i.e. that the complexity of proximal processes can increase over time), the fact that particular resources must be available to individuals to enter into these proximal processes, and that in order to understand an individual's development, one must examine the entire ecological system within which growth occurs.

Second, education scholars outside IS have long understood that students' academic performance is influenced by a range of contextual factors that are beyond their own immediate environment. Within IS, however, research on students' academic performance tends to overlook these factors. BET can be used in IS to address this gap. IS scholars can use BET to examine the impact of features of the broader ecological systems within which our students are embedded on their academic performance. BET is especially well suited to this task because it is based on a conception of not only the developing person or the environment (immediate and distal) within which they are based but also on the dynamic interaction between the two—this is its unique and compelling characteristic.

Finally, Bronfenbrenner's framework is comprehensive and well supported by multiple empirical studies carried out over decades. As we illustrate in this paper, it can effectively be used to map IS education research and to identify important gaps for future research.

3 **Research Design**

Our aim in this study was to evaluate existing IS education research using the lens of Bronfenbrenner's theoretical framework [54]. Our first step was to adapt Bronfenbrenner's framework to suit IS research (see Table 1). The framework posits that the ecological components of human development consist of five nested and interrelated structures; i.e. microsystem, mesosystem, exosystem, macrosystem and chronosystem. We developed a set of operational definitions of each ecological component of the framework that we could use to review the IS education literature.

We carried out a systematic literature review (SLR). An SLR is a distinct research method used to aggregate evidence (see [67]). It addresses a clearly formulated question and uses systematic and explicit methods to identify publications, select

Table 1 The bioecological model of human development in higher education, derived from [54]

System	Operational definition
Individual	The individual student who is at the centre of Bronfenbrenner's theoretical framework. Various characteristics of this individual are likely to be relevant to their academic development including their age, gender, ethnicity, social class, health and wellbeing
Microsystem	The institutions and groups that most immediately and directly impact the individual's development, e.g. college, college community, local community, family and friends
Mesosystem	Interconnections and interactions between the microsystems; i.e. interconnections and interactions between friends, college, college community, local community, family
Exosystem	Involves links between a social setting in which the individual does not have an active role and the individual's immediate context. For example, a student's experience at college may be influenced by their peers' experience at home or by their instructors' experience at work
Macrosystem	Describes the culture in which individuals live. Cultural contexts include developing and industrialized countries, socioeconomic status, poverty, and ethnicity. Members of a cultural group share a common identity, heritage, and values. For example, a student, his or her school, his or her peers, are all part of a large cultural context
Chronosystem	The patterning of environmental events and transitions over the life course, as well as sociohistorical circumstances. For example, leaving the family home is one transition; the increase in career prospects available to those who have graduated higher education is an example of a change in sociohistorical circumstances

publications relevant to the question critically appraise the publications analyse the data reported in the relevant publications report the combined results from relevant publications. As such, the method is designed to bring the same level of rigour to reviewing research evidence as should be used in producing that research evidence in the first place. The procedure we followed is based on recommendations set out in [65] and is as follows:

- (1) Identify higher education (HE) journals listed in the ABS ranking with three or more stars in 2010 (i.e. *Studies in Higher Education*, the *British Educational Research Journal* and the *Academy of Management Learning and Education*) and identify the top "basket" of IS journals (i.e. *Information Systems Research*, *MIS Quarterly*, *Journal of Association of Information Systems*, *Journal Management Information Systems*, *Journal Strategic Information Systems*, *European Journal of Information Systems* and *Information Systems Journal*).
- (2) Conduct a keyword search of all articles published in those three journals between 1996 and 2018 to identify those studies that reported on academic performance (various keywords were used; specifically, 'performance', 'outcomes', 'achievement', 'success').

- (3) Review the titles and abstracts of these studies ($n = 86$) using pre-specified inclusion and exclusion criteria to eliminate those studies that either (a) did not concern higher education, (b) were concerned with retention and completion rather than achievement, (c) did not present findings regarding the factors affecting academic performance, or (d) did not provide an adequate account of the empirical methods used to generate findings.
- (4) Analyse the remaining studies ($n = 50$) using an adaptation of Bronfenbrenner's initial research to both map and review the literature [54].

The strength of this systematic approach is that it can be replicated at any stage in the future to trace the evolution of research in this area over time. At the same time, whilst time constraints have necessarily limited the scope of this search, the same procedure can be replicated by future researchers with the capacity to conduct a broader search across a greater number of databases.

4 Results

Table 2 summarises research published in leading IS and HE journals between 1996 and 2018 regarding the factors known to impact academic performance (see also Appendix 1). The table summarizes (i) whether each study was carried out in a qualitative, quantitative or mixed methods mode, (ii) whether each study was student-centric or faculty-centric, (iii) the scope of the dataset used in the study, and (iv) which ecological components of achievement in higher education were assessed in the study.

Students' academic performance is a topic of enduring importance in both the IS and HE journals we examined between 1996 and 2018. There has been a steady stream of publications since 2013. Prior to that, a burst of publications in 2007 was preceded by an absence of publications in 2004, 2005, and 2006; and a burst of publications in 2002 was preceded by an absence of publications in 1998, 1999, and 2000. In total, we found thirty-two articles in the three HE journals (twenty-six of those had been published by *Studies in Higher Education*) and eighteen articles in the eight IS journals that met our search criteria. Space limits preclude an in-depth discussion of the fifty articles. Instead, the remainder of this section summarizes the results of our analysis of the dataset overall.

Overall, we found that the studies in the sample focus primarily on the individual and the institution within which that individual is embedded. Most studies focus specifically on individual student attributes ($n = 14$) or specifically on features of the microsystem ($n = 10$) or on a combination of individual and microsystem attributes ($n = 17$). These studies often investigate the impact of individual (i.e. student) factors on academic performance. These factors include student demographics, such as age (e.g. [5, 40]) and gender (e.g. [40]), prior academic achievement (e.g. [17, 21]), subjective experience of the learning environment (e.g. [25, 26, 33]) and supports (e.g. [35]), as well as behavioural approaches to higher education (e.g. [30, 32,

Table 2 Summary of academic performance research published in leading IS and HE journals between 1996 and 2018

Citation	Domain	Research mode	Orientation	Dataset	Individual	Micro	Meso-	Exo-	Macro-	Chrono-
[1] Bailey et al. (2014)	EDU	Quantitative	Student-centric	***		✓				
[2] Barger et al. (2002)	IS	Quantitative	Student-centric	*	✓					
[3] Bauman and Tuzhilin (2018)	IS	Quantitative	Student-centric	***	✓					
[4] Beenstock and Feldman (2016)	EDU	Quantitative	Student-centric	***		✓				
[5] Cassidy (2012)	EDU	Quantitative	Student-centric	***	✓					
[6] Clayton et al. (2012)	IS	Qualitative	Student-centric	****	✓	✓	✓		✓	
[7] Coppola et al. (2002)	IS	Qualitative	Faculty-centric	***		✓	✓			
[8] Crawford and Wang (2015)	EDU	Qualitative	Student-centric	***	✓	✓				
[9] Crawford and Wang (2016)	EDU	Quantitative	Student-centric	***		✓				✓
[10] Dancer et al. (2015)	EDU	Quantitative	Student-centric	*		✓				
[11] Dhar and Sundararajan (2007)	IS	Qualitative	Faculty-centric	****		✓				
[12] Diseth (2007)	EDU	Quantitative	Student-centric	**	✓					
[13] Franceschi et al. (2009)	IS	Quantitative	Student-centric	**	✓	✓				
[14] Galliers and Huang (2012)	IS	Qualitative	Faculty-centric	*****				✓		

(continued)

Table 2 (continued)

Citation	Domain	Research mode	Orientation	Dataset	Individual	Micro	Meso-	Exo-	Macro-	Chrono-
[15] Gasson and Waters (2013)	IS	Qualitative	Student-centric	****	✓					
[16] Grayson (2011)	EDU	Quantitative	Student-centric	****				✓		
[17] Gropper (2007)	EDU	Quantitative	Student-centric	**	✓					
[18] Hatzakis et al. (2007)	IS	Quantitative	Faculty-centric	**		✓				
[19] Heinze and Hu (2009)	IS	Quantitative	Student-centric	****	✓					
[20] Hustad and Olsen(2014)	IS	Qualitative	Faculty-centric	*		✓				
[21] Kuncel et al. (2007)	EDU	Quantitative	Faculty-centric	****	✓					
[22] Kwok et al. (2002)	IS	Quantitative	Student-centric	**	✓	✓				
[23] Kwok et al. (2002)	IS	Quantitative	Student-centric	**	✓	✓				
[24] Litmanen et al. (2010)	EDU	Quantitative	Student-centric	**	✓					
[25] Lizzio et al. (2002)	EDU	Quantitative	Student-centric	***	✓	✓				
[26] Loyens et al. (2007)	EDU	Quantitative	Student-centric	*	✓	✓				
[27] Malm et al.(2012)	EDU	Quantitative	Student-centric	**	✓	✓				

(continued)

Table 2 (continued)

Citation	Domain	Research mode	Orientation	Dataset	Individual	Micro	Meso-	Exo-	Macro-	Chrono-
[28] Mann and Robinson (2009)	EDU	Quantitative	Student-centric	***	✓	✓				
[29] Mansfield (2011)	EDU	Quantitative	Student-centric	**	✓	✓				✓
[30] Masui et al. (2014)	EDU	Quantitative	Student-centric	***		✓				
[31] Mathiassen and Purao (2002)	IS	Qualitative	Faculty-centric	*****		✓				
[32] Newman-Ford et al (2008)	EDU	Quantitative	Student-centric	**	✓					
[33] Nguyen et al. (2016)	EDU	Quantitative	Student-centric	*	✓	✓				
[34] Nicholson et al. (2013)	EDU	Quantitative	Student-centric	**	✓					
[35] Ning and Downing (2010)	EDU	Quantitative	Student-centric	***	✓	✓				
[36] Ning and Downing (2012)	EDU	Quantitative	Student-centric	**	✓	✓				
[37] Piccoli et al. (2001)	IS	Quantitative	Faculty-centric	*	✓					
[38] Reinig et al. (1997)	IS	Quantitative	Student-centric	*		✓				
[39] Richardson (2008)	EDU	Quantitative	Student-centric	***	✓					
[40] Richardson and Woodley (2003)	EDU	Quantitative	Student-centric	*****	✓					

(continued)

Table 2 (continued)

Citation	Domain	Research mode	Orientation	Dataset	Individual	Micro	Meso-	Exo-	Macro-	Chrono-
[41] Román et al. (2008)	EDU	Mixed	Student-centric	***	✓	✓				
[42] Santhanam et al. (2016)	IS	Quantitative	Faculty-centric	***		✓				
[43] Sheetz et al. (1997)	IS	Qualitative	Student-centric	*	✓	✓				
[44] Simone (2003)	EDU	Quantitative	Student-centric	**	✓	✓				
[45] Smith and White (2015)	EDU	Quantitative	Student-centric	***	✓					
[46] te Wierik et al. (2015)	EDU	Quantitative	Student-centric	***		✓				
[47] Thiele et al. (2016)	EDU	Quantitative	Student-centric	***	✓			✓		
[48] Torenbeek et al. (2013)	EDU	Quantitative	Student-centric	***	✓	✓				
[49] Trigwell et al. (2012)	EDU	Quantitative	Student-centric	*	✓					
[50] Wilkins et al. (2016)	EDU	Quantitative	Student-centric	***	✓	✓				

*Single module, single programme, single university

**Multiple modules, single programme, single university

***Multiple modules, multiple programmes, single university

****Multiple modules, multiple programmes, multiple universities

*****Multiple modules, multiple programmes, multiple universities, multiple countries

48])—especially surface versus deep learning (e.g. [12, 41, 50]). The mesosystem was examined in two studies [6, 7]. The exosystem was examined in two studies [14, 16]. The macrosystem was examined in one study [6]. This study was interesting as it investigated the impact of students' parents' education on their educational experiences and achievements. Finally, the chronosystem was examined in just two studies [9, 29]. These studies both investigated the impact of going on placement on students' subsequent academic achievements.

Methodologically, we found that most studies rely on quantitative techniques applied to large data sets, with very little variation across research methods used—very rarely to researchers investigate multiple variables and when they did, they generally failed to investigate any interplay that might take place between these variables over time. These studies therefore do not reveal any great insight into the dynamics of academic achievement over time and are not particularly helpful in seeking to understand the totality of an individual's situation and its impact on their development (see [61]).

There were several differences in the IS and HE articles in terms of the topics covered and also the methods and datasets used. First, the IS articles focused on two main topics: the design and delivery of the IS curriculum within the broader context of business education, and the development and use of new types of learning technologies. The HE articles, on the other hand, were far more specifically focused on predicting and explaining students' academic achievement and on issues related to grading practices within and across disciplines. Second, the IS articles featured a mix of qualitative and quantitative approaches as well as a mix of faculty-centric and student-centric studies. However, a significant proportion of the IS articles used module-specific data which can pose issues related to generalizability (i.e. the data was unique to individual modules within individual programmes within individual universities). Our first thought was that perhaps the qualitative IS articles were module specific but a closer inspection revealed that this was not the case. Instead, it was those articles that focused on specific learning technologies that tended to rely on module-specific data gathered during design science and action research studies and then analysed quantitatively. On the other hand, all of the HE articles in our sample used quantitative methods and were student-centric in nature. The majority of the HE articles we sampled used datasets that spanned modules and programmes and universities.

5 Discussion and Conclusion

Bronfenbrenner has made an enduring contribution to our understanding of the interplay between the biological and ecological factors that impact upon human development. Bronfenbrenner's BET provides a powerful lens through which a more holistic understanding of human development can be seen; an understanding of human development that takes the interrelatedness of individual, physical, sociohistorical and cultural aspects into account. Indeed, Bronfenbrenner is credited with bring-

ing attention to contextual variation in human development and with increasing the ecological validity of studies of developing individuals in their natural environment [62].

Though he has had a substantial impact beyond IS, his work does not appear to be well known in IS or in HE research. In this short paper, we present the results of a systematic literature review of IS and HE research published in the past two decades carried out from a Bronfenbrennerian perspective. The analysis reveals that a great deal is known about the factors that affect academic achievement in IS and in HE, particularly regarding the role of the individual's own characteristics in shaping academic outcomes. However, when examined through the lens of Bronfenbrenner's work, it becomes clear that the literature has tended to focus primarily on the individual (or the microsystem) and to analyse one or possibly two factors at most, relying heavily on quantitative techniques applied to large data sets in doing so, and demonstrating very little variation across research methods. Many factors that have been shown to potentially influence academic achievement in other disciplines where Bronfenbrenner's work is more well-known have not yet been examined in IS or in business education, particularly those that exist beyond the confines of the microsystem.

Going forward, IS researchers can use Bronfenbrenner's work to better understand our students' engagement with the IS curriculum and with higher education more generally. In particular, Bronfenbrenner's conceptualization of proximal processes offers some explanation of how individuals engage in particular tasks and can provide guidance as to how IS designers might design educational tasks for individual learners. In addition, his work on the contextual factors that influence individuals' academic performance should inform the design of IT artifacts that support students' learning processes in higher education. Emerging learning technologies afford educators and researchers new opportunities to better understand and optimise the dynamics of academic achievement over time, perhaps to a point of being able to predict student success [51]. In particular, IS researchers are developing new learning technologies to enhance students' engagement with the IS curriculum and in higher education more generally (e.g. [13, 42]) and are using emerging learning analytics tools and techniques to monitor and respond to what Bronfenbrenner would call individual students' proximal processes (e.g. [3]). These tools and technologies can afford a fine-grained understanding of students' proximal processes and deliver fresh insights into the dynamics of academic achievement over time. But in the meantime, IS scholars should ask whether these tools are developmentally disruptive or developmentally generative. We also want to encourage more IS scholars to follow in the footsteps of scholars who are investigating the impact of meso-, exo-, macro- and chronosystems on students' experiences with IS and with higher education more generally.

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Appendix 1: Results of Systematic Literature Review¹

1. Bailey, M.A., Rosenthal, J.S., Yoon, A.H.: Grades and incentives: assessing competing grade point average measures and postgraduate outcomes. *Stud. High. Educ.* 1–15 (2014)
2. Bargerón, D., et al.: Asynchronous collaboration around multimedia applied to on-demand education. *J. Manag. Inf. Syst.* **18**(4), 117–145 (2002)
3. Bauman, K., Tuzhilin, A.: Recommending remedial learning materials to students by filling their knowledge gaps. *Manag. Inf. Syst. Q.* **42**(1), 313–332 (2018)
4. Beenstock, M., Feldman, D.: Decomposing university grades: a longitudinal study of students and their instructors. *Stud. High. Educ.* 1–20 (2016)
5. Cassidy, S.: Exploring individual differences as determining factors in student academic achievement in higher education. *Stud. High. Educ.* **37**(7), 793–810 (2012)
6. Clayton, K., Beekhuizen, J., Nielsen, S.: Now I know what ICT can do for me! *Inf. Syst. J.* **22**(5), 375–390 (2012)
7. Coppola, N.W., Hiltz, S.R., Rotter, N.G.: Becoming a virtual professor: pedagogical roles and asynchronous learning networks. *J. Manag. Inf. Syst.* **18**(4), 169–189 (2002)
8. Crawford, I., Wang, Z.: The impact of individual factors on the academic attainment of Chinese and UK students in higher education. *Stud. High. Educ.* **40**(5), 902–920 (2015)
9. Crawford, I., Wang, Z.: The impact of placements on the academic performance of UK and international students in higher education. *Stud. High. Educ.* 1–22 (2016)
10. Dancer, D., Morrison, K., Tarr, G.: Measuring the effects of peer learning on students' academic achievement in first-year business statistics. *Stud. High. Educ.* **40**(10), 1808–1828 (2015)
11. Dhar, V., Sundararajan, A.: Information technologies in business: a blueprint for education and research. *Inf. Syst. Res.* **18**(2), 125–141 (2007)
12. Diseth, Å.: Approaches to learning, course experience and examination grade among undergraduate psychology students: testing of mediator effects and construct validity. *Stud. High. Educ.* **32**(3), 373–388 (2007)
13. Franceschi, K., et al.: Engaging group E-learning in virtual worlds. *J. Manag. Inf. Syst.* **26**(1), 73–100 (2009)
14. Galliers, R.D., Huang, J.C.: The teaching of qualitative research methods in information systems: an explorative study utilizing learning theory. *Eur. J. Inf. Syst.* **21**(2), 119–134 (2012)
15. Gasson, S., Waters, J.: Using a grounded theory approach to study online collaboration behaviors. *Eur. J. Inf. Syst.* **22**(1), 95–118 (2013)
16. Grayson, P.J.: Cultural capital and academic achievement of first generation domestic and international students in Canadian universities. *Br. Edu. Res. J.* **37**(4), 605–630 (2011)
17. Gropper, D.M.: Does the GMAT matter for executive MBA students? Some empirical evidence. *Acad. Manag. Learn. Educ.* **6**(2), 206–216 (2007)
18. Hatzakis, T., Lycett, M., Serrano, A.: A programme management approach for ensuring curriculum coherence in IS (higher) education. *Eur. J. Inf. Syst.* **16**(5), 643–657 (2007)
19. Heinze, N., Hu, Q.: Why college undergraduates choose IT: a multi-theoretical perspective. *Eur. J. Inf. Syst.* **18**(5), 462–475 (2009)
20. Hustad, E., Olsen, D.H.: Educating reflective Enterprise Systems practitioners: a design research study of the iterative building of a teaching framework. *Inf. Syst. J.* **24**(5), 445–473 (2014)
21. Kuncel, N.R., Credé, M., Thomas, L.L.: A meta-analysis of the predictive validity of the graduate management admission test (GMAT) and undergraduate grade point average (UGPA) for graduate student academic performance. *Acad. Manag. Learn. Educ.* **6**(1), 51–68 (2007)
22. Kwok, R.C., et al.: Role of GSS on collaborative problem-based learning: a study on knowledge externalisation. *Eur. J. Inf. Syst.* **11**(2), 98–107 (2002)
23. Kwok, R.C.-W., Ma, J., Vogel, D.R.: Effects of group support systems and content facilitation on knowledge acquisition. *J. Manag. Inf. Syst.* **19**(3), 185–229 (2002)

¹The 50 papers that were analysed in this study are listed below.

24. Litmanen, T., Hirsto, L., Lonka, K.: Personal goals and academic achievement among theology students. *Stud. High. Educ.* **35**(2), 195–208 (2010)
25. Lizzio, A., Wilson, K., Simons, R.: University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Stud. High. Educ.* **27**(1), 27–52 (2002)
26. Loyens, S.M.M., Rikers, R.M.J.P., Schmidt, H.G.: The impact of students' conceptions of constructivist assumptions on academic achievement and drop-out. *Stud. High. Educ.* **32**(5), 581–602 (2007)
27. Malm, J., et al.: Supplemental instruction for improving first year results in engineering studies. *Stud. High. Educ.* **37**(6), 655–666 (2012)
28. Mann, S., Robinson, A.: Boredom in the lecture theatre: an investigation into the contributors, moderators and outcomes of boredom amongst university students. *Br. Edu. Res. J.* **35**(2), 243–258 (2009)
29. Mansfield, R.: The effect of placement experience upon final-year results for surveying degree programmes. *Stud. High. Educ.* **36**(8), 939–952 (2011)
30. Masui, C., et al.: Do diligent students perform better? Complex relations between student and course characteristics, study time, and academic performance in higher education. *Stud. High. Educ.* **39**(4), 621–643 (2014)
31. Mathiassen, L., Puraio, S.: Educating reflective systems developers. *Inf. Syst. J.* **12**(2), 81–102 (2002)
32. Newman-Ford, L., et al.: A large-scale investigation into the relationship between attendance and attainment: a study using an innovative, electronic attendance monitoring system. *Stud. High. Educ.* **33**(6), 699–717 (2008)
33. Nguyen, T.H., Charity, I., Robson, A.: Students' perceptions of computer-based learning environments, their attitude towards business statistics, and their academic achievement: implications from a UK university. *Stud. High. Educ.* **41**(4), 734–755 (2016)
34. Nicholson, L., et al.: The key to successful achievement as an undergraduate student: confidence and realistic expectations? *Stud. High. Educ.* **38**(2), 285–298 (2013)
35. Ning, H.K., Downing, K.: The impact of supplemental instruction on learning competence and academic performance. *Stud. High. Educ.* **35**(8), 921–939 (2010)
36. Ning, H.K., Downing, K.: Influence of student learning experience on academic performance: the mediator and moderator effects of self-regulation and motivation. *Br. Edu. Res. J.* **38**(2), 219–237 (2012)
37. Piccoli, G., Ahmad, R., Ives, B.: Web-based virtual learning environments: a research framework and a preliminary assessment of effectiveness in basic IT skills training. *Manag. Inf. Syst. Q.* **25**(4), 401–426 (2001)
38. Reinig, B.A., Briggs, R.O., Nunmaker Jr., J.F.: Flaming in the electronic classroom. *J. Manag. Inf. Syst.* **14**(3), 45–59 (1997)
39. Richardson, J.T.E.: The attainment of ethnic minority students in UK higher education. *Stud. High. Educ.* **33**(1), 33–48 (2008)
40. Richardson, J.T.E., Woodley, A.: Another look at the role of age, gender and subject as predictors of academic attainment in higher education. *Stud. High. Educ.* **28**(4), 475–493 (2003)
41. Román, S., Cuestas, P.J., Fenollar, P.: An examination of the interrelationships between self-esteem, others' expectations, family support, learning approaches and academic achievement. *Stud. High. Educ.* **33**(2), 127–138 (2008)
42. Santhanam, R., Liu, D., Shen, W.-C.M.: Research note-gamification of technology-mediated training: not all competitions are the same. *Inf. Syst. Res.* **27**(2), 453–465 (2016)
43. Sheetz, S.D., et al.: Exploring the difficulties of learning object-oriented techniques. *J. Manag. Inf. Syst.* **14**(2), 103–131 (1997)
44. Simonite, V.: A longitudinal study of achievement in a modular first degree course. *Stud. High. Educ.* **28**(3), 293–302 (2003)
45. Smith, E., White, P.: What makes a successful undergraduate? The relationship between student characteristics, degree subject and academic success at university. *Br. Edu. Res. J.* **41**(4), 686–708 (2015)